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ABSTRACT

Collected here are 55 papers presented at the 1975 College and University Systems Exchange (CAUSE) national conference. Papers are organized to reflect the activities at the conference: 10 papers are grouped in the section for management presentations, 10 papers are included in technical presentations, and 12 papers are included in mixed management and technical presentations. In addition to the complete papers, abstracts of 23 contributed papers are provided followed by 10 abstracts of vendor presentations. (CH)

College And University Systems Exchange

CAUSE

Higher Education Information Systems: The Challenge of Change

Proceedings of the
1975 CAUSE National Conference

Denver, Colorado December, 1975

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Edited by

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and

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INTRODUCTION

Today, higher education is faced with economic uncertainties, legislative restrictions, rapid technological advancements, and a greater demand for accountability. Information systems in higher education are certainly not exempt from the challenges presented by such widespread change; consequently, the theme of the 1975 CAUSE National Conference, "HIGHER EDUCATION INFORMATION SYSTEMS: THE CHALLENGE OF CHANGE" reflects the present concern with these issues.

Papers were selected by the Program Committee for presentation at the conference and inclusion in this publication to offer a wide variety of experiences in meeting the challenges posed by change in facing the problems encountered and in identifying proven and potential solutions to these problems.

The contents of this document reflect the conference activities: the Management Track and Technical Track which provided continuity for those who have strictly managerial or technical orientation, or the Mixed Track which provided variety for those who have interests in both areas; the presentations by vendors; the Contributed Papers Track; the Keynote and General Sessions. This year, a number of user groups met in conjunction with the conference, providing an opportunity for those using a particular product to exchange specific experiences and ideas.

It is hoped that the reader will derive benefit from sharing the experiences of others and therefore become more successful in meeting the challenge of change to improve the quality of higher education information.

C A U S E

The College and University Systems Exchange provides, through the National Conference, the opportunity for an exchange of ideas, systems and experiences among the many speakers and participants. Throughout the year, the opportunity for exchange is continually presented to CAUSE members as evidenced by the following statement of the goals of the organization:

1. To serve as a clearinghouse for an active program of exchange of information, application programs, and information systems among institutions of higher education;

2. To serve as a catalyst and to provide support for cooperative ventures among institutions in the development of improved systems, operations and standards;

3. To promote the general advancement of information systems technology and data processing management in higher education; and

4. To provide a professional association for administrative data processing in higher education.

Jane N. Ryland
1975 Conference Chairperson

Charles R. Thomas
Executive Director

ACKNOWLEDGMENTS

It would be impossible to identify all of the many people who contributed their time and professional expertise to produce a conference which by all accounts has heightened the standard of excellence maintained by the annual CAUSE National Conferences. Nevertheless, the efforts of several groups deserve special acknowledgement.

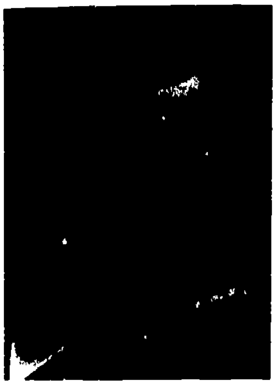
The Program Committee, with the CAUSE staff, spent many hours to produce an effective and smoothly-run conference. Their efforts and the the support of their institutions is gratefully acknowledged.

From left to right, Seated: Debbie Smith, Jane Ryland, Martha Fields. Standing: R. Brian Walsh, Wayne Donald, Dick Leurig, Chuck Thomas, Gary Devine, Dave Wearley.

The process of registering for a conference can be an unpleasant one without an efficient and well-organized group of people. For making registration a pleasant experience, the friendly smiles of the registration workers are deeply appreciated.

Coleen Ford

Barbara Leurig



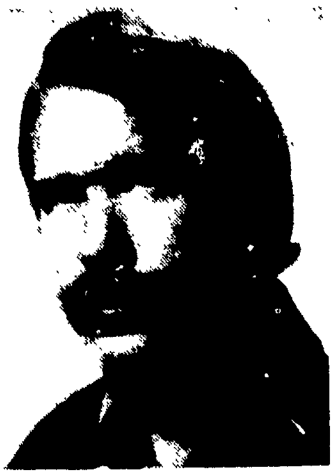
Patty Angerer

Debbie Smith

Without the continued support of the CAUSE Board of Directors and the membership whom they represent, the National Conference would not be possible. Their guidance contributed substantially to the success of this year's conference.

From left to right: Jane Ryland, Frank Martin, Paul Plourde (Vice President), Dick Leurig, Bob Taylor(President), Mike Schouest, Don Tiernan, Bart Carlson(Secretary/Treasurer), Jack Thornton, Chuck Thomas(ex officio). Note: Jim Morgan(ex officio) was not present.

To handle the many details of local arrangements, from session announcement boards to slide projectors, much behind-the-scenes work and planning is required. The cooperation and efficiency of Gary Devine, Coordinator of Local Arrangements, and his associates at the University of Colorado, Boulder Campus, is acknowledged as instrumental to the success of the Conference.



Gary Devine

Finally, the financial support of several organizations who sponsored presentations in the Vendor Track, or who sponsored a coffee hour at the Conference is especially appreciated. In addition, the contribution of the IBM Corporation to assist with the production of this publication deserves grateful recognition.

COLLEGE AND UNIVERSITY SYSTEMS EXCHANGE

HIGHER EDUCATION INFORMATION SYSTEMS: THE CHALLENGE OF CHANGE

Proceedings of the 1975 CAUSE National Conference

Denver, Colorado December 2-5, 1975

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GENERAL SESSIONS

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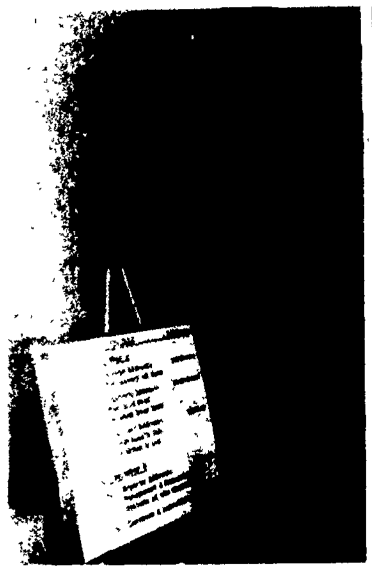
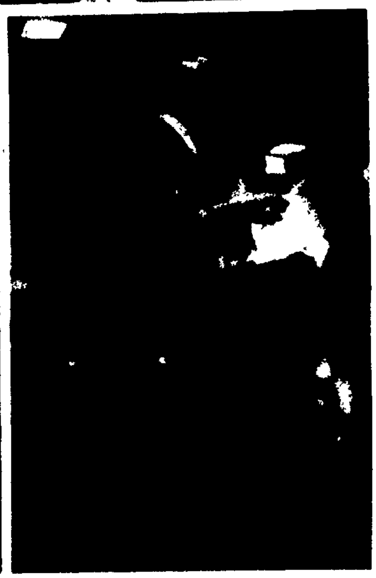


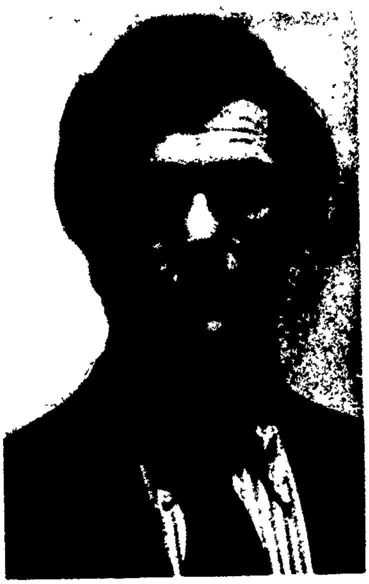


COFFEES, MEALS, AND SOCIAL HOURS

Some of the most beneficial and rewarding experiences at conferences are provided by the opportunity to informally exchange ideas between sessions, at meal times, and during social hours.

TRACK I
MANAGEMENT PRESENTATIONS

R. Brian Walsh



John Keane

W. R. Bradshaw

Coordinator: R. Brian Walsh
Notre Dame University

MANAGING THE COMPUTER RESOURCE

W. R. Bradshaw
Corporate Director of Information Systems
IBM Corporation
Armonk, New York

This paper addresses management approaches and techniques that have proven useful within IBM's internal computer installations. The focus is on the individual computer installation, its management needs and relationship to the broader mission of the institution.

The paper includes such topics as installation planning and relationship to the institution plan, project and equipment justification and management, and operational measurements. Obvious computer resources - equipment and people - are considered, along with the other factors such as data files and programs, plans and strategies, applications under development, space and energy, user credibility, and responsibilities for privacy, security and auditability.

Good morning. It's a pleasure for me to be here with you and to lead-off your discussions in this part of your conference. It was suggested that I might speak on the general topic of "Managing the Computer Resource". I agreed to that topic feeling that it would give me plenty of latitude to pick and choose from many possible subjects.

The approach I'd like to use is simply to share with you some of our experiences in IBM that relate to the topic. My vantage point in the company gives me a birdseye view of our internal computer installations and how they are managed. I also have a responsibility for providing various degrees and forms of guidance and direction as well as planning and control for our internal computer installations.

I looked over the roster of probable attendees at the Conference trying to picture the nature, size and purpose of the installations you are concerned with. I concluded, possibly somewhat incorrectly, that most of you have interests that relate to a single central computer facility with perhaps several remote satellites or branches.

I am also assuming that most of your installations are basically involved in processing administrative data for your institutions ....and that while your facilities may be used part time in support of technical or research type projects, this is not your primary purpose.

I also assume that most of you are the management person directly responsible for managing a computer installation. It is to you that I'll address my remarks.

I realize that each computer facility is unique in many ways, but the experiences we have had in trying to manage the resources of our computer centers within IBM should have some relation to your situations. So it is with that view-point in mind that I'll proceed.

Let's think for a minute about the elements which we might include as computer resources. I've listed the items that I have in mind. The list includes the following:

- Data Processing people
- Data Processing Equipment
- Computer Files
- Computer Programs
- Programs under Development
- Applications under Design
- Installation Plans - Strategies
- Dollars (associated with all above)
- Reputation (credibility in the eyes of user)
- Responsibility

  (for security - privacy - auditability)

You'll note that as we come down the list I'm sort of reaching further and further to include items which you might argue are not actually computer resources. You can argue but it won't do you any good. Because I want to talk about them.

I imagine no-one would disagree, however, that our Data Processing people are a critical resource. And we all read or hear new ideas, or approaches, or concepts for effectively managing people. From a management point of view, however, there's nothing particularly different about a Data Processing person as compared to other people; and in a direct sense I'm going to pass this resource by this morning. I think there are more appropriate forums for considering the subject of managing people. But I think we'll find that many of the things we'll be talking about at least indirectly relate to managing people.

Now Data Processing equipment is another thing. I do want to talk about that subject....as you might have guessed. Data Processing Equipment tends to change from time to time. And the things we do with it change, and the things your people have to do to make the newer equipment work effectively change.

This is an exciting period of time in the computer business. We are in many ways on center stage. We're being bombarded with criticism on the one hand and lauded with praise on the other.

Criticized for spending too much money and lauded for being the salvation of the enterprise.

We are being criticized and legislated against because of exposures we create...exposures for abuses against such things as individual freedom and privacy. And we are at the same time exposing our institutions and our business to upheavals in the traditional ways of doing business. We are plaqued with creating added costs which are clearly identifiable, while the offsetting savings are frequently hidden in the dynamic nature of our users and their environments.

At the same time we are on the threshold of many new and vital breakthroughs in a still evolving profession.

We are surrounded by technical advancement potentials which we, as the experts, barely understand and our users, our clients, will perhaps never understand.

And we are charged with managing these advancements and the resources entrusted to us!

I remember 10 years ago one of our managers, a user of Data Processing services, was complaining to me that he wished we were back in the punched card machine era rather than the 360 era we in IBM were just entering. His reason was simply that since the advent of computers he had lost touch - he no longer understood what happened to his data and how his reports were generated. He was no longer his own master. Between the time he prepared a transaction and the time its effect showed up in his reports, things happened that left him uncomfortable in a way that he didn't experience in the good old days.

Well, wrapped up in that example is the heart of my message.

If I can use a grossly simplified summary statement, I think two keys to effectively managing the computer resources are to:

- Concentrate on making our users comfortable;
- Keep our focus on fundamentals.

As I proceed, these two points will sort of intermingle... because they are related in many ways.

In those good-old-days as you and I may remember them, and I'm thinking back now to the first generation of computers in the mid-fifties, things were indeed simple by today's standards.

Things were simple in the sense that it was pretty much a one-man-show. One person, the programmer analyst, had the whole ball game in his palm. He designed the system, planned the programming logic, did the coding, personally developed the test plan and data, conducted the tests, wrote the operator's instructions, trained the user...and all the while he had confidence that he knew what the computer was doing at each step of the way. He should because he wrote every step of the program. In the very early days all code actually being written in machine language. The user was dependent on the computer man to be sure, but contrast that with today.

Picture an organization chart of one of our large computer installations. The specific one I have in mind has 4 major functions reporting to the Director of Information Systems. These are:

- Data Processing Operations
- Applications Development
- Environmental Support
- Information Systems Business Office

Each of the four basic functions has responsibilities for working with the user.

The Data Processing Operations group interfaces with the user daily for all normal work in and out of the computer room.

Applications Development people work with the user on new application development. In this function there also are 3 separate departments that support the user and the rest of the I/S organization on matters of basic architecture, data base management, and release and document control procedures.

The Environmental Support function is a group in the middle. They support the Operations Group with basic system support work. They support the Applications Development Group with basic activities like systems planning and installation support. And they support the user directly for basic application maintenance and enhancement work. This group also supports the user directly for any terminal services he may be getting.

The fourth group, the I/S Business Office, is concerned primarily with the planning, control, and operation of the I/S function. But their mission also involves strategic planning and the staffing of a separate user liaison department.

I've described this particular organization - and it's not unlike many of the others we have-to make two specific points.

First, technology, coupled with the economics of centralization, leads to a complex organization; which leads to many I/S people interacting with the user. This in turn exposes the user to confusion and frustration in knowing how to effectively work with I/S. Who do you, the user, talk to about a problem? How do I, the I/S Director, keep my many user interface departments from passing the buck among themselves? It seems to me we must bend over backwards to find ways to make our complexities more transparent to our users.

My second point is an extension of this first. To do the job, we develop an organization of specialists. Then we have to define the mission, the responsibilities, of each of these specialists.. ..in a rapidly changing, technology driven environment. And in the process we expose ourselves to creating gaps in responsibility coverage...I call these "specialization cracks".

You might say that we in the computer installation have been our own worst enemies. We've built a rather solid wall around ourselves, called it technology, and pretty much left the user out there on the other side. He, the user, is frequently put in the position of becoming more and more dependent on the computer installation, but at the same time having to be a magician. He has to find out the secrets, the doors, the language, that he needs to get us to do what he wants done. We've been thru an era, a period where the drive to use the equipment effectively and efficiently has forced us in I/S to a high level of specialization. This has forced us to have complex organizations. This leads to much, if not most, of our communications being within our I/S world, and with only an occasional glance outward to the user.

It's a constant problem. A large part of my job and that of our Corporate I/S staff is to try and overcome this inward focus. And I think in recent years we've been quite successful.

Some of the things we have done include:

- Requiring each installation manager to submit an annual operating plan as an integral part of the plan for the business unit (division, etc.) that he is a part of, and requiring the user to concur in the plan before we do.

- We can and do non-concur in the unit's plan if the Information Systems plan appears to be a unilateral Systems Plan, rather than a systems plan in support of the user.

- We push for and get User Councils in many areas and in many forms.

- We require joint user - I/S Phase Reviews at regular intervals on all major projects.

- We conduct Information Systems Reviews from the Corporate staff level of all key development projects and in almost every case the scope of the review falls heavily to an independent evaluation of whether the users and the Information System people have achieved an adequate, effective working relationship..one that will guarantee if you wish, that the job I/S is doing, the application they are developing, is the one the user wants, the one that agrees with his specifications.

So in this matter of organization, again the two points I want to make are that:

- First, it seems to me we have to bend over backward to keep our internal complexities transparent to the user..or as transparent as our ingenuity will permit.

AND

- Second, that our technical and organization complexities expose us to creating "specialization cracks" or gaps. These should be a primary focus for management attention. I'll have more to say on this later.

Getting back to the main theme, remember I said earlier that one of the keys to effectively managing our computer resource is to find ways to make our users less uncomfortable about us. Lets focus for a few minutes on how we might go about this.

We've just talked about one way IBM tries to do this...keep him, the user, in the act as far as our plans and projects are concerned. That seems to me to be an essential ingredient, and unfortunately one that's all too easy to side-step unless we have a discipline in place to keep us alert to the problem. I mentioned such things as formal plan review and project review procedures as disciplines that help us in this area.

Another ingredient we've just talked about in making our users more comfortable is this business of making our complexities transparent to the user.

But I think there is another, more fundamental ingredient to this business of keeping our users comfortable.

A security analyst commented recently in a taik that "the batch processing approach typical of the last twenty years was dehumanizing. The batch computer could be approached only by the specialist initiated in the rites of using the system." I think he is correct!

And of course the opposite or alternative to batch processing is on-line processing, or let me generalize and speak to interactive processing. I'm using the term in a loose way referring to any use of terminals or satellite CPU's located in the user's work area and available for the user to work directly with the computer center.

I believe the user, by-and-large, wants to do his own thing. So, in IBM, we let him, within reason. We've gone from one terminal for every 20 people in 1970 to one for every nine in 1975. And this trend will doubtless continue and perhaps even accellerate in 1976. It is clear to me that this dramatic growth in the use of terminals has begun to put our users back in the driver's seat.

We can't take the time to dwell on the various types of interactive systems or applications available to our users, but I would like to focus on two characteristics of these systems.

First, through a series of studies we've been conducting for the last couple years, we are convinced that these interactive systems are not only good for the user, but also they are good for us. They make our computer centers more productive and efficient. They require fewer operators, sometimes dramatically fewer for an equivalent amount of hardware - less than half as many. Interactive Systems reduce the tape loading process and virtually eliminate application schedulers. Also, by letting the user "do his own thing" through a terminal, the need for application programmers can be significantly reduced. There is also a reduction in the amount of effort needed to maintain application programs. On top of this, there is evidence that interactive systems tend to make more efficient use of the CPU and memory because of the more disciplined environment that comes with these systems.

The skeptic may immediately respond with the obvious conclusion that we get this efficiency by shoving the work out of the computation center and burying it in the user's department and in his budget. This is sometimes true, but if you then go the next step and examine the user's productivity....as we have...the answer is pretty clear that he also is more productive..as well as less uncomfortable in dealing with us. For example, in our rather large on-line system that processes all computer orders we have found that our field people are able to process 40% more transactions per person. So I believe a pretty strong case can be built for interactive systems on the grounds of productivity improvements.

The other characteristic of interactive systems I'd like to focus on for a minute is that there are two basic kinds. There's the interactive system to handle the big volume, transaction oriented type of work. Here we let the terminal replace the key punch and the printer. On line order-entry systems are a typical example of this.

But then there's another type of interactive work. Earlier I used the phrase "Do your own thing" to refer to this type. Here the user is not simply feeding transactions to the computer...but rather he is using the computer via a terminal to get information, or to solve his problem of the moment. He may be getting information via an inquiry language from a large centrally maintained data bank, or he may be creating his own file and then developing answers to his problem; perhaps it's an engineering problem, or a pricing problem, or a forecasting problem. The list is unending.

One of the most apparent of these "Do your own thing" interactive systems is APL. We, like many of you are heavy users of APL. Also, probably like you, the use of APL generally started in the technical, scientific areas of the business. But we've seen its use spread to almost all areas of the business in the last 2 - 3 years. Several of our divisions have their planning work heavily dependent on APL. Finance people, personnel people, and yes certainly our own Information Systems people use APL extensively. One of our divisions has a series of pre-planned applications written in APL to support their entire Sales Force. Each Branch Office is equipped with terminals hooked to their APL processor. Even though many of our people deal directly with APL, in some cases, such as in this example, the comfort of the user is further increased with pre-planned APL programs.

I think the main reason APL usage has spread so rapidly and pervasively is that it quickly and dramatically eliminates the two problems I mentioned earlier. It solves both the specialization-crack problem and buys us our transparency at the same time.

Moving on, the statistic I mentioned a few minutes ago of 1 terminal for every 9 employees may soon become a meaningless number. It may well be made obsolete as we move into what I consider to be a major new concept. The industry has sort of adopted the phrase "Distributed Processing" or "Distributed Intellegence," or "Distributed Data Banks" to talk about this concept. Unfortunately it still means different things to different people.

By distributed processing I mean simply putting a device out there in the user's hand that:

- Has some degree of independence and logical processing capability and;
- Is still hooked to the central host computer for access to major data files and processing logic.

In other words, distribute the workload to where it best fits, but within a structured environment.

I said this is a new concept. Let me qualify that. The words distributed processing are new, but in fact they refer to a rather old and fundamental concept. In our manufacturing plants for instance we've been using exactly this concept since the mid-sixties; called it hierarchical processing. In most of our plants we have large host computers sharing the total processing load with a series of smaller processors.

In a typical example we would see a test device being operated by a manufacturing person. He may be checking the accuracy of the chip manufacturing process. We need to check hundreds of characteristics, electrical and physical, about a chip before it goes into a computer.

Tied to the tester is a computer. In our plants typically this is a System 7. The System 7 may be feeding test parameters to the tester and then recording the results of the test.

Periodically, in some cases daily, in others hourly, and in many cases continuously, the System 7 computer is in direct contact with a larger host computer. Again, this is usually a two-way communication. The host is supplying the test parameters for the next part number, or the next series of tests on the same part number; and at the same time the host receives the data collected during the test by the System 7.

The host computer is programmed for any number of data file updates, or data reduction and analysis operations.

So distributed processing itself isn't new for us by any means. And I doubt if it is for some of you. I can imagine at least some of you, perhaps those with multiple campuses, having some form of remote processing hooked to and dependent on a central or host CPU. Perhaps your various academic sub-units, divisions, colleges, etc., have their own administrative processing capability but again are part of a network of remote and central processing.

The thing that's new for us in IBM is the expansion we are seeing now of this concept to new application areas. Let me describe just one example of what I mean.

Our General Systems Division is installing a project to tie one of their small computers in each of their branch offices into a host computer at their headquarters in Atlanta.

The Atlanta computer will be performing a similar function to the host in our process control example...Collecting data from the locals, the remotes, the users' CPU, call them what you will; and after updating the various data files affected, detail information about the day's activity, along with the cumulative results for the week, or month, or year, organized by product, by region, by branch office, by customer, etc. will be made available for management use via a number of interactive, inquiry type routines.

What I've described so far is not new. We've been doing this for years. The new story is the small computer (in addition to a terminal) being used at the user's end. Periodically now, every night for some data, weekly or monthly for other data, we will send from the Atlanta host computer to each remote computer the management information files that are of interest to that Branch Office.

Now for the first time the end user, the branch manager, can use this data as he sees fit, completely independent of the central supporting CPU. Perhaps he likes to see customer names on the right margin rather than the left, or perhaps more meaningful, he has peculiar needs for analysis this month. He now controls the means to accomplish it. In addition he still has his terminal for direct input or inquiry type activity to the host computer.

So in a sense, a very real sense, terminals and distributed processing bring us full circle. We started 20-25 years ago with a direct one to one relationship, the computer man (working probably in the user organization) doing the whole job. For the last 20 years we've been pushing the user farther and farther away from the tool that's at the same time becoming more and more his life blood. Now I believe we've found the way to get back to the basics of letting the user do his thing as only he can and at the same time keeping the benefits of the large central CPU and data files.

At the beginning I said that two keys to effectively managing our computer resources were to concentrate on keeping our users comfortable and to focus on fundamentals. We've kind of wandered around that theme. Let me speak now for a few minutes to several examples of what I have in mind by fundamentals.

First let me comment that frequently focusing on these fundamentals also serves to help keep our users happy.

What are some of these fundamentals; well we've just been talking about a key one, perhaps the single most significant one; that is to get and keep that user in the act, give him a terminal, or a little CPU, make him an integral part of the planning, design, and education process. Don't act unilaterally out of expediency.

Another key ingredient is the theme we mentioned earlier of keeping your technical complexity transparent to the user.

An example of this: Our Rochester plant uses four large computers. They are all in one central computer installation and they're organized with totally switchable gear and files so that any job can run on any of the 4 CPU's. Indeed jobs do move from one CPU to the other frequently as part of the overall load balancing process. Now this looks on paper like a very complex organizational lash-up of hardware, and it is..but the point is, it's all transparent to the user. He never knows nor really has reason to care which computer runs his work. We've even finally got the billing algorithm refined to the point where the user's computer costs are consistent with his workload and not reflective of the particular CPU in use.

Our Rochester I/S team has also done a nice job of getting the user to help them fine-tune the system...by really thinking seriously about priorities, overnight vs 1st shift response, etc. And one way they've done this is by going out of their way to organize, simplify and standardize the way they ask for help.

But more important, they've gone the extra step to be cognizant of their users. We all know the frustration of getting computer runs that look like they were designed by a Martian or something closely related thereto, hard to read, poorly organized, lots of computerized headers and trailers...we all know the picture. Rochester has a practice of periodically, I think about once every 18 months, having the programmers take a turn at manning the printer stations. I should comment that the installation of 4 CPU's is organized into work stations. All 4 CPU's together, and operated by CPU operators; all tapes together, manned by tape operators; all printers together actually in an adjacent room, and manned by printer operators.

Well, they figure that if a programmer has to spend a couple of hours a day, for a week or so every couple of years, standing in front of a printer, he'll become aware of the things he and other programmers do that simply are ridiculous in the eyes of the user. My first reaction was to snicker at the idea, or even criticize it for being an inefficient use of people, but I've changed my mind; it works.

Another fundamental - a real key in the old days, one all programmers were conscious of - is tape (or disc) blocking factors. We knew from first hand experience how inefficient we could make a job by improper blocking of the tape record.

Tape blocking rarely appears as a subject for discussion anymore. It stretches my imagination to believe that all our programmers just automatically do the right thing. Is it possible that this is one of the basics that somehow has slipped thru the specialization crack. You know, the nature of tape hasn't changed..at least not until our new 3850 mass storage system. But that's another story - and blocking still is a critical decision affecting I/O time.

Another basic is rerun analysis. I remember, and perhaps you do too, the days when the hottest daily operating report was the tabulation of the previous day's reruns..all jobs properly coded as to the cause and the time and cost of the rerun. When an audit was made, the rerun record was the first thing looked at.

Again, I don't see much of this anymore; how about you? Is it possible we don't make mistakes anymore? I wonder if some of us aren't too busy adding up statistics like computer busy time, channel busy time, and wait time to have any time left over for the mundane questions like: did the user get his job on time?.. and was it properly run to his expectations? And then the key question..did we have any trouble running it?..and if we did is someone analyzing why and fixing it? Perhaps I overstate the case. I'm sure we are still analyzing rerun statistics and fixing the causes..but then I also wonder why it's another subject rarely discussed.

Maybe, we all should go back and ask our people to give us an analysis of last month's reruns and incidentally ask them for the current blocking factors on their 20 most active large tape files. I just have a hunch we would get a surprise or two.

Now, I'm sure you realize that I've picked a couple of rather simple, obvious examples to illustrate my point...but to me the message is clear. We are tremendously exposed to the specialization crack. We all know about tape blocking and rerun analysis. And we all know a number of similar basics which we grew up on. But for very cost effective reasons we have specialized our people, and become dependent on vendor supplied software to take care of our gets and puts, our reads and writes, and most of everything else. All this leaves a tremendous amount of room for us to just assume that "it's taken care of...by the system..or by Joe". In fact the system or Joe is all too often assuming that we are taking care of it, or at least telling it or him how to take care of it.

The point of all this of course is that there are many exposures for mis-use of the computer resource. Not only are there more exposures than in the past but in many cases the consequences of improper balancing or tuning of the system are more upsetting. In the old days, the programmer knew full well where the responsibility for these exposures fell. It fell on him. But today all too frequently we see evidence of the notion that because the software, the operating system, the data management system, the security system, etc., "did it to me", I'm not responsible. This is where our continued management emphasis is needed.

By now, some of you may be saying something like, "but I thought the theory today is to make the processing so fast, the memory, the disk, etc., so cheap that it just doesn't pay to fine tune a job." The logic being simply that the cost incurred to save a few microseconds of processing time will be offset in something like 999 years of processing time savings. Obviously there's truth in that logic for some percentage of our jobs.

But what about the job we have in one of our plants, a daily job and still essentially a batch job, that runs 14 hours every day. When that job was first installed about a year ago it ran about 20 hours. We frequently caught ourselves by the tail; couldn't start the new day's cycle on time because yesterday's was still churning. Well, by tuning we've got the job down to 14 hours, and are currently shooting for 12. Is the tuning worth it in this example? It sure is!! And in many situations.

We've been talking a bit about tuning a computer job. Obviously there's a time for tuning and a time not to. I'd like to make a point here that we should develop, if we don't already have one, a a system, a discipline, to help us focus on when tuning of a job should be undertaken...and when it should not. We shouldn't leave it to chance. You may have found like we have, for instance, that perhaps 20% of your jobs account for 80% of your computer time. And another point, that we won't have time to expand on, is that frequently the environment is what needs tuning rather than the application code. I'm thinking of such things as the way we organize the various software systems in our CPU's, the balancing of channels, and a host of similar items.

Well, I've about used up my time.

At the start I mentioned a number of elements or things I considered as computer resources. I think we've covered, at least indirectly everything on that list except the last one. This was the one I called "Responsibility for Security, Privacy, and Auditability".

You may have concluded back then that this in no way can be called a computer resource. And obviously in a sense I fully agree with you. But if your job is to manage the computer resources, do you know of a quicker way to lose your job than to grossly mismanage this one.

I assure you I'm not about to launch into all the good words about security, privacy, and auditability. But I purposely saved this point for last, and I purposely grouped these three subjects together as one topic. I did this to simply dramatize the one point I want to make.

And that point is that these three subjects will never be dealt with adequately until we:

- stop lumping them together as one topic - as I just did.
- and stop leaving them till last as I have done.

We manage a tremendous asset for our enterprises. I'm thinking of not only the capital assets but also the data under our control. We as computer installation managers have got to assume the lead in dealing with these matters. We can't leave it for others, even though they frequently are involved and may even give evidence of taking the lead. We need the help of others, for instance, to give some measure of the value of security. But only we can supply the half of the equation that describes the cost involved. It's our job.

And on that profound note I'll stop by saying again that I welcomed the invitation to meet with you and have certainly enjoyed the opportunity to share some of my thoughts with you.

PRODUCTIVITY MANAGEMENT

The Missing Crystal to Fine-Tune Your Information System

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The computer has brought an "inverse industrial revolution." While machines once were the primary source of increased productivity, today it is the management of those machines -- especially computers -- that will provide the much needed economic gain. This paper discusses the six proven techniques for improving data processing productivity, with case history illustrations from the speaker's experience as President of one of the Nation's largest information systems development firms.

Two hundred years ago, a group of Scottish weavers showed up for work one morning and discovered that their little hand looms had been replaced by much larger, more complicated devices that did some of their work for them. Their reaction was decisive and immediate. They took off their wooden shoes -- called sabots -- and threw them into the workings of the hideous machines.

Two important events occurred that day. One was the coining of a new term in our lexicon: sabotage. The other was the beginning of the industrial revolution.

Machines that could do the work of men had arrived. And the world has never been the same.

The discovery of this new force set in motion two centuries of the greatest inventiveness -- and the greatest productivity -- in the history of civilization:

- It changed society from an agrarian to a goods-producing basis.

- It radically altered population distribution by hastening the concentration of people around the new centers of productivity.

- It created a new standard for measuring humanity: wealth.

.And it polarized to this day the political systems of the planet -- between the "haves" and the "have nots".

Until recently, the tools of productivity have been machines. Special purpose machines. A reaper that just reaped. A power shovel that just dug. An airplane that hastened travel. A single tool for a single function. By applying lots of the same tool to a specific function -- as in a factory or plant, for example -- a manager could quickly and easily increase his output. And essentially, it was this multiplier of more and more special-purpose tools that powered the enormous productive output of the industrial revolution.

Computer As A Tool

Today's tool is the computer. Its awesome speed and power allows us to manage masses of data within very narrow time constraints. The same computer can process student records, guide a satellite to the moon, or schedule the production of goods through a factory. This very characteristic of the computer makes it completely different than any other tool we have used in the past. The computer is different because of its generalized capability, which must be specialized to the specific needs of a user. This process of specialization, not only involves the writing of tens of thousands of individual program instructions but the part-time involvement of many individuals in the organization who are neither knowledgeable with the computer nor familiar with the discipline it requires for its successful use.

All of us in this room are familiar with the task of implementing computer systems. And a few of us can really feel good, I suspect, about the progress we have made. Each has tried to staff with good systems and programming personnel. Each has probably employed the technique of throwing more and more tools at the problem in an effort to solve it. And none of us would be here today if we weren't seeking out better ways to get computers to do what we need to have done.

Business of Keane

Getting computers to do the specialized functions we want them to do is the business of Keane Associates, and has been for 10 years now. How well we, and other companies like us, have done is reflected in our financial statements over the years. And within the computer industry the record of computer services companies has been spotty at best. Not because their people are more inept than their counterparts in computer departments or organizations like your own, but because their efforts have been very analytically measured in the marketplace. The free enterprise system is a marvelously efficient way of sorting out the weak from the strong, the responsive from the unresponsive, the efficient from the careless. A poorly run computer department may make management unhappy, but a poorly run computer company goes bankrupt. This provides considerable incentive from a person like myself to think carefully about what is happening in the world of computer technology. In this context I would like to talk to you about a subject I feel very strongly about. I call it Productivity Management, and it relates to the design and implementation of computer systems.

About three years ago, we at Keane felt pretty good about our ability to implement major computer systems. We had an enviable track record. We prided ourselves on doing what we say we would do, and committed our company's resources to implementing computer systems for client companies on a fixed price, fixed schedule basis. We had been successful by almost every criterion and we were confident. Then something began to happen, slowly at first, but finally with the thud of a sledgehammer. Projects started to run over budget. Schedules began to slip. The reasons were numerous, but in most cases they were subjective and intangible. Surprisingly, some of our most senior technical people were involved.

Needless to say we became increasingly concerned. No organization can long tolerate five and six figure overruns, and stay around very long. We held a series of post mortems, did considerable soul searching, and looked to see the experience others were having.

Reasons for Project Overruns

The conclusions we came to were amazing and completely unexpected. First of all, we were not alone. The problems we were experiencing were not the result of increased technical complexities of the computer, rather they were people and organization related. Secondly, most problem projects involved either new computer users, or completely new systems for existing computer users. Upon some reflection we recognized that most computer implementation efforts in the sixties and early seventies concerned a change in technology, e.g. tape to disk, DOS to OS, Assembly language to COBOL or an extension or modification to an existing computer system, purchasing capabilities to an accounts payable system. With the passage of time and advent of Data Based systems and Telecommunications capabilities, people started to rearchitect completely new systems. This rearchitecture requires the involvement of individuals outside of the computer organization. These people are needed for their knowledge of how the generalized capabilities of the computer must be specialized, for making decisions involving costs versus benefits, and in some cases providing resources necessary for assuring the integrity of data input to the computer. The involvement and dependency of these people added a new dimension to the data processing function.

Finally, we came to the realization that the Project Manager in a computer implementation effort had responsibility for accomplishing certain objectives, but in many cases did not have authority over the people he was dependent on. This is a fundamental dilemma and one not easily resolved. One of the first precepts of good management is that a manager should have authority commensurate with his responsibility.

What Should Be Done

What did we do with the findings of these post mortems? Well, we first assembled a series of guidelines to educate our own managers in how to approach the management of a computer implementation effort. We encapsulated these guidelines in a short audio-visual presentation which can be shown to every member of the project team, and to others in the organization whose support and cooperation is necessary. Then realizing that most of us learn only through experience, we assembled a series of case histories of actual projects (both good and bad) which we require all of our managers to study in a three day seminar, held away from home.

We have recently begun to hold a modified seminar for personnel outside our own company because of the apparent need for this type of education.

To see it as it is, we are all pioneers in the application of computer technology which obsoletes itself every five years. IBM and other hardware vendors announce new machine or software capabilities, and thousands of us attempt in our own way to apply these capabilities. We don't have the experience of others to rely on, and are forced to pay the price of working our way through a "learning-curve". We don't have the experience of others to rely on, and are forced to pay the price of working our way through a "learning-curve". We are dealing with a technology where people turnover varies between 20% and 30%. If we are not happy with the results of our efforts, we shrug our shoulders with the small comfort that everyone else we know is in the same boat.

If I can impart any message here today, it is that we all can do better, <u>much better</u>, and to do this we have to become better managers. I will try to describe precisely what this means in the area of computer development efforts. Unlike what many people think, the management of successful computer efforts is not an art, it is hard work, careful planning, and good discipline.

Project Concept

The fundamental concept of Productivity Management is to treat every effort as a Project. What is a Project? It is a task with a specific beginning and a definite end. Each project generates a tangible product, whether it be a report, a design, a series of programs, or conversion A project is limited in scope, to that which can be fully understood at the outset. It is measurable. It has checkpoints. It can be scheduled. It can be assigned specific resources, including people, dollars and support equipment and activities.

Each project has a manager, even if he is the only one assigned to the project. And he has a scoreboard, which tells him and others how well he is performing.

If my definition of a Project seems elementary to you, you are certainly correct. But look around to see how infrequently these criteria are applied. Most of us when starting a major development effort assign several good people to it. And they go to work, and report back to us periodically how they are doing. In most cases these types of projects, if they are of any size at all, drag on for many months or even years.

In my opinion, people should not be just assigned to work on something. Rather, that something should be defined in scope and identified as a project with a beginning, an end, a budget, resources, and a manager.

Many Types of Projects

For example, it may appear to be a forgone conclusion that ABC Company wants and needs a manufacturing control system. Rather than just assigning several good people to begin work, we should look at the phases this work will be proceeding along. The first phase may be a feasibility study which describes the systems capabilities, and identifies the time, resources, and costs of achieving these capabilities. This feasibility study should be treated as a project with a manager, a budget, and a deliverable product which is a report which outlines what can be accomplished in what time frame for what costs. In this way management can logically weigh costs versus benefits and approve the alternative most suitable for the organization as a whole.

Only upon approval should effort continue to the next phase which may be General Design. This too should be treated as a project, with a manager, a budget, and a deliverable product which is general systems specifications. This too treated as a project completed, approved, and effort continuing in the same way through Programming and Conversion.

This approach structures the effort in a meaningful way so that it is visible to everyone directly involved. More importantly, it gets management involved during the development effort so that a Cadillac is not developed by technicians, when a Pinto is desired by the bill payer.

This is simply the ability to gain increasing levels of awareness and participation at every stage of a systems's evolution by being able to demonstrate to all involved that you are capable of doing what you say you will do. It starts in the beginning by thorough preparation, and it grows as you execute as you said you would.

Six Steps in Productivity Management

That sounds a lot easier than it actually is, of course, which is why there are a series of techniques and principles which must be used to assure the right result. There are six that we employ, and they are the core of the productivity management concept.

Let's look at each of these steps in some detail -- after first enumerating them.

-Step One is Getting Down to Detail, deciding precisely what you want to do, and exploding it into very specific elements.

-Step Two is Getting the Right People Involved, or assembling the resources to do it -- a critical step.

-Then comes the Estimate of Time and Costs

-Fourth is to Assign Work According to an 80 Hour Rule

-Since change is a constant, the fifth step establishes precise methods of Recognizing and Integrating Changes in Scope.

-Finally, Define Acceptance Criteria. You cannot start a project unless you know how it will end. Your knowing isn't sufficient. Everyone must know. So mechanisms to assure that acceptance are mandatory.

All six of these steps must be established before a project is initiated. If they are, management becomes far less problem-related, and far more opportunity-reactive. In the end, systems productivity is increased markedly.

Let's look further at Productivity Management and how you can apply it.

Step One: Getting Down to Detail

The starting point, somewhat obviously, is deciding what needs to be done. When you look at a computer, you recognize precisely what it can and can't do. That's your business as systems developers. But it is critical to convey that understanding to the user departments as well. They are the ones that not only know their needs, but know them far more precisely than you do. In a manual system, a file clerk can ask questions. But in a computer, unless it was thought through and implemented beforehand, you are already in trouble. The computer can't ask questions.

Thus the decision process is in fact a matching process -- a careful sorting and sifting of priorities, preferences, and desires that serves a dual purpose: to match the user's understanding and needs to the realities of the information systems' potential; and to force him to specify to the finest detail what it is that he requires.

I am sure we have all gone through one or more stages like this. But the point of differentiation is pursuit -- pursuit to the level at which no questions need ever be asked by the computer after the fact. At Keane, we use a checklist of over 65 specific areas of project definition, each of which has its own decision tree. The checklist certainly gets us down to a detailed level from which we can proceed with our other controls; but it is equally valuable in bringing the organization's comprehension and expectation levels into the sharpest focus.

We have a saying at Keane that, if it isn't in writing, it doesn't exist. This is an essential concept in the development of information systems. When many departments are involved compromises are a must, and effective communications can only be assured when details are documented and signed off by interested management.

Step Two: Get The Right People Involved

Now it is time to assemble the team -- to put the right people together to get the job done, people who can sign off specifications, people to make cost benefit analysis, approve budget, change of scope, provide computer time, test data and so forth and so on. If these people are good, know their job and are available at the right time, you should be able to expect good results. Unfortunately, the right people are not always available at the right time. This problem is magnified when these people are not under the Project Manager's direct control. People he must rely upon. People whose services, facilities, knowledge are crucial to the success of his effort.

We've all experienced the frustration of having such non-existent personnel resources. The best computer test schedule is meaningless if the hardware is unavailable due to a crisis run. What good is getting computer programs coded if they can't get through the data entry bottleneck?

The solution to these issues is a management solution.

In part it rests on the credibility you achieve by simply going through the planning cycle in the detail already discussed. In part it rests with advocacy -- the function of keeping the development effort in the forefront of everyone's consciousness. In part it's assembling the procedures that keep everyone well informed of their role in the project. And in part it is the leadership which keeps goals and milestones visible and acknowledges their attainment importantly.

There is an interdependency, rather than an ivory tower, at work in assembling the team. It is the clarity with which all participants see the advantages of the interdependency that can overcome the natural problems of putting together new relationships, new procedures and new priorities.

Step Three: Estimate Time and Costs

The next stage is determining time and cost elements. But these costs are relevant only when specific benefits are detailed. Each of us does this, but once again the difference between good performance and haphazard execution is a qualitative/quantitative one.

The effective implementation of computer systems is not an art as some people think. It is the result of hard work and careful planning. In football, we keep track of touchdowns. In baseball, we score runs. With computers, the principal measurement devices are time and cost. Thus it makes sense to finely hone time and cost estimates at the smallest level of detail; and since you have already assembled that level of detail in earlier planning stages, it becomes simply a matter of assigning realistic dollars to a time factor that -- in most of our experiences -- is often based on educated estimates.

The time and the costs that are assigned and approved in this stage, becomes the scoreboard against which project performance is evaluated.

Once the project has been defined in detail, the right people involved, and time and costs identified, it is time to assign effort to specific individuals for completion.

Step Four: 80 Hour Rule

The axiom "divide and conquer" is as relevant to managing systems projects as it is to plotting political intrigue.

The technique we use at Keane Associates is called the "80 Hour Rule". Essentially, what that means is that no task -- and I specifically mean no task -- in a system project should require more than 80 hours, or two man weeks, to complete. When our systems managers submit their development plans, we require that every work item be reduced to under that period of time.

We do so for several reasons. First, because it forces him into Precision Decisions -- every logical step must precede and follow the one before or after it. Second, because it forces him to think in terms of deliverable components that are measurable in the short-run. Third, because it imposes "all or nothing" strictures at brief intervals, from the start to the finish of the total project; an 80 hour segment is either complete or it isn't; there can be no sliding. We are all familiar with the 90% syndrome, where 90% of the effort goes into the final 10% of the job. Fourth, it acts as an early warning system; a segment that is starting to slip is identifiable and correctable within a single two-week time span. And last, because 80 hour tasks enable you to assign precise time and cost factors that are essential to control the scorekeeping.

Individual accountability underlies the "80 Hour Rule". But in practice, you will find it has an outstanding effect on your team resources. It instills confidence in the team. Everyone wants to succeed. A two-week assignment is far less difficult than an undefined six-month task. Since everyone has his own scorecard, the level of self-motivation increases. Since the measurement period is every two weeks, a team member has 25 or more opportunities to succeed over the course of a year's project.

The effect isn't simply better control of the project, nor is it simply a means for rapidly isolating potential slippage. Rather it is a technique for building pride, spirit and confidence in each member of your project team.

Reporting is an important aspect of the 80 Hour Rule. If a team member feels comfortable with a series of attainable short-term goals, and if he knows that he will be assisted in reaching each if the need arises, he will be encouraged to "tell it like it is" in his bi-weekly reporting.

The cumulative effect of many bi-weekly milestones being reached by the team, and quick fixes applied to those not reached, is to build momentum.

The reports used to build this momentum should be simple, clear and easily understood by anyone reading them -- even a non-technical person. And the essence of 80 Hour Rule reporting is: If it isn't written, it didn't happen.

Step Five: Provide for Changes in Scope

Everything changes. Which is why provision must be made, during the earliest planning stages, for a mechanism that will deal efficiently with change of scope requests that will inevitably come.

It is important to convey early the likelihood of changes and the importance of making them visible. A good rule of thumb is that even the best-conceived system is likely to change by 10 per cent over its development cycle.

Recognizing changes as a fact of life goes a long way toward making them visible as they should be. Otherwise good people tend to overlook changes as they occur and to take original time and cost estimates less than seriously.

When the scope of a project changes, everything else changes. Time estimates. Cost estimates. Resources allocations. Scheduling routines.

Thus, any change, however small, must be reduced to the same measurable and quantifiable elements as the original project. That means committed to writing, divided up by the 80 Hour Rule, assigned time/cost factors, and integrated into the overall plan.

Again, the benefits of this approach are multiple.

First, it eliminates the element of surprise. If there is a first precept of sound management, it would be the simple two-word declaration: "No surprises." Changes reduced before the fact to measurable terms adhere beautifully to that precept.

Second, it permits reasonable management judgment on the cost-benefit tradeoffs of the proposed change, resulting in the best decision change by change, and assuring full understanding of the consequences before a commitment to the change is made. Formal change of scope procedures prevents the technician from making judgments of system enhancements that should more properly be made by a financially responsible manager.

Third, it eliminates misunderstanding entirely. And misunderstanding has been a plague upon the houses of most data processing systems developers since the advent of the computers. Everybody knows the implications of a change clearly identified, can assess the values, and can live by the decisions as they are resolved change by change.

Every project has unforseen obstacles. Some like the unavailability of computer test time, or personnel turnover have hidden costs that should be identified. When this is done, logical alternatives may appear for the first time.

Step Six: Define Acceptance Criteria

The final stage in applying productivity management is perhaps best described by a statement made recently at a seminar by our corporate systems manager:

"Plant a radish, grow a radish." Loosely translated, that means: Establish acceptance criteria before the project is initiated. At the end of an eighteen-month development is no time to discover that, while you actually planted a radish, the user really wanted a rose.

Acceptance is actually a process, not an event. It derives from understanding and participation at each step of the development, so that final acceptance becomes a relatively straightforward process, rather than a breath-holding drama.

But you have to know when you are finished -- and that's what acceptance testing does. If you agreed initially on a test plan, reaching the project's end becomes easy.

When the system is completed, there are five levels of testing that we at Keane perform. First, unit testing of individual programs. This tests a programmer's logic. Programs are then grouped, and run together in a string testing phase, using pre-determined test data. This assures that assumptions made by programmers regarding programs written by others are valid. Finally, when test data runs well, the programs are run together as systems testing, to be sure that what the systems analyst wished to accomplish has been done. Then volume testing takes place, using large quantities of real data - not live, but previously live data. Finally, live testing, using small, then larger quantities of live files, completes the process.

Often, time pressure suggests shortening this seemingly lengthy test cycle. Don't. You'll regret it.

That's Productivity Management.

Treat every system as a project with a beginning, an end and a payoff. Develop precise decision rules at the start and get down to detail. Assemble the relevant resources and GET THE RIGHT PEOPLE INVOLVED. Provide the project and its team members with a visible scorecard in terms of time and costs. Assign work in 80 hour modules that can be reported as complete or not complete. Plan for change, because it will happen, and know when a project is complete by having well-defined acceptance criteria.

They sound like easy steps to take. And they are.

If you use them you'll be that much closer to perfecting the means to help you evolve your future information systems.

CHANGING FACULTY ATTITUDES AND THEIR POSSIBLE EFFECT ON DATA PROCESSING

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The psychological distance between the world of teaching and the world of management is most appropriately measured in light years. Communication is slow, understanding is limited, and since different languages are spoken, much is lost in the translation. At present these two worlds seem to be approaching one another more than in the past years, and glimmers of harmony, even cooperation, are on the horizon as both worlds direct more attention to the mutual goal of serving the common client, namely learners of all ages. This paper is an explanation of some communications and new perspectives among administrators and faculty members, and the roll of information science in fostering the learning process.

I shall never forget that day in a windy April of the Chicago loop area when I walked into the office of the Underwood Company. The whole graduate student population of the Chemistry Department of Northwestern University had suddenly discovered the punchcard of McBee-Keysort variety as a way of storing and retrieving our pearls of Chemistry wisdom, gleaned from articles, abstracts and lecturers. We were fascinated with with our ability to index, cross-index and retrieve from a shoebox, the precise piece of information which we had squirrled away in our storehouse of nonhuman memory. I found myself saying -- if we had come this far with a knitting needle and cardboard, what might a more highly mechanized system perform.

These people had recently imported a magic machine from England which worked with funny little cards of various sizes (most about the size of business cards) with round holes punched in them, not indeed in the periphery, but in the body of the card. I, who was used to atoms, molecules, valence bonds, molecular orbitals and hydrogen bonding, was mystified and enchanted by the magic machine, which from those funny little cards could print out invoices, statements, balance sheets and other miracles. Yet, now I look back upon this as if it were before the flood and Noah's Ark had not yet landed on Mount Ararat.

Unfortunately the sense of wonder about information processing systems has not decreased among neophytes nor has the state of over-arching expectations and their subsequent feelings of frustration when Utopias do not flow forth from the output rooms of our computer centers.

Despite the downpour of technological miracles, there are still many individuals in business, government, and education for whom data processing is troublesome, confusing and frustrating.

In education the psychological distance between the world of instruction and the world of management is most appropriately measured in light-years, communication is slow, understanding is limited and since different languages are spoken, much is lost in translation. At present, these two worlds seem to be approaching one another more than in past years, and glimmers of harmony, even of cooperation, are on the horizon as both worlds direct more attention to the mutual goal of serving the common client, namely learners of all ages. It is the purpose of this paper to explore the different goal settings from which the participants in these two worlds come, new perceptions and changing attitudes among administrators and faculty members, and the role of information science in fostering the learning process.

There are some key differences between faculty members and administrators which traditionally have influenced their differing attitudes toward each other. Most colleges and universities are decentralized, loosely organized, and the faculty member is able to operate under few contraints. He is relatively free to determine his own activity, free of supervision and direction, and free of evaluative controls in comparison with analogous members of conterpart organizations. He works in an environment where there is a high degree of specialization and what he does in teaching and research is only generally related to what fellow members in the organization do. His possession of a unique expertise, skill and experience and the lack of relatedness to the work of other faculty members in other disciplines limit the authority of superiors and substantially limit the applicability of the concept of organizational hierarchy. He is not too concerned about organizational objectives which are translated into operating plans that specify for the immediate future, in quantifiable terms, what is to be accomplished and when. Few academic departments have plans that clearly set forth instructional, research and service missions. Fewer still express much interest in the number of student hours produced, the number of majors, the cost of credit hour production, and similar data.

Typically, the faculty member is not sensitive to management's need to know, to measure, to control organizational function, and to meet schedules on time. The faculty member operates in a goal structure where it is important to examine a problem from every side, to understand it fully, and not to be bound by the limits of time and space. He seeks fullness of understanding, and he is understandably reluctant to accept responsibility for an action until he has achieved that goal. To the manager, who prides himself on making decisions with excellent consequences with, often, minimal and insufficient data, the faculty member's insistence on completeness of understanding can seem like making a lion out of a tame cat, or, as one wag put it, taking the infinitely little and making it infinitely large, granted only that it is infinite enough.

Management, too, brings to its work a particular tradition. It has a different set of expectations and needs. Management is accounting and information oriented. It needs to be convinced that any individual program is reasonably efficient in moving toward the organization's major goals. Management demands a system of control. A good deal of internal effort is often expended to accumulate statistical information and analyses to support what the average faculty member would regard as both unnecessary and unimportant, or as a preestablished contention. The need to find, to measure, to analyse, to optimize, to decide, to observe the results and to begin the cycle again; this is the way decision making is carried out.

For most managers, time is a crucial element in this cycle; time is o consequence because the density of events occurring within a limited period of time can be enormous, as any manager knows. This introduces a contraction of time which means that the manager may not enjoy the luxury of understanding every side of an issue or problem and must make a decision on the basis of limited information and knowledge. He cannot be patient with delays.

There are other differences between these two worlds that sometimes lead to misunderstanding and recrimination. A decreasing number of college and university managers see their future in terms of advancement as a physicist or a historian so that the scale of values that controls their indentification with members of the faculty has changed. Similarly, there are some indications that fewer faculty aspire to positions of managerial responsibility. In general, this is not a serious source of difficulty, but this divergence from the historical pattern of vocational identification and aspiration can contribute to accenting the differences in goal structures.

As mentioned earlier, the faculty member performs his function in the organization with minimal interference and in semi-isolation from the rest of the organization. The manager, on the other hand, sees the organization as a complex system consisting of many sub-systems, and how well it functions depends on the articulation of properly functioning parts. His concerns necessarily span a broader range of organizational activity.

Differences in language and terminology are also apparent. The manager speaks in terms of organizational roles and positions of centrality and peripherality, directional flows of data, systems, assessment measures, feed-forward controls, and the like. In contrast, the average faculty member draws from a different lexicon. These differences can lead to communication breakdowns, always high on the diagnostic checklist of organizational health. These breakdowns can lead to feelings of impotence, distrust, resentment, insecurity, social inconsequence and a lot of other fairly normal human emotions.

The psychological effects of data on some people in both management and instruction contribute to communications problems. The growing dependence on information science and enormous progress in EDP applications has created some difficulty for members of the before-computer generation. It is not uncommon for these people to experience trouble with tabular data. Others do not understand through numbers. Still others can read the data but do not absorb it or sense its uses and significance. In education, as in many other sectors of society, data and computers enjoy widely varying receptivity. Many older people are still dubious and indifferent, with the result that data is thrust into a hostile environment. It is fairly common to see faculty members and managers frustrated and angry because they cannot read computerized reports of one kind or another. The meaning is not there. Few people, however, experience much difficulty in reading a payroll check produced by a computer.

Despite conflict and the lack of understanding arising from the new emphasis on data and the widely different goal structures, there are forces at work in the environment that are broadening the perspective of both faculty members and managers.

One of the more obvious of these forces is that the world we live in is exceedingly complex and that the pace of progress is proceeding at an expotential rate, and, that, accordingly, decision making is correspondingly more difficult. Confronted almost daily with problems that resist easy solution--and by some that are not solvable--few would quarrel with this observation. With machines that can deal in minutes with combinatorial or numerical problems so complex that the mere reading of their terms would take longer than the time the computer takes to reach a final solution must surely argue for our resort to their use as a tool of modern management.

No one would dispute the importance of the electronic treatment of information in calculating the equations of trajectories in a space launch. And only the most stubborn critic of the cybernetic age would deny the value of the computer to the airline reservation system, or in navigation. If acceptance by faculty of the usefulness of electronic data processing in educational management has been slow, it has, nevertheless, won new adherents.

There is also the recognition by faculty members and managers alike that they are in the same fragile vessel, and that it will require the best efforts of both to avoid mishap in choppy economic waters. Both of these ranks understand today, if they did not before, the first principle of economics; that resources are finite and must be used wisely. Both understand that fractured approaches, reckless planning, and faulty decision making will lead almost certainly to ship wreck. Both realize that the chart and compass of a good management information system will be necessary if they are to steer into a safe harbor.

In both worlds healthy attitude change has taken place. For faculty members there is the reality of decreased mobility and the necessity of the instructional mission to better meet the needs of the student. For the manager, come out of a science that has grown rapidly, there is a new and humble posture born in the recessions of 1970 and 1973-1974, which demanded new standards of accountability. He recognizes that the gains in information science offer possibilities that are great for modest problems but that these gains are often modest for large scale problems. He understands that in the wake of solving one problem, another one soon pops up which holds progress up to ransom. Both the faculty member and the manager have developed a new sense of service; there is a new awareness of what it means to serve a common client and of the opportunities which lie ahead in the field of education.

Management has reacted to some of the problems and pressures upon it by placing great stress on improved planning and decision making. The importance on long-range strategic planning is not lost on the modern manager, for he knows that not to plan is not to anticipate and that not to anticipate is to leap stone blind into that awesome void called the future. And in planning today the manager in education does not cast his lot with the Leviathan technology as he did a few years ago. He understands its limits, its uses, and is not deluded by false promises of technological advancement.

Alvin Toffler, author of the best seller Future Shock, served as editor of Learning for Tomorrow, to which 18 psychologists, social scientists, and educators, and others contributed. The thesis of this thought-provoking book is that current education is oriented to the past and present, rather than to a new and vastly different future. Some might regard it as a kind of manifesto for the next wave of change in our educational institutions. In this book can be found yet another force that is collapsing the distance between the faculty member and the manager.

New-found information processing capabilities are making it possible for students in some settings to access information and knowledge that a few years ago would have been impossible. Students are already making use of computers in a variety of ways, ranging from the large-scale analysis of data to simulation and model building.

At first, there was the usual suspicion and doubt about the value of computer-assisted instruction. Its desirability was questioned. That is no longer the case. Faculty members increasingly argue for its necessity when departmental budgets are constructed. Obviously the contribution of information science to instruction and research has provided yet another common ground upon which faculty members and managers can meet.

In short, there is good reason to believe that the distance between the faculty member and the manager is being narrowed, and that the limitations imposed by the distinctiveness of goal structures are not so great that they cannot be overcome. A beachhead has been established, and what is required now is a persistent encouragement to build further bridges between the professoriate and management.

UNIVERSITY EXECUTIVES AND COMPUTERS: A TENUOUS RELATIONSHIP

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A recent study examining executives' use of computer-based information systems in higher education came to a troubling conclusion: contemporary systems simply do not adapt well to the individual management styles of top administrators. A major source of this problem rests with the inherent structure of the systems themselves. While executives and the institutions in which they serve have diverse and changing needs, systems are seldom flexible enough to meet this managerial variation. In fact, computer-based management systems are typically rigidly designed and require relatively large, complex programs. Thus, they are often expensive to operate and difficult, if not impossible, for executives to use or understand. The result tends to be a stand-off. Many executives virtually ignore the systems and their output; the systems become increasingly isolated from the world of top management.

Recent advances in hardware and software technology suggest that information systems more responsive to the idiosyncrasies of higher education management are now a cost effective possibility for a range of schools. Instead of the currently popular single super-system structure, such systems would have a modular design. Depending on the information requirements of executives and their institutions, numerous "standard" building blocks could be combined with a few specially developed parochial modules to produce a "tailored" system within a short period of time. Moreover, this approach need not be limited only to those large institutions which can afford expensive computer and communications hardware. The availability of inexpensive micro and mini-computers and the imminent appearance of national and regional networks could make such systems a viable option for virtually every college and university.

The abstract of this paper is included for the interest of the reader. For references to the complete paper, please contact the author.

HOW TO IMPLEMENT THE PLANNING PROCESS INTO THE UNIVERSITY

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Once envisioned as a panacea, MIS has generally failed to live up to its promise. So much so that it often leads top administrators to agree with John Dearden's allegation that "MIS is a Mirage."

This paper contends that times have changed. Several colleges and universities are now using proven methods for developing practical information system plans that meet the long and short term organization-wide objectives.

For information systems executives, the opportunity and the challenge of implementing the planning process into the university is truly rewarding. To help you accomplish this objective successfully, this paper identifies several essential requirements for effective information system planning.

How would you like to get promoted? Most people I talk with answer with an eager, although sometimes skeptical, "Yes!" A few hesitate and then say "Yes, but not yet. I have more to contribute in my present assignment before I'm ready to move on". Occasionally, someone responds with a definite "No!" Usually, this person has struggled through a career crisis that leads them to the peace of mind that says "I am in the right job. I expect to be able to continue to both contribute and grow in my present position."

If you desire to be promoted, the question arises: How does one <u>earn</u> a promotion? Peter Drucker says "Promotion should go to the person who makes his job a <u>different</u> job - a <u>bigger</u> job."[1] You must do something beyond what is expected of you, something that is not in the job description.

Whether or not promotion is a major objective of yours, I believe it is important for each of us to keep asking ourselves the question Charles Schwab, at one time President of Bethlehem Steel, learned to ask himself "What is the most important thing only I can do for my organization?" Only you are in your particular place in history at this time. Only you have unique strengths to apply to your unique opportunities.

I would like to share with you a way to earn a promotion, a way to make your job a different, bigger job, a way to do the most important thing only you can do for your organization. In short, here is what you need to do:

<u>Take on the responsibility to make sure that your university develops an information system plan that meets the long and short-term business objectives</u>.

Note that I did not say this is the only way to earn a promotion or make your contribution. But it is an excellent way. In many organizations it is so much needed that it is a rare opportunity as well as a challenging, exciting and rewarding one.

And for those of you in colleges and universities where an excellent job of information system planning has been done, your contribution may lie in making sure that your institution continues and improves its information system planning process.

Obviously, I cannot guarantee you success. I do know, however, of a number of cases where it has worked.

- The user who led the information system planning team at a major manufacturer was promoted to the position of International Vice President.
- The representative from the information systems department on the team of a major airline was promoted to the position of Director, the first woman to hold that title in that organization.
- The president and chief executive officer of a Boston bank reached that position because of his involvement in his organization's long range planning.[2]

Your chances of success will depend on how well you do your job. In what follows, I would like to offer some suggestions for doing the information systems planning job well.

The Planning Process

This paper deals with the planning process. The word process has several different meanings in the field of information system planning.

> Process as technique. One of the techniques in the Business Systems Planning (BSP)[3] methodology involves defining the business processes, that is, the major activities or decision areas in an organization. They are defined independent of the organizational structure.

> Process as procedure. In information system planning, it is important to have a step-by-step plan to plan, a methodology, an organized approach to do planning. Sometimes this is referred to as the planning process.

> Process as interaction. In this usage, process refers to the interacting of the parts involved as in the case of chemical interaction, human interaction, or the communication process. This concept of process is especially important because of its potential synergistic effect. Synergistic means the whole is greater than the sum of the parts.

It is this third meaning of process, process as human interaction, that I will focus on. You might think of it as the psychology of planning.

Let me illustrate. Some time ago two men from a financial institution attended our five-day Information System Planning class.[4] On the second day, after we had covered some of the major techniques (process as technique) in the planning methodology (process as procedure) that forms the basis of the course, one of the men said "We've done everything you said to do. But it didn't work. Our plan is sitting on the shelf." I was puzzled by their comment because I knew these methods had worked for numerous other organizations. It was late Thursday, we were discussing a film on planning[5] when one of them almost jumped out of his chair. The realization had dawned: <u>The process of planning may be more important than the plan itself</u>. The necessary and appropriate participation of people all levels and in all areas of the organization (process as interaction) is more important than the written plan itself. The masterpiece plan resulting from someone elses efforts is not nearly as effective as the good plan that result from the efforts of you and everyone else in your organization upon whose support the success of the plan depends.

This third meaning of process, process as human interaction or the psychology of planning, is sometimes very subtle. To be able to sense when it is needed and how to go about it is the art and challenge of information system planning.

The rest of what I have to say is intended to help you gain further insights into this planning process and some things you must do to succeed at information system planning.

The Business of Information Systems

Information Systems is a business within a business. Let me explain.

I think of public institutions and other non-profit organizations as businesses. The trouble is we often don't run them like a business. Dr. Dominic Parisi, Chairman of the Department of Management at DePaul University, claims all non-profit organizations -- including universities -- are on a profit basis. That is they are on a social profit basis. If they do not return a profit to society, society will not support that organization through taxes, votes or contributions.

Further, the information systems department is a business within the university business and should be run like one. What business are you really in? Peter Drucker says a business is defined by the needs of its customers.[6] Who are your customers? The Board of Directors, the president, the administration, the faculty, the students, the alumni, the researchers, the data processing people, and the public are the major customers. What are their needs? Their needs are many and varied -- and often conflicting.

While visiting Ireland Pearson Hunt[7] discovered Finagle's Law of Information:

1. The information we have is not what we want.
2. The information we want is not what we need.
3. The information we need is not available.

It is the job of the information systems department to find out the information needs of its customers and then make available "the right information in the right place at the right time".

This does not mean Information Systems should make available all information in all places at all times. No, limited resources, privacy laws, and other considerations require that priorities be set. Priorities are essential so that the Information Systems business in your organization, whether held accountable for dollar profit or social profit, will survive.

In short, Information Systems is a business within a business. We in Information Systems need a business-oriented perspective throughout the information systems planning process.

Requirements for an Effective Planning Process

The information system planner has many things to keep in mind. At the top of my list are five essential requirements for effective information system planning.

Requirement #1: Commitment From the Top

In my opinion one of the two most widespread problems in information systems is the gap between top management and information systems management. Often there is a lack of trust on both sides. Richard Beckhard says "the way to build trust is to do things together." [8] Ultimately long range planning, including long range information systems planning is top management's function. But it cannot do it alone without the participation of information systems people. Information systems planning requires the joint commitment and active participation of both top management and information systems personnel.

A university Computing Center Director once told me "I have consent from my President, but not commitment." I wonder how often we misconstrue consent for commitment? Consent is passive -- approval of what is done or proposed by another person or group. Commitment is active -- a pledge to do something, an emotional obligation to work together to accomplish group goals.

Commitment from the Administrator at the "top" of the University is a necessary requirement for the information system planning process for two primary reasons - candor and conflict.

Candor is necessary so that each person interviewed will share with the planning team the most accurate statement possible of his objectives and information needs. An information system is only as good as the information on which it is based. It is essential that the top administrator establish a climate of openness, participation, and candor.

Conflict is bound to arise throughout the information system planning process. Generally, this conflict is healthy and good and should be welcomed. Usually, it will be resolved naturally through the planning process. Occasionally, the issues may be so deep, such as those dealing with organizational matters, that they can only be resolved at the highest level of the organization.

Thus, involving top administrators actively in the information system planning process may be more important than the plan itself.

Requirement #2: Information System Planning is the User's Responsibility

In my experience, the second widespread problem in information systems is the user is not adequately involved in information systems planning and implementation.

If you ask anyone in data processing "Whose plan is it?" regarding the plan for a specific application, he will usually say "The user's plan." But is it really? I wonder how often it is really the data processing department's plan <u>for</u> the user.

But how do you get the user involved in information systems? The information system planning process is an excellent catalyst.

George Steiner points out that "planning is a line function, not a staff function. If the staff develops the plan sooner or later, there will be a plan the line does not like and they will say 'The staff developed the plan, let the staff carry it out' and you will have trouble. To be sure, it is often important for the staff to assist the line in developing the plan."[5]

The users are "line", information systems people are "staff." It is crucial that the users take on the responsibility for the plan. The key to getting the users to take on responsibility is to get them involved. Some of the best information system plans I have seen have been developed by teams of users and data processing people. A high ranking user is usually the team leader and the users are in the majority on the team. Extensive interviewing of a broad cross-section of users ensures further user involvement and responsibility.

Initially, the planning process may require the staff to do "more than its fair share" of the work but over a period of time, and it may take years, the user should take on more and more of his responsibility for the planning process.

Again, the process of planning -- one in which the user takes responsibility for the plan -- may be more important than the plan itself.

Requirement #3: Use an Information System Planning Methodology You Can Have Confidence In

Information system planning may be one of the most challenging endeavors you ever undertake. It involves substantial risk. It is an activity that is highly needed by and highly visible to management at all levels. It is very rewarding but the process of planning can also be very frustrating at times. It is at times such as these that one needs a clear sense of direction. For this, you need a methodology that works, one you can have confidence in.

In addition to incorporating the requirements I have previously stated I believe an effective information system planning methodology should have, at the very least, these characteristics:

1. Your methodology should have clearly identifiable phases. Information system planning is itself a major project. Basic to good project management is a phased life cycle with milestone reviews. Go/no go decisions at the end of major phases allow for gradual commitment. Whereas you may find it difficult to get top administrators to commit to a large planning effort, you will often find it relatively easy to get them to commit to the next phase of a large multi-phase planning effort.

2. The team approach should be used. John Humble suggests this team be "a diagonal slice of the organization."[9]

As mentioned earlier, I believe it should consist of both users and data processing people, be led by users, and sponsored by the top administrator.

3. Your methodology should follow the basic philosophy of top down planning/bottom-up implementation. For a description of this approach, read Chapter 15 of Gordon Davis' book[10] and the BSP Information System Planning Guide.[3] With this approach, you can have reasonable assurance that the plan you come up with will meet its primary objective which is to support the business objectives. You can also proceed with the confidence that the applications you implement now will be complimentary to, not contradictory to, future applications.

Dick Heath, Chief Fiscal Officer for the State of Arkansas likens this to the nation-wide Interstate Highway Plan that was developed 20 years ago. This Plan gave the states a clear picture of the long-term objectives so they could proceed to meet shorter-term objectives. The states could then build sections of Interstate highway with the confidence that two adjoining sections built by different states or built several years apart would not be five miles apart when they were indeed supposed to join.

4. Your methodology should be yours. To be sure, it is often highly beneficial to receive guidance from persons outside your organization who have successfully used the methodology. But the plan should be yours, not an outsider's. Thus, you should make certain the methodology you use can be learned. You should strive to learn it so you can adapt and improve it for optimal use in your university.

One methodology that possesses these characteristics is Business Systems Planning (BSP). BSP was first used by IBM to plan its own organization-wide information system. It has since been used by more than 75 organizations including several colleges and universities. I will leave it to Dick Mann in a paper elsewhere in these Proceedings to describe BSP and its use at the University of Illinois.

Once again the process of planning -- here in the sense of process as procedure -- may be more important than the plan itself.

Requirement #4: Manage Data as a Resource

More and more I hear the phrase "data is a resource."[11] I must confess that I do not fully understand all the ramifications that those who use the phrase imply. Nonetheless, I feel there is something very important here.

The analogy is often made to dollars as a resource. Clearly top management recognizes the importance of money throughout the organization. Proper attention is given to the management of money. The sources and uses of funds are coordinated through the financial arm of the organization. Managers and workers at all levels are held responsible for expenses, budgets and profits. Although it is more difficult to quantify the value of information, data permeates the organization even more than the dollar and is likely considerably more important. Consequently, should not top management give at least as much attention to managing data as they do to managing dollars?

Let me restate this in practical terms for the university information system executive: Make sure your data processing "house is in order" from a management point of view so that you will be in a position to implement the plan once it is established. Two major aspects must be considered.

First, you must provide for the management functions that apply specifically to information systems management in a contemporary environment. For example, you must be able to manage large projects well for the plan will undoubtedly call for the implementation of a series of large projects. You must also provide for the data base administration functions for the plan will undoubtedly call for the sharing of data across organizational lines. Also, you must provide for the plans and controls function to assure the plan is implemented and is also updated at least once annually. In other words, you must make sure you have the information system management system you need when you need it.

Second, you must provide for the management functions that apply generally to all management in a contemporary environment. The job of a manager is to plan, organize, lead and evaluate.[12] Every member of your management team should be trained in the up-to-date management concepts and techniques, such as Management by Objectives (MBO).[13]

Again, the process of planning -- in this case the ability to implement the plan through sound management practices and processes -- may be more important than the plan itself.

Requirement #5: There is No Substitute for Good Judgement and Common Sense

Even with a good methodology like BSP, there is no Betty Crocker cookbook for information system planning. Good judgement and common sense are required at every step in the procedure of planning.

To illustrate, you will constantly struggle with the question "What is the appropriate level of detail?" Too little detail leads to inadequate plans and delays in implementation. Too much detail is a waste of precious time and resources. There is no rule to answer this question. At best there are broad guidelines. Such as "only down to the level necessary" or "planning should provide a minimum of information, not a maximum of information"[5] or "processes should be identified down to the sub-process level in Phase One and down to the sub-sub-process level in Phase Two." None of these come close to being as definite as "add one cup sugar." Good judgement and common sense are essential.

Let me illustrate again. Things have value, people have values. Things acquire their value only to the extent that people, according to their values, give them value. It cannot be emphasized enough that the planning team should make every effort to quantify the value (cost/benefit) of the information system. But it should be emphasized even more that the team should identify and incorporate the values of users at all levels into the information system. "It's opinions that give meaning to facts" says Peter Drucker.[14] Good judgement and common sense are essential.

I believe everyone of you is blessed with good judgement and common sense. But sometimes we need someone other than ourselves to help bring it out. That is one reason the team approach to planning is so valuable. That is also another reason why it is important to get top administration and user involvement. Some have even gone beyond that. In one of my visits to a BSP site, the planning team had adopted the prayer of Reinhold Niebuhr as a motto: "God grant me the serenity to accept the things I cannot change, the courage to change the things I can, and the wisdom to know the difference."

Once more the process of planning -- with the requirement for good judgement and common sense -- may be more important than the plan itself.

The Challenge

As you think about the process of information systems planning you may begin to wonder if it takes some superhuman person or team to succeed. The answer is no, it does not. Effective information system planning can be learned. I take great comfort personally in the statement attributed to Admiral Halsey "There are no great men; only average men doing a great job." There are many opportunities in information system planning for "average men" to do a great job.

I believe one of the most rewarding opportunities of your career may be lying at your doorstep. I challenge you to earn a promotion, to make your job a different, bigger job, to do the most important thing only you can do for your university.

ACKNOWLEDGEMENTS

The ideas I have shared with you in this paper are a collage gleaned through the process of human interaction with --

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- my top management friends at Science Research Associates (SRA) who provided me with my first opportunities for in-depth experience with long range planning as well as numerous opportunities for meaningful relationships with the educational community.

- the many persons who used the BSP methodology and who so generously shared their time, experiences, and insights with me.

- my colleagues at the IBM Systems Science Institute who share a deep sense of purpose for the work we do with the data processing management community.

- Miriam Roberts and Phil Brooks with whom I have spent countless hours wrestling through the concepts of information system planning and who share with me the teaching responsibility for our Information System Planning course.

- the students of the Systems Science Institute who, by sharing their experiences and asking their penetrating questions, are the "refiner's fire" for these ideas.

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BUSINESS SYSTEMS PLANNING AT THE UNIVERSITY OF ILLINOIS

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Several universities have made use of the Business Systems Planning concept offered by IBM. This planning approach, which attempts to assess the quality of the institution's present information systems support, defines priorities for new systems development, establishes a long-range plan for such development and identifies the first system in some detail, was undertaken by the University of Illinois in 1974-75. Over 300 administrative, faculty, and managerial staff were interviewed as part of the project, and senior management from the system and each of the campuses were heavily involved. This paper discusses BSP concepts, mechanics, benefits to academic institutions, and pitfalls to avoid, in the context of the University of Illinois experience. This paper should be of special interest to both data processing management and to administrative generalists.

BUSINESS SYSTEMS PLANNING AT THE UNIVERSITY OF ILLINOIS

Section I - The University, 1974

The University of Illinois is a three-campus system with a general university administration. The President and three Chancellors are the operational officers of the University. Except for the financial community, each Chancellor has his own organization within the campus. Relationships between the campus operational offices and general university staff offices are consultative in nature (See Figure 1).

The data processing community consists of three administrative data processing offices, one on each campus; a general university-level MIS office; and a general university computer utility known as the Consolidated Administrative Computer Center (CACC). All ADP offices and MIS utilize a central computer currently located in Urbana. All files are accessible to MIS, including those owned by the campuses. Common software, common university-wide development, and data base administration are facilitated by such an administrative data processing network. Management of the campus ADPs, however, is on a local campus basis. Coordinative councils and organizations exist to facilitate cooperative or joint ventures between the university and campuses (See Figure 2).

The Office of Management Information Systems is a general university function which is responsible for three basic objectives:
a) information retrieval from campus and university files to support analytical requirements, budget preparation requirements, and other

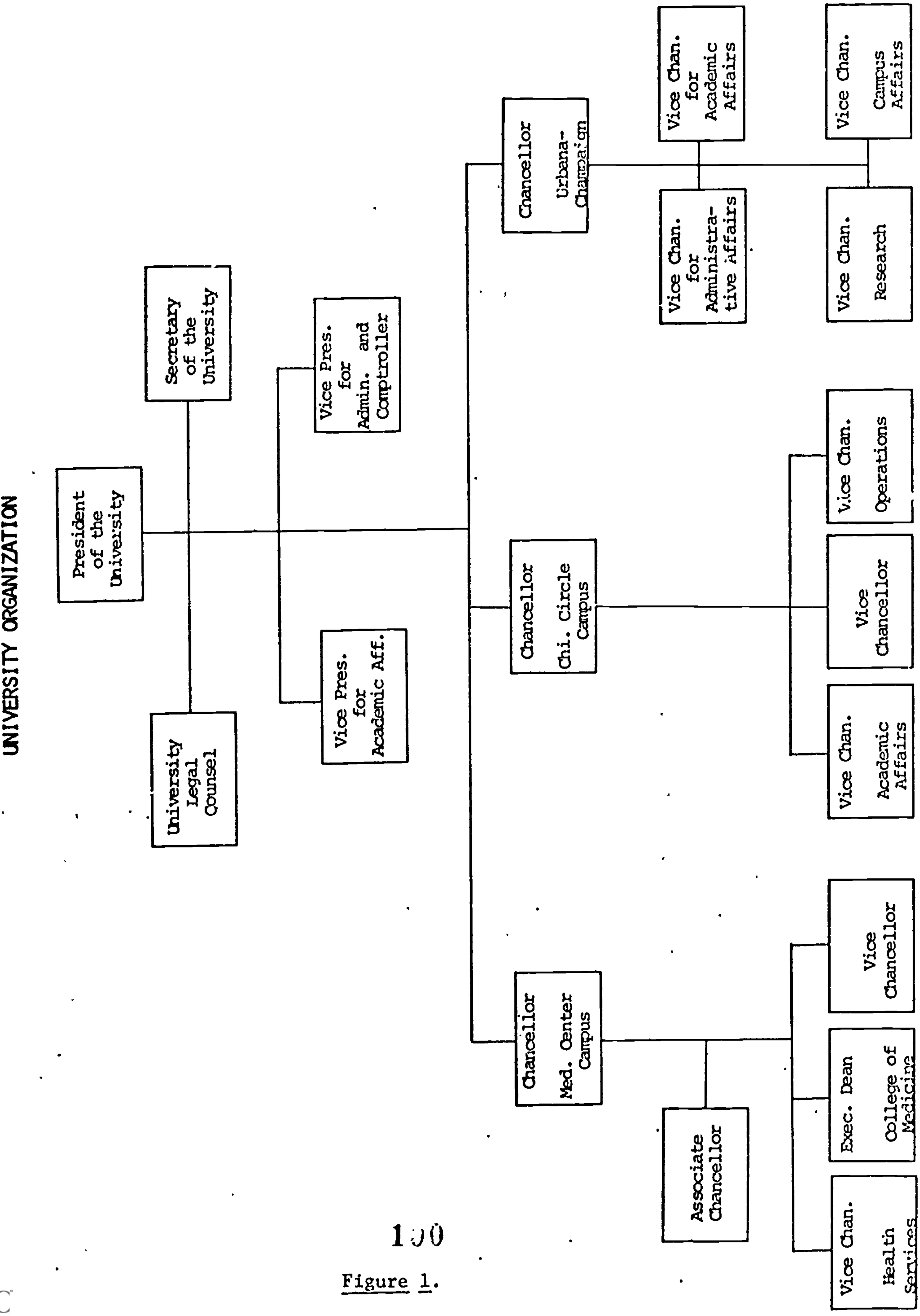

UNIVERSITY ORGANIZATION
President of the University
Secretary of the University
University Legal Counsel
Vice Pres. for Admin. and Comptroller
Vice Pres. for Academic Aff.
Chancellor Urbana-Champaign
Vice Chan. for Academic Affairs
Vice Chan. Campus Affairs
Vice Chan. for Administrative Affairs
Vice Chan. Research
Chancellor Chi. Circle Campus
Vice Chan. Operations
Vice Chancellor
Vice Chan. Academic Affairs
Chancellor Med. Center Campus
Vice Chancellor
Exec. Dean College of Medicine
Vice Chan. Health Services
Associate Chancellor

Figure 1.

UNIVERSITY OF ILLINOIS RJE NETWORK

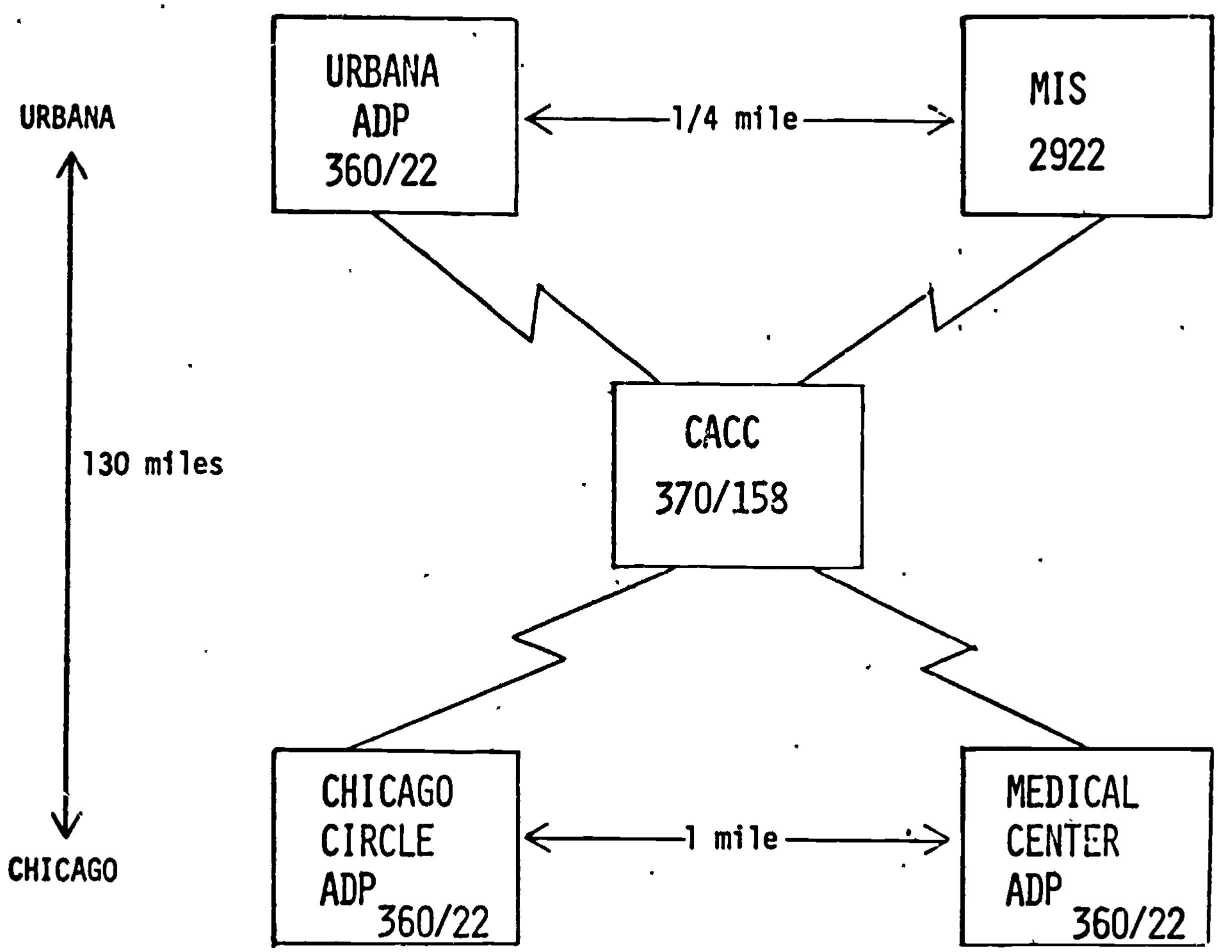


Figure 2.

reporting needs of the general university; b) data base administration, including control of critical data elements and code definitions to provide consistency in university-wide reporting and analysis, and with the advent of a data base management system, control not only over the integrity of the data but also over the use of the data base management software; c) the development of common university-wide systems to facilitate the development of those data bases and the retrieval of information from them.

The key problem in developing common university data bases is the fact that multi-campus systems development is a considerable problem in a geographically-dispersed multi-campus institution whose organization is also diffused by campus. Such problems as organizational complexity, the geographical dispersion of the campuses, and differences in the mission and nature of each of the campuses (such as those between a residential and a commuter-campus, and those between a professional school campus, an undergraduate institution and a research-oriented campus) tend to complicate development of information systems. Added to this complexity the fragmented management of the data processing function across the campuses and the general university, and the alien concept of the data base approach to systems development, the development of multi-campus systems becomes an extremely tedious process. For example, when a system needs to be developed, there are frequently at least three, but sometimes nine or ten user offices directly involved in that system across the three campuses. Not only is systems definition a problem, but also determining what priority a system should have. One campus may feel an accounts receivable system is the most important project while the other campuses may feel different system projects are more critical for them. What is needed is a university-wide agreement on 1) system development priorities, and 2) a plan for the orderly sequence of systems development across the three campuses, particularly on those systems that have three-campus or general university implications.

Section II - Business Systems Planning

Business Systems Planning (BSP) can be defined as a method of developing a long-range information systems plan to serve the needs of an organization. The approach was first developed by IBM for the development of its internal advanced administrative system, and is now being provided by them as a free service to many of its major customers in attempting to aid them in developing their own long-range information system needs and requirements. BSP focuses not on an organization, but rather on the major processes of the enterprise in which the study is conducted. The approach is information systems rather than data processing oriented. That is, it focuses on management information needs as opposed to just operational information needs. BSP consists of two phases: Phase I - Customization, and Phase II - Definition. Phase I - Customatization, lasts from 3-4 weeks and employs a combined IBM/Institution User/Data Processing Team to conduct the study. Members of the team are located in a 'war room' in which their desks, secretarial support, and all tools which will be needed during the study are located. The members of the organization to be studied are completely separated from their day-to-day functions and are dedicated to the project over the necessary time span. The major functions of customization include the interviewing of the organization's top management, the identification of the major processes or functions of the institution, an evaluation of the information system needs of the institution based on these interviews and identified processes, and finally the specification of the first system to be developed by the institution based on identified needs and information system requirements. Phase II or the Definition Phase, lasts for 6 months, also uses the combined IBM/User Data Processing Team from the host institution, and concentrates on the following functions: 1) interviewing all key operational management within the institution; 2) identifying problem areas and priorities within the system area that has been selected for development; 3) defining the first system in detail through a general system design and a data base design; and 4) defining the overall systems development plan for the university which follows on from the first systems implementation. Throughout the BSP approach, the concept underlying the whole study is that of a data base approach to the university's information system needs.

Section III - BSP Phase I Customization

The first major function of the Phase I BSP Team is to identify the institution's major processes. The process can be defined as a major logical group of activities directly related to the support of the mission of the University of Illinois. Within each of these processes, sub-processes which define specific tasks can also be defined. At the

University of Illinois, nine major processes were identified:

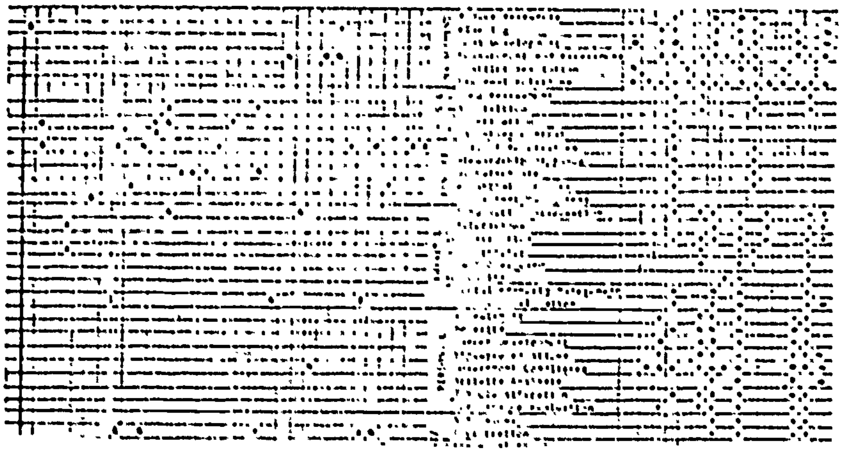
1) institution/curriculum
2) research
3) public service
4) student/alumni
5) personnel
6) physical resources
7) finance
8) goods and services
9) management

Eighteen top executives in the University were interviewed to get their opinion and views on the major processes of the institution and these were refined to reflect their feelings as to the institution's functions. These executives were also asked to define their information system requirements and to evaluate how existing systems were supporting their information needs. Additionally, external constraints imposed by state or other outside constituencies were also considered in the study of the University's information systems needs.

Once the interviews were completed, the data was analyzed and combined with a study of the University's existing data processing resources and information systems support. A series of analyses were conducted to compare the University's existing information systems support to the needs identified by the executives. Included in this study was a comparison of the organizational position of the executives and the processes for which they had responsibility, the relationship between systems currently running at the University and processes, the relationship between existing systems and major files, and the relationship between major files and organization (See Figure 3). Although the study did not get into the quality of the existing information systems, it did point out a number of interesting problems. For example, very little in the area of personnel systems exist at the University of Illinois. What personnel functions take place are handled in a series of other systems or are maintained on rather ad hoc bases by each campus. The powerful executives within each campus can also be identified by the number of processes for which they have control.

Overall, the analysis showed the point at which the University stands in terms of the number of systems and files which are supporting the existing functions and organization of the University. Another analysis which was performed was an attempt to group the types of information which were specified as needed by the top executives into general categories or data bases. Five major data bases were identified: student, curriculum, finance, facilities, and personnel (See Figure 4). Although these data bases were conceptual, they attempted to relate the processes to the data bases which would be required to supply the information to support them. As can be seen, every one of the processes requires data from more than one data base.

Another analysis which was conducted was a comparison of the data bases which support the information needs required by the processes and



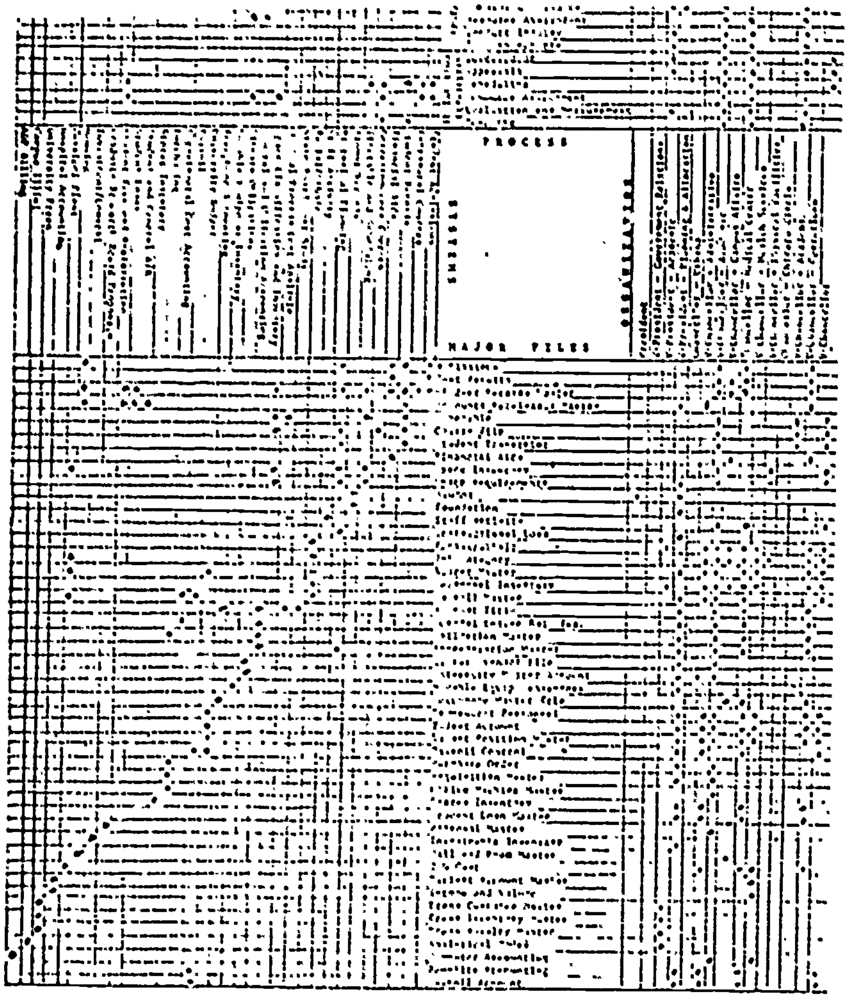


Figure 3.

PROPOSED PROCESS DATA BASE SUPPORT

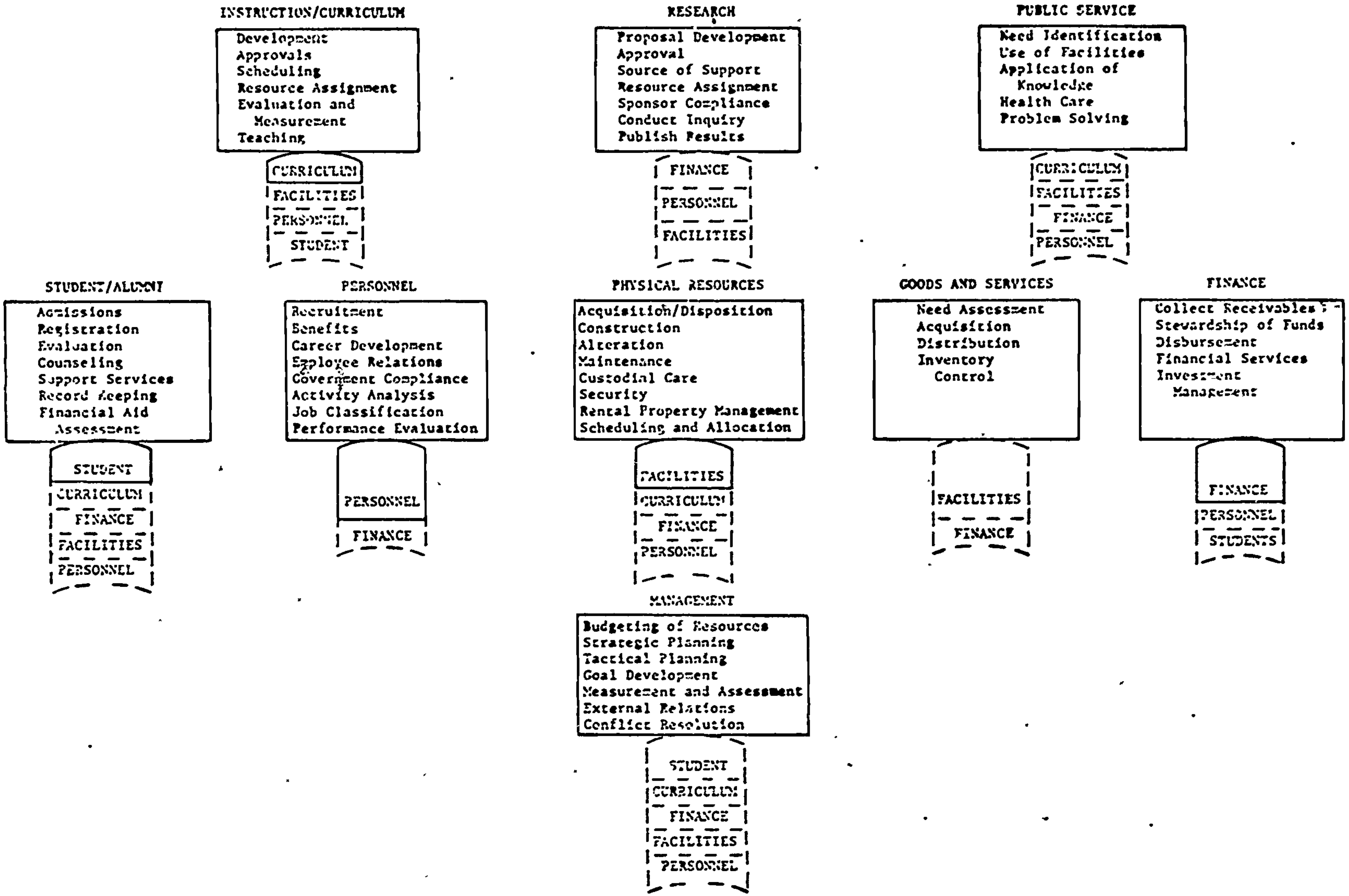


Figure 4.

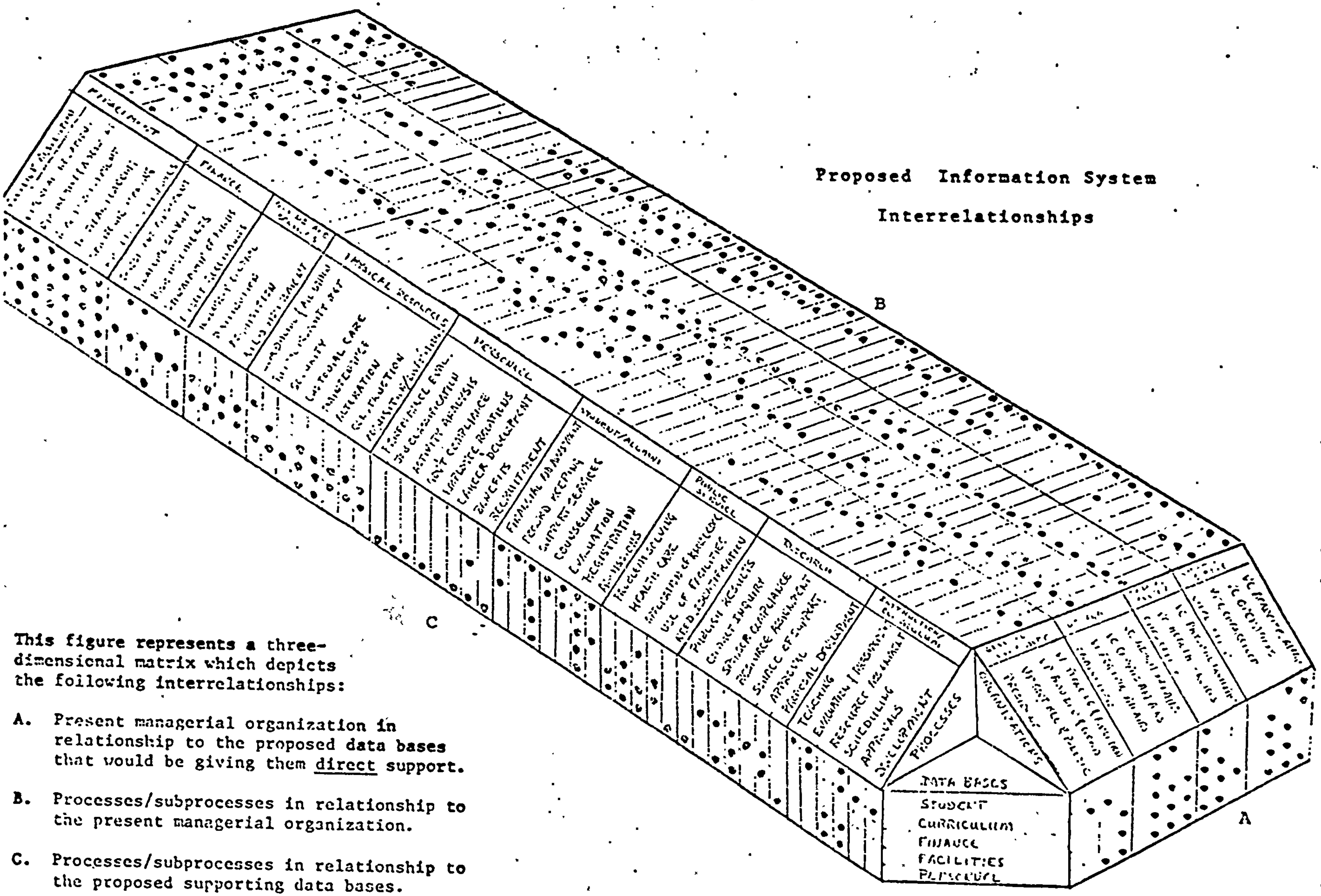
the executives who have responsibility for those data bases and processes (See Figure 5). Finally, a definition of the information system network which included the processes and the data bases affected by the information requirements imposed from either internal or external constituencies was laid out (See Figure 6). As can be seen, the information systems network is a rather complicated and inter-related set of information flows for which rather sophisticated information systems must exist in order to support the University's information needs adequately.

The final function of BSP Phase I was to identify the first system area to be put under development and to be studied in Phase II of BSP. The three areas most frequently identified as needing enhancement--personnel, financial and student/alumni were evaluated on four criteria:

1) demand
2) risk
3) return on investment
4) chance of success

Weights were given to each of these criteria and the team voted on weights to be assigned to each system by each of the criteria. The result showed the greatest weighting given to personnel, second to financial, and third to student/alumni. Although the team initially recommended that personnel be developed first, primarily because of its higher chance of success due to lesser complexity than the financial area, the chief executives in the University indicated that the financial area should be the first development project. In addition, a personnel system was under analysis and development and it was felt that that area would be handled satisfactorily by that existing project. The financial area, being extremely complicated,

Proposed Information System Interrelationships



This figure represents a three-dimensional matrix which depicts the following interrelationships:

A. Present managerial organization in relationship to the proposed data bases that would be giving them direct support.

B. Processes/subprocesses in relationship to the present managerial organization.

C. Processes/subprocesses in relationship to the proposed supporting data bases.

Figure 5.

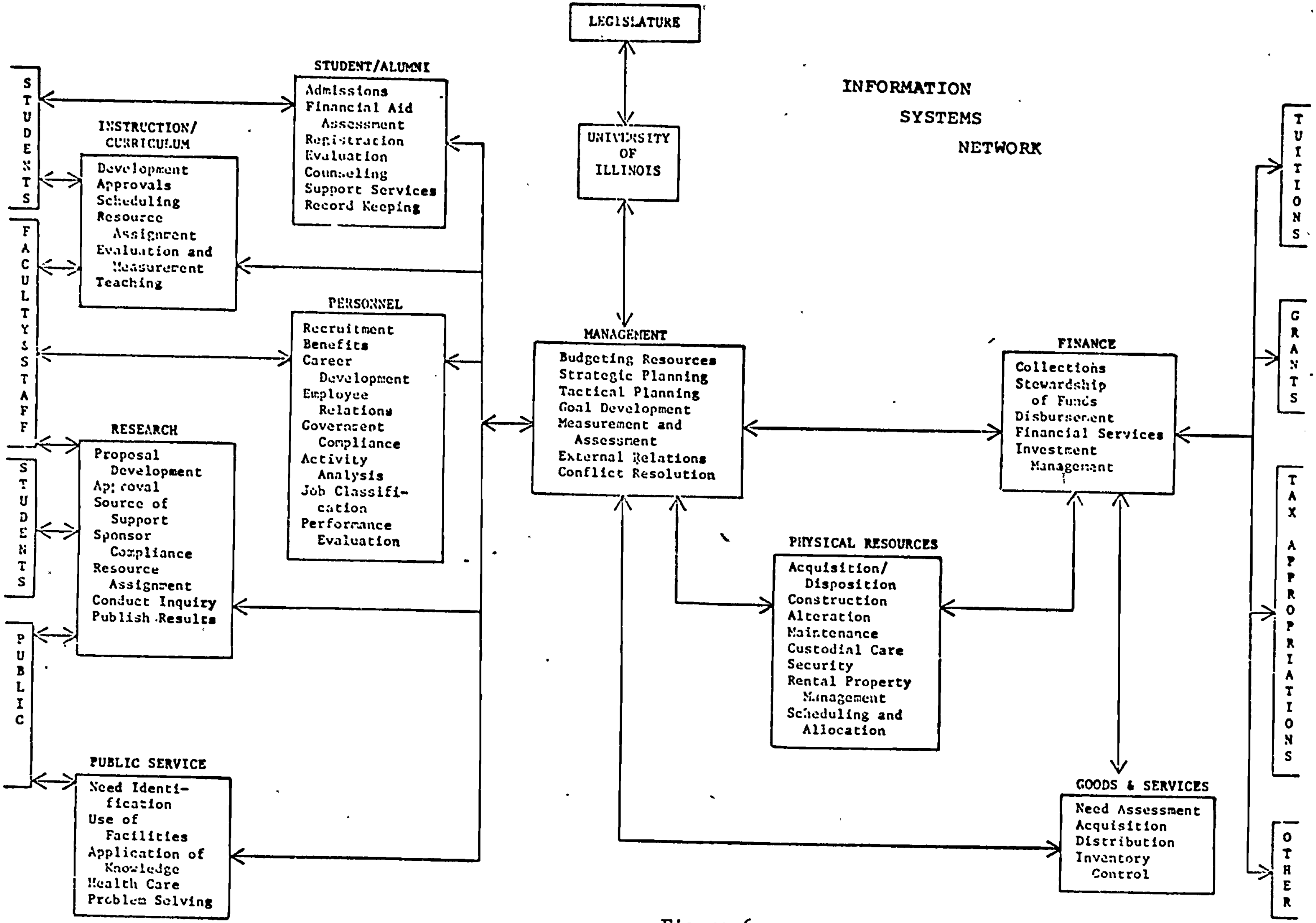

INFORMATION SYSTEMS NETWORK
LEGISLATURE
UNIVERSITY OF ILLINOIS
MANAGEMENT
Budgeting Resources
Strategic Planning
Tactical Planning
Goal Development
Measurement and Assessment
External Relations
Conflict Resolution
FINANCE
Collections
Stewardship of Funds
Disbursement
Financial Services
Investment Management
TUITIONS
GRANTS
TAX APPROPRIATIONS
OTHER
PHYSICAL RESOURCES
Acquisition/Disposition
Construction
Alteration
Maintenance
Custodial Care
Security
Rental Property Management
Scheduling and Allocation
GOODS & SERVICES
Need Assessment
Acquisition
Distribution
Inventory Control
STUDENT/ALUMNI
Admissions
Financial Aid Assessment
Registration
Evaluation
Counseling
Support Services
Record Keeping
INSTRUCTION/CURRICULUM
Development
Approvals
Scheduling
Resource Assignment
Evaluation and Measurement
Teaching
PERSONNEL
Recruitment
Benefits
Career Development
Employee Relations
Government Compliance
Activity Analysis
Job Classification
Performance Evaluation
RESEARCH
Proposal Development
Approval
Source of Support
Sponsor Compliance
Resource Assignment
Conduct Inquiry
Publish Results
PUBLIC SERVICE
Need Identification
Use of Facilities
Application of Knowledge
Health Care
Problem Solving
STUDENTS
FACULTY/STAFF
STUDENTS
PUBLIC

Figure 6.

required the six month BSP II study to help define priorities and systems definition (See Figure 7).

Section IV - BSP Phase II

BSP Phase II began with 234 interviews of operational managers throughout the three campuses and general university. Three interview teams conducted 89 sessions using the standard interview format and feedback to each of the interviewees as to what was discussed (See Figure 8). As a result of these interviews, the BSP team analyzed two types of problems:

1) Those not requiring systems development but which require policy or organizational action to alleviate; and

2) Problems that did require systems development to help solve them.

These problems were identified by priority and also grouped into the data base areas defined in BSP Phase I. Many of the information system based problems crossed over several data bases and often required more than one system to be changed in order to alleviate the difficulty. As a result of the problem and data base analysis, a conceptual data base structure was put together which attempted to show some of the inter-relationships. Admittedly, this first cut at a data base structure was very complicated and quite frankly, inadequate. However, it did serve to show some of the inter-relationships that would have to be constructed between the data bases in order to meet the information system requirements identified in the interviews (See Figure 9).

BSP I

FIRST SYSTEM SELECTION ANALYSIS

PROCESS AND SUBSYSTEM	CRITERIA				TOTAL POINTS
	DEMAND	RISK	RETURN ON INVESTMENT	SUCCESS	
PERSONNEL - ACADEMIC AND NONACADEMIC PROFILE INFORMATION	6	4	8	8	26
FINANCE - BUDGET/ ACCOUNTING INFORMATION	8	2	8	5	23*
STUDENT/ALUMNI - STUDENT PROFILE INFORMATION	2	6	4	10	22

*FINANCIAL SYSTEM AREA SELECTED FOR PHASE II

Figure 7.

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QUESTIONS

I. What is your role and that of your organizational unit?

II. In what ways do the activities of your organizational unit depend upon financial information?
NOTE: Record in terms of:

Planning
Operations

III. How much of your time is spent in administrative activities related to the financial operations of your unit?

A. Roughly how many people do you have performing these financial activities in your unit?

IV. Information

A. Would you identify the financial information that you obtain from others and the source?
1) Planning

2) Operational

B. Would you identify the financial information that your unit furnishes to others and to whom?

1) Planning

2) Operational

V. Information currently needed but not available.

A. What information do you need that you are not presently receiving? Please propose a source and estimate the cost associated with the absence of this information. Give us some feel for the priority of these items.
B. What information do you feel that you should be supplying to others, that you are not currently producing? Please identify the destination and estimate the cost associated with the absence of this information. Give us some feel for the priority of these items.

VI. What forms or reports do you use as a basis for your decisions?

VII. What financial information is or would be useful to you for comparative purposes? For example: ratio data, trend data, etc.

VIII. What future changes do you foresee that would cause additional information needs and what would those needs be?

IX. Do you have anything not previously discussed which you feel germaine to this interview?

Figure 8.

PROPOSED FINANCIAL DATA BASE STRUCTURE

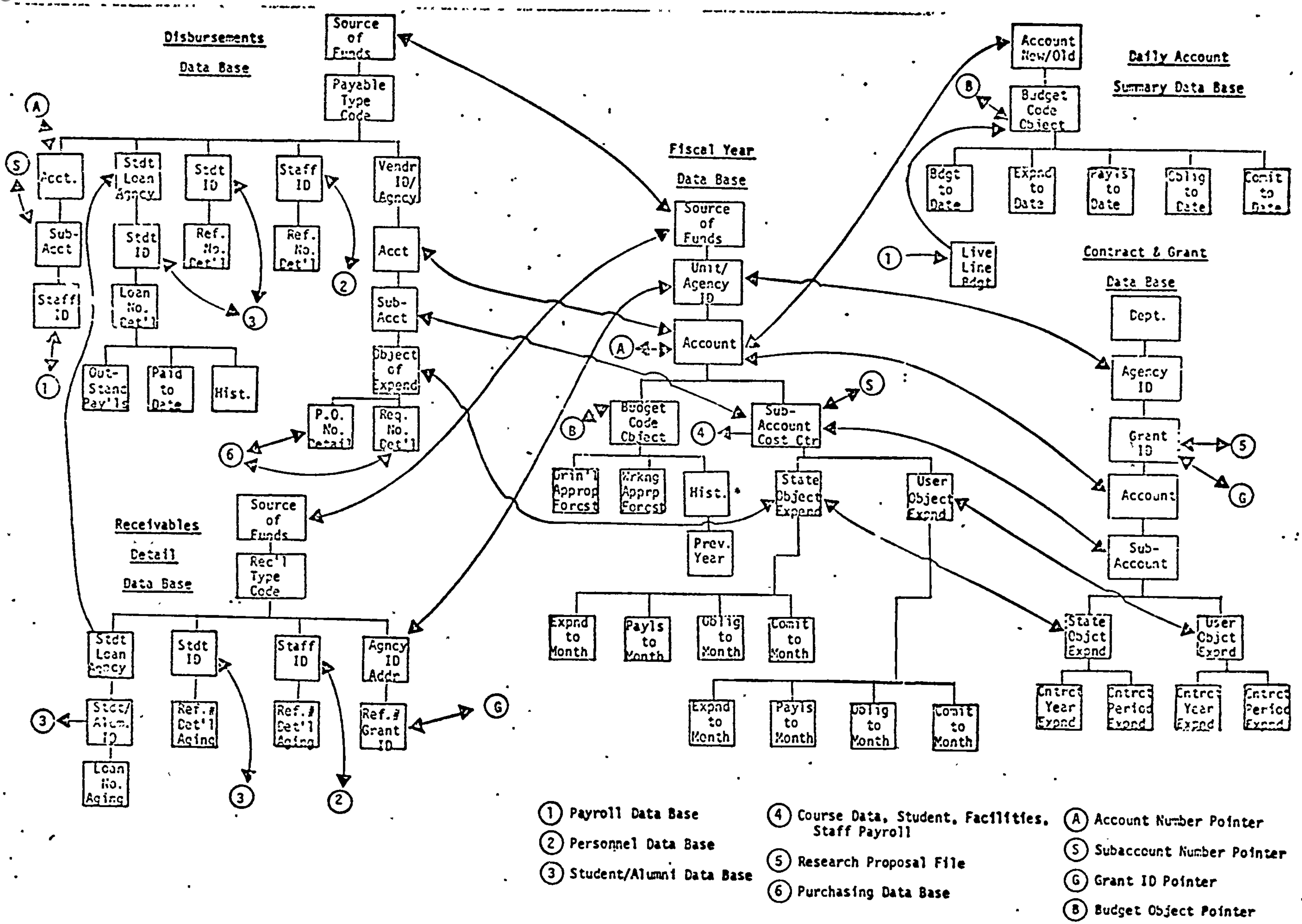

Figure 9.

As a result of the interviews and the subsequent analysis, the BSP team found that problems relating to Procurement/Disbursement appeared to be the most severe and required the most immediate attention. Problems including a lack of up-to-date cost figures to aid budgeting, information not available to plan acquisitions, slow bill payments, duplicate payment of invoices, and cumbersome and slow bank reconciliation all tended to contribute to a rather poor reputation and bill payment record on the part of the University of Illinois. A number of significant advantages could be obtained by developing a system to address the Procurement/Disbursement problem (See Figure 10). It was decided by the team that the Procurement/Disbursement system should be the first system developed and as such, the team commenced to study the several existing systems supporting the Procurement/Disbursement function. The team also designed a conceptual data base, laid out a system design, estimated the resources needed to develop the Procurement/Disbursement System, and laid out an implementation sequence for the P & D System. The BSP team's last major function was to define the follow-on set of systems to be developed in the financial area and other associated areas to which financial information must relate to provide the information needs specified by the executives and the operational management of the institution (See Figure 11).

Section V - BSP in Retrospect

The University is currently designing and beginning to program a Procurement/Disbursement System. In addition, the follow-on systems

PROCUREMENT AND DISBURSEMENTS BENEFITS

TANGIBLE	INTANGIBLE
• ADMINISTRATIVE IMPROVEMENTS	• EXTERNAL ENVIRONMENT
- INCREASED PRODUCTIVITY	- PROMPT PAY REPUTATION
- MANUAL OPERATION DISPLACEMENT	- INDUSTRY LEADERSHIP
• BETTER CASH MANAGEMENT	• INTERNAL ENVIRONMENT
- PROMPT PAY DISCOUNTS	- ELIMINATE HARRASSMENT OF DEPARTMENTS
- FAVORABLE VENDOR PRICE QUOTES	- REQUISITION TO PAYMENT STATUS TRACKING
- PAY BILLS AT OPTIMUM TIME	- IMPROVED BUSINESS PLANNING
- IMPROVED CONTROL OF CASH FLOW	- STRATEGIC INFORMATION SYSTEM BASE
• EXPANDED BIDDERS LIST	- THREE CAMPUS PROCEDURE STANDARDIZATION
- MORE COMPETITIVE BIDS	

Figure 10.

PROPOSED FOLLOW-ON SYSTEMS IMPLEMENTATION SEQUENCE

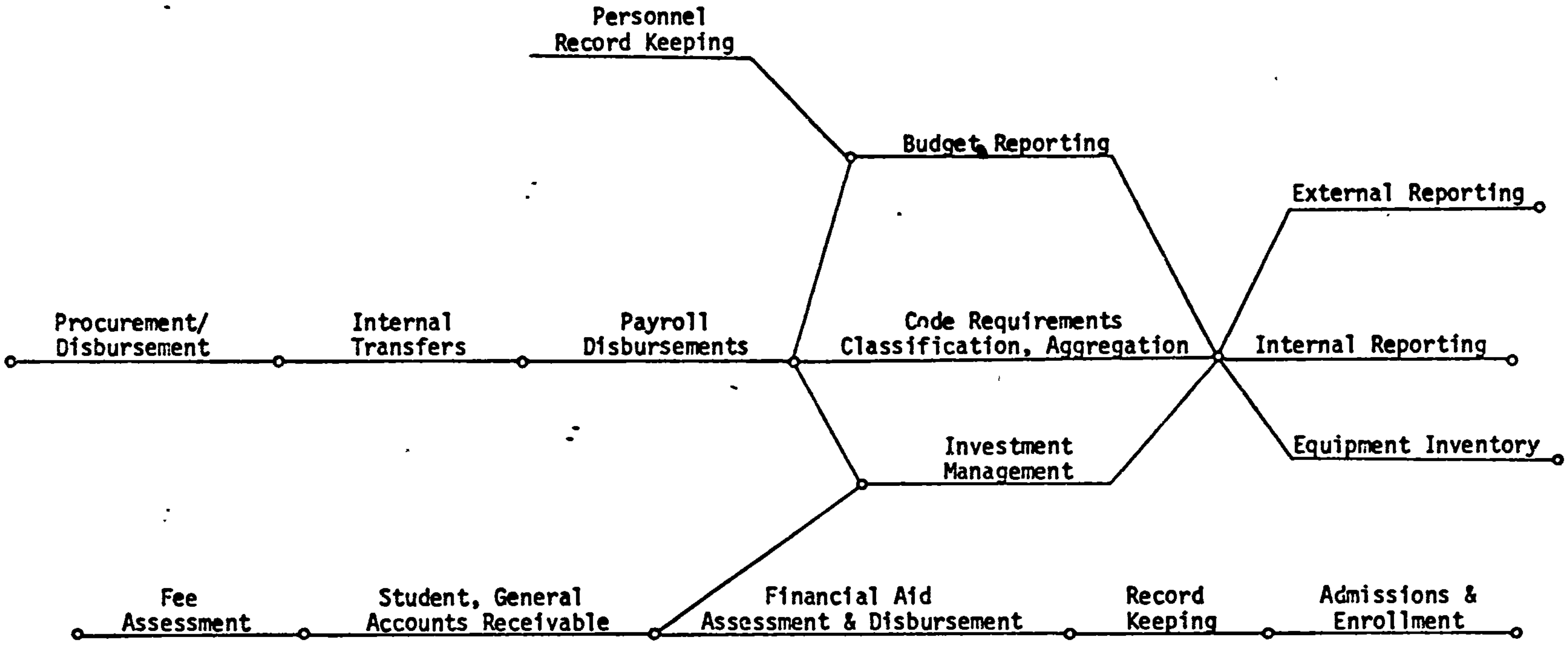

Figure 11.

implementation sequence is a focal point for university-wide systems development and constitutes a plan for the next 5-7 years. The BSP methodology is also being used to develop an information systems plan to meet the unique needs of the University of Illinois Hospital.

Several observations can be made about the University of Illinois BSP experience:

a) It's greatest value was that it helped establish a firm systems development plan for the University of Illinois to meet its information system needs.

b) BSP II attempted to do too much. It should have either concentrated on designing the first system or it should have concentrated on laying out all of the inter-relationships and policy considerations needed to determine an information systems development plan and priority sequence for systems development.

c) The University of Illinois gained several benefits, as did IBM. For the University, an outside certifying agency gave BSP a legitimacy not typically found when such studies are conducted internally. Another advantage was the rigor with which the BSP process was conducted. The IBM consultants frequently forced the team to make decisions that could have been left up in the air by traditional University methods. In addition, experienced BSP practitioners from IBM were very effective in getting the BSP team to reach conclusions in situations where there may have been considerable disagreement. For IBM, the BSP program allowed it to have an in-depth understanding of its customer, and helped it market more effectively to the University. The writers have found more sensitivity and awareness on the part of IBM to the problems facing the University of Illinois in its information systems development.

d) A number of BSP techniques have been adopted for standard use in the sytems development process. These include the BSP interviewing technique, the 'war room' concept, as well as the adaptation of HIPO as a standard for systems development documentation.

e) High-level institutional project leadership on BSP and a university staff (both user and data processing) commitment of a full-time nature is mandatory to make the BSP effort successful.

f) It is very important that the DP executive in the organization participate almost at a detail level in both phases of BSP in order for him to identify with and influence the course of the BSP project.

Over all, BSP is viewed as a valuable systems planning tool and most importantly, helped the University of Illinois achieve what it had not been able to effectively do itself--develop and commit to an information systems plan. More detail on this study can be found in the CAUSE Library. The University has submitted four volumes -- one a summary of BSP Phase I and three volumes on BSP Phase II.

MANAGE IT NOW:
COLLECTIVE BARGAINING AND AFFIRMATIVE ACTION

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Principal
Cresap, McCormick and Paget Inc.
San Francisco, California

Educational administrators are finding that National trends in these two areas are having increased effects upon colleges and universities. Many of the sources of change are legislative. The intent of legislation is to insure fair and equal treatment of disadvantaged classes of prospective and active employees, and to offer employees an alternative employee relations system which is based on an adversary process. Managers reading this paper will receive a brief review of the important events and acts which are shaping the pressures for change in each area, and an assessment of present and future impact upon university management (with particular reference to EDP groups). Most importantly, some suggested guidelines will be received on what to do to manage the change that is occurring, rather than to be swept before it.

When I was asked to speak at this year's conference, I was at first surprised. During my eleven years in consulting, I have worked most frequently in the areas of organization planning, management planning and control, and particularly on projects involving compensation and personnel administration.

The firm with which I am associated, Cresap, McCormick and Paget Inc., has conducted a great many systems studies involving computer applications in educational institutions, and I have worked on parts of several of these studies. However, in no way would I identify myself as an expert before this group. So I wondered how my particular expertise might be relevant to your interests.

Then when I saw the theme of this conference and the names of some of your other speakers, I was ready to go. "The Challenge of Change: in systems, objectives, procedures, personnel legislation and other external events." I believe I know a lot about change in those last three items.

Since about 1970, clients have increasingly asked us for assistance in working with the legislated emergence of affirmative action planning. During this same period, the emerging willingness of employees in hospitals, government, schools, colleges and universities to strike for economic gains has surprised many of us. These years have also been marked by serious debate about legalization of collective bargaining for state and local employee relations systems and inevitably for public educational institutions.

The changes occurring in these two areas have been relatively slow to reach the educational and academic communities. Now, however, they are impacting administration with greater and greater force.

My purpose today is to provide some background and some ideas about how administrators should behave to deal with changes in these two areas. I have entitled this speech "Manage It Now." The title originated in some sage advice from a friend who is a group manager of 25 very similar profit centers in a regional area. Like a multi-campus community college system or state university such as the California or New York models, each center is affected by the same legislation and the same external environment.

Our discussion was about management of change as a concern of top management. Bill M______ quickly sorted his team into three categories:

I. "What happened and why did it happen to me?"

II. "Now that these changes have been made, how can I get some help?"

III. "What's going to happen next and how can I make it work to my advantage?"

I don't want anyone to leave this presentation asking "What happened?" To those of you with responsibility for implementing collective bargaining systems in your units or for living up to affirmative action objectives, I want you to take an active posture. Manage it yourself.

Collective Bargaining

Collective bargaining is one of three basic employee relations systems.

The first is the feudal system where employees get what's left after the owner takes "what is needed" - that is, what he wants.

Second, the administrative system wherein the owner of the enterprise seeks to provide equitable treatment, a living income for his employees, while remaining within his own assessment of what he can afford to take from the enterprise.

Finally, the collective bargaining system which, based on a knights-in-armor concept and clad in modern legal terminology, attempts to ensure a fair fight over the division of fiscal assets.

Collective bargaining is a formal adversary process which has a crystalline simplicity. What results from an adjudicated negotiation is ipso facto correct. There are no implications of subservience to the owner's largesse.

Unfortunately for colleges and universities, administrations adhered to feudal concepts of employee relations for too long. Unlike governments -- which shifted rapidly to administrative systems in the 40's and 50's -- and in spite of a collegial philosophy of governance, colleges and universities were administered on a patriarchal model. Sometimes the president was the strong king. Sometimes the departments were the strong barons.

Given the improvement of economic conditions following World War II, I am sure administrators considered themselves benevolent, generous men. Thus the advent of teacher militancy was a severe shock.

It should not have been. National policy has favored collective bargaining for nearly forty years. It is widely practiced in the industrial sector. John F. Kennedy's most significant domestic act of 1962 was the approval of collective bargaining, including the right to strike, for U. S. government employees.

By the late 1960s, the movement toward union organization of nonprofit institutions had gained momentum. Industry was fairly well developed by this time with little potential for big growth, so the attention of the unions turned toward the institutional sector.

At the same time education as an industry matured and financial difficulties emerged. The economic well-being of faculty and staff began to be adversely affected.

To give you an idea of the growing appeal of unions during this period, there was an eightfold increase in the number of faculty covered by collective bargaining agreements between 1968 and 1974. As of mid-1974, 10 per cent of higher educational institutions were engaged in collective bargaining.

It is clear that proponents of collective bargaining are a significant force. In CMP's view it is imperative that college and university management understand certain principles so that it can manage its future vis-a-vis collective bargaining rather than be in a defensive position.

These principles are:

1. Collective bargaining is an adversary process. It is based on precedents from adversary proceedings. Like it or not, industry-based precedents will be used by people seeking solutions in the institutional sector.

2. Carefully written contracts are essential.

3. Collective bargaining issues fall into two basic categories, "bread and butter" and "working conditions". Bread and butter issues include economic elements such as salary, benefits and overtime. Working conditions include local work rules and other non-economic elements.

4. Persons employed in management tasks should not become part of the bargaining unit. These tasks include hiring, budgeting, discharging, adjudicating grievances, et al, wherein independent judgment is used.

5. Large bargaining units favor continuity of service. Multiple small units favor frequent disruptions. For example, British labor turbulence is supported by strikes by small units which are then supported by full trade union associations.

6. The employee's sanction is withholding his services. A primary union purpose -- solidarity -- [illegible] to protect and join the single brother or sister who is driven to withhold services to gain justice.

7. Economically a strike is weak against nonprofit institutions.

   - Short run revenues are only weakly affected

   - At the same time, short run expenses are saved.

Whether or not you favor collective bargaining, there are certain tasks which you as a manager must accomplish.

First, there should be a clear definition of management tasks. In particular, the leadership of computer departments should identify management teams, treat them as such, call them to staff meetings, delegate to them responsibilities for coordination and control of activities and ensure that they acknowledge and accept the primacy of their management responsibilities.

Second, there should be a plan for the definition of bargaining units, which is advantageous to the school as a whole. Because of its uniqueness and the special skills that are required in its people, the computer services department represents a force for a small specialized bargaining unit. The benefits of such a unit are likely to work against the interests of the institution as a whole.

Third, there should be a clear definition of what is meant by employment, the rights of full-time versus part-time employees, and the rights of employees who are on university payroll versus those on grant-supported payroll.

Fourth, topics subject to the contractual agreement must be clearly set forth. Certain matters are mandatory, established by NLRB precedent and invoked typically in the laws enabling collective bargaining to occur. Such items include wages, hours and conditions of employment. Other matters are "permissive", which means that there is no precedent duty to bargain on these issues and no prescription that these clauses be a condition of agreement. An important concern of the managers of nonprofit institutions is to avoid being drawn into bargaining on permissive elements, since under the rule of precedent and practice it is possible that a future interpretation may encompass these clauses into conditions of employment.

Finally and perhaps most importantly, the manager cannot wear his "administrative system" character in a collective bargaining situation. He must not start with a reasonable offer but rather must negotiate to it. He is an adversary who should not deny the other side a chance to get a reasonable settlement with a good, visible battle for the employees. In a way, collective bargaining is like the situation wherein two fighters try to box to a draw while pleasing the crowd of supporters for both sides.

Affirmative Action

Now let's look at affirmative action.

The first legislation in the equal employment opportunity era was signed by President Lyndon B. Johnson in 1965. In 1967 women were included under the law's protection. Then in 1972 Congress put muscle into the policy by enabling the Equal Employment Opportunity Commission to sue violators of the Civil Rights Act. The first landmark suit resulted in the payment by A T & T of a settlement of $38,000,000 in back pay. As a result of this decision and other similar decisions, industry now pays attention!

Executive Order 11246 and the amendments thereto, Executive Orders 11375 and 11478 and Revised Order No. 4 encompass affirmative action requirements. Correction of past inequities is one element of affirmative action. The elimination of the effects of past discriminatory practices is another. I will now discuss these requirements, beginning with a look at the current situation with particular emphasis on the computer field, and then indicating some of the management tasks that the laws require.

Computer management has had a good record for employing women since the nineteenth century. In fact, Lord Byron's only legitimate daughter, Ada Augusta, Countess of Lovelace, was so familiar with Charles Babbage's first computing machines she might be called the first programmer.

When the demand for systems and programming talent was outstripping the supply of men, the necessary response was apparent -- hire women. Thus there are many women in the industry today, and the primary EEOC focus for women is not mere numbers employed, but the proportion of women employees who achieve management status. Some general census numbers indicate gradual change. For example:

In 1958, 15.2 per cent of managers and administrators were women.

In 1968, 15.9 per cent were women.

In 1974, 18.5 per cent were women.

But more rapid change is in the offing. One strong indication is in the business schools, where the number of women in graduating classes has risen strikingly:

	1968-1970	1975-1976
Wharton	4%	25%
Stanford	2%	20%

It takes 15 to 25 years to reach upper management levels in the United States. So there will be a rapidly emerging increase in the number of women available for middle management roles in the near future. The change will be far more apparent than in the past five years.

It is also true that minority employees have often had the opportunity to become programmers, computer operators and systems analysts. In this area, too, the industry had a better starting point when Equal Employment Compliance audits began. Furthermore, colleges and universities often provided better opportunities for minority employees to establish careers for two reasons. First, the general community was more accepting of the idea of equal opportunity in employment. Second, the university generated its own pool of qualified minority candidates from which it could identify and hire capable persons.

So much for the mild kudos. In each institution the employment situation is different, and in fact, despite the advantages of universities and colleges which I have described, most of the situations I see still do not meet the full intent of our national equal employment opportunity policy.

Do you know where you stand? There are some things that any systems department manager should be doing. Here is a primer on what they are.

1. Be a "compliance officer" or delegate the responsibility to one of your staff. This person should know policy, status and new laws and be able to answer all questions.
2. Prepare a Salary and Classification Plan to meet your production needs, one which is equitable to all employees.
   - Write position descriptions in terms of output-related tasks and job-related minimum qualifications.
   - Evaluate the relative salary worth of the classifications (not incumbents) based on nondiscriminatory factors. This will result in a salary plan which is internally equitable and defensible under the Equal Pay Act.
3. Organize your classifications in a pattern which will simplify Workforce Analysis for Affirmative Action Planning.

- Indicate lines of career path progression.
- Classification families.
- Classification series.

4. Analyze your current workforce utilization in terms of Equal Employment Opportunity
   - HEW Format of August 1975

Federal Register, Vol. 40, No. 165, p. 37065

Job Title	Wage	Total	Male	Female	Minority	Black M	Black F	Hisp M	Hisp F	Asian M	Asian F	Am. Ind. M	Am. Ind. F

5. Analyze your available applicant pool percentages
   - Group the classifications logically
   - Local recruiting -- Region -- National
   - Get the best statistics you can
6. Analyze your internal manpower inventory
   - Career path potentials
   - Anticipated needs
7. Prepare a Manpower Plan and Affirmative Action Goals
   - Anticipate openings for recruitment
   - Formulate goals for correcting any underutilization

- Formulate Affirmative Actions
    - o Recruitment effort
    - o Internal Training

8. Establish a monitoring scheme so your Compliance Officer is responsible for measuring and reporting on progress.

Now to some of you these eight points may sound like a terribly complex burden. But look at it this way. Doesn't it really make sense to know as much as you can about your staff? From my viewpoint as a professional management consultant, affirmative action has given the first external stimulus to Manpower Planning, a management task that I have spent many years promoting and installing in enlightened companies. I believe affirmative action is one of the few Federal programs which is truly stimulating better management, and there are benefits to be taken from its introduction which will exceed its equal employment starting point.

I think it was Peter Drucker, a business writer of philosophical bent, who first put the title on this management era. In 1968 he called it the "Age of Discontinuity," an age for the flowering of many seeds which were planted in the soil of the 30s, 40s and 50s, and an age of the decline of many exhausted ideas. I am not a social psychologist, but I believe that affirmative action is firmly rooted in the economic change of working families that followed World War II. This change is perhaps more responsible for the strength and the staying power of programs of affirmative action than the more visible striving for equal opportunities by ethnic groups. The seed concept of the working wife has logically flowered into the working woman of the 1970's, whether single, married or divorced. This group aspires to equal participation in the offerings of our society. In my view they form the deep waters in the stream of change. Thus, I believe the direction of affirmative action is the more profound change of the two areas I have discussed today. The alternative -- unequal opportunity or unequal pay for equal work -- seems possible only under a cultural reaction which succeeds in opposing the economic interests of over a third of the population, not to mention opposing many of the root premises of American citizenship.

It is not as clear that collective bargaining is founded on as broad a stream of change. It is an old idea; having been used for many years, its operating limitations are visible. Furthermore, it was designed for a different economic setting, one in which the economic choice by the ultimate customer was accepted as the moderating control. In this setting, labor and management were each grappling for a share of a value which would thereby become profit or wages. The transformation of such an idea to colleges and universities is not easy to accomplish. First, there is no profit in educational institutions. Second, each "customer" provides a significant amount of revenue, especially for private institutions. Under such conditions a marginal increase in tuition cost may create the absence of a tuition-paying student and the risk of such high-dollar losses goes to the heart of job security. Thus, finally, the system of job security in education may be incompatible with collective bargaining rights.

Unlike equal employment opportunity and affirmative action, which have no appealing alternative approaches, there is an alternative to collective bargaining which has not served its clientele badly in terms of economic benefits even though it has generally been poorly administered across this country. A substantial improvement of the administration system of employee relations would go far to remove much of the threat from the collective bargaining system.

Although I do not think that collective bargaining is as strong a pressure as affirmative action, the demand for collective bargaining is going to be felt. Managers are going to initiate patterns of response, including preparation for representation elections, a critical review of existing personnel management processes and added attention to employee relations activities. Colleges and universities need more and better personnel management at a basic human level. I hope that the demand and threat of collective bargaining stimulates great improvement in this area.

MANAGE IT NOW. I return to my starting point. You are in the middle of a rapidly changing era in which these two forces, collective bargaining and equal employment opportunities, will impinge somehow upon the work of each of you. It behooves you to prepare for such change and to develop a thorough grasp of the personnel management needs within your organization. There is no point in being the man who asks "What happened?" Affirmative action planning is legally forced upon most college and university administrators.

There is a long way to go before the gap between national policy objectives and the current status of employment on campuses around this country is bridged. There is a strong financial commitment to implementing and monitoring affirmative action and, for each of you with management responsibility, there is a high chance of being held accountable for actions or for nonactions in the equal employment opportunity area. Although computer groups can feel more comfortable than most about overall female employment numbers, the presence of females in upper level supervisory and management positions and the employment of ethnic minorities are areas of weakness.

Preparation for collective bargaining presents a special case. In order to avoid operating from a defensive posture in employee relations, most college and university administrators need to establish a programmatic position. I am afraid that the feudal system of employee relations is not truly a viable option. Thus the choice is either to accept the inevitability of collective bargaining in your environment and make an adjustment to it, or to attempt to improve, legitimize and enhance the equitable treatment of employees and the fair treatment of employees under an administration system of employee relations in which collective bargaining is not perceived as necessary by employees.

PLANNING AND MANAGEMENT USES OF INSTITUTIONAL DATA: EXAMPLES, ISSUES, AND PLANS

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This paper focuses on the question of actual use of data to support institutional planning and management. Particular emphasis is placed upon data and applications associated with the products of the National Center for Higher Education Management Systems (NCHEMS). A series of case examples are described. These examples cover a wide range of problem areas and institutional types. Certain issues that arise regularly in the context of this type of data use are then highlighted. For example, the need for intra-institutional dissemination of data is discussed. Finally, the objectives, progress, products, and future plans of the NCHEMS Institutional Data Uses project are described and explained.

Introduction

Planners and managers within institutions of postsecondary education are currently faced with a plethora of issues, problems, needs, and questions that demand their attention. Furthermore, the likelihood that this situation will soon change for the better seems remote. Indeed, most signals point to even greater complexity in the future. Consequently these institutional decision-makers have a compelling need for supports that can help in meeting the challenges they confront.

One particular kind of support that has been the subject of a great deal of attention is the collection of data and its translation into information useful in institutional planning and management. Efforts in this sphere rest upon the conviction that the provision of relevant and reliable information can improve the effectiveness of the decision-making process. The National Center for Higher Education Management Systems (NCHEMS), for example, defines its research, development, and implementation efforts as intended to:

> Improve planning and management in postsecondary education through 1) better information to support decision making, 2) enhanced communication of planning and management information within institutions and between the institutional, state, and national levels in postsecondary education, 3) better analytic tools and procedures to support decision making and policy formulation, and 4) a strengthened capability within the postsecondary education community to deal with planning and management problems.

There is considerable support for the idea that data can be productively brought to bear upon planning and management problems. However, there is also a strong body of opinion that developments in this arena constitute distinctly mixed blessings. Frederick Balderston, for example, observes in his recent book [1] that:

> Information is a weapon. It is not clear to the universities that they should suffer the short-term penalties of providing more informational ammunition to their superstructure adversaries in return for the (uncertain) future benefits of greater understanding [p. 97].

Other examples of cautions, obstacles and expressions of skepticism are easy to find.

This paper treats both positive and negative facets of the institutional data use issue. Some specific possibilities for the productive use of data in institutional planning and management are first noted in a series of case examples. Certain issues and problems that arise regularly in the context of institutional data use are then highlighted. Finally, the objectives, products, and future plans of the NCHEMS Institutional Data Uses project are described and explained. The project represents an attempt to develop vehicles for institutional data use while remaining cognizant of the underlying policy and philosophical issues. Certain related efforts are also noted.

Examples

In the context of this paper, "planning and management" refers to the continuous process of examining alternate courses of action in an attempt to find the most appropriate response, given the constraints and circumstances of the situation in question. Planning and management attempts to integrate information about resources available, their utilization, and the benefits received in order to make decisions about future courses of action. This general focus rather clearly encompasses an array of specific functions and problem areas. A wide variety of conceptual schemes are available for identifying and examining these component functions. One such framework is given below. Variants of it are discussed by Murdick and Ross [6], Steiner [9], and Terry [10], among others and no particular claim of originality is intended here. Rather, this framework is presented as one useful context for discussions of actual use of information in planning and management of postsecondary education institutions. In this conceptualization, seven component functions are identified:

<u>Needs assessment</u>: identification of the publics and clientele to be served and determination of their needs for instruction, research, and other services.

<u>Institutional mission/role/scope</u>: determination of the range of goals, objectives, and services of the institution and its programs.

<u>Program planning</u>: determination of the particular sets of activities to be developed and implemented to achieve institutional goals and objectives.

<u>Resource acquisition</u>: determination of the financing pattern best suited to program implementation and development of strategies for obtaining the necessary resources.

<u>Resource allocation</u>: determination of the optimum feasible distribution of resources among the institution's competing programs.

<u>Program implementation</u>: development of an organization structure, management system, and operating policies and procedures needed to carry out the institution's programs; execution of the programs.

<u>Program evaluation</u>: monitoring of program operation and outcomes, determination of the extent to which program objectives have been achieved, and identification of both positive and negative unintended consequences and side effects.

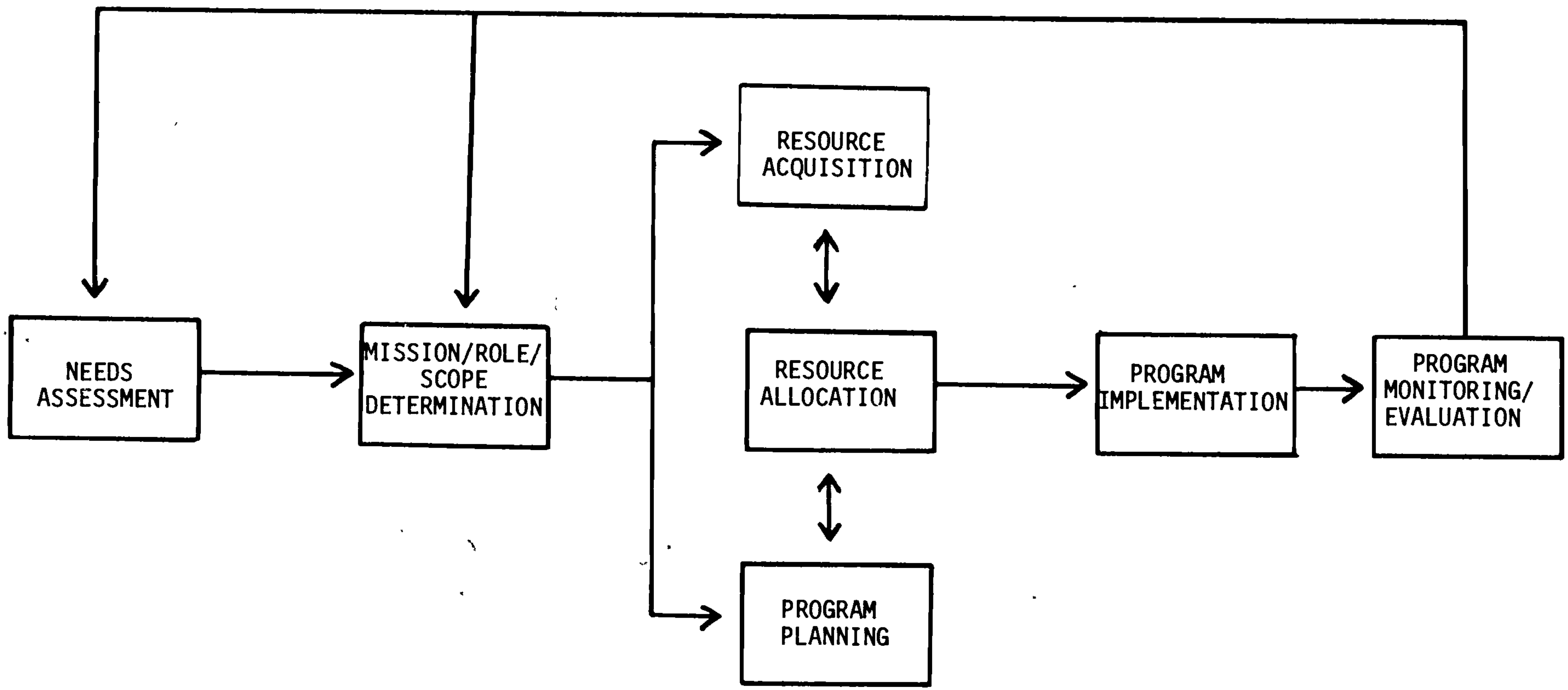
These functions and some of their interrelationships are depicted schematically in Figure 1. Every college and university performs these functions to some degree or in some fashion. It is important to note, however, that reality is obviously much more complex than the simplification above may imply. For one thing, every function is related to or potentially impacts upon every other function. Furthermore, the functions are not necessarily performed in a sequential or time dependent manner. Rather, many functions are carried out simultaneously and the institutional manager stands somewhere in the midst of a dynamic environment characterized by uncertainty, competing pressures, and limited resources. In addition, the manager must often rely on already available institutional data--data that have not necessarily been generated with any specific planning and management function in mind. Issues such as organizational context, data quality, and the differential susceptability of these functions to quantitative support only serve to complicate matters further. In short, the functional categorization proposed above should be regarded as an ideal or prototype rather than a precise and detailed view of actual planning and management activities. Questions surrounding use of data in institutional planning and management are simply not amenable to easy answers or simplistic descriptions.

Given this state of affairs, one strategy that may generate some insights involves examining and documenting selected institutional examples of actual data use. These examples may then provide the basis for generalization or further development. At the very least, this approach should serve to highlight some of the organizational and technical complexities mentioned above.

A dozen such examples are catalogued briefly in Profiles of Management Information Use [4]. The cases touch on a variety of different planning and management functions and institutional situations. For example,

FIGURE 1

INTERRELATIONSHIP OF INSTITUTIONAL PLANNING AND MANAGEMENT FUNCTIONS



Mansfield State College in Pennsylvania has capitalized upon Induced Course Load Matrix (ICLM)[1] data and altered its program planning process in a major way:

> Degree program planning now leads departmental planning at Mansfield State College. First, a package of degree programs with target enrollments is constructed. Then, using the ICLM to determine the impact of those degree programs on certain disciplines, the various department budgets are constructed. This is necessarily an interative process since constraints and unique situations within particular departments must be accommodated. The important thing is that the driving force behind the planning process is a concern for the demands of students in degree programs for courses, as opposed to a concern for the wishes of the individual departments and faculty to offer certain courses and activities [p. 22].

Examination of similar data at St. Joseph's College in Rensselear, Indiana led the Chairman of the Physics Department to propose:

> that physics be dropped as a major and become only a minor field of study. Since there had been only a small number of physics majors who were requiring several specialized courses that had to be taught with very small class sizes, it is understandable that the Physics Department had appeared quite expensive. By offering mainly service courses as part of the core curriculum of the college and eliminating the highly specialized courses intended only for majors, the Physics Department hopes to attract many more students and remain a viable academic unit [p. 15].

Thus it seems that data can contribute to the program planning process in specific as well as general ways.

Resource allocation is another function frequently cited in this series of examples. The Community College of Philadelphia, Rider College (New Jersey), and the State University of New York at Plattsburgh, among others, report significant use of data in the resource allocation process. This ranges from specific applications such as the establishment of targets for faculty

[1]The Induced Course Load Matrix (ICLM) is an NCHEMS product that supports specification of relationships between departments (or other organizational units) and student programs (or other student categories). In its simplest form, the ICLM indicates the average number of units (e.g., student credit hours) that a typical student in each program takes from each department.

productivity through the more general such as broadening the base of participation in decision-making or otherwise modifying the process. In all cases, there seems to be evidence that introduction of data into the resource allocation process has provided a stimulus for its use in the context of other functions. This is probably due to the centrality of resource allocation among planning and management functions.

In addition to the essentially internal uses in program planning and resource allocation, a variety of externally oriented uses are documented, particularly in the area of resource acquisition. Several institutions report using various data produced with NCHEMS products to support and justify budget requests to funding agencies. At the University of Northern Colorado, for example, the output of the Resource Requirement Prediction Model (RRPM)[2]:

> was the basic support document for the budget presentations to the Colorado Commission on Higher Education, to the Executive Budget Office, and finally to the Joint Budget Committee of the Legislature. The University gained considerable credibility during these budget presentations due to its imporved ability to support specific budgeted figures with hard data. When queried about specific budget items, the RRPM support data allowed the university administrators to describe exactly how the budget calculations and decisions had been developed [p. 43].

Similar situations are reported concerning the County College of Morris (New Jersey), New Mexico Junior College, and others. This appears to be a highly visible form of data use whose frequency can be expected to increase.

Although some other uses of data are noted, the most substantive and frequent appear to fall into the categories described above. When viewed against the background of the full set of planning and management functions, these uses really cover only a relatively small segment. Needs assessment, the determination of institutional mission/role/scope and program evaluation are treated only indirectly, if at all. Although some progress has been made,

[2]The Resource Requirements Prediction Model (RRPM 1.6) is a computerized instructional cost simulation tool developed at NCHEMS.

the opportunity and need for further advances is substantial. Some current NCHEMS strategies for meeting these needs are described in the final section of this paper. First, however, some of the confounding factors present in institutional data use need to be highlighted.

Issues

One common characteristic of the documentation of data use just described is that it tends to focus almost entirely on the "positive" aspects of data use. In some sense, this is reasonably typical pattern in such work. Nevertheless, it cannot be denied that there are certain problems and issues that must be reckoned with before effective data use can be accomplished. Although no exhaustive treatment of such concerns will be attempted here, some key issues can be delineated. These issues can be grouped into three sets: issues related to the conceptual basis upon which institutional data use rests, issues pertaining to the adequacy of the data themselves, and behavioral/organizational issues likely to be encountered.

Perhaps the most significant of the issues related to the conceptual base that supports data use in institutional planning and management is the underlying model of decision-making. Although this model varies by degrees from one setting to another, it does have some basic attributes that remain constant. Decision-making is regarded as a rational process that involves a conscious choice among a set of alternatives on the basis of some criterion or assessment mechanism. The rationality may be scientific, economic, behavioral, organizational, or even personal or political. It need not be the formal and explicit rationality that undergirds the scientific method.[3] Similarly, the assessment mechanisms used may be explicit or implicit, formal or informal, quantitative or qualitative. Individual human values and preferences must obviously play a role here as do history, environment, and the type of decision under consideration. Thus the issue is not that individual decision instances need conform closely to some predefined model. However, it is crucial that there be some acceptance of the underlying logic of the rational choice model. If one regards decision-making as a totally unstructured and non-rational process, then one is likely to see little point in collecting data intended to impact that process.

Given the underlying model, it becomes clear that the key role of data and information in a general sense is to enrich identification and understanding of the set of alternatives available to the decision-maker. The richer the set of alternatives considered, the greater the likelihood of a "good" decision, i.e., a choice that has the intended impact. As Quade [7] puts it:

> If the alternatives are all good, the decision will be a good one--perhaps not the best, but still good. If some of the alternatives are poor, the issue may still be in doubt [p. 123].

Without alternatives and the opportunity to choose among them, no real decision can occur and the role of information cannot go beyond the cosmetic.

A closely related matter in the conceptual area is the need to recognize that context, underlying philosophy, and individual values differ--sometimes dramatically--from one planning and management situation to another. This can emerge not only across institutions but also between different parts of the

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[3] See Mann [5], especially Chapter 2, for an excellent treatment of this issue.

same institution or the same component at different points in time. Ideally, information utilized ought to reflect these differences, i.e., ought to be appropriate to the context and consistent with the underlying philosophy and values. Without such consistency, the intended use is likely to be illusory, if not actively dysfunctional. The question of whether sufficient consistency exists is, of course, unique to each situation and its answer must remain the province of the decision-makers in each specific setting.

Two remaining conceptual issues each involve the need for understanding of certain important distinctions. One of these is the difference between data and information. In Balderston's [1] words:

> Raw data--individual entries in the ledger, lists of names in a file cabinet, notes in an envelope in the president's coat pocket, or a record that Andrew Green got a B- in English 103 in the fall quarter--scarcely qualify as information. Information is a set of elements needed for a current or future decision. Raw data always need to be aggregated, transformed, interpreted, and appropriately conveyed to serve as information for a decision [pp. 230-231].

In a very real sense, the effectiveness and appropriateness of the transformation applied to convert data to information determine whether management actually uses the result or simply adds it to a possibly large collection of existing data. Thus, for example, several institutions cited earlier[4] were able to transform a set of student registrations for individual courses (i.e., data) into a display of student credit hour consumption patterns (i.e., information). The latter was then successfully used in the management of the institution. A different transformation of the same data set might well have led to a different, more or less effective, management use.

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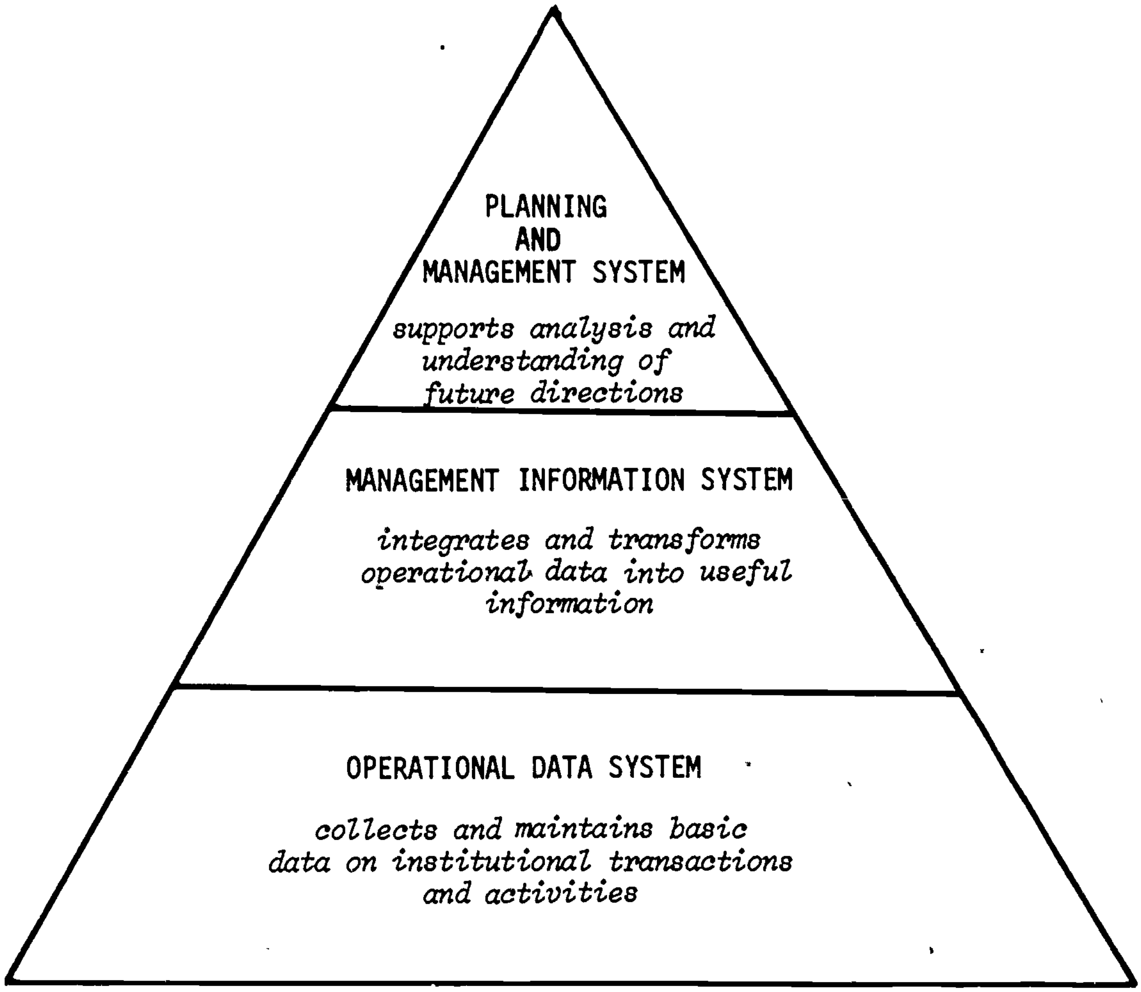
[4]See p. 6.

It is possible to take the data/information distinction one step further and note that the simple existence of information does not automatically produce knowledge or understanding. In other words, truly effective use of information comes about when the manager or planner can learn something that contributes to understanding of future activities and decisions. Indeed, one of the major contributions of data and information may be to add in a general way to the manager's overall understanding of the institution and its programs.

The data/information/understanding spectrum can be neatly summarized in terms of the hierarchy of management systems that exists in some form in every institution. At the base is a set of data systems that produce operational data about the day-to-day activities and transactions of the institution. These typically include payroll systems, student record systems, and a variety of other systems. They provide the data that may be transformed into management information and subsequent understanding. It is in this sense that the overall process can be thought of as institutional data use, i.e., data are always the basic raw material upon which information and knowledge rest. The next level in the hierarchy, frequently referred to as the management information system, integrates and transforms operational data into information useful in planning and management. The student credit hour consumption analysis mentioned earlier is a good example of material produced by an institutional information system. Finally, the hierarchy is completed by a system, sometimes described as a planning and management system that uses management information modified by judgment and other factors to provide better understanding of possible future directions and decision alternatives. This hierarchy of systems is portrayed in Figure 2.

FIGURE 2

INSTITUTIONAL SYSTEMS HIERARCHY[5]



[5]This hierarchy has been suggested by Sheehan [8], among others.

The final conceptual issue that needs to be mentioned also concerns important distinctions that are often confused. The issue is simple to state: quantitative and objective are not synonymous--the terms refer to different dimensions. Quantitative or numerical data should be distinguished from qualitative data (or information), i.e., descriptive or other non-metric type data (or information). Similarly, one can make a distinction between objective and subjective data. The former refers to data that have a "true" value or admit a "correct" answer in the sense that two different individuals applying a perfect measurement instrument will reach the same conclusion. A statement of objective fact by one scientist is independently verifiable by others.

Thus, the number of students in a particular program is a quantitative statement of an objective fact while the statement that one program is "larger" than another is a qualitative statement of an objective piece of data. Subjective data, on the other hand, do not admit a "correct" answer. One person's opinion is as good or valid as another's. Value or priority information is perhaps the most pertinent example of subjective information. The assertion that one program is more important to the institution than another is a qualitative statement of a piece of subjective information whereas assigning program A a rating of 85 out of 100 and program B a rating of 55 out of 100 is a quantitative statement of the same piece of subjective information.

The point here is that both objective and subjective data and information can be quantified. The process of quantification does not change the inherent nature of either type. Nevertheless, information that is inherently subjective often tends to be viewed as objective simply because it is quantified. This can be seriously misleading. Opinions are opinions whether quantified or not and subjective information remains subjective even if it is put in numerical form.

The distinction is a critical one and imposes an important limitation upon quantitative data which must be kept in mind when such data are used to support planning and management.

Issues in the set related to data adequacy are somewhat more obvious. The user needs to be concerned, first of all, with the accuracy of the data. Do the data correctly represent the entity or phenomenon they are intended to portray? Within what ranges of tolerance or confidence do they do so? If multiple institutions are involved, are the data sufficiently compatible?

This concern is complemented by the need for some assurance that the data are adequate with respect to coverage, i.e., that all the important aspects of the subject have been described. A frequent example of inadequate (or at least uneven) coverage occurs in the realm of outcomes data. Cost data are typically much more readily available and more clearly defined than data concerning the results or benefits of education. Information describing institutions and their components tend to exhibit a parallel bias.

This kind of imbalance in coverage would not be so serious were it not for the fact that when part of a system is quantified, however well or badly, that part tends to receive more attention and attain a kind of competitive advantage with respect to the non-quantified part of the system. Thus some of the current emphasis on costs of education would seem to be attributable to the fact that costs are quantitative information that stand in direct contrast to the usually qualitative statements of educational outcomes. Kenneth Boulding[2] recognized one particularly complex manifestation of this phenomenon in noting that when part of a hierarchy of goals is quantified, "the quality and apparent objectivity of quantitatively measurable subordinate goals can easily lead to failure to bear in mind that they are in fact subordinate" (p. 165). Since the coverage provided by quantitative data will in all likelihood always be incomplete, users of such data and information based upon them would do well to present qualitative information that can serve to reduce, if not eliminate, the kinds of distortions described above.

Finally, there is a question alluded to earlier in this paper. Is the information available the "right" information for the intended use, i.e., is it appropriate to the planning and management function in question? Although some formal research and development has been done in the area of information requirements analysis, none of the results to data are particularly operationally useful. Thus the institutional user must rely largely on judgment and experience when transforming data items and attempting to effect a "match" with a specific planning and management need or question. This match can take one of two forms. A particular piece of data, e.g., a faculty member's salary, might be useful in accomplishing a variety of tasks, e.g., explaining costs, defining resource needs, etc. Alternatively, a given question or task might give rise to a variety of data needs. Explanation of costs might use faculty salary data, class size data, etc. In either case, the key issue is the conscious accomplishment of a match between a data element and a planning and management function or task.

<u>The behavioral and organizational issues</u> that arise in the context of institutional data use are legion. They span the range from the simple need to identify prospective data users to the complications and perceived threats that arise from the potential for "mis-use" of data. As noted earlier, data and information can (and should) lead to increased knowledge and understanding and thus constitute a form of power. Thus it is not surprising that attempts at data use provoke complex reactions and questions that have no easy answers.

However, some insights are possible. For example, focusing on the purpose of a particular use should serve to identify who the user is (or ought to be) in that situation. Purposes might be defined in terms of the taxonomy of planning and management functions used earlier[6] or some other convenient breakdown. Clear explication of purpose should also help with respect to the issue of incorrect use of data and information. Nothing short of complete suppression of all data can completely remove the possibility of mis-use but explicit delineation of the purpose (or purposes) for which a given body of information was developed and intended may at least put some bounds around the possibilities.

Finally, it must be observed that many of the issues and difficulties surrounding data use are really only symptoms of larger organizational questions. Matters of trust--both between individuals and organizations; general resistance to change or innovation; declining or stabilizing resources; and organizational boundary conflicts are all examples of these sort of phenomena. If barriers to use arise from these types of sources, it is likely that no amount of rationalization about the value of such use will have any effect. Larger issues of organizational health will continue to dominate. Institutional data use is, after all, only a tool that can be used to address certain planning and management problems. It is not a solution to those problems in and of itself.

NCHEMS Plans

In response to both potential and problems in the institutional data uses area, NCHEMS launched the Institutional Data Uses (IDU) project in late 1974. This step really presented an increased and explicit emphasis rather than a new venture since the use of data as a support for planning and management in institutions of postsecondary education has always been an underlying focal point of NCHEMS product development and implementation. Individual projects

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[6]See Figure 1, page 5.

and products vary considerably with respect to the extent of emphasis on the issue but there can be no argument that use of data (as opposed to acquisition) is the ultimate intention in virtually every case.

The project is organized around two complementary perspectives: (1) examination of the uses of available data to support planning and management needs; and (2) examination of particular planning and management functions (e.g., resource allocation) and facilitation of the identification and use of appropriate information in carrying out each function. The so-called "data" and "problem" approaches are, of course, complementary and relatively little of the project's results will fall unambiguously into one or the other area.

In the course of this work, one body of existing data that is receiving particular attention is that produced by institutions through the NCHEMS Information Exchange Procedures (IEP) project. In fact, the IDU project's first formal product is IEP-related. IEP Analysis and Use: Single Institution Data [3] is designed to support an institution's use of its own IEP data in addressing planning and management concerns. Three types of data use are described and illustrated. The first is a general descriptive narrative of the institution, aimed largely at acquainting the nontechnical user or audience with the scope and potential of IEP data. The second consists of more detailed and more quantitative descriptive profiles of the institution's departments and student major programs. These are intended to assist the user to understand what is happening in the important instructional units of the institution. The third and most extensive type of data use is directed toward explanation in addition to description. The particular concerns addressed in this third category of IEP data use are differences in costs and in student outcomes measures across the departments and student major programs of the institution.

The procedures and guidelines presented in this document are being pilot tested during late 1975 and 1976 in institutions participating in IEP. Special attention is to be given to documenting the actual use of IEP data to support planning and management functions within the institution and to supplementing the manual with illustrations of such use. The results of the pilot test and field review will be incorporated as appropriate in a revised version to be published in late 1976.

Late in 1976 the project intends to produce a first version of a document that contains a set of procedures that support institutional analysis and use of selected nationally available data (e.g., HEGIS/EDSTAT, National Longitudinal Survey). Procedures will depend only on currently available national data and will not require any new data collection. The procedures will be organized in terms of applicability to specific institutional planning and management functions. This work complements efforts in the NCHEMS Information and Analytic Resources project that focus on the question of access to various nationally available data bases.

These various efforts in the procedures area are being complemented through a set of case studies documenting specific planning and management uses of information at selected institutions. These studies will emphasize but not necessarily be restricted to information producted in connection with NCHEMS products. They will not only describe technical details and present exemplary data but also treat surrounding organizational and behavioral factors to the greatest extent possible. Among the case studies scheduled to be completed in early 1976 are:

> Comparative Analysis and Use of Student Data at Central Washington State College: A Case Study.
>
> Institutionalized Use of Data at SUNY/Plattsburgh: A Case Study.
>
> The Use of RRPM in Planning and Budgeting at Colorado State University: A Case Study.

Certain more specialized analytic efforts are also being undertaken in the IDU project. These are designed not only to yield specific analytic results but also to develop and test various analytic techniques that might be susceptible to use in institutional planning and management.

One such effort focuses on the subject of comparative analysis utilizing data from multiple institutions. The identification of insights that can be gained used multi-institution data, particularly IEP data, and the development of appropriate generalized procedures are the major objectives in this area. Data collected during the 1973-74 pilot test of IEP are the principal basis for this work.

A closely related effort involves an analytic study of institutional comparability and its determinants. Both statistical data (primarily recent HEGIS data) and subjective data (e.g., expert judgments and attitudinal data) will be utilized. The objectives of the study are to: (1) identify patterns of institutional clusters and their dependence upon factors utilized and (2) assess and document general methodologies for establishing institutional clusters useful in comparative analysis. These results should not only contribute to future NCHEMS products that utilize institutional comparative analysis but also support improvements in institutional clustering techniques developed for reporting and more general analytic purposes.

The third effort of this type is an analytic study designed to enhance understanding of the operation of marginal cost phenomena in instructional disciplines and student programs. Analysis will focus not only on the identification of marginal costs but also on delineation of the effects of related variables (e.g., program size). The basic data utilized will be IEP data collected during the 1973-74 pilot test. Although the study is strictly exploratory in nature and no definitive results are expected, this work should contribute to future work in the costing area by NCHEMS and others.

Finally, it should be noted that efforts within the Institutional Data Uses project are to be complemented by various other NCHEMS projects. These include planned efforts focused on Needs Assessment, Institutional Mission/ Role/Scope, Program Planning, and Resource Allocation.

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STATE LEVEL USE OF COMPUTER SYSTEMS IN BUDGET PLANNING AND PRESENTATION

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Washington, D. C.

This paper outlines several of the crucial factors involved in the implementation of a computerized capability in the budget planning and presentation activities at a state-level higher education coordinating board. The paper also indicates the particular demands placed on those who undertake such implementation for clarity of presentation of computer capabilities, flexibility in consideration of policy problems, and careful attention to perceived needs of policy makers. Finally, a description is given of the type of support, both hardware and software, which allows the full integration of the computer capability into the administrative and political budget process.

This paper will outline some of the factors involved in the planning, development, implementation and use of a computerized budget planning and presentation system at a state higher education coordinating commission. In particular, the operational results of such a system will be described as they impacted on the course of budget hearings and presentation of the requests for operating funds through the legislative process. While the major activity involved in this process occurred during the 1975-77 biennial budget cycle at the Indiana Commission for Higher Education, the development and results of a computerized approach to budget detail presentation, in the author's opinion, can be generalized to other states and multi-campus institutions.

The relevance of generalizing to other states becomes more important when one looks briefly at the statistics on coordinating or governing boards at the state level. As of 1974, 47 of the 50 states have some form of oversight body for their state's public higher education, either a coordinating board (28 states) or a governing board (19 states). The experiences described here should be helpful to those intermediate states with small but potent coordinating authority.

Usually in papers of this sort, individual attention is given to the technical tools of implementation; however, in the course of the last decade it has become increasingly clear that political and organizational problems are often a more important factor in the usability of computer assisted activities. Consequently, considerable time will be spent in this paper on the environment in which computer assisted budgeting is being implemented.

THE STATE

The State of Indiana, in which much of this budget development took place, ranks 11th in the U.S. with a total population of 5.2 million, a per capita personal income of $4366 (just under the national average) and a public post-secondary educational system enrolling some 163,000 students. To support this student population for 1975-76, the State allocated $246 million (approximately 25% of the general fund) in operating appropriations to 6 institutions made up of a total of 16 campuses. These 6 institutions included two nationally recognized research institutions with substantial amounts of restricted government grants, Purdue University-West Lafayette and Indiana University-Bloomington; two comprehensive state universities (an outgrowth of the state normal school), Ball State University in Muncie and Indiana State University in Terre Haute; a vocational technical college with 13 locations throughout the State, Indiana Vocational Technical College, and a predominantly two-year community college, Vincennes University. In addition to these main campuses there exist a total of 12 regional campuses throughout the State: three belong to Purdue University; seven administratively to Indiana University, including a large urban institution with a medical school; Indiana University - Purdue University at Indianapolis; and there is one regional campus in Evansville for Indiana State University.

These institutions combined provide a comprehensive post-secondary program offering some 25,000 identifiable academic programs. In terms of governance, there are "single governing boards" for the three multi-campus universities, Purdue University, Indiana University and Indiana State University, and individual boards of trustees for Ball State University, Vincennes University and Indiana Vocational Technical College.

A BRIEF BUDGET HISTORY

With the complexity of organization described above, it is worthwhile to look briefly at the historical relationship between the institutions and the State of Indiana. Prior to and including World War II, the boards of trustees of the four main institutions (I.V.T.C. and Ball State University had not been founded) submitted separate, uncoordinated budget requests to the Legislature. By 1947, however, the intense competition for funds and program development between the two largest institutions, Purdue University and Indiana University, had tended to fracture various mutual understandings between the universities. In 1949, the Legislature specified in the Appropriations Act that the institutions were to "cooperate in working out a formula" to appropriate funds to the institutions based on such things as "cost per student...number of state students...etc." The outcome of this was a proportional distribution of state funds based on the proportion of "need" calculated primarily by each using total enrollment and faculty salaries as key variables. When the State provided less money than was requested, as almost always happened, the institutions split the money, keeping the same proportions as in the request. Though this arrangement was "approved" by all other institutions, the result was that the large institutions got larger and the smaller ones did not increase as rapidly.

By 1955, it became clear that a more precise means of determining "need" would be necessary. It was known that several programs maintained by Purdue

University, engineering and agriculture, and programs like medicine and music at Indiana University required higher support per student than many other academic programs -- but it was unclear how much more money they needed per student.

As a result of the participation of Indiana University and Purdue University in the early "California-Big Ten Cost Study," the principle of multiplying current costs per student by level by the anticipated number of students, minus other income contributed, was advanced as a method. It was felt by most of the institutions that such a cooperative method based on a cost study better expressed real "need." This method was effectively used from 1957 through 1965. Its chief result was that the institutions themselves continued to exercise primary responsibility for the distribution of funds and for the major variables used to determine their level of need.

This program basically ended in 1967, when a new governor requested that an accounting firm develop a new budget and cost procedure for all the public institutions. The result was a so-called "programmatic budget" document which required that the institutions project for two years into the biennium the exact course enrollments for all academic courses offered. Using this projection, and based on fixed faculty loads and salary increases, a dollar figure for enrollment increases was generated, as well as a dollar figure for program improvement. The institutions retained from the old cost-study approach the distinction of "unavoidables" for all utility and benefit expenditures which were considered necessary for the operation of the institution, and they continued to use fixed percent increases for salaries and supplies in calculating need. In 1967, the traditional budget and the new "programmatic budget" were submitted together. The request based on the "programmatic budget" was too high for the fiscal realities of the State and the Legislature reduced the amount provided.

However, the allocation of funds did not follow the proportions established under the old "cost study" method, but rather followed more closely the proportions suggested by the new method. With the addition then of a complex budget document for each large institution weighing some 25 pounds, the State Budget Agency (the Governor's fiscal office) became a more important participant in the higher education budget process.

By the 1969-71 biennium, the budget request was firmly keyed to the "programmatic budget," however the political combinations in 1969 led to budget decisions which were more directly political than rational according to any cost data. Part of the problem was the amount of audit-type effort expended by an understaffed Budget Agency chiefly concerned with ensuring the mathematical accuracy of the voluminous computer-generated budget requests. Little time was left for this agency to give careful consideration to programmatic concerns.

In the two subsequent biennia, 1971-73 and 1973-75, the "programmatic budget" document remained the primary request document for the post-secondary institutions. The structure of budget recommendations thereby developed by the State Budget Agency rested on a complex document, and there was less than a month and a half to analyze it. Because of its complexity, the programmatic aspects of the document never fully surfaced in the legislative process. In addition, although the State public institutions traditionally received not line-item but lump sum appropriations, the Legislature generally reviewed budget increases from a line-item standpoint (salaries, supplies, etc.) -- a standpoint which the budget document and procedure were ill-equipped to support. Into this problem area a new State body was introduced.

A BRIEF COORDINATING BOARD HISTORY

Following the 1969 General Assembly, a Higher Education Study Committee with sixteen legislators was formed to study the need for improved coordination of higher education in Indiana. Not only were national trends in favor of this type of action, but the competition for funds and students among the institutions had at times become more than the Legislature could readily understand or adjudicate. Distrust had developed in Indiana as in many other states over the ability of self-interested institutions to reduce duplication of program offerings and to equitably decide on the allocation of resources among themselves. By 1971, a recommendation was made to establish a coordinating board, and legislation was subsequently written which established the Indiana Commission for Higher Education. It was established with statutory authority to review and make recommendations to the Governor and General Assembly on all university budget requests, to approve or disapprove new programs or campuses for public institutions, and to engage in continuous planning for the publicly-supported state system*. Authority to intervene in the internal management of the institutions was explicitly withheld.

The first Commission staff, hired on a very small beginning budget, and making extensive use of people on loan from the public post-secondary institutions in the State, had a great deal of difficulty compiling a professional and organized operation. The staff was by and large young, with little collective budget experience, and no strong, experienced second-level leadership. While a master plan remained the key focus of Commission efforts during its first year, by 1972 it had to develop staff to make a recommendation on the 1973-75 budget requests. The small size of the Commission staff created considerable problems in matching the budget deadlines established. Considerable time was spent simply ensuring the mathematical accuracy of re-

* Thereby falling under Berdahl's "Regulatory Coordinating Agency" category.

quests; insufficient time was spent on documenting appropriate salary increases and inflation factors, or on the needed allocation of monies among the various regional campuses. Finally, poor timing created a situation where the Commission's recommendations came after the first major review phase in the legislative process. The outcome for the 1973-75 biennium was that the Commission received blame from the institutions for not aiding the budget process and ensuring adequate funding for the institutions and a good deal of criticism from the Legislature for not tackling, persuasively, the hard issue of equitable allocation of available monies among the institutions. In addition to these problems was a legislative ceiling on the revenue from instructional fees which could be levied, thereby constraining the institutions in a new way and contributing to dissatisfaction with overall results.

Some six months after the legislative session, amidst problems of confidence in the Commission staff and an initially poor track record, the first Commissioner resigned. Shortly thereafter an acting Commissioner was appointed and several new personnel were added. This new group assisted in the reopening of the 1974 budget to allow additional funds for utility cost increases. A new, ad-hoc budget approach was taken and attention was given to key budget items. The result of the budget reopening was an additional $1 million for the institutions.

At the same time, a "Study of the Financing of Post-Secondary Education in Indiana" was undertaken with the goal of establishing:

- -- improved methods of developing budget recommendations;
- -- the procedure for allocating funds among institutions;
- -- a statewide budget and financial planning system that would ensure that adequate and comparable financial data would be submitted by the institutions.

With this expanded staff, and a commitment of the Finance Study staff to the near term problems of the Commission, the Commission spent considerable time preparing for the key questions for the 1975-77 biennium: appropriate salary increases for faculty, supplies and expense money needed to offset inflation, the size of enrollment increases at the institutions,* the amount of money to be deducted from institutions which had lost students, and funds necessary to provide roughly equivalent amounts of money per student throughout the State.

THE ORGANIZATION SETTING

John Millett and others have spoken of the need for a coordinating board to be always half-way between the two major forces in its existence -- the Governor and Legislature and the State universities. In order to function effectively with multiple audiences, a board must never allow one faction to see in as its representative alone.

The Indiana Commission, following the installation of its second permanent commissioner in March 1975, functioned in much this manner. Every effort made, whether programmatic or budgetary, was undertaken with the idea of establishing an equitable position in the midst of opposing groups. For example, because of its role as the Governor's spokesman in budget matters, the Budget Agency was given every offer of assistance and was frequently consulted to avoid duplication in requests and to establish at a minimum a common base of data. Analytical problems were occasionally discussed commonly, but it was understood that a Budget

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* Two major studies originated as part of this effort, an enrollment projection and review conducted by Purdue University, and the construction of an inflation index for those goods which a university, by contrast with civilian households, purchases for itself.

Agency had to above all serve the Governor. The very small size of the Budget Agency staff in the area of education, one man, ensured that for detailed, effective analyzing of state issues , the Commission was the only group capable of adequate response. In similar fasnion, the Legislative Council,which had a very small and overworked staff,was encouraged to share concerns with the Commission, although the Commission was usually responsive to the Legislature directly. In either case, the policy adopted at the Commission very early was that the Commission must remain between the State Legislature and the interests of the public post-secondary system. At times, as well, it would find itself between the Governor and the Legislature, between the competing factions in the Legislature, and at times between competing institutions. The central goals, particularly as they appeared in the process of budgeting then, were:

- Credibility, which in the arena of budgeting means having the correct figures (and if not always, more often than not) and sound projections when figures are not adequate. It means as well:
  - projective efforts to establish common data
  - feedback of results to concerned parties to insure common data
  - simplicity of presentation whenever possible
- Ability to analyze and to present the results of deliberation and data clearly and to the point -- and to be able to summarize the results of often lengthy research
- Ability to move quickly and flexibly; the ability to sense major arguments or stumbling blocks in the budget process and prepare

appropriate responses.[1] It also means reducing the turnaround time from argument to analysis substantially

- Development of working relationships with key participants in the budget process, both at the state government level and at the institutional level
- Sensitivity to the resource use and costliness of ad-hoc requests for information

One of the tools that it appeared might contribute to the Commission's efforts in these areas, despite its small staff, was a reasonably integrated computerized data and budget system.

INITIAL SYSTEMS DEVELOPMENT

With the general operating guidelines described above as parameters, several months of research were undertaken to evaluate in what manner computer assisted budgeting and planning could aid the Commission. It should be noted that, with the exception of the voluminous data generated for the "programmatic budget" -- little of which was ever used internally at the institutions in the State -- computerized financial planning was not part of Indiana institutions. Hence, several key technical requirements were established:

-- accessibility

-- low maintenance

-- low and controllable cost

-- ease of use

-- simplicity in terms of operator access and in terms of ability to allow manual recalculation of output

-- a hands-on trial period

-- maximum use of available facilities

No extensive promises were made about the computer's usefulness since there was some top level scepticism. The previous experience of the new leadership was that data processing tended to get out of hand and become a monolith. It soon became clear that the machine would have to prove itself in a demanding operating environment.

As a result of the independently funded "Study of the Financing of Public Post-Secondary Education in Indiana," computer funds were available and a trial relationship was established with a nearby campus to use their time-sharing facilities supported by a Digital Equipment Corporation PDP-10* Time-sharing was chosen initially for its convenience and responsiveness, and because the volume of data processed was not so great as to require the immediate efficiencies of batch processing. This choice was to prove fortuitous in the process of introducing computerized budgeting to the Commission staff and the legislature.

Along with the choice of a relatively uncomplicated computing support service, which included pre-arranged system consultation at frequent intervals, working relationships were established with three other campuses to ensure that machines with complementary characteristics, a CDC 6600, and IBM 370-158, could also be put at the Commission's disposal on a remote batch basis**

In line with the continuous effort at simplicity, the Western Michigan Modified BASIC was chosen as the source language for all of the first Commission programs. A brief review was made of ANS-COBOL, FORTRAN IV, PL1, and ALGOL and it was determined that the flexibility needed in a time share mode was lacking in each of the languages. Beyond that, it was deemed essential that a non-program trained person be capable of readily grasping the logic

* Commercially available facilities were investigated, however minimum usage requirements and the commercial rates charged suggested an uneconomic relationship.

** In contrast with other states, Indiana has not developed centralized computer purchasing, nor is this a major controlled item. By and large, each major university has funded one or more of its units through research grants.

and algorithms incorporated in the source program. Finally, what appeared to be the widely varying demands for formatting flexibility suggested that the various default features in the Western Michigan BASIC would provide the needed speed and simplicity.

As a last step, various budget-oriented software packages were reviewed, including PLANTRAN, RRPM 1.6, CAMPUS, TEMPLAN, an unpublished package called PUPLAN (similar in many ways to PLANTRAN) and several other commercial packages which were primarily designed as strict accounting packages. As often occurs, these packages were either too complex because of their primary orientation to institutional planning, or too simple to match the computational requirements of a state-level budget. As a result, a custom program which matched the precise needs in terms of budget issues, presentation options for displaying system totals as well as individual campus totals, and ease of access was developed. The source program uses individual campus base year data supplied manually by the institutions and maintained in separate data files. The same basic set of operations are performed on each set of data through the master program, thereby ensuring consistency of treatment for each campus. The program serves not only a housekeeping function of electronically saving data and updating as necessary, but allows rapid alteration of budget parameters.

The key to the successful implementation of this program was the continuous support, once it had proved its worth, from top leadership at the Commission and their ability to use the output persuasively rather than merely having it tell the story. And very compelling in its success was that mere data manipulation during initial budget submission was reduced from two weeks out of a six-week budget review period to two days.

The computer-generated output was used directly in the legislative process as a "talking" document* -- it was also used in a verification mode for manually performed calculations, and "what if?" types of simulation questions.

THE OUTCOME

The Indiana budget process for the 1975-77 biennium was essentially a base plus approach. The unrestricted fund budget level for the previous year was modified, mostly upward, in response to increases in:

- -- salaries
- -- inflation on basic supplies and expenses
- -- increases in essential utilities (unavoidable expenses necessary to maintain the physical operation)
- -- enrollment changes
- -- institutional support for developing institutions
- -- program additions or improvements

The State deducted all unrestricted operating revenues (the primary one being student fees) and based on the prior negotiated operating level met the shortfall between expenditures and revenue with State appropriations. The appropriations were given on a lump sum basis without line item control. No

* This point is made eloquently in an unpublished paper, "Data for State Budgeting Decisions: Are Centralized Higher Education Information Systems Working?", p. 13.

real attempt had been made previously to seriously analyze the base according to formula or guidelines. As a consequence, the Legislature was not very sensitive to such things as productivity ratios (e.g., credit hours, faculty member, class sizes or teaching loads) or operating ratios (instructional expenditures as a percent of I & G). The universities, as noted earlier, rather strongly guarded these prerogatives and resisted any efforts to introduce them -- maintaining that such matters had to do with institutional management, not public policy.

As EXHIBIT 1 shows, the computer program entitled "BUDGET" followed the format of budgeting precisely. The run shown provides the total for the Indiana system. It provides in considerable detail the composition of the budget recommendation in each major area as well as the projected increases and totals. Hence, on one page it provides the entire operating budget recommendation for the post-secondary community. The individual line items such as personal services, inflation, and unavoidables can be altered interactively at the terminal in the main source file or else, in a similar manner, the individual data files can be altered. To recast or recalculate the entire system takes approximately twenty minutes using a 30 C.P.S. terminal. Individual program items that are additions to the base budget, enrollment, "minimum instructional support," or quality improvement, can as well be altered proportionately or individually by changing one line in the BASIC source program. A one line change in this system thus can result in a change for all sixteen campuses.

This basic program was used to provide the results of various salary and inflation options in summary fashion during Commission discussions and also as basic supporting documentation for the Commission budget recommendation.

Another key role which this program played was to summarize the financial consequences of each stage of the legislative deliberations. In Indiana there have been essentially seven major budget steps:

--The Institutional requests

--The Commission recommendation

--The Governor's budget recommendation developed by the State Budget Agency

--The House Bill

--The Senate Bill

--The Conference Committee Proposal

--The Final House Appropriation Bill

Because the appropriations to public post-secondary institutions are based on lump-sum appropriations, but usually arrived at by line-item increases (through which participants in the budget process express different budget priorities), there has occurred in the past considerable confusion as to the manner in which final appropriation figures were developed. While the Legislature's intent in recommending certain appropriations has never been binding, considerable ill will has occasionally been generated between the institutions and the Legislature, when institutions ignored or apparently misconstrued those items for which the Legislature felt it had provided funds. By means of the computer budget program, and careful attention to key members during the legislative process, a record was kept during the 1975-77 session of the component parts of each appropriation bill. For example, at the close of the Senate consideration of the higher education appropriation, the specific items in the budget request which the Senate intended to fund were identified for each campus. Thus, at each stage of the legislative process, the starting point for new legislative negotiation could be established. The institutions were given copies of the outcome at each stage and, hence, severe coordination problems occasioned by differing interpretations of the financial outcome of deliberations were avoided.

The effort and capability to follow accurately deliberations about salary increases and inflation contributed greatly to keeping the focus of the Legislature on key issues of concern to the universities. In part because of the efforts of several new members of the House to direct the attention of their committee members to budget issues rather than just distribution of appropriations, budget presentations which put issues first and campus distribution second appeared to contribute some direct rationality to the budget process. Hence, although the budget process was not directly programmatic, there was considerable attention given to those factors which had direct programmatic implication.

EXHIBIT 2 shows a variant of the budget program described earlier. Called a Funding Allocation Plan, it allowed Legislators and members of the Commission to do what often occurs in the legislative process -- to start from a given available amount of money and to allocate the funds back to the institutions based on budget priorities, salaries, inflation, unavoidables or program changes, using identical guidelines. Hence, "what if?" types of questions could be confronted so that if the legislative priority was salaries and only a certain amount of total dollars were available, the consequences could be easily seen. Additionally, since the State has not reached a firm policy on student fees* as a specific proportion of total operating revenue, the option was provided for assessing the impact on fees of additional fee revenue generated

* With the exception of limiting increases to $7 million total in the 1973-75 biennium.

from fee increases. The bottom line of EXHIBIT 2 shows the representative cost to an undergraduate student of fee increases needed to generate various levels of revenue.

Because these outputs were all generated in a time-share environment, a legislator could himself investigate a variety of funding and priority options. During the session none did. However, the Commission was often called upon to provide data in this format for a variety of proposals. Needless to say, the time saved in calculation alone allowed staff to provide considered responses in most cases within the day.

Some have argued that allowing this range of "what if?" questions is denying the real needs of the institutions by tacitly admitting that other alternatives are viable. However, it is clear that in almost every legislative process, an allocation decision will be made; the reasonableness of the grounds for the decision will be the item which varies.

By emphasizing the service which a specialized agency could provide, and by ensuring adequate feedback to the concerned parties -- the institutions, and the legislative staffs -- the legislators gained more confidence in a process which emphasized more directly the issues involved,in a budget decision.

The mere fact of a ready cross-check on manual calculations and the ability to rapidly generate a common data base throughout the legislative process appeared to reduce the actual legislative error and to allow more time for the consideration of basic issues. Additionally, the rapid sharing of data about all the institutions, among the institutions, reduced somewhat the use of mere political power and ensured that other institutions in the system, often the best auditors of each other's data, would aid the process of ensuring good base information.

CONCLUSION

Indiana's experiences are not radically different from those of other states. The number of coordinating or governing boards which have developed just since 1960, 27 then versus 47 in 1974, suggests a wide range of common problems across state lines. Though the structures are different, many of the same problems of coordination, accurate information, responsiveness, and developing political relationships are the same. The particular need of the Indiana Commission to develop objectivity and credibility in one phase of its activities, budget planning and review, and to provide meaningful and sought-for guidance in the resource allocation process is not unique to this agency.

One of the factors in the development of this capability has been support for a responsive budgeting system which increases participation in the budget process while at the same time maintaining the accuracy and integrity of the data. Beyond that, one measure of a commission's effectiveness must surely be its ability to take and hold an issue-oriented approach built on sound educational principles throughout the legislative process.

Improvements in the budget procedure which support the consideration of issues, such as a computerized budget system, and which make a wider range of legislative options available for consideration surely contribute to more sound evaluation of educational policy.

The budget programs described here suggest not just additional software, which frees the support staff from a great deal of manual labor, but as well an approach to the consideration of budget issues and to the concept of service which a coordinating body can adhere to.

The development of this type of computer capability (primarily oriented to a time-share environment) in Indiana has allowed:

-- more time for consideration of policy problems;

-- a wider variety of policy options considered;

-- flexibility in the consideration of conflicting policy positions;

-- responsiveness to legislative and executive needs for data and interpretation;

-- improved communication on budget matters with the institutions;

-- a general increase in the funds provided by the State based on an indication of more efficient management and control of the system;

-- some prodding of the large institutions, because of new state-level abilities to review their posture on effective planning tools -- many of which are based on computerized planning models.

None of these comments should be construed to mean that such a budget improvement could single-handedly improve a bad situation. As in most endeavors, skillful use of the part of top management is essential, and sound advice based on good data remains the key to effective credibility with the legislative branch. However, the budget package described can contribute significantly to the worth of the data.

Some general comments about the implementation of this system or other similar ones:

- Always state as clearly as possible for the other operating staff what can and cannot be done by the computer -- and in what time frame.
- Ensure that budget data produced is free from errors. Even small errors can badly damage the credibility of a new computer enterprise. We generally used a three stage verification process which could be accomplished quickly.

- Keep the entire system as simple as possible -- particularly if the staff is small and the board bears heavy political responsibility. The budgeting system must reflect the dominant conceptual mode of budgeting and, as recent budget literature has suggested, the issues and problems which are key for this year's budget process are not necessarily the same as those the following year. For this reason, it remains to be seen whether the NCHEMS Statewide Planning Model will gain widespread use and support.
- Ensure that there is abundant feedback of budgeting data and that it is clear that information requested is being used.
- Approach the matter of computer service, both for yourself and for the computer support group, from a very highly service-oriented perspective. The chief focus should always be on <u>user needs</u> -- not machine capability.

The total cost for computer operations from August 1974 through August 1975 came to approximately $5500. Even during the heaviest months of use, at times averaging 80 hours a month of connect time, the total charges were under $550 per month. Some forms of commercial time-sharing with educational discounts, or shared university facilities, should allow comparable costs elsewhere in the country. Personnel time, a potentially great cost factor, is reduced considerably because of the attractive characteristics of the BASIC computer language. Most reasonably skilled budget analysts can learn enough of the language to feel comfortable using it within three days. The I.C.H.E. program, for example, was transferred to the Indiana State Budget Agency computer in one afternoon and only several sessions were needed to acquaint the analyst with the major program features and possible modifications for agency use. Since the author has left the Commission, program maintenance and operation has been taken up by a previously non-program-trained analyst. With economies of this sort available, even the smallest coordinating body should be able to make use of interactive computer assistance in the budgeting process.

With the demands for accurate information, and the increasing number of participants in state-level budgeting for post-secondary education, it is increasingly important that tools be used which directly assist top leadership, without vastly increasing the size of support staffs. Additionally, the time frame allowed for careful policy consideration appears to have shrunk in the face of competing demands on time -- top leadership needs the space for the appropriate kind of reflection. As F. Balderston has pointed out:

> What they (individuals) need to know for immediate action usually is more precise and timely information than has traditionally been delivered up to them; but what they need for perspective is even more important, and...leadership has a heavy responsibility to help people get it...[2]

A responsive computerized budget planning system, which can be used directly in the legislative process and which can present options to top leadership, whether they are executive officers or legislators, can help give leadership the time it needs for perspective.

1975-77 EXPENDITURE BASE ANALYSIS
INDIANA COMMISSION FOR HIGHER EDUCATION

EXHIBIT 1

INSTITUTION: TOTAL SYSTEM CAMPUS: --- DATE: 11/20/74

	1974-75 ADJUSTED BASE BUDGET	1975-76 INCREASES (OVER 1974-75)	-%-	1976-77 INCREASES (OVER 1975-76)	-%-	TOTAL BIENNIAL INCREASES
1. PERSONAL SERVICES (ADJUSTED):	206,547,832	20,654,782	10.0%	18,176,209	8.0%	59,485,774
2. SUPPLIES & EXPENSES (ADJUSTED):	55,312,543	5,531,254	10.0%	6,084,379	10.0%	17,146,888
3. UNAVOIDABLES:						
A. FUEL	6,060,198	1,805,231	29.8%	780,764	9.9%	4,391,226
~~B. UTILITIES~~	8,619,451	931,805	10.8%	1,125,973	11.8%	2,989,703
C. TELEPHONE	2,572,358	136,334	5.3%	270,869	10.0%	543,539
~~D. POSTAGE~~	1,235,368	123,536	10.0%	135,890	10.0%	382,964
E. MEDICAL INSURANCE	3,282,714	376,504	11.5%	475,937	13.0%	1,228,945
~~F. SOCIAL SECURITY~~	4,268,566	333,378	7.8%	372,775	8.1%	1,039,531
G. MINIMUM WAGE	4,488,060	345,155	7.7%	345,122	7.1%	1,035,432
~~H. RENT-LEASE~~	86,057	100,000		0	0.0%	200,000
I. PLANT EXPANSION	0	1,686,943		615,836	36.5%	3,989,722
TOTAL UNAVOIDABLES	30,612,772	5,838,947	19.1%	4,123,166	11.3%	15,801,062
4. OTHER BASE BUDGET ITEMS:						
A. STAFF RETIREMENT	13,915,195	1,391,519	10.0%	1,224,537	8.0%	4,007,576
~~B. UNEMPLOYMENT COMP.~~	393,166	0	0.0%	0	0.0%	0
C. WORKMEN'S COMP.	233,625	0	0.0%	0	0.0%	0
~~D. FEE REMITS (STAFF)~~	385,930	0	0.0%	0	0.0%	0
E. STUDENT AID	13,626,446	0	0.0%	0	0.0%	0
~~F. COST SHARING(MATCH.)~~	1,168,848	0	0.0%	0	0.0%	0
G. LIFE INSURANCE	2,133,481	213,348	10.0%	187,746	8.0%	614,442
~~H. CARRY FORWARD~~	5,331,634	0	0.0%	0	0.0%	0
I. COST ALLOCATION	11,926,074	1,546,467	13.0%	1,251,951	9.3%	4,344,885
TOTAL OTHER ITEMS	49,114,399	3,151,334	6.4%	2,664,234	5.1%	8,966,903
5. ENROLLMENT CHANGE		2,302,479		2,148,531		6,753,489
6. MINIMUM INSTRUCTIONAL SUPPORT		786,848		1,522,243		3,095,939
6A. INSTRUCTIONAL PROGRAM ADJUSTMENT		-200,000		-300,000		-700,000
7. QUALITY IMPROVEMENT		672,200		352,000		1,696,400
8. NEW PROGRAMS		0		0		0
TOTAL EXPENDITURE INCREASES	341,587,540	38,737,846	11.3%	34,770,764	9.1%	112,246,458
LESS:						
A. STUDENT FEES	86,164,020	1,749,387	2.0%	1,618,649	1.8%	5,117,423
B. FEE REPLACEMENT	2,021,467	696,773	34.5%	339,118	12.5%	1,732,664
C. GIFTS,GRANTS,CONTRCTS.	6,071,365	-14,097	-0.2%	-217,000	-3.6%	-245,194
D. SALES & SERVICE	12,839,617	397,971	3.1%	351,559	2.7%	1,147,501
E. INVESTMENT/ENDOWMENT	580,400	44,400	7.6%	40,000	6.4%	128,800
F. OTHER INCOME	6,849,016	102,650	1.5%	-58,950	-0.8%	146,350
G. COST ALLOCATION	1,354,690	0	0.0%	0	0.0%	0
H. CARRY FORWARD	5,684,967	-353,333	-6.2%	0	0.0%	-706,666
TOTAL OFFSETTING REVENUE	121,565,541	2,623,751	2.2%	2,073,376	1.7%	7,320,878
RECOMMENDED APPROPRIATION INCREASE		36,114,095	16.4%	32,697,388	12.8%	104,925,580*
RECOMMENDED TOTAL APPROPRIATION	220,021,996	256,136,092	16.4%	288,833,484	12.8%	544,909,576*

*Does not include recommended $4,000,000 for New Programs

EXHIBIT 2

THE FOLLOWING PROGRAM WILL DETERMINE THE ALLOCATION OF EXPENDITURE DOLLARS GIVEN A FIXED TOTAL AMOUNT FOR THE POSTSECONDARY SYSTEM. EACH BUDGET CATEGORY (EG. PERSONAL SERVICES) CAN BE GIVEN FULL PRIORITY FOR FUNDS (FULLY FUNDED) OR IT CAN RECEIVE ITS PROPORTIONATE SHARE OF RESOURCES AVAILABLE TO THE ENTIRE SYSTEM ONCE THE FIRST PRIORITY BUDGET CATEGORIES HAVE BEEN FUNDED. IN TURN THE DISTRIBUTION OF THE SOURCES OF REVENUE, STUDENT FEES AND STATE APPROPRIATION WILL THEN HAVE TO BE DETERMINED.

THE NEW EXPENDITURE LEVEL FOR THE BIENNIUM IS: 2102000000

THE ADDITIONAL STUDENT FEE REVENUE DESIRED FOR YEARS 1 AND 2 IS: 20,7000000

INDICATE BUDGET CATEGORY STATUS FOR YEARS 1 AND 2 AS FOLLOWS:
IF FIRST PRIORITY (FULLY FUNDED) = 1
IF SECOND PRIORITY (IE. RECEIVES ITS PROPORTION OF FUNDS AFTER FIRST PRIORITY NEEDS) = 2
IF CATEGORY SHOULD BE ELIMINATED = 3

PERSONAL SERVICES:	?2,2
SUPPLIES & EXPENSES:	?2,2
UNAVOIDABLES:	?1,1
OTHER BUDGET ITEMS:	?2,2
ENROLLMENT CHANGES:	?2,2
MINIMUM INSTRUCTIONAL SUPPORT:	?1,1
INSTRUCTIONAL PROG. ADJUSTMENT:	?2,2
QUALITY IMPROVEMENT:	?2,2
NEW PROGRAMS:	?2,2

FUNDING ALLOCATION PLAN
1975-77 POSTSECONDARY OPERATING BUDGETS
INDIANA COMMISSION FOR HIGHER EDUCATION

INSTITUTION: TOTAL SYSTEM CAMPUS: DATE: 1/21/75

	1974-75 ADJUSTED BASE BUDGET	1975-76 INCREASES (OVER 1974-75)	-%-	1976-77 INCREASES (OVER 1975-76)	-%-	TOTAL BIENNIAL INCREASES
1. PERSONAL SERVICES (ADJUSTED):	206,547,828	17,632,089	8.5%	15,516,239	6.9%	50,780,419
2. SUPPLIES & EXPENSES (ADJUSTED):	55,312,543	4,721,791	8.5%	5,193,969	8.7%	14,637,552
3. UNAVOIDABLES:	30,612,772	5,836,947	19.1%	4,123,166	11.3%	15,801,060
4. OTHER BUDGET ITEMS:	49,114,399	2,690,156	5.5%	2,274,340	4.4%	7,654,654
5. ENROLLMENT CHANGE:		1,965,526		1,834,107		5,765,160
6. MINIMUM INSTRUCTIONAL SUPPORT:		786,848		1,522,243		3,095,939
6A. INSTRUCTIONAL PROGRAM ADJUSTMENT:		-170,731		-256,096		-597,559
7. QUALITY IMPROVEMENT:		573,827		300,487		1,448,142
8. NEW PROGRAMS:		3,414,626		-3,414,626		3,414,626
TOTAL EXPENDITURE INCREASES	341,587,540	37,453,082	11.0%	27,093,830	7.1%	102,000,001
LESS:						
A. STUDENT FEES:	86,164,026	1,749,387	2.0%	1,618,649	1.8%	5,117,423
B. ADDITIONAL STUDENT FEES:		0		7,000,000		7,000,000
TOTAL STUDENT FEES		1,749,387	2.0%	8,618,649	9.8%	12,117,423
C. FEE REPLACEMENT:	2,021,467	696,773	34.5%	339,118	12.5%	1,732,664
D. OTHER INCOME:	33,380,055	177,591	0.5%	-115,609	-0.3%	470,791
TOTAL OFFSETTING REVENUE	121,565,540	2,623,751	2.2%	9,073,376	7.3%	14,320,878
RECOMMENDED APPROPRIATION INCREASE		34,829,331	15.8%	18,020,454	7.1%	87,679,122
RECOMMENDED TOTAL APPROPRIATION	220,022,002	254,851,332	15.8%	272,871,788	7.1%	527,723,120

PER STUDENT UNDERGRAD. RESIDENT FEE IMPACT OF ADDITIONAL STUDENT FEES ASSESSED

MAIN CAMPUSES+VINCENNES	726	0	0.0%	58	8.0%	58
REGIONAL CAMPUSES	644	0	0.0%	51	8.0%	51
I.V.T.C.	494	0	0.0%	39	8.0%	39

FOOTNOTES

1 Frederick E. Balderston, "The Design and Uses of Information Systems," Evaluating Institutions for Accountability, New Directions for Institutional Research, Number 1, Spring, 1974, p. 76.

Balderston aptly sums up the problem:

> "Unless its [a board's] powers are securely anchored in law, political agreements and respected past performance, the State board of higher education may well be entirely bypassed on any important issue or may find itself confronted on some issues by an overwhelming coalition against whose members it has little or no power of retaliation."

2 Ibid, p. 56.

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COSTING IN HIGHER EDUCATION: STATUS, PURPOSES AND USES

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Costing systems and cost information are receiving increased attention in post-secondary education. Institutions faced with declining enrollments are finding that cost systems which serve their needs in periods of growth are no longer applicable when planning and budgeting future educational activities. Governmental agencies and legislators are requesting cost information to assist them in appropriating funds. The National Commission for Post-Secondary Education has called for cost information on a national basis. As a result, institutional managers must become familiar with the types of costing systems that may be used to satisfy these needs.

The purpose of this paper is to describe the status of costing systems in higher education. The basic cost determination systems and analyses are described, since their selection should depend on the purposes for which cost information is used. Specific attention is directed to describing the type of management costing system necessary to serve the current needs of higher education. Also provided is a brief description of the Cost Analysis Manual and Information Exchange Procedures developed by the National Center for Higher Education Management Systems.

Institutions of higher education have experienced significant changes in the last century. During the 100 years ended 1970, vast amounts of money were appropriated to expand the quantity and quality of our institutions. This expansion of higher education was motivated by a number of factors. These included (1) providing access to higher education for a greater number of students, (2) recognizing that higher education provided the nation and individual students with increased abilities to satisfy the demands of current and future societies and (3) satisfying the increasing needs of agriculture, the professions and industry.[1]

More recently, the rate of expansion in higher education has declined rapidly. For some institutions enrollments have remained constant while for others they have declined. This phenomenon has occurred principally as a result of "(1) the abolition of the draft, (2) the sharply rising costs of college attendance that have been associated with accelerated inflation rates and accompanying increases in tuition and other college charges, (3) the changes that have occurred in the job market for college graduates, especially in the demand for school teachers and in the narrowing gap between wages received by high school and college graduates, and (4) liberalization of college rules to permit deferred admissions and 'stopping out' of students in the midst of college careers."[2] Predictions of enrollment for the next 25 years vary but generally seem to indicate a "steady state". Certainly, for the typical 18 to 21 year old undergraduate student, these predictions appear correct considering the significant decline in the birth rate we have experienced as a nation.

THE NEED FOR
COST INFORMATION

What are the implications for higher education of this changing enrollment pattern? What are the pressures facing higher education governance and those external to institutions as a result of decreased enrollments and a decline in the purchasing power of the dollar? What is the impact that may be expected for management systems and most particularly existing methods of costing and what are the different types of cost information which will be most useful in the future?

The answer to these questions can be identified succinctly in a single word "change." Change in financing, in organizational structure, in programs and in other aspects of higher education. Change as we have never seen before in the decisions facing boards of trustees, chancellors and presidents, administrators and faculty. Change in the type of information required to assist those both within and outside our institutions to evaluate past circumstances, consider alternatives and to select the appropriate course of action to be taken in the future. It is this changing environment that has and will continue to foster the expansion and development of new sophisticated management tools. Among these tools will be costing systems and studies designed to assist management to perform the functions of planning and budgeting, controlling and evaluating performance.

But we are getting ahead of ourselves. Before discussing costing and the purposes and uses of cost information to assist in dealing with change, it is necessary to consider briefly the evolution of costing and the costing activities now going on in higher education.

EVOLUTION OF COSTING

Cost accounting has been used for many years to assist institutions of higher education to examine the cost of instruction, research, public service and related support activities. "Cost accounting is concerned with accumulating, classifying, summarizing, interpreting, and reporting the cost of personnel, goods and services, and other expenses incurred to determine unit costs."[3] Cost information has been developed by using costs incurred in the past called "historical cost" as well as costs planned for the future called "projected cost".

Costing systems, cost studies and cost information have been developed for many years by individual institutions and by groups of cooperating colleges and universities. These included cost studies by the "Big Ten" schools, the institutions comprising the Western Interstate Commission for Higher Education (WICHE), the nine college study[4] and many others. In fact, in the 1935 edition of Financial Reports for Colleges and Universities[5] an approach was proposed for program costing which closely parallels the costing procedures now employed by some of our institutions. Cost information has been determined by institutions for many purposes including the following:

1. comparing the historical cost of programs or organizational units to a subjective assessment of the benefits derived,

2. examining historical cost as compared to revenue to determine whether a net inflow or outflow of funds resulted from a particular activity,

3. determining the amount of direct and indirect cost for reimbursement on sponsored research contracts and grants, and

4. analyzing projections of cost and revenue to plan and budget future educational and related activities.

More recently, there has been increasing pressure from external agencies to receive cost information. Federal, state, and local governments have expressed a growing interest in receiving cost information to assist them in allocating funds designated for higher education among competing institutions. Implicit in this external use of cost information is the assumption that this information coupled with other non-cost information will be useful in evaluating the programmatic activities of institutions of higher education.

NCHEMS COSTING SYSTEMS

Although costing systems, studies and cost information are not new, most recently interest in costing and cost information has surged. The National Commission on the Financing of Postsecondary Education has urged that national costing standards be established. Attempts have been made at establishing costing systems which could be used nationally by all post-secondary institutions. These systems, referred to as the Cost Analysis Manual[6] (CAM) and the Information Exchange Procedures, Cost Study Procedures[7] (IEP), were developed by the National Center for Higher Education Management Systems (NCHEMS) at WICHE. It is reported that CAM/IEP have been used by over 100 institutions at least once with a portion of these institutions using CAM or IEP more than once. Of this group, the number of institutions using this cost information as part of their management processes is not clear at this time.

Recently a number of states, including Colorado and New York, have called for their state institutions to implement CAM/IEP costing procedures. In fact, New York has provided funding as part of its "Bundy Aid" to private institutions of higher education to implement this system on a test basis in selected institutions. Additionally, studies are now being conducted to determine whether different costing systems (other than CAM or IEP) containing another level of cost and related statistical information are necessary to satisfy the needs of state budget officers and other statewide officials to assist them in appropriating funds. These activities indicate the growing interest in obtaining and using cost information for internal management purposes and for various external needs.

COSTING ACTIVITIES BY NACUBO

Because of the growing interest in cost information as a management tool, the National Association of College and University Business Officers (NACUBO) and its Costing Standards Committee decided to focus its attention on costing systems, studies, and cost analyses being proposed for higher education. Because of the attention given to NCHEMS costing systems by the National Commission on the Financing of Postsecondary Education, there was concern about the potential effect such a system might have on individual institutions using this information and on higher education in general. Many asked whether the cost information obtained from this system could (1) assist internal management to analyze the cost of educational activities and to plan for the future, (2) provide information which was valid and representative of the institution when exchanging data and making comparisons, (3) disclose institutional differences. NACUBO recognized the importance of costing and the effect that CAM/IEP might have on higher education in the years to come. As a result, NACUBO decided to conduct an evaluation of the CAM/IEP costing systems. This evaluation was conducted essentially in two phases. First, it was determined that a common body of knowledge, terms and definitions for costing in postsecondary education were not available. Such a body of knowledge was necessary (1) to serve as a basic frame of reference for future costing efforts and (2) to establish the framework upon which CAM/IEP could be evaluated. As a result, in Phase I a document describing cost definitions, methods and approaches, cost analyses, important costing issues and costing standards was prepared to serve as this framework. This "first of a kind" document entitled <u>Fundamental Considerations for Determining Cost in Higher Education</u>[8] was written by the Costing Standards Committee of NACUBO with the assistance of Peat, Marwick, Mitchell & Co.

The second phase concerning an evaluation of the CAM/IEP costing systems was completed and has been presented in draft form to NCHEMS. The evaluation focused on the purposes and uses of CAM/IEP cost information and the costing procedures used to determine cost. A formal response to the findings, conclusions and recommendations of the evaluation was received recently from NCHEMS and is now being reviewed by NACUBO.

NACUBO and its Costing Standards Committee are now undertaking the preparation of another landmark document concerning the use of fixed and variable cost in higher education. Very little has been written regarding the use of this type of costing in higher education and clearly such cost information will be essential in coping with the rapid change facing many institutions in the future. It is expected that this effort will result in a description of how fixed and variable cost is identified and used and will indicate the factors and conditions which cause cost to change.

PURPOSES AND USES OF COST INFORMATION

One of the most important results of the Fundamental Considerations document written by NACUBO was placing into perspective the importance of determining clearly the purpose for which cost information is to be used before actually determining cost. Illustration A, which is taken from the NACUBO document, indicates that the purposes of cost information should be determined first before selecting the appropriate:

- definitions of cost,
- cost objectives and costing units,
- types and classifications of cost,
- relationship of financial accounting and statistical data to costing,
- cost determination methods and approaches, and
- cost analysis,

to be used in the costing process. Too often it is assumed that cost information determined by a single system or study can serve the wide variety of questions being asked by management. Such an assumption is erroneous and the resulting cost information may prove misleading. For instance, questions such as the following all require different costing approaches:

1. What was the full cost (direct and indirect cost) of the history program last year?

2. What is the cost of the history instructional activities as compared to budget at this point in time?

3. What if class size increased or decreased next year or if faculty workload were adjusted - what would be the cost effect?

In the first case, historical cost is used to determine the full cost of a particular activity. The determination of full cost requires that all direct cost be identified and indirect cost be allocated to determine the total cost attributable to the program. In the second case, the cost used is again historical cost. In this instance, the cost determination approach used is different. This cost determination approach involves identifying cost with the organizational unit responsible for the incurrence of the cost. In this type of cost determination, the objective is not to determine full cost but to attribute only that cost which is under the control of a particular organizational unit. Moreover, the attempt here is to compare this cost with some yardstick, such as a budget or standard to identify variances. This cost determination and comparison to budget is typically made periodically and may be performed monthly. The third case pertains to determining the predicted cost of future activities. In this case, historical cost is not relevant except for purposes of reference. What is required is a cost determination method which recognizes the fixed and variable nature of cost to assist in predicting cost behavior.

This distinction among cost approaches and their relationship to purpose is not an academic one. Unless the appropriate cost determination approach is used the cost results, the cost analysis which follows, and the conclusions drawn therefrom can be misleading. Too often we hear of the situation where the average historical unit cost, such as cost per student credit hour, is assumed to also represent projected cost. Substituting average historical unit cost for projected cost may result in erroneous conclusions since future events do not necessarily follow the historical average.

Because the interplay between the purposes for which cost may be used and the costing approach selected is so important to determining valid institutional costs, we have prepared the following examples to illustrate when each costing approach should be used. These examples are taken from a report prepared by Peat, Marwick, Mitchell & Co. for NACUBO as part of the evaluation of the CAM/IEP costing systems.

FULL COSTING AND EVALUATION

"Full costing is defined as the accumulation of all direct and all indirect costs attributed to units of service."[9] Cost information obtained from a full costing approach may be used to assist in evaluating the cost of programs in light of institutional priorities. Historical full cost information assists management in performing an after the fact review of instruction, research, public service and other activities. Such a review involves an analysis of program services provided and results achieved to determine if institutional expectations were accomplished and whether resources were effectively employed in conducting these functions. Analyzing institutional activities and related full cost information permits management to examine programs in light of available resources and thereby establish a revised priority sequence for these activities. As a result, the evaluation process provides guidance in deciding how future program activities are to be conducted and identifies potential needs for reallocation of resources. Such analysis and guidance is a necessary prelude to planning and budgeting.

The role of cost information in performing an evaluation can be illustrated by a situation in which the president of an institution of higher education desires to review how resources were used in conducting institutional programs. The need for such an evaluation may be precipitated by a decline in student enrollment in general and in certain major fields of study in particular as well as a continuing rise in total institutional costs. To accomplish the evaluation, the president obtains the historical full cost of programs for each of the past three years. Accompanying the cost information are certain statistical data, such as student credit hours, number of students enrolled and degrees granted which may be used to determine the cost per unit of service provided by program.

Of the programs being evaluated, the president has identified three in particular which warrant close analysis. These are history, English and biology. Illustration B depicts the cost per student credit hour trend line experienced by the institution over the past three years. History and English cost per unit have increased slightly with the more pronounced rise of the two experienced during 1975 in the history program. Biology on the other hand has had a dramatic rise in cost per student credit hour. The concern of the president in conducting the evaluation is (1) to identify those causative factors which affected the cost of these programs and (2) to determine how each program has supported the achievement of institutional goals and objectives. Based on this information, it is the president's intention to identify program priorities and various alternatives which should be considered when planning and budgeting future institutional activities.

The evaluation process commences by examining the full cost of programs and the components of cost. In each case attention would be directed to uncovering why the cost per unit of service had increased, decreased or remained constant. The factors governing the cost results may relate to specific policies established by a department, school or university as well as changes in student demand for educational services. Identifying how these factors have changed from year to year can assist in explaining the relative differences in cost per unit of service. For instance, in our example the evaluation process might indicate that the English program experienced a slight increase in cost per student credit hour because the number of English majors has increased modestly while faculty and other expenditures have increased by a greater proportion. As a result, the average cost per credit hour of an English major has gone from $70 in 1973 to $75 per student credit hour in 1975. In examining the history program, a different phenomenon has occurred. Although enrollment and expenditures have increased by a similar amount as in the English program, it was apparent that there was a proportionately greater increase in cost per unit in history (from $65 in 1973 to $74 in 1975). After some analysis, it may be determined that the cost of the history program has increased because certain departmental educational policy changes were initiated during 1975. The most important of these might involve the elimination of some seminar courses and the reduction of class size for upper division sections. The biology program on the other hand presents a different problem to the institution. The cost of this program has risen dramatically over the past three years. This condition has been caused by a significant decrease in the number of students majoring in biology. The cost per student credit hour for this program has been mitigated somewhat by institutional policy actions which have reduced the number of non-tenured faculty in the biology department. Such policy options no longer appear available for this program.

Based on the results of this evaluation of historical full cost data as well as the analysis of other information relative to educational policy and the priority attributed to each program, the president identifies a number of alternatives which should be considered. For the history program, this might include reinstating seminar courses and increasing class size to reduce cost per credit hour. For English, consideration might be given to initiating curriculum changes to improve quality while still maintaining a constant cost per credit hour. For the biology program, it may be determined that a number of alternatives should be considered. For instance, it may be appropriate to consider eliminating biology as a major or affiliating with another institution to share instructional capabilities and cost.

Although these and other alternatives may come to light as a result of the evaluative process, historical full cost <u>cannot be used</u> as the means of determining the potential future cost consequences of one alternative over another. For instance, the cost of the English program cannot be assumed to remain at $75 per credit hour in 1976 because of changes which may be made in policy relative to proposed potential curriculum modifications and changes in other variables - all of which may have a distinct effect on increasing or decreasing the cost per student credit hour. A similar situation exists for the biology program. In this instance, the alternative to eliminate the biology major program does not mean that the institution can expect a reduction in cost in 1976 of $100 per student credit hour. Such an assumption would be far from reality. If all biology faculty and related cost could be eliminated (which may not be feasible in the short-run) fixed costs allocated to the biology program from other departments servicing biology students as well as support costs would remain. Such costs must be incurred if ongoing programs are to continue.

The example described indicates that historical full cost is useful for evaluating past performance but is significantly less useful in determining the projected cost of future activities of an institution. To put it another way, historical full cost is useful for purposes of evaluation but cannot act as a substitute for determining projected costs.

FULL COSTING AND PRICING

Full cost information is also useful in examining "prices" of services rendered by the institution in relation to the cost of such services. With this information, management can determine the effect of historical pricing strategies for tuition, fees, contracts, and grants and identifying a need for adjustments in prices. Furthermore, such information assists in justifying governmental appropriations. Analysis of full cost and related revenue provides necessary information to management when considering future price adjustments. Again, such historical cost information is important but must be tempered by changing future conditions affecting cost.

The use of full cost information can be illustrated by the case of an institution that wishes to examine the validity of current tuition and fees charges for instructional services provided to students. To conduct this examination, it is necessary to determine the cost incurred and revenue received for units of service. Illustration C presents a situation which indicates the average cost incurred and revenue received from students over the past 3 years. Based on the full cost determination, it is apparent that the institution has experienced dramatic increases in cost per student while revenues have remained relatively constant.

In this case, the determination of the historical full cost as compared to revenue indicates that the institution should further investigate this situation to determine the appropriate action which may be required. As a result, it may be decided that a more detailed examination is required. In this instance, it may be necessary to identify those factors which caused the cost per student to rise so rapidly and to reexamine the rationale followed when establishing tuition and fees during these years. Based on this examination, it may be determined that student enrollment has decreased because students have selected program alternatives at other institutions. As a result, the number of students paying tuition and fees has decreased without a proportionate reduction in cost. Added to this may be the discovery that maintenance and cleaning costs have continued to increase because of the high standards followed by the institution. Furthermore, it may be determined that the policy restricting the number of tutorials was relaxed in 1974 to provide students with greater programmatic flexibility. It was apparent, therefore, that a combination of these factors caused the cost per student to increase rapidly.

During this period, the institution did not significantly increase student tuition and fees. Such a possibility along with initiating various cost controls are options which may be considered by the institution. For instance, the president may propose (1) initiating a campaign to attract a greater proportion of students to the institution, (2) reducing maintenance and cleaning costs, and (3) restricting tutorials.

In summary, examining the historical full cost and related revenue per student serves to assist in uncovering specific areas where prices may require adjustment. Additionally, the examination of full cost and the components of cost indicate where opportunities to reduce cost may be available. Historical full cost as illustrated can provide the cost information necessary to perform this examination. More importantly, historical full cost information is significantly less useful when attempting to determine the projected cost consequences of different options which may be available in the future. As was the case in evaluation, projected costs of future activities must be determined based on changes in policy and other variables affecting cost. Thus, the historical full cost per student of $2,750 in 1975 might be expected to change in 1976 in concert with changes in those variables affecting cost.

FIXED AND VARIABLE COSTING FOR PLANNING AND BUDGETING

As we have mentioned earlier, historical full cost information is of limited value when preparing plans and budgets. In many cases, reliance on historical cost alone can result in erroneous projections of cost. Historical full cost information is not necessarily representative of future costs because cost variations resulting from changing conditions do not follow the average. Often future costs will be different from historical costs as the number of units of service provided increases or decreases or as policies are changed. As a result, recognition must be given to the impact of changing conditions on cost when preparing plans and budgets. In costing these conditions are considered in order to classify costs into their fixed, variable and semi-variable components.

The importance of identifying costs as fixed or variable when planning and budgeting can be explained by using the example of the history program described earlier. In Illustration B, the average full cost per student credit hour increased from $65 in 1973 to $67 in 1974 and again to $74 in 1975 based on the relative number of credit hours earned by history majors of 2,800, 2,600 and 2,200 respectively.

In planning and budgeting for the future it would be erroneous to assume that if student credit hours in 1976 were expected to decline to 1,800 that average cost would remain at $74 per student credit hour with total program cost being reduced by $30,600 (400 student credit hours x $74 per credit). Such a condition is depicted on Illustration D-1 by line A which represents the full cost at $74 per student credit hour. The false assumption here is that all program costs are variable and will change proportionately to the number of student credit hours. This is not the case typically in institutions of higher education.

Rather than assuming that all costs are variable and will decline by $30,600, one might make a different false assumption that full costs will be entirely fixed and thereby remain constant regardless of changes in the number of student credit hours. This supposition appears on Illustration D-2 as line B and indicates that the average costs per student credit hour rise rapidly as the number of credit hours declines.

Obviously, neither of these conditions is realistic in most cases. Often certain costs are variable and may be increased or decreased proportionately as student credit hours increase or decrease or as instructional policies affecting cost are changed. Other costs, however, remain fixed regardless of the number of student credit hours or become semi-variable. Fixed, variable and semi-variable costs can often simultaneously affect the cost of a program. For instance, fixed cost in the history program for 1976 may be $140,000 in the short-run because of existing commitments relative to tenured faculty, non-tenured faculty having contracts and other commitments made previously. This fixed cost is depicted on Illustration D-3 as line C. Variable cost for 1976 may only be $20,000 of which $10,000, representing overload and part-time faculty cost, can be eliminated at a volume of 1,800 student credit hours. As a result, the projected full cost is shown on Illustration D-4 as line D with average full cost per credit hour determined at $83.30.

As can be seen, full historical cost which is representative of line A in the illustration cannot be used to determine the projected future cost of programs. In many cases, reliance on historical cost alone can result in erroneous projections of cost. Historical full cost is not necessarily representative of future costs because cost variations resulting from changing conditions do not follow the average. As a result, projected cost must be determined by identifying fixed, variable and semi-variable cost.

STANDARD COSTING AND CONTROL

Standard costing is an approach which uses predetermined cost referred to earlier as "standard costs" which are compared to actual historical costs to determine variances. Such comparisons are made periodically, often monthly, to measure the operating performance of the individual responsible for incurring the cost. The resulting variances identify areas requiring further analysis and action by management.

Cost information obtained from a standard costing system may be used to assist in controlling the cost of institutional activities. In higher education, standard costing has been used most often in operation and maintenance of plant activities. Standard costing for purposes of control may be illustrated by the case of an institution having separate plant maintenance departments for carpenters, painters and plumbers. Typically, these activities represent a signficant cost in relation to the total operation cost of the institution. For this reason, they require careful monitoring and control to identify variances early.

The carpentry department in our example works on a number of jobs ranging from special cabinets for research projects to renovating existing institutional facilities. On Illustration E, the budget and actual cost for a single renovation project referred to as "job A" are compared. At the beginning of the year, the plant maintenance department established a predetermined hourly rate for work to be performed during the next year. This rate was based on the projected number of hours of work for the year as compared to the annual budget of salary and fringe benefits. As jobs were submitted, such as job A in our illustration, the budget cost was developed by multiplying the number of hours expected to complete the job by the predetermined hourly rate. This is how the budget for job A was developed, i.e., \$3.00 x 1,000 hours = \$3,000.

Actual cost displayed to the right of the budget is based on the actual rate paid and hours worked on job A. In this case, the number of actual hours required to complete the job on schedule was 2,000 hours. At an actual rate of \$4.00 per hour the total project cost was \$8,000. The variance from budget to complete the job on schedule was 1,000 hours which was accomplished by working overtime. The dollar variance on this project was \$5,000. When analyzed, this variance may be explained as being caused by the following two factors:

1. A rate variance of \$2,000 resulting from payment of an additional \$1.00 per hour for 2,000 hours of work, and

2. An efficiency variance of \$3,000 resulting from 1,000 additional hours at the budgeted rate of \$3.00 per hour.

Standard costing and the variances from actual historical cost which are identified by this costing approach are useful for measuring performance and controlling cost. By periodically scrutinizing variances as jobs progress, management can identify those jobs which are being completed above or below standard. With this information, management can select the appropriate action required to reduce future project cost.

SUMMARY

In summary, before developing a system for determining cost, it is necessary to identify the purpose for which cost information is to be used. Once the purpose for costing is clearly established the appropriate cost determination method may be selected. Four purposes for using cost information and the appropriate costing approach which may be used to satisfy these purposes are as follows:

1. to evaluate the historical cost of programs use the full costing approach,
2. to examine prices of services rendered in the past use the full costing approach,
3. to determine projected cost for planning and budgeting use the fixed and variable costing approach,
4. to control the cost of processes or projects use the standard costing approach.

Each of these approaches will result in different determinations of cost designed to satisfy the different needs of the institution. The inappropriate use of one approach to serve another purpose may result in an erroneous cost determination and improper management action.

BOOKS

[1]The Carnegie Foundation for the Advancement of Teaching, More than Survival, Prospects for Higher Education in a Period of Uncertainty, Jossey-Bass, Inc., 1975, pages 25 & 26.

[2]Ibid, More than Survival, p. 31.

[3]National Association of College and University Business Officers, Fundamental Considerations for Determining Cost Information in Higher Education, Part 4, Chapter 5, p. 3.

[4]The Sloan Study Consortium, Paying for College, Financing Education at Nine Private Institutions, 1974

[5]The National Committee on Standard Reports for Institutions of Higher Education, Financial Reports for Colleges and Universities, The University of Chicago Press, 1935, Appendix A.

[6]James R. Topping, Cost Analysis Manual, Field Review Edition, Technical Report No. 45, National Center for Higher Education Management Systems at Western Interstate Commission for Higher Education, Boulder, Colorado, 1974.

[7]Richard S. Johnson and Robert A. Huff, Information Exchange Procedures, Cost Study Procedures Manual, Technical Report 65, National Center for Higher Education Management Systems at the Western Interstate Commission for Higher Education, Boulder, Colorado, January 1975.

[8]Ibid, NACUBO

[9]Ibid, NACUBO, p. 8

Illustration A

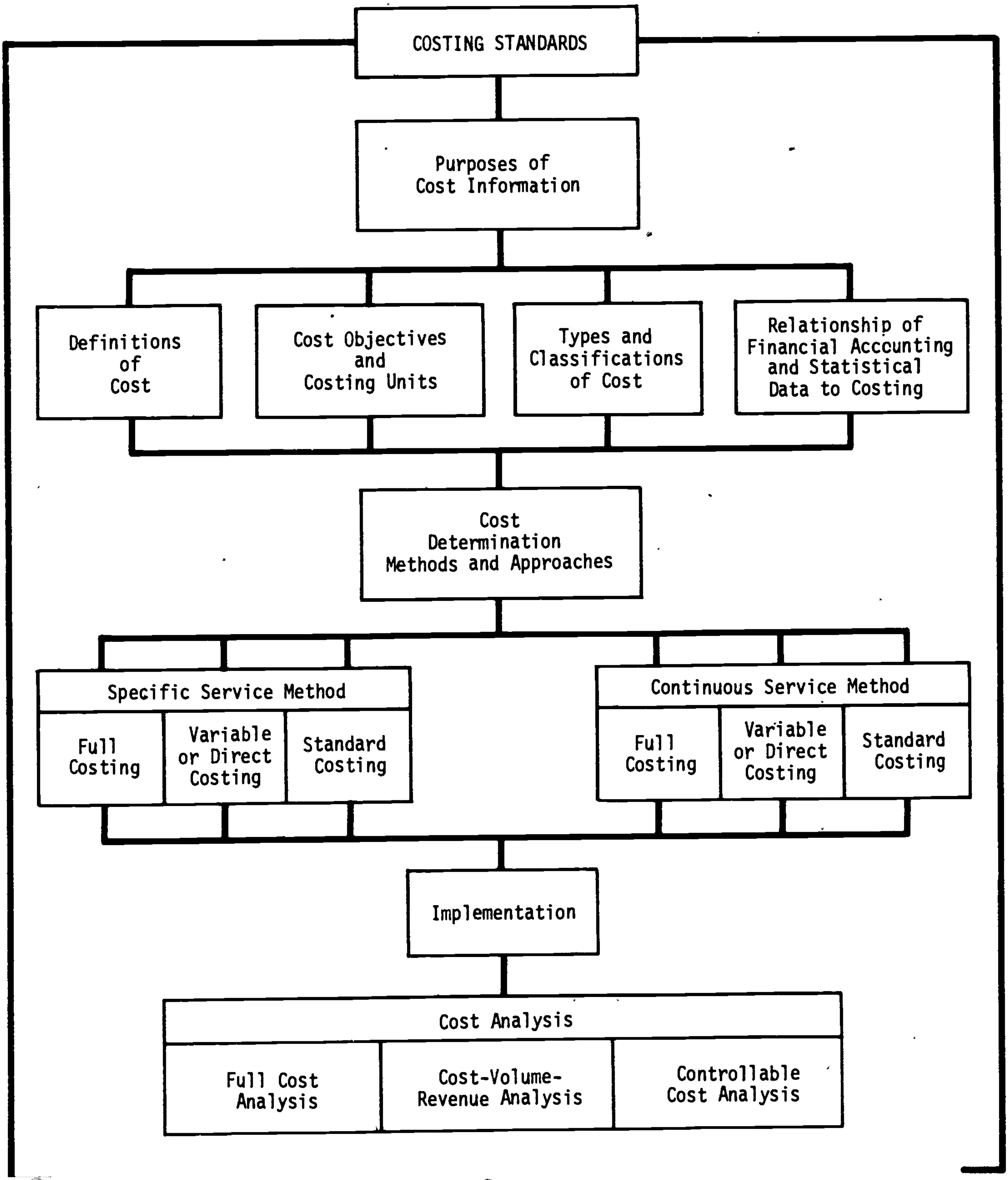


Illustration B

HI-ED UNIVERSITY

FULL COST PER STUDENT
TREND FOR THREE YEARS

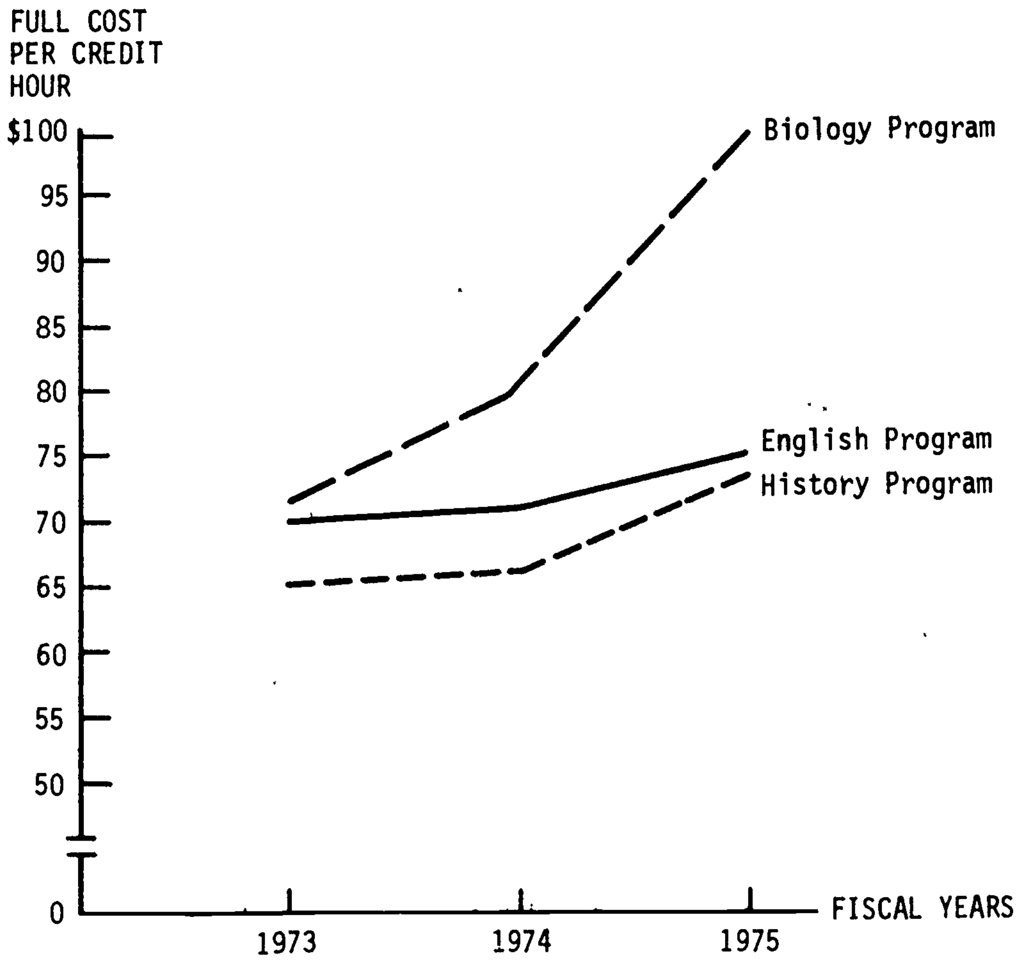


Illustration C

HI-ED UNIVERSITY

INSTRUCTIONAL COST AND REVENUE

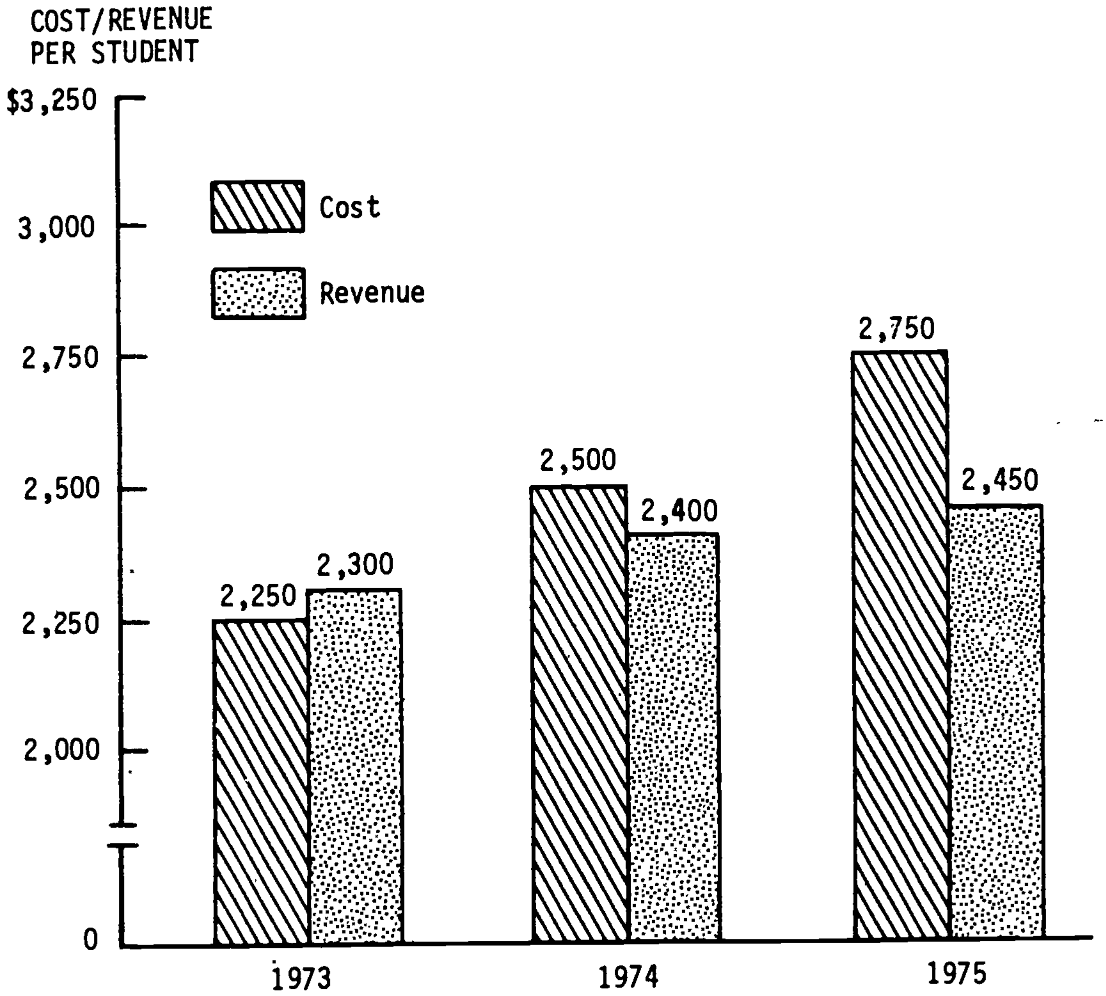


Illustration D-1

HI-ED UNIVERSITY

HISTORY PROGRAM COSTS
PROJECTED 1976 AVERAGE FULL COST
PER STUDENT CREDIT HOUR

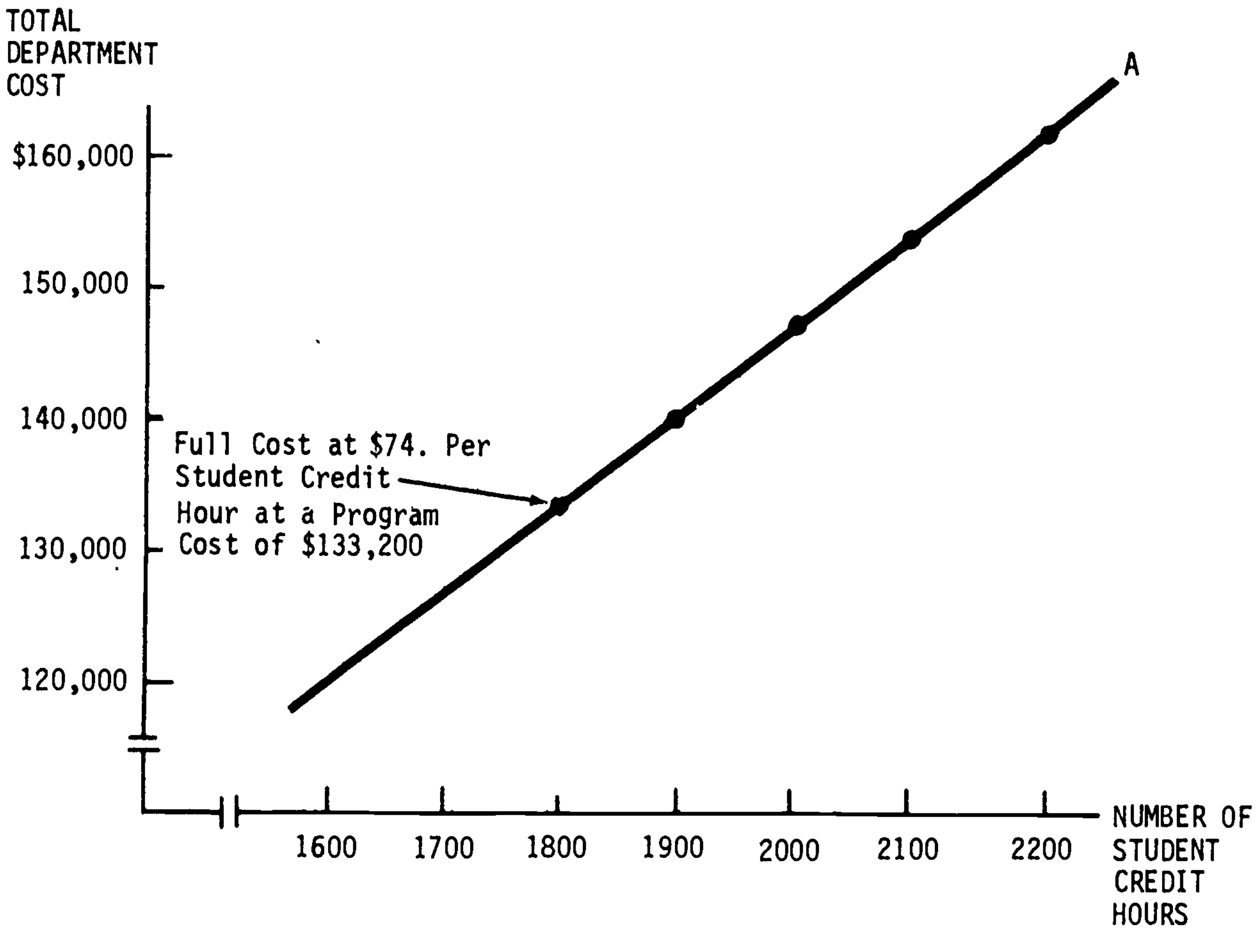


Illustration D-2

HI-ED UNIVERSITY

HISTORY PROGRAM COSTS

PROJECTED 1976 AVERAGE FULL COST
PER STUDENT CREDIT HOUR

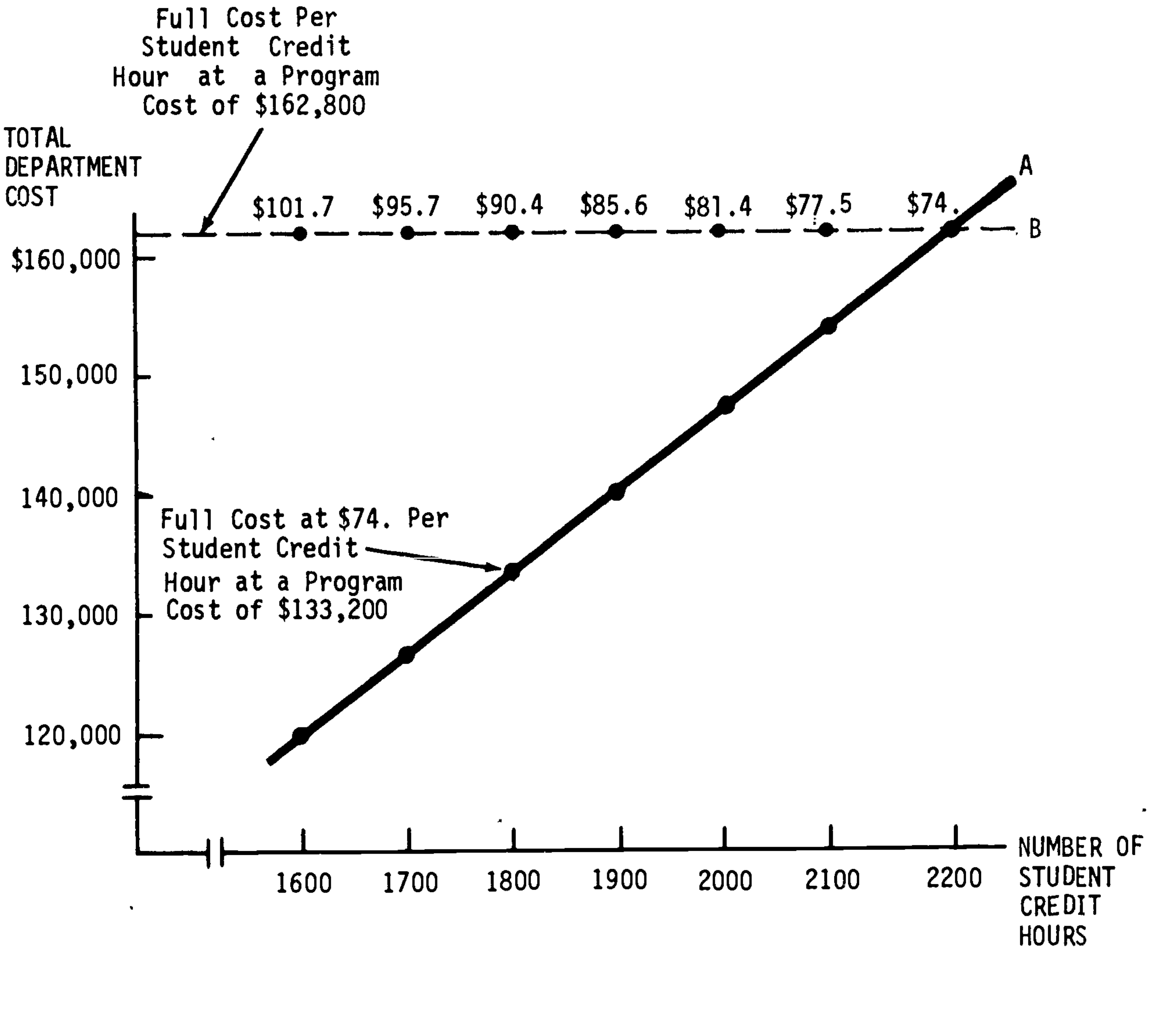


Illustration D-3

HI-ED UNIVERSITY

HISTORY PROGRAM COSTS

PROJECTED 1976 AVERAGE FULL COST
PER STUDENT CREDIT HOUR

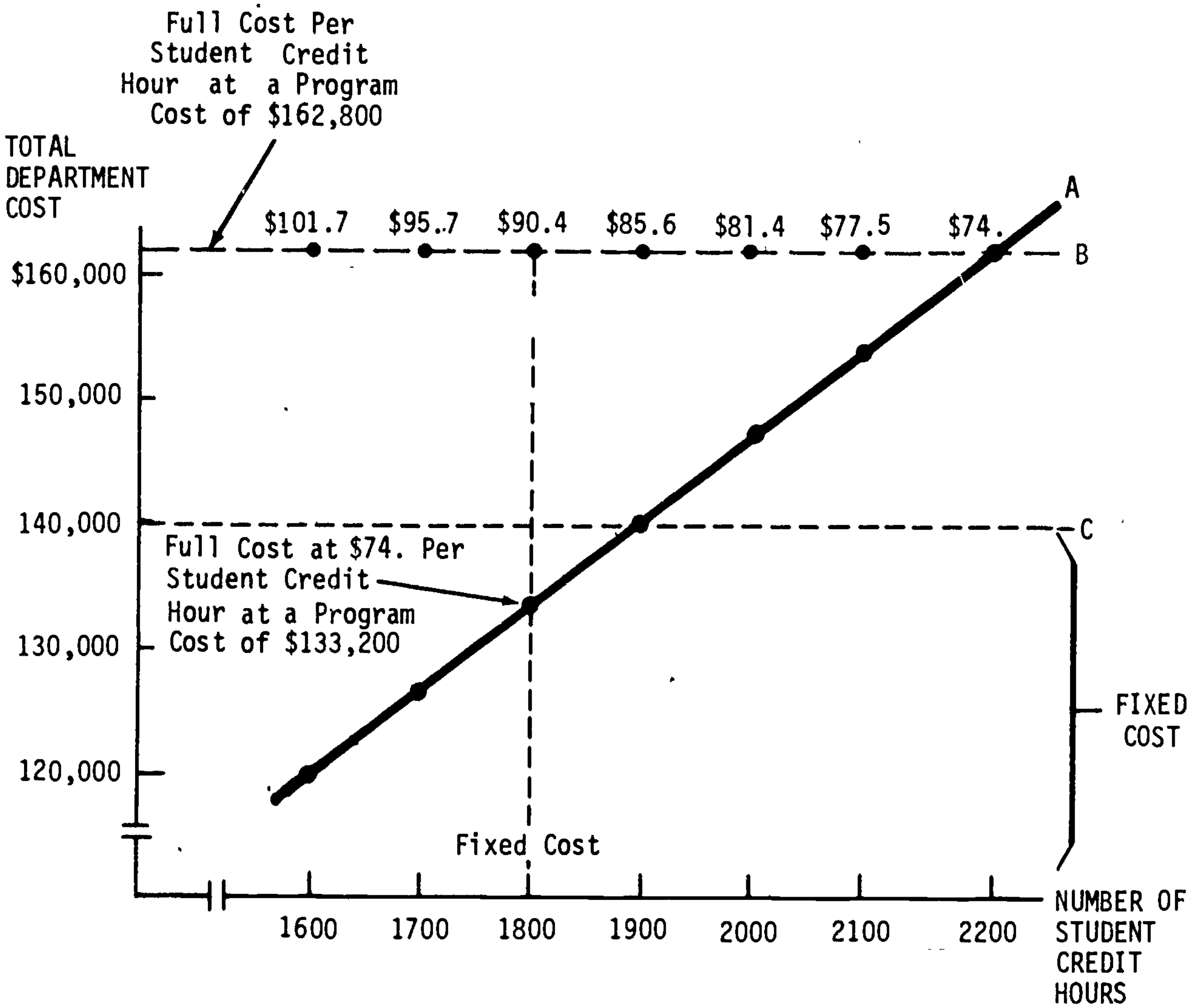


Illustration D-4

HI-ED UNIVERSITY

HISTORY PROGRAM COSTS

PROJECTED 1976 AVERAGE FULL COST
PER STUDENT CREDIT HOUR

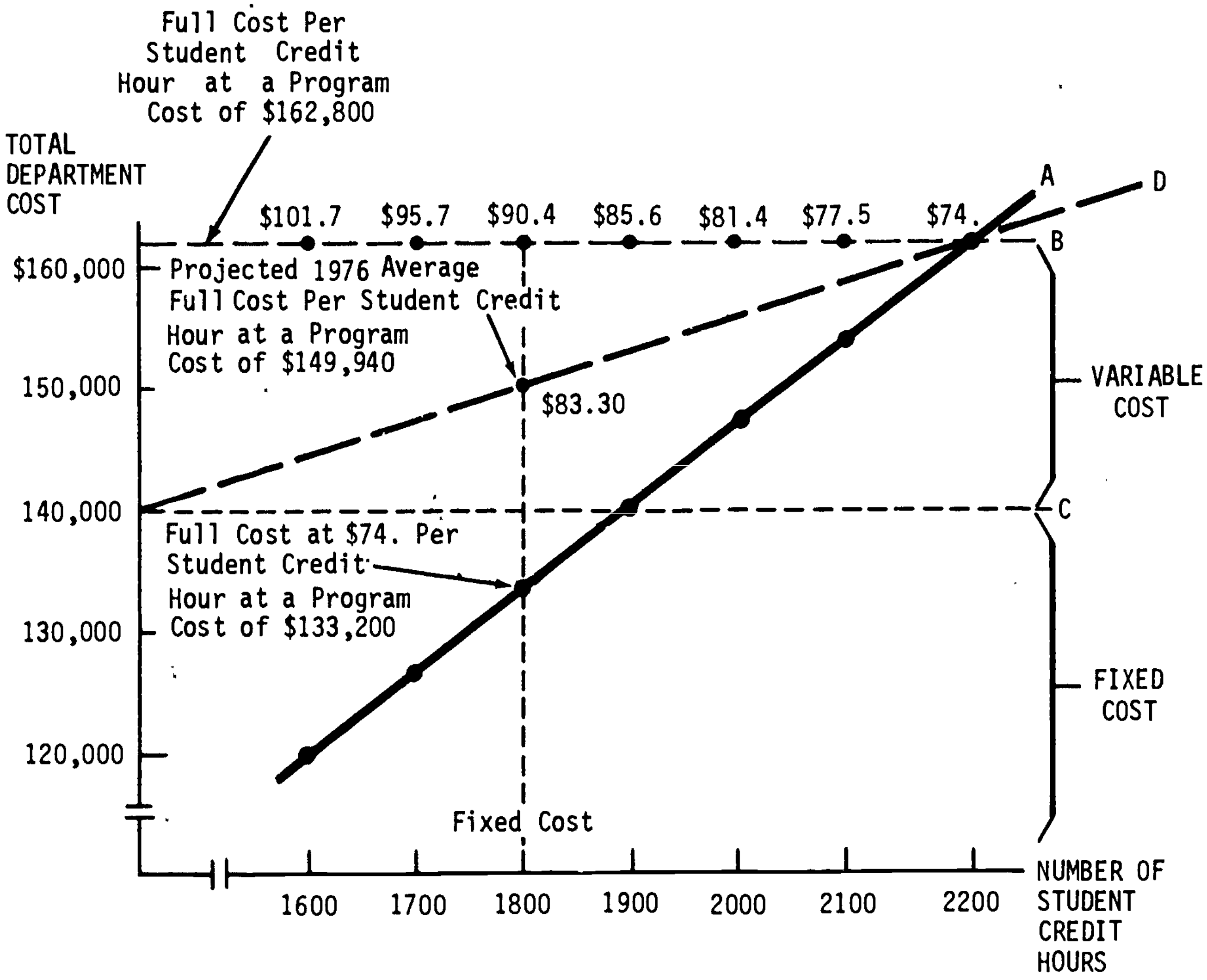
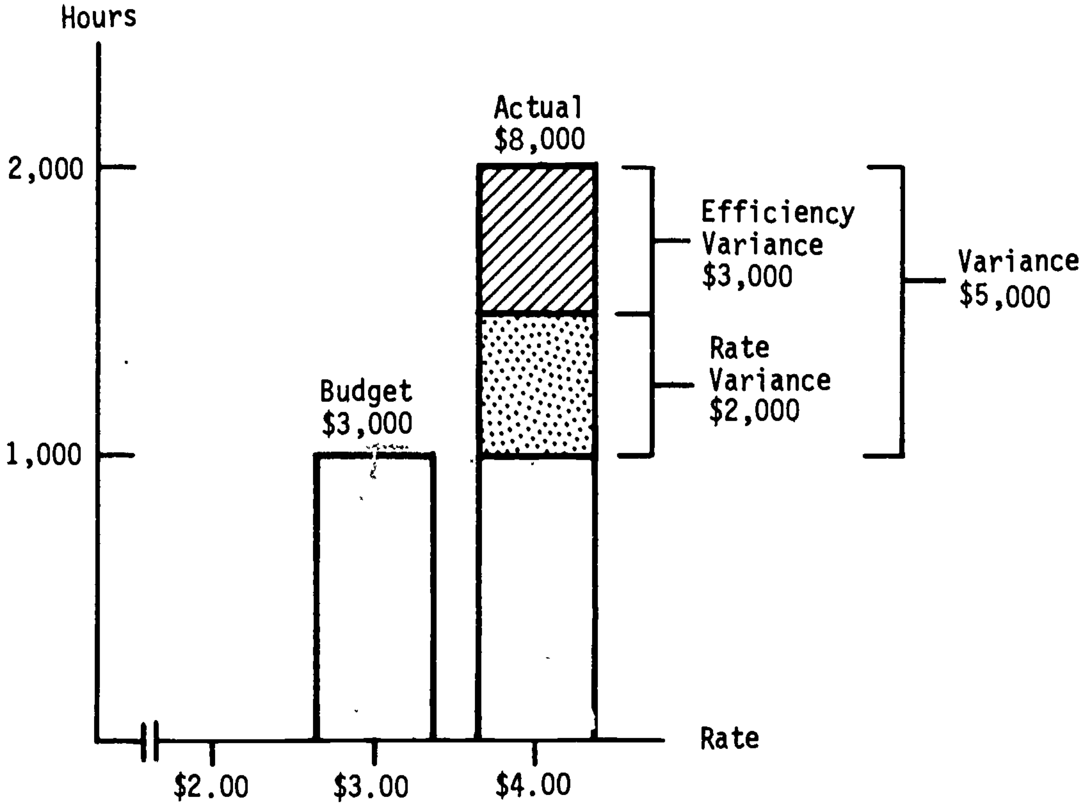


Illustration E

HI-ED UNIVERSITY
STANDARD COSTING FOR
JOB A



TRACK II
TECHNICAL PRESENTATIONS

Martha Fields

James McGovern

William Childers

Coordinator: Martha Fields
State University System of Florida

STATEWIDE SERVICE ANALYSIS FOR DATA BASE SYSTEMS

James J. McGovern
Director
Information Systems
Connecticut Commission for Higher Education

The State of Connecticut for the past year has been analyzing its informational needs among its 20 public colleges. The final results have been accumulated and analyzed in terms of the data elements, the time requirements for response, availability, and the differences between the two-year, four-year, and university schools. The specifications for a Request for Proposals have been developed and presently vendors are responding.

In this paper, the intention is to summarize the results in such a way that they can provide guidance to state coordinating boards and large universities in similarly deciding on a data base management system. The methodology is also presented, since it is probably as important as the summary of findings.

Introduction

There is a story of a famous mathematician named Smith who, at a meeting like this, proposed a toast: "To pure mathematics, may it never be of use to anyone." More recently, Jacob Bronowski, the author of The Ascent To Man, said "There is nothing so practical as good theory." This paper follows the latter philosophy and will compare some analysis theories for data base management syetems.

Presently, there is not only a significant amount of program duplication but there also appears to be increasing amounts of planning and analysis duplication. For example, several states and large universities are producing planning studies for information systems. It is not clear that states and universities are aware of previous studies. Indeed, consultants and vendors may find advantage in providing this "service" of developing an information system plan.

Unsolicited responses from several states have shown the use of a process-organization matrix which should only be necessary to discover two or three times.[1,2,3] Similarly a process diagram showing the inter-relationship between data, information systems and organizations is fine to include in a planning document but it should not be viewed as a great discovery nor as overly helpful. In other words, it is time that we moved beyond the statements of generalized planning and moved into the analysis of data needs and the development of phase plans.[4,5,6,7] In short, data base management systems are a large undertaking and resources should not be squandered in doing things in one state which have been done in another. Our studies in Connecticut indicate a great similarity among institutional data needs and data access requirements. Thus, we can learn from other studies provided we are honest enough to share information and humble enough to realize our procedures should always be improved.[8]

In Connecticut, we wrote an Information Systems Plan about three years ago and have found most of it useless. A business planning system was used by vendor-consultants to structure our needs but our new knowledge with data base management systems has since displayed the previous organizational schemes to be interesting but not directly useable.[9]

For instance, a data base management system needs to know not only data needs but also the timing and volume statistics associated with each element. It would seem likely that no state or university can afford to interview administrators on successive rounds: once to determine data needs; next, to determine timings and thirdly, to determine volumes. In short, the operation of a data base management system should be understood before even general plans and procedures are undertaken.

The next section will quickly analyze some of the usual systems analysis procedures and show why they are inadequate (individually).

Systems Analysis

The Study Organization Plan (SOP) gathers information about the present organization; specifies systems requirements and immediately moves to determine the equipment configurations necessary. This procedure is much like a "truism" which says everything but too generally.[10]

The Application Customizer Service (ACS) has the user complete a questionnaire for each application and shows the processing methods he required from among those presented. This is good for moving quickly into the design phase and forces the user to think in terms of computer processing.[11]

The Business Planning System (BPS) moves away from the hardware concerns (too much so) and suggests that the user concern himself only with the general processes: to cut across organizational lines. This is fine but doesn't help much with the practical problems of program conversion and hardware constraints.

The Time Automated Grid (TAG) requires information on not only data elements but also on their volume, frequencies of use, and priority. Based on these output requirements, TAG produces a report indicating both the outputs and their necessary inputs and further produces the file format and data-flow descriptions. This procedure is, of course, the most detailed of those mentioned but what is missing is verification by having the results assessed by several similar users. The latter process will require further procedures and will be discussed later.[12]

The point in mentioning some of the available procedures for systems analysis is that they are not conflicting but rather that they emphasize different aspects of the system. Interestingly, they echo some aspects of management schools of thought: scientific management, functionalism, human relations, behavioralism and management science. Actually, an analysis of the management "schools" extend our analyses to the various dimensions involved when a group of people join in producing some product or service. Systems analysis is actually an analysis of this fundamental system called management.

The Scientific Management of Frederic Taylor analyzed tasks to determine their basic elements so that these tasks might be reassembled in a more efficient way.[13]

The functionalism of Henri Fayol determined the basic functions that "should" be a part of management: planning, organizing, directing and controlling.[14]

The human relations school of Mary Parker Follett, and more recently of Simon and McGregor, stated that organizational structure is fundamentally a matter of people and determining their needs in making the organization work.[15]

The behavioral approach of Chester Barnard viewed the organization as a social system containing such activities as communication, reward and decision making.[16]

Lastly, the management science school emphasizes decision making as the unifying theme and uses models or constructs to identify the significant variables in an organization.[17]

All of these are presently being collected together in what is called systems management.[18] We might say then that the individual schools of management describe different dimensions of reality. This is reminiscent of one of the contributions of Aristotle when he showed that previous philosophers did not contradict each other but rather were speaking of different aspects or types of causes: final (Plato), formal (Pythagoras), material (Thales), and efficient (Heracletus).[19] It is interesting to note that the management science school seems to project final causes on management activities by its focus on objectives; scientific management concentrates on the components or "materials"; functionalism indicates formal or organizational causality; while human relations and behavioralism are concerned with the users or the efficient causes.

Hopefully, an understanding of the "dimensions" of management will allow us to construct a valid and sufficient systems analysis procedure.

The recent synthesis of the schools of management into systems management is based on the following five interlocking proposition:[20]

1. Activity occurs in interrelated systems.
2. Each system of action is coordinated internally and externally with supra-systems.
3. Managers are the coordinators of systems.
4. All managers perform the same basic systems coordination functions.
5. The mix of systems coordination functions varies according to the level and responsibilities of managers.

If this theory is true, it holds profound significance for analysis. It tells us (1) that we should expect an overlap in responsibilities and data usage; (2) that there are subsets of data; (3) managers need data from "other" systems; (4) there is transferability from one college's service analysis to another and (5) that the mix of data or the type (and by implication, the timings) of data vary with management level. Specific to the last point, one author showed that data about the external environment increases with level while the need for data about the internal environment decreases with level.[21] This suggests that top-level interviews are not enough and that interviews at all levels are necessary (and most especially necessary) at the lower levels.

The Delphi Method, consisting of a series of questionnaires and feedback of responses, can be structured in the format of a systems analysis (successively addressing objectives, constraints, tradeoffs, and priorities).[22] The Delphi approach to systems analysis is worthy of closer inspection as it provides some good theoretical reasons[23] for determining a statistical result (response from a large group) in any written or interview approach to systems analysis.

Delphi Method of Systems Analysis

Systems analysis usually starts with the desired output and then works back to obtain the necessary inputs. In higher educational information systems, the outputs are administrative systems and we must work back through the information needed for analysis to the data or measurements which are needed as inputs. (See Figure 1.) Thereby, the usual steps of systems analysis are varied somewhat to include the users or behavioral dimension. (See Figure 2.) A further advantage of this statistical approach is that it combines the principles of systems analysis (theoretical) and decision analysis (practical). Decision analysis is used to indicate the flexibility and uncertainty associated with the results. The resulting statistics can be used to determine the consequences, confidences, risks, reliabilities and "validity" of the results.[24]

By way of clarification, it is important to realize that unknowingly doing the same analysis in several states is not what is meant by the statistical approach to systems analysis. What is needed is communication so that studies may be done in a comparable way. Further, even within state, it is not simply a matter of obtaining large numbers to assure "validity." Norman Dalkey of the RAND Corporation contends that "group value judgments depend in part upon the degree to which it is considered that the group is judging something rather than simply reporting personal attitudes."[25] Dalkey gives three criteria for assuming that group judgment is involved:[26]

> (1) Reasonable distributions:
> If the distributions of group responses on a given numerical value judgment is flat, indicating group indifference, or if it is U-shaped, indicating either that the question is being interpreted differently by two groups, or actual differences of assessment...then it seems inappropriate to assert that the group considered as a unit has a judgment on that question.
>
> (2) Group reliability:
> Given two similar groups... the group judgments on a given value question should be similar. Over a set of such value judgments, the correlation for the two subgroups should be high.
>
> (3) Change, and convergence on iteration with feedback:
> This condition is proposed in part by analogy with results from experiments with factual material, that is, shifts of individual responses toward the group response.... More generally, if members of the group do not utilize the information in reports of the group response on earlier rounds when generating responses on later rounds, it seems inappropriate to consider these responses as judgments.

The written questionnaire approach is usually viewed as more difficult than the interview approach to a Delphi-type analysis but results differ. The written form may be easily analyzed by statistical tests of significance to determine reliability and apparent validity.[27] See last paragraph.[28] The interview technique was found to be limited in assessing the quantitative components of management but better in "seeing" some of the functional and behavioral aspects. Therefore, both techniques, written questionnaires and interviewing seem to be appropriate; it is a matter of selecting the method to fit the dimension under analysis. For instance, upper-level management might be interviewed while lower level operators are questioned by means of a questionnaire and limited interviewing. A detailed analysis has been published elsewhere.[29]

We should also be aware of what appears to be an Uncertainty Principle. That is, there seems to be a limit on the amount of generalization and precision that can be expected in consensus results. Reliable generalizations appear to be limited by the individual differences uncovered. In other words, we can not optimize both generalizations and accuracy simultaneously.[30]

Data Base Data Analysis

Now we are in a position to appreciate "what" should be analyzed in preparing for a data base management system. The direct answer is that we need the data needs of several sets of people. Thus, to return to Figure 1 and Figure 2 again, we can use the expertise of the users themselves to have them analyze their own systems and only tell us their data needs. Notice that this approach is a combination of SOP, TAG...and several other systems analysis methods. Two further items that the users must give for each data element is the frequency of use (e.g., once per year) and the turnaround time of use (e.g., 24 hours). The method proposed by Leo Cohen, a national expert in data base management systems, is that the user first identify the services needed (e.g., dean's list of students) and then indicate its frequency and turnaround times as well as its list of necessary data elements. Consequently, Cohen calls such a study a service analysis and maintains that a detailed systems analysis can be done for each application program later. The important point is that a service analysis will give the data elements, volumes (upon adding frequencies, etc.) and timings necessary to select and begin the design of a data base management system. The results of such a service analysis is contained in the Appendix. A further description of the procedures of the service analysis has been given in an accompanying paper, "Data, Response Time and Frequency of Use," which will be published in the 1975 Forum of the Association of Institutional Research.

Specifications for a Data Base Management System

The specifications for a data base management system (DBMS) obtained from the statewide service analysis in Connecticut has been included in the Appendix. The total document, containing another 100 pages of summary information is available through the CAUSE library. Indeed, several other similar documents are available through the CAUSE systems exchange service.

The enclosed specifications are not intended to serve as a final model but only to indicate what one of our consulting companies believes are the dimensions to be analyzed and reported. Data Base Management Inc. (DBMI) has helped implement data base management systems (Total, IMS, etc.) at Aetna, Travelers Insurance Companies, United Technologies, H.E.W., etc. and hence has the total picture of analysis, design and operation. Nevertheless, we have already spotted some needed corrections and candidly state that a major purpose of distributing this paper is to invite comments and changes.

As an aid in reading the specifications, an overview will be given:

Each of the data base areas are described in terms of:

1. General Information
2. Volume and Size
3. Data Element Groups
4. Dependent Data Element Groups
5. Data Base Access
6. Cross Reference Requirements
7. Major Processing Requirements

DBMI DATA BASE MANAGEMENT, INC.
SYSTEMS AND PROGRAMMING SERVICES

VERNON PROFESSIONAL BUILDING
VERNON CIRCLE
VERNON CONNECTICUT 06066
(203) 646 3264

TO: J. J. McGovern, Director of Information Systems, CHE

FROM: M. L. Reiser, Data Base Management, Inc.

DATE: June 25, 1975

RE: Specifications for a Data Base Management System

Attached are the general and detailed specifications for the Data Base Management System (DBMS) that should be procured in order to support the Higher Education Information System (I/S). The DBMS specifications and I/S requirements have been organized in such a fashion so that they might readily be incorporated within a Request for Proposal (RFP). The RFP should be distributed to prospective DBMS vendors in order to solicit proposals and pricing information for DBMS software which might serve to support the I/S data base system.

SECTION I

EVALUATION CONSIDERATIONS

1.0 Introduction

The Commission for Higher Education will evaluate and validate offerors' proposals. Those proposals which do not meet the requirements of the enclosed specifications will be deemed non-responsive and will not be considered for selection. Proposals will be technically rated using the general criteria listed below, which is further described in Section III.

a. DBMS capability, expandability and reliability
b. Vendor support as related to systems documentation, maintenance, implementation, technical support, training and probability of expanding product line.
c. DBMS complexity, skill level requirements, data base administration requirements and configuration compatability.
d. Availability of the DBMS as it relates to the I/S' implementation schedule.
e. DBMS demonstration (if required).

Proposals will also be evaluated based on these costs:

a. purchase or lease costs
b. staffing costs
c. training and education costs
d. maintenance and upgrade costs
e. technical support costs
f. implementation and conversion costs

The Commission's intent is to obtain true costs for development, implementation, maintenance and operation of the proposed DBMS. Although the DBMS to be procured as a result of this RFP will be made operational at the University of Connecticut's Computer Center (Storrs, Connecticut), the DBMS may be suited to the needs of other state agencies and, therefore, may also be installed at State Data Processing (Hartford, Connecticut). Therefore, charges should be stated as follows:

a. single CPU

b. Multiple CPU's within a single data center

c. Multiple CPU's within multiple data centers

The function of the DBMS will be to support the data base information System (I/S) proposed by the Connecticut Commission for Higher Education (CHE). The I/S will serve CHE's four constituent units, i.e., the University of Connecticut, state colleges, regional community colleges and the state technical colleges, and will be centrally operated at the University of Connecticut's Computer Center. In addition to the economies of supporting one data center rather than twenty-one (21) individual campus installations, the I/S should promote resource sharing, the minimizing of redundant/duplicate applications development and the providing of integrated information which would allow for valid comparisons between schools and constituent units. Communications with the central site will be via dedicated point to point facilities such as RJE terminals. In addition, in order to facilitate online data base processing, interactive communications will also be provided utilizing both typewriter and CRT terminals.The implementation of the I/S is a direct and necessary supporting service to the Master Plan for Higher Education in Connecticut.

SECTION II

GENERAL SPECIFICATIONS

1.0 Introduction

The requirements and specifications included in this section identify the constraints and desired DBMS capabilities which prospective suppliers must satisfy in order to be considered responsive to this Request for Proposal. Owing to budgetary constraints and the constraints of the existing data processing environment, the Commission will consider a phased plan for achieving the objectives of this RFP.

1.1 Operating Environment

The I/S must be able to accommodate extremely large production volumes in the areas of admissions, registration, accounting, payroll, personnel, etc., with production peaks occurring bi-weekly, monthly, annually and at the beginning and end of each semester. The I/S will be made operational at the University of Connecticut's Computer Center, specifically on its IBM 370/155-II computer. The system presently consists of a 3155-K central processor (CPU), four 3360 high speed storage frames totalling two megabytes, four I/O channels (a byte and three block multiplexor channels), a 3215 Console Printer Keyboard, Disk Storage and Control modules including eight 3330 disk spindles, several 3270 display consoles, one 1403 printer and one 3505 reader. Presently, several of the remote users of the proposed I/S are already utilizing the Computer Center's facilities via RJE.

The utilization of a DBMS cannot adversely affect the higher education production schedule. The majority of applications which presently make up the production workload are intended to be designed, converted and implemented using data base management technology. Vendors should note any anticipated impact on these present production schedules and should indicate if main memory must be expanded in order to accommodate the DBMS software.

Proposed DBMS software must be made operational on the equipment configuration described earlier. The Commission requests that prospective vendors comment on the necessity of increased equipment capacity needed for effective production processing.

The Commission intends to use ANS COBOL as an application programming standard. The proposed DBMS must interface with ANS COBOL.

1.2 Security Requirements

1.2.1 Introduction

The intent of the Commission is to restrict access to all data elements managed by the DBMS. Access to information will be on a "need to know" basis only. The Commission intends to protect the confidentiality of the information maintained within the I/S and this security consideration will become a major factor during systems design.

Phased implementation of the I/S will initially allow for batch processing to be later followed by data communications and interactive processing. Online access to the I/S' data bases will further involve data access security.

Safety of data requirements, i.e., measures taken to insure that data is not accidentally destroyed, alter or lost, will later be addressed in paragraph 1,2.3 of this Section.

1.2.2 General Guidelines for Security

The Commission intends to rely on features of the DBMS for specific techniques of restricting access to data elements. In addition, the proposed DBMS should provide these basic security capabilities.

a. encrypting of data elements
b. restricting access to data elements
c. restricting access to data element groups
d. restricting access from or through terminals to data bases, data elements and/or groups of data elements

1.2.3 General Guidelines for Data Safety

The Commission intends to employ strict managerial and operational standards to minimize loss of or damage to data. These basic features must be provided by the proposed DBMS:

a. Identification and explanation of DBMS failures, including correction and recovery measures to be employed.

b. Logging capability of data base transaction activity.

c. Utilities for:

- Restart/recovery
- Reorganization of data bases, if applicable
- List data bases
- Optional utilities
  . Loading data bases

1.3 Future DBMS Requirements

1.3.1 Data Communications Interface

The I/S will be served by a large data communications network which will access its data bases for:

. Immediate response inquiry
. Online data collection
. Online data base updating

The proposed DBMS must have the capability of interfacing with data communications software systems which support:

. Bi-synchronous terminal devices
. CRT devices
. Typewriter terminal devices

1.3.2 Report Writer Software Systems Interface

The Commission itends to provide ad hoc reporting capability of data elements contained within the I/S data bases. The proposed DBMS must have the capability of interfacing with at least one report writer system that features:

a. Use with both data files and other file structures
b. Ease of use to provide report development capability to non-EDP users.

1.3.3 Data Dictionary System

The Commission intends to control and standardize all data elements managed by the DBMS by providing a central source of documentation. The proposed DBMS should provide the capabilities of organizing, maintaining and retrieving data element information.

1.4 Data Structure/Basic Capabilities

The following major data bases will be managed by a DBMS: Student, Staff, Facilities, Course, Financial (see Section III for details). In order to process the applications of the higher education sector, the proposed DBMS must have the following capabilities:

a. Sequential and random processing
b. Multiple data base and conventional OS file access in any given application program
c. Accessing of any given data base via multiple paths or keys
d. Cross references to other data bases

1.5 Support Requirements

1.5.1 Education and Training

The Commission may rely on the DBMS supplier for extensive training and education support. Necessary training/education should be itemized as it relates to:

a. Data base support group personnel

b. Software personnel

c. Applications programmers

d. Systems analysts

e. Computer operators

1.5.2 Maintenance

Many critical applications will use the DBMS, e.g., payroll, registration, etc. It is vital that DBMS vendors have the capability of providing DBMS maintenance support on-site within a maximum of four hours. The Commission intends to enter into contractual arrangements with the DBMS vendor for maintenance support.

SECTION III

DETAIL SPECIFICATIONS

1. 0 INTRODUCTION

This section provides specifications for:

a. The proposed five (5) data bases which will serve the I/S

b. DBMS features and capabilities

Although the five data bases will be implemented in a phased approach, they all will be eventually managed by the DBMS procured as a result of this proposal. It should be noted that, for security reasons, each of these data bases may exist for each of the twenty-one colleges served by the I/S rather than have, for example, the student information from all twenty-one colleges reside within the same physical I/S student data base.

Student Data Base - this data base will contain all information pertaining to students who have enrolled at or have applied to the institution. In addition, the data base will contain certain information regarding alumni.

Course Data Base - will contain all information pertaining to academic courses and their sections, i.e., course attribute data, section attribute data and section resource data.

Facilities Data Base - this data base will contain all information pertaining to any physical structure or space which is required by the institution in order to carry outs its programs and related activities. In addition, the data base will eventually contain information pertaining to supplies and equipment in order to satisfy the data requirements associated with inventory, purchasing and warehousing.

Financial Data Base - will contain all financial and accounting information pertaining to the programs and functions conducted and performed at the institution.

Staff Data Base - will contain all information pertaining to the institution's staff personnel, both its teaching staff and its administrative staff.

The Commission requests that each vendor furnish information regarding its experience in developing data bases comparable to the five described above. The Commission also requests vendors to include descriptive information, if possible, concerning design details for these data bases, or names of individuals and institutions that the Commission may contact to obtain this information.

The Commission expects each vendor to furnish detailed technical material describing its DBMS. The Commission requests that each vendor include in its proposal detailed description of the DBMS features and capabilities addressed in this section. In the event that these features and capabilities are either not required or not available for a proposed DBMS, the Commission requests a complete explanation for either situation. The Commission is particularly interested in the proposed DBMS features and capabilities as they relate to the proposed I/S data base schema.

2.0 I/S Data Base Descriptions

2.1 Student Data Base

2.1.1 General Information

- The information contained on the Student Data Base will be used to support the administrative processes associated with admissions, registration, scheduling, grade reporting, financial aid, student billing, housing, institutional research and alumni records.
- The data base will contain all information on students currently enrolled at the institution and will contain all application data for those students seeking admission to the institution. The data base will also contain selected information on the institution's alumni.
- The Student Data Base will contain demographic and biographical information on each student, data regarding the student's previous educational experiences, information regarding the student's admission to a specific program or degree objective, data regarding the student's residence, data regarding the student's financial status, and for each enrollment term, data regarding courses taken and the associated grades received.

2.1.2 Volume and Size

- Presently, approximately 94,000 full-and-part time students are enrolled in Connecticut's public colleges. This volume is expected to grow at a rate of 1-2% per year.
- The minimum record size associated with each student is estimated at 350 characters. The maximum record size may approximate 3000 characters. The DBMS, therefore, must provide for open ended expansion of these records by individual student.

2.1.3 Student Data Element Groups

a. Demographic and biographical data - that information used to describe the student's current demographic and biographical characteristics (200 bytes).

b. Previous educational experience data - that information used to define each previous educational experience of the student, including the student's final secondary educational experience. The data will be collected for each educational experience of the student regardless of whether or not the student received a degree/certificate for that experience (55 bytes).

c. Admittance data - this data is used to provide information regarding a student's admission to a specific institutional program or degree objective. This data should be recorded for each attempted admission by the student (65 bytes)

d. Term data - used to define information about a student for each term that the student is enrolled in a course (30 bytes).

e. Course Data - used to define information about each course attempted by the student. These data elements, for example, are used for generating student transcripts (45 bytes).

f. Student accounting data - this data will be used to provide information regarding the student's financial status at the institution. It will be updated with tuition information, library fines, student fees, etc. and will similarly reflect all student payment information (200 bytes).

g. Financial aid data - this data will provide information regarding the student's need analysis, the variable number and type of awards granted the student and information regarding award cancellation (300 bytes).

h. Housing data - used to provide information regarding the student's on campus housing accomodations as well as information regarding the student's meal plan (30 bytes).

i. Alumni data - used to provide information regarding the institution's alumni including contact data, gift data, employment data, etc. (300 bytes).

j. Placement data - this data will provide information regarding the student's job preferences, e.g., type of job desired, preferred geographical job location, etc. (85 bytes).

2.1.4 Dependent Data Element Groups

- A group of demographic and biographical data elements and at least one group of previous educational experience data elements would be associated with each student (or applicant). In addition, each student would have one or more admittance data groups and associated with each admittance group may be one or more term data groups. Associated with each term data group would be one or more course data groups.
- One student accounting group would be associated with each student. Transaction detail would be maintained on the data base to support the summary totals reflected in the student accounting group.
- One financial aid group may be associated with each student and detail depicting the variable number and type of awards will also be maintained on the data base.
- One housing data group may be associated with each student.
- One alumni data group may be associated with each student.
- One placement data group may be associated with each student.

2.1.5 Student Data Base Access

- Normal access to the Student Data Base will be by the student's social security number.
- Secondary access into the data base may be by student name and/or by the student's identification number (if different from social security number).

2.1.6 Cross Reference Requirements

- At a minimum, The Student Data Base must directly cross reference the Course (course identifiers) and Facilities (housing) data bases and must indirectly relate to the Staff and Financial data bases. The Student Data Base would also directly cross reference the Staff Data Base for advisor information.

2.1.7 Student Data Base Major Processing Requirements

- The Student Data Base will be accessed daily for both online and batch processing.
- In addition to monthly and annual processing in which the entire Student Data Base will be processed for reporting purposes, etc., the following volumes pertain (totals are presented separately for the state's largest public institution, i.e., the University of Connecticut, and for all other state public colleges):

* College current enrollments
  UCONN 23,000 Others 71,000

* Admissions applications processed each year (batch)
  UCONN 21,000 Others 55,000

  The admissions data would be applied twice weekly.

* Online admissions inquiries (for the peak periods of March - May)
  UCONN 1100/day Others 2900/day

  (non peak periods)
  UCONN 100/day Others 280/day

  The output message response to the admissions inquiry, excluding terminal control characters and format headers, approximates 130 characters of information.

* Financial aid applications processed each year (batch)
  UCONN 13,500 Others 42,000

The following transactions counts are associated with the above financial aid application counts:
UCONN 60,000 Others 180,000

These transactions would be applied weekly.

* Financial aid online inquiries per year
  UCONN 5,000 Others 15,500
  (maximum size of message response - 300 characters)

* Financial aid online data entry transactions per year
  UCONN 5,000 Others 15,000
  (maximum input transaction size - 300 characters)

* Online job placement inquiries per day
  UCONN 200 Others 600
  (maximum size of message response - 110 characters)

* Online job placement data entry transactions per day
  UCONN 50 Others 150
  (maximum input transaction size - 80 characters)

* Housing assignments per year (batch)
  UCONN 9,000 Others 6,500

* Alumni data elements groups on file
  UCONN 50,000 Others 150,000

* Alumni maintenance transactions each year (batch)
  UCONN 20,000 Others 60,000

* Online transcript inquiries each year
  UCONN 33,000 Others 100,000
  (average response message size - 140 characters)

* Online admissions data entry transactions each year
  UCONN 29,500 Others 60,000
  (maximum input transaction size - 320 characters)

* Student bills each year (batch)
  UCONN 44,500 Others 134,000

* Student Payments each year (batch)
  UCONN 44,500 Others 134,000

* Online miscellaneous student inquiries
  UCONN 23,000 Others 71,000
  (average response message size - 60 characters)

* Registration transactions each year (batch)
  UCONN 98,500 Others 204,000

  Although peak periods exist prior to each semester, maintenance activity would be applied weekly

* Online add/drop transactions each year
  UCONN 10,000 Others 20,000

2.2 Course Data Base

2.2.1 General Information

- The information contained in the Course Data Base will be used to support the administrative processes associated with course scheduling, master schedule maintenance, registration, institutional research and grade reporting.
- The Course Data Base will contain all information regarding the academic courses offered by an institution, will contain all information regarding the sections associated with each course, and will contain all information pertaining to the resources associated with each section.
- The above information will be maintained historically in order to retain information on each course for every term it is offered.

2.2.2 Volume and Size

- Approximately 10,000 courses are offered by the four constituent units.
- The University of Connecticut presently maintains 36,000 records on its master schedule which describe each course and section offered by the institution, i.e., 5,000 course records and 31,000 section records. This file is historical and grows at a rate of 10,000 records per year. This growth rate may be proportionately applied to the other three constituent units.
- The minimum record size associated with each course offering is approximately 185 characters. The maximum record size depends on the number of sections for the course and the corresponding section resource requirements (as many as eighty sections might be associated with a course). The DBMS must be able to accommodate a variable number of occurrences of these data element groups.

2.2.3 Course Data Element Groups

a. Course attribute data - that data used to provide information regarding each course offered by the institution (120 bytes).

b. Section attribute data - that data used to provide information regarding the sections associated with each course. One or more section attribute data groups may exist for each course (25 bytes).

c. Section resource data - that data used to provide information regarding the resources associated with each section. One or more section resource data groups may exist for each section (50 bytes).

2.2.4 Dependent Data Element Groups

- A course attribute data group will exist for each course offered by an institution, and a section attribute data group will similarly exist for each section of the course. Each section will have one or more section resource data groups associated with it. Therefore, it is possible to have multiple section resource groups for each section and it is possible to have multiple section attribute groups for each course.

2.2.5 Course Data Base Access

- Normal access to the Course Data Base will be by a unique course identifier.
- Secondary access into the data base may be by course title and/or by WICHE Program Classification Structure coding.

2.2.6 Cross Reference Requirements

- The Course Data Base would directly cross reference the Student Data Base (social security number), the Staff Data Base (employee number) and the Facilities Data Base (building, room/facility identifier). In addition, the Course Data Base would relate to the Staff, Facilities and Financial data bases via the WICHE Program Classification Structure coding associated with each record in the data base.

2.2.7 Course Data Base Major Processing Requirements

- The Course Data Base may be accessed daily for both online and batch transaction processing.
- In addition to monthly and annual processing in which the entire Course Data Base will be processed for reporting purposes, the following volumes are significant (again, totals are presented separately for the state's largest public institution, i.e., the University of Connecticut and for all other state public colleges):
  - Registration transactions processed each year (batch)
    UCONN 98,500 Others 204,000
  - Online course registration transactions processed each year
    UCONN 8,500 Others 25,500
  - Online add/drop activity each year
    UCONN 10,000 Others 20,000
  - Master schedule maintenance will be performed three times per week (batch). Number of transactions processed per run
    UCONN 1,700 Others 1,500

2.3 Facilities Data Base

2.3.1 General Information

- The information contained in the Facilities Data Base will be used to support the administrative processes and functions associated with housing, inventory, space utilization, course and examination scheduling. The Facilities Data Base may additionally serve both warehousing and purchasing.
- The data base will contain all information on the institution's buildings, rooms, equipment and land facilities. In short, it will contain information on any physical structure, piece of capital equipment or space required by the institution for the performance of its programs and related activities.

2.3.2 Volume and Size

- With the exception of equipment inventory, approximately 22,000 records are presently contained in the state's facilities files. Of the 22,000, approximately 10,000 records are associated with the University of Connecticut and the remaining 12,000 are associated with the other constituent units. This volume is expected to grow at a rate of 2% per year.
- The University of Connecticut's equipment inventory file presently contains 155,000 equipment records, all of which may be assimilated into the UCONN Facilities Data Base. This volume may grow at a rate of 10% per year.
- The minimum record size associated with a facility is approximately 80 characters. The maximum record size, for example, may depend on the number of rooms per building and, therefore, may approximate several thousand characters.

2.3.3 Facilities Data Element Groups

a. Facility data - that information used to describe characteristics common to each facility of the institution (80 bytes).

b. Building data - that information used to describe the characteristics applicable to each building of the institution (50 bytes).

c. Room data - that information used to describe the characteristics of the assignable interior spaces of a building, i.e., each room within each building (50 bytes).

d. Equipment data - this data is used to describe the characteristics of each piece of equipment at the institution (100 bytes).

e. Land data - this data describes the characteristics of institutional real estate (60 bytes).

2.3.4 Dependent Data Element Groups

- For each facility of the institution that is a building, there will exist one facility data group, one building data group and one room data group for each room within the building.
- One equipment data group will exist for each piece of equipment.
- One land data group will exist for each piece of institutional real estate.

2.3.5 Facilities Data Base Access

- Normal access to the Facilities Data Base will be by a unique facilities identifier.
- Secondary access into the data base may be by building and room and/or via WICHE Program Classification Structure coding.

2.3.6 Cross Reference Requirements

- The Facilities Data Base will directly cross reference: the Course Data Base in order to determine building and room assignments by course/section, the Staff Data Base regarding office assignments and the Student Data Base regarding dormitory assignments.
- In addition, the Facilities Data Base will be related to the Staff, Course, and Financial data bases via WICHE Program Classification Structure coding.

2.3.7 Facilities Data Base Major Processing Requirements

- The Facilities Data Base may be accessed daily for both online and batch transaction processing.
- In addition to monthly and annual processing in which the entire Facilities Data Base will be processed for reporting purposes, the following volumes are significant:

* Course/section classroom assignments per year (batch)
  UCONN 10,000 Others 10,000
* Examination room assignments per year (batch)
  UCONN 10,000 Others 10,000.
* Dormitory room assignments per year (batch)
  UCONN 9,000 Others 6,500
* Equipment maintenance transactions processed per month (batch)
  UCONN 3,200 Others 4,000
* Facilities maintenance transactions processed per year (batch)
  UCONN 1,200 Others 1,500

2.4 Financial Data Base

2.4.1 General Information

- The information contained in the Financial Data Base will be used to support the administrative processes associated with accounting, budget, planning, expenditure analysis, purchasing, payroll, financial aid, auditing and institutional research.
- The Financial Data Base will contain all information regarding the institution's financial affairs, both administrative and academic; and will provide both summary and detail information for the institution's accounts payable and accounts receivable systems.
- The information on the data base will be maintained historically in order to satisfy auditing requirements and to facilitate financial accounting from one fiscal year to the next.

2.4.2 Volume and Size

- With the exception of student and staff billing systems, approximately 60,000 accounts are maintained in the constituent units' financial systems. These budget accounts are maintained for each fiscal year and grow at a rate of 10%.
- The minimum record size associated with each of the above accounts is approximately 300 characters. The maximum record size for each account will vary depending on the number of detail transactions associated with the account.
- The DBMS, therefore, must provide for open ended expansion of these records by individual account.

2.4.3 Financial Data Element Groups

a. Account identification data - that information used to identify an account, i.e., fund, agency, special idenficiation, function, activity, character & object, project and fund source. In addition, account identification data will include WICHE Program Classification Structure coding (40 bytes).

b. Account descriptive data - that information used to describe the account, i.e, fund description, activity description, project description, etc. (180 bytes).

c. Account summary data - that information used to depict the current status of the funds associated with the account, i.e., allotment total, encumberance total, expenditure total, free balance total, etc. (35 bytes).

d. Account detail data - that information used to describe the detailed accounting transactions applied against the account, e.g., fund transfer transaction, encumberance transaction, etc. (45 bytes).

2.4.4 Dependent Data Element Groups

- An account identification data group, an account descriptive data group and an account summary data group will exist for each account.
- Associated with each account summary data group will be an or more account detail data groups.

2.4.5 Financial Data Base Access

- Normal access to the Financial Data Base will be by account identifier.
- Secondary access into the data base may be by WICHE Program Classification Structure coding.

2.4.6 Cross Reference Requirements

- At a minimum, the Financial Data Base will cross reference the Course, Facilities and Staff data bases via WICHE Program Classification Structure coding. In addition, the Financial Data Base will indirectly relate to the Student Data Base via the Course Data Base.

2.4.7 Financial Date Date Major Processing Requirements

- The Financial Data Base will be accessed daily for both online and batch transaction processing.
- In addition to monthly and annual processing in which the entire Financial Data Base will be processed for reporting purposes, the following volumes are signficant:

* Number of accounts currently maintained
  UCONN 20,000 Others 60,000
* Number of payments processed per month (batch)
  UCONN 15,000 Others 45,000
* Number of transfer vouchers processed per month (batch)
  UCONN 15,000 Others 45,000
* Number of purchase orders issued per year (batch)
  UCONN 23,000 Others 69,000
* Number of accounting transaction processed per month (batch)
  UCONN 25,000 Others 75,000
* Online accounting inquiries per day (for peak periods March - June)
  UCONN 750 Others 2,250

  (for non-peak periods
  UCONN 450 Others 1,350

The output message response to the accounting inquiry, excluding terminal control characters and format headers, approximates 75 characters of information.

* Accounting online data entry transactions per day (for peak periods March - June)
  UCONN 600 Others 1,800

  (for non-peak periods)
  UCONN 300 Others 900

The average data entry input transaction will contain approximately 40 characters of information.

2.5 **Staff Data Base**

2.5.1 General Information

- The information contained on the Staff Data Base will be used to support the administrative processes associated with personnel, payroll, faculty evaluation, position control, service longevity, attendance reporting and institutional research.

- The data base would contain all information on persons considered employees of the institution, i.e. professional staff, classified personnel and student help, including biographical and demographic data, previous educational experience data, appointment data, assignment data and if appropriate, faculty activity data.

2.5.2 Volume and Size

- Presently, approximately 20,000 professionals and classified staff personnel are employed by the state's four constituent units. Included are both full and part time staff members. This volume will grow at a rate of 1-2% per year.
- The minimum record size associated with each staff member is approximately 400 characters. The maximum record size will vary based on the number of dependent data element groups associated with the staff member. Again, the DBMS must be able to accommodate the variable number of occurrences of these dependent data element groups.

2.5.3 Staff Data Element Groups

a. Demographic and biographical data -- that data used to provide information regarding the employee's demographic characteristics and cumulative professional background (250 bytes).

b. Previous education experience data -- that data used to provide information regarding each educational experience of the staff member (40 bytes).

c. Appointment data -- this data will be used to provide information about each appointment of the staff member (80 bytes).

d. Assignment data -- this data is used to provide information regarding the employee's assignments within the institution (30 bytes).

e. Faculty activity data -- this data is used to provide information regarding each faculty member's activities. A separate faculty activity data group will exist for each activity of a staff member (40 bytes).

2.5.4 Dependent Data Element Groups

- A demographic and biographical data element group and one or more previous educational experience data groups will exist for each staff member. In addition, each employee will have one or more appointment data groups and each of these appointment data groups may have one or more assignment data groups associated with it.
- Each employee of the institution considered to be a faculty member will have multiple faculty activity data groups, i.e., one faculty activity data group per activity, associated with each assignment data group.
- The appointment, assignment and faculty activity data groups will be maintained historically according to the aforementioned hierarchy in order to relate specific assignments to appointments and specific faculty activities to their appropriate appointments and assignments.

2.5.5 Staff Data Base Access

- Normal access to the Staff Data Base will be by a unique Employee Number.
- Secondary access into the data base may be by Position Control Number, Social Security Number, Employee Name or by WICHE Program Classification Structure coding.

2.5.6 Cross Reference Requirements

- The Staff Data Base may directly cross reference the Course Data Base (course identifier), the Financial Data Base (account identifier) and the Facilities Data Base (course building and room, office/facility identifier). In addition, the Staff Data Base would relate to the same three data bases via WICHE Program Classification Structure coding. The Staff Data Base would indirectly relate to the Student Data Base via the Course Data Base regarding course/instructor information for a student.

2.5.7 <u>Staff Data Base Major Processing Requirements</u>

- The Staff Data Base may be accessed daily for both online and batch transaction processing.
- In addition to the bi-weekly payroll requirements and monthly and annual processing in which the entire staff Data Base will be processed for reporting purposes, the following volumes are significant:

* Number of full and part time staff members employed by the state's four constituent units

  UConn 7,500 Others 12,500

* Number of full and part time faculty staff members employed by the state's four constituent units (faculty activity data groups may be associated with these personnel).

  UConn 1,400 Others 3,200

* Number of faculty evaluation transactions processed each year (batch)

  UConn 45,000 Others 96,000

* Number of personnel maintenance transactions processed each year (batch)

  UConn 15,000 Others 27,000

* Online personnel data entry transactions per day (peak) periods)

  UConn 120 Others 220

  (non-peak periods)

  UConn 80 Others 150

* Online personnel inquiry transaction per day (peak periods of August, February, May, June)

  UConn 90 Others 170

  (non-peak periods)

  UConn 40 Others 75

The average output message response to the online personnel inquiry, excluding terminal control characters and format headers, approximates 80 characters of information.

3.0 DBMS Features and Capabilities

3.1 Introduction

- Of particular interest to the Commission are the DBMS features and capabilities outlined below. These items will be weighed heavily when determining which DBMS product will best satisfy the needs and requirements of the I/S.
- Vendors are required to discuss each item or topic in their proposals and are encouraged to include additional information which will permit the Commission to more effectively evaluate the proposed DBMS.

3.2 Ease of Use

- The Commission is desirous of quickly implementing data processing applications using the DBMS procured as a result of this RFP. Therefore, the Commission would like to avoid, if possible, costly and lengthy education and training in the use of the DBMS. In order to better evaluate this requirement, DBMS vendors must present the following information as part of their proposals:

  a. Details of calls/coding necessary for application programs written in ANS COBOL in order to use the DBMS. Include calls/coding necessary in order to access a data base retrieval and updating (include adds, changes, deletes).

  b. Details of language/coding necessary to:
     - define a data base
     - define how a data base is cross referenced to one or more data beses
     - define the accessing of a data base using multiple keys

  c. Details of coding/instructions necessary to use the utilities requested in Section II, Paragraph 1,2.3, General Guidelines for Data Safety.

  d. The Commission will be responsible for providing a central staff with the technical skills required to support the DBMS software. Vendors are requested to outline the skills required to support their DBMS with the Commission's anticipated operating environment which will involve:
     - Data base/data communications
     - Multi-programming/multi-processing
     - Complex operating system software
     - High volume production schedules having high end of month, semester and year processing requirements.

3.3 Support

- The assurance that production schedules will continue to be met is most important to the Commission. The I/S must not be impacted by delays in computer production resulting from software problems and resultant trouble shooting efforts.

- Vendors should specify in detail what their DBMS maintenance policies and contract obligations are relative to:
  a. Guaranteed reponse time to a call for service
  b. Diagnostic services in order to determine whether or not a software problem is of DBMS origin
- Include a list of documentation and training material available and arrange, if requested, to have it inspected by Commission representatives.
- Include a detail schedule of formal training and education courses. Specify the length in days, the content of each recommended course and, if appropriate, pricing information for each course.
- Specify the onsite assistance support provided by vendor technical personnel on DBMS development and use. Include resumes of support personnel.

3.4 DBMS Operating Environment

- Multiple Programming Use

The DBMS will be used concurrently by multiple application programs. Individual data bases will be accessed concurrently by multiple application programs. Vendors must describe techniques used by their proposed DBMS to accommodate this mandatory operating specification effectively.

- Multi-level Operating System

Describe requirements involved in converting the proposed DBMS from operating with the I/S expected operating system (370/OS) to any other operating system which the vendor is proposing as a future consideration for the I/S, e.g., VS.

- DBMS Module/Operating System Relationship

Identify and explain the DBMS module(s) and their relationship to the operating system including:
  a. Where do DBMS module(s) reside, i.e., do they reside in same region as the application modules.
  b. Core requirements for DBMS module(s).

- Data Communications System

Identify and describe those data communication software products with which the proposed DBMS can and has interfaced. Include additional core estimates and include a list of users that can be referenced.

- Logging

Identify and explain DBMS logging capabilities and techniques for accomplishing logging. Describe how the log records produced by the DBMS are to be used for restart/recovery. Include log record descriptions. The Commission wishes to evaluate whether or not the proposed DBMS logging is of practical operational use for restart/recovery.

- Recovery/Checkpoint

In the event of system failure, describe the technique for recovery and restart. The Commission is particularly interested in measures required to restore the data bases to operational use.

3.5 <u>Data Base Structure</u>

- Explain the techniques by which the proposed DBMS provides these mandatory capabilities:
  - a. Data base access using multiple keys
  - b. Multi data base accessing and/or cross referencing
  - c. Sequential processing of very large data bases
- Identify and describe the physical storage of data bases including:
  - a. Record size and volume limitations (include examples of largest data bases in actual use with the proposed DBMS).
  - b. DASD storage planning guidelines. Specify the ratio between raw data and the structured data base.
  - c. Describe automatic storage optimization and compaction capabilities included in the proposed DBMS. Explain, if not automatic, how storage optimization and compaction are accomplished.

- Data Base Change and Growth Potential

The data base record volumes cited earlier in this section under subsection 2.0, I/S Data Base Descriptions, reflect I/S record volumes based upon current requirements. In the event of substantial growth in data base size or the development of new processing requirements, vendors should explain how a data base can be restructured using the proposed DBMS and the consequent effect, if any, on application programs. Vendors should include descriptions of procedures to:

- a. Add a group of data elements
- b. Delete a group of data elements
- c. Modify a group of data elements

FOOTNOTES

1. SHEC Task Force (Frank Degnan, Chairman), Study Report and Information System Plan, Hartford, Connecticut: Commission for Higher Education, 1973, pp. 2-6 to 2-8.

2. Task Force (Paul Andrews, Chairman), Information Systems Study, Burlington, Vermont: Vermont State Colleges, 1974, p. 5 and pp. 43 to 48.

3. Task Force (David Hollowell, Chairman), Information Systems Planning Study, Boston: Boston University, 1974, p. 6 and pp. 38 and 39.

4. Thomas R. Gildersleeve, Data Processing Project Management, New York: Van Nostrand Reinhold Company, 1974, pp. 71-137.

5. Charles Mosmann, Statewide Computing Systems, New York: Marcel Dekker, Inc., 1974, pp. 139-177.

6. Frank G. Kirk, Total System Development for Information Systems, New York: John Wiley and Sons, 1973, pp. 50 to 149.

7. Paul Siegel, Strategic Planning of Management Information Systems, New York: Petrocelli Books, 1975, pp. 33 to 56 and pp. 299 to 346.

8. CAUSE (College and University Systems Exchange), 737 Twenty-Ninth Street, Boulder Colorado has a constantly updated book of systems with various key-word listings.

9. We have hired Leo Cohen of Performance Development Corporation of 32 Scotch Road, Trenton, New Jersey, who has helped implement data base management systems across the country.

10. Robert V. Head, Manager's Guide to Management Information Systems, Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1972, p. 129.

11. Ibid., p. 130.

12. Ibid.

13. Thomas A. Petit, "Systems Approach to Management Theory," Journal of Systems Management, July 1972, p. 32.

14. Ibid.

15. Donald A. Woolf, "The Management Theory Jungle Revisited," Advanced Management Journal, Vol. 30, No. 4, October, 1965, pp. 6-15 in Harold Lararus and E. Kirby Warren (eds.), The Progress of Management, Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1968, p. 42.

16. Ibid.

17. Petit, pp. 32-33.

18. Petit, p. 33.

19. Robert S. Brumbaugh, The Philosophers of Greece, New York: Thomas Y. Crowell Company, 1964, p. 186.

20. Petit, p. 33.

21. Robert J. Thierauf, Systems Analysis and Design of Real-Time Management Information Systems, Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1975, p. 45.

22. James J. McGovern, A Study of Faculty Data Needed for Management Control and Program Budgeting: A Delphi Systems Analysis, Ph.D. dissertation, New York University, 1973, University Microfilms Inc., Ann Arbor, Michigan, 74-12,848, pp. 15-22 and pp. 56-57.

23. Ibid., pp. 47 to 55 and pp. 59 to 67.

24. Ibid., p. 54.

25. Norman C. Dalkey and Daniel L. Rourke, Experimental Assessment of Delphi Procedures with Group Value Judgments, Report R-612-ARPA, Santa Monica, California: The RAND Corporation, 1971, p. 5.

26. Ibid., pp. 5-6.

27. McGovern, pp. 62-67, pp. 84-86.

28. It is difficult to know when validity has been obtained and the suggestion is that the "shape" of the distribution of opinions (see Dalkey's criteria on p. 7 of this article) is an indication. This is a "Monte Carlo Approach" where the statistics are arranged to discover the underlying laws or principles.

29. John W. Sutherland, Systems: Analysis, Administration and Architecture, New York: Van Nostrand Reinhod Company, 1975 (especially pp. 58, 118, 119, 203-207, 306-312, and 328-331).

30. McGovern, p. 139.

FACULTY DATA	FACULTY INFORMATION	FACULTY DECISIONS
Degrees	Tenure/Untenured	New appointments
Tenure status	Cost/Course	Promotions
Rank	Students/Faculty	Planning
Publications	Students/Department	Programming
Students contact hours	Professors/Department	Budgeting
Subjects taught	Total Publications	Regional cooperation
Salary	Average Salary	Independent study
... etc.	... etc.	... etc.
(MEASUREMENT)	(ANALYSIS)	(ADMINISTRATION)

Figure I. Successive Levels of Abstraction

Organization of Data by CATEGORY and (Process)

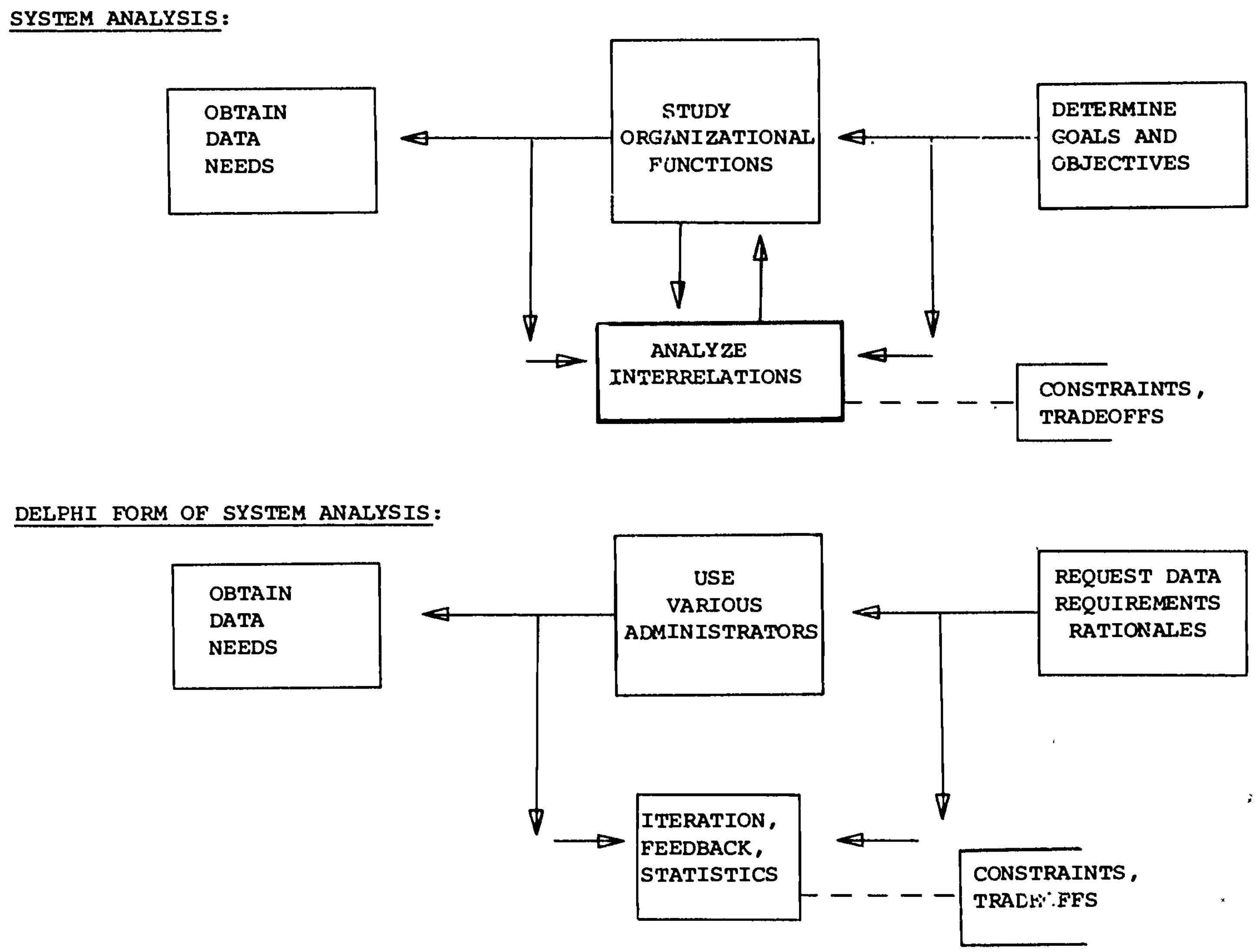


FIGURE II. Schematic of Delphi Procedure as System Analysis

DATA BASE DESIGN FOR STUDENT AND FINANCIAL INFORMATION SYSTEMS

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Through the use of data mapping techniques, standardized programs can be written which converse with varying data bases. Conversely, standard data bases can be constructed to support changing environments. This discussion centers around a conceptual design for a set of data bases to support student and financial-related processes and the implications of using standardized definitions to support the unique requirements of an educational institution.

The term "blue sky" has frequently been used to refer to possible program enhancements and to new applications which, conceptually, were highly advanced in design and function. But with the hardware, software, programming and systems technology of the past decade, the relative inefficiency of such systems (were they ever programmed) would degrade system performance beyond usability.

However, technologies are now emerging which make it possible to create a sound and workable plan for the future. New applications programs can be developed in an evolutionary fashion. With a proper systems plan, new functions can be easily inserted into an existing section of code with only minor, if any, re-programming effort. It should no longer be necessary to re-program when new data elements are added to a file or when a college adds a new grading system or a new piece of hardware is installed. These new technologies should make massive conversion efforts a thing of the past. Instead, the vast majority of programming effort can be directed at implementing new functions and capabilities rather than simply maintaining and altering old code.

Data Communications

Data communications is an approach that can place the end user in close contact with the data and gives data control to the user rather than to a data processing function. With data communications, data and data processing are more accessible to both students and administrators. Decisions can be made in real time, based upon data contained within the system, rather than requiring successive delays inherent in the batch method.

Improved Programming Technologies

Improved programming technologies include several relatively new concepts. These technologies help to produce programs which are more easily maintained. Because of top-down design, the initial design is more likely to satisfy the original design requirements. This top-down design allows coding to be developed in a modular fashion so that problems can be more easily identified. New modules of code can be added without adversely affecting existing code. This means that applications can be implemented in an incremental fashion. Programs may initially contain only the minimum function necessary. Later, as appropriate, code can be inserted to add new functions with little, if any, re-programming.

Structured programming and HIPO diagrams help to clarify the function of code. Fewer initial problems should be encountered and later maintenance can be accomplished more easily. Structured walk-throughs help to make other members of the programming team aware of what is happening in related areas and provide a way of detecting at a relatively early stage in development the logical errors that have entered a design or a program. Additional concepts also relate to making the development process more efficient, and making the final product free from error.

Altogether, these improved programming technologies help to enhance the capabilities of a programming staff by reducing the amount of re-programming effort and reducing the amount of time spent on debugging and maintaining existing code.

Integrated Systems Planning

Integrated systems planning involves a top-down approach to application planning. The plan begins with a long-range objective, and recognizes that all systems within an institution of higher education must in some way be coordinated with an interface to other systems. For example, a schedule of classes results from the integration of student, personnel, financial and facilities systems. The integration of these systems in the past has largely been a manual effort. A long-range systems plan should at the very least identify the major interfaces between sub-systems and establish a road map for merging sub-systems at appropriate places and at the appropriate time.

The development of an integrated system is accomplished in small increments. Each phase of the development plan will probably cross application areas. The initial functions supported will consist of the highest priority applications. The plan should continue through multiple phases, slowly adding functions, outlining new applications to be programmed and specifying new points of integration until, in the final phase, a single system has been described.

Occasionally, interim systems will be necessary, but if these are designed and coded in a modular fashion using structured programming and proper documentation techniques, much of the code could be usable when that system is replaced.

It is important to emphasize that, although the development plan proceeds from the current time toward a future single system, the planning of that system must proceed in reverse order, beginning with a description of the final system, then outlining the phases of development that must occur in order to make the system a reality. In short, the approach combines the aspects of top-down planning and bottom-up implementation.

Data Maintenance Technologies

Conceptually, data base technology was an instant success. Lack of understanding, lack of experience and early software limitations have slowed the actual growth rate. It is only recently that the potential of the data base concept is being fully realized. Although support of data bases usually requires a sizable overhead in terms of main storage requirements and processing time, once the system has been "tuned" sufficiently, the benefits derived are well worth this small price.

The prime benefit of data base cannot be overstated. The concept provides the ability to add data elements and data structures without affecting existing programs. This is one of the major reasons why the frontier of application technology has been expanded. As new functions are added, new data elements and data structures are inevitable. This capability reduces the re-programming effort necessary to add new function so that programmer time can be used more productively.

Data bases help reduce data redundancy, thereby reducing data inconsistencies and providing the vehicle for complete integration of applications. No longer is there a requirement or a place for a financial aid system and an admissions system and a registration system. Instead, using the data base approach, a single system can evolve. For a time, several sub-systems may actually exist, but eventually, they can be integrated into a single, cohesive system.

But data base is only one of the data maintenance technologies which anticipates change. Another, and equally important, is data mapping. This technique has been incorporated into data management systems on a limited basis but has seldom been utilized elsewhere. The idea of data mapping is to remove the definition of the data as far as possible from the code which utilizes the data. It is the interlocking of code and data definition which has contributed more than anything else toward thwarting the exchange of code. This interlocking of code and data definition has actually stifled the implementation of proposed innovations and has led to unmanageable maintenance processes. Although data mapping technology has not yet completed its evolutionary cycle, early benefits are being derived. For example, if the possible values of students' academic standing, grading systems and other institutionally defined codes are placed on a data base rather than programmed as part of the code, programs need not change simply because the institution defines new codes or changes the meaning of old ones. Using data mapping techniques, the format of input and output documents/displays are irrelevant to the programs performing the processing. Data mapping, thus, not only allows for institutional change, but it also allows for transportability, taking programs that were written at one institution and installing them at another institution without necessarily requiring a change in document formats or in procedures.

The Synergism of an Advanced Systems Approach

Although many of the technologies necessary to produce advanced systems are here today, the tasks that remain are so great in number and sufficiently complex to insure several more years of development before full-function integrated systems can be realized. In order that emerging technologies be fully utilized, it is necessary that we now call a halt to traditional methods which yield only minimal solutions to short-range problems and thwart the development of long-range solutions.

But, oddly enough, implementing data communication technologies may solve only a few problems. Implementing improved programming technologies may solve only a few problems. Data base systems may solve only a few problems. Indeed, without proper planning, the projected solution may turn into a disaster. It is the careful merging of these new technologies that offers hope for the future.

The synergism gained by co-mingling integrated systems planning with data bases, data mapping, improved programming technologies, data communications, and the proper set of hardware can lead to the attainment of systems previously thought to be wishful thinking -- "blue sky". These systems should stand up to educational change. Efforts can be concentrated on new code rather than maintaining old code. More importantly, code produced elsewhere can be made useful for an institution whose educational and procedural policies are different from those of the institution producing the code.

To assist in overcoming initial barriers toward implementation of data base information systems, IBM has produced conceptual data base designs with the following criteria and objectives:

- The minimum acceptable level of standardization within college and university data bases is the WICHE/NCHEMS Data Element Dictionary. This planning tool establishes 30 to 40% of the data elements needed for an operational system. Beyond this, data bases must be designed so that they can function at a given institution but have a compatible structure and framework to encourage exchange.
- Many institutions are incapable of centralizing data base definitions within a multiple location system. Advocating centralized data base definition within a multi-campus system is often strongly opposed by the autonomy oriented locations that then seek out other solutions. Therefore, the data base design must allow for institutional autonomy within a multiple location system.
- The largest, most complex university may find that the data base designs provided here are perhaps 80-90% of what they

wish to implement, whereas a small community college may find that these structures are far in excess of their applications requirements. Data processing managers have told us they need to stage their applications implementation so that they can add piecemeal to a compatible data base set. Some data processing directors have said one of their greatest fears in moving into the data base environment is the need to have to restructure and completely redo the data base designs every two years as they add a new, major application. Therefore, a design criterion for these data bases is that one can incrementally add such applications such as admissions, registration, and financial aid over time.

- The general assumption is made that performance and multiple user requirements will change some of the structures in implementation. Therefore, the material enclosed is a first draft to be reviewed, analyzed, and refined over time.

A comprehensive administrative system requires a complex set of interrelated data. Because of the high degree of data interrelationships, traditional file-oriented systems are not fully capable of satisfactorily performing all administrative applicationns within a higher educational environment. A file orientation in such a complex environment normally requires such a high degree of data redundancy that either data is inconsistent from one place to another or else, in the attempt to gain consistency, performance is unreasonably degraded. The Student Data Base is a classic example of how a complex set of data can be logically grouped into a series of simple structures that can be efficiently processed while at the same time maintaining a high degree of data reliability.

The implementation of complex data bases can be accomplished only incrementally. It is suggested that applications be added one at a time in their simplest form, gradually increasing in the number of applications and the complexity of the applications. The data base, however, should, insofar as possible, reflect the design of a comprehensive system. It should not be necessary to install all segment types simultaneously. Indeed, it would be foolish to attempt to do so. However, as each segment is implemented, it should be placed at the correct hierarchical location within the data base whenever possible. Where it is possible to simply insert data structures into a data base rather than to re-arrange the data base, it should also be possible to insert programming modules within the current system without reprogramming.

THE DATA BASE DESIGNS

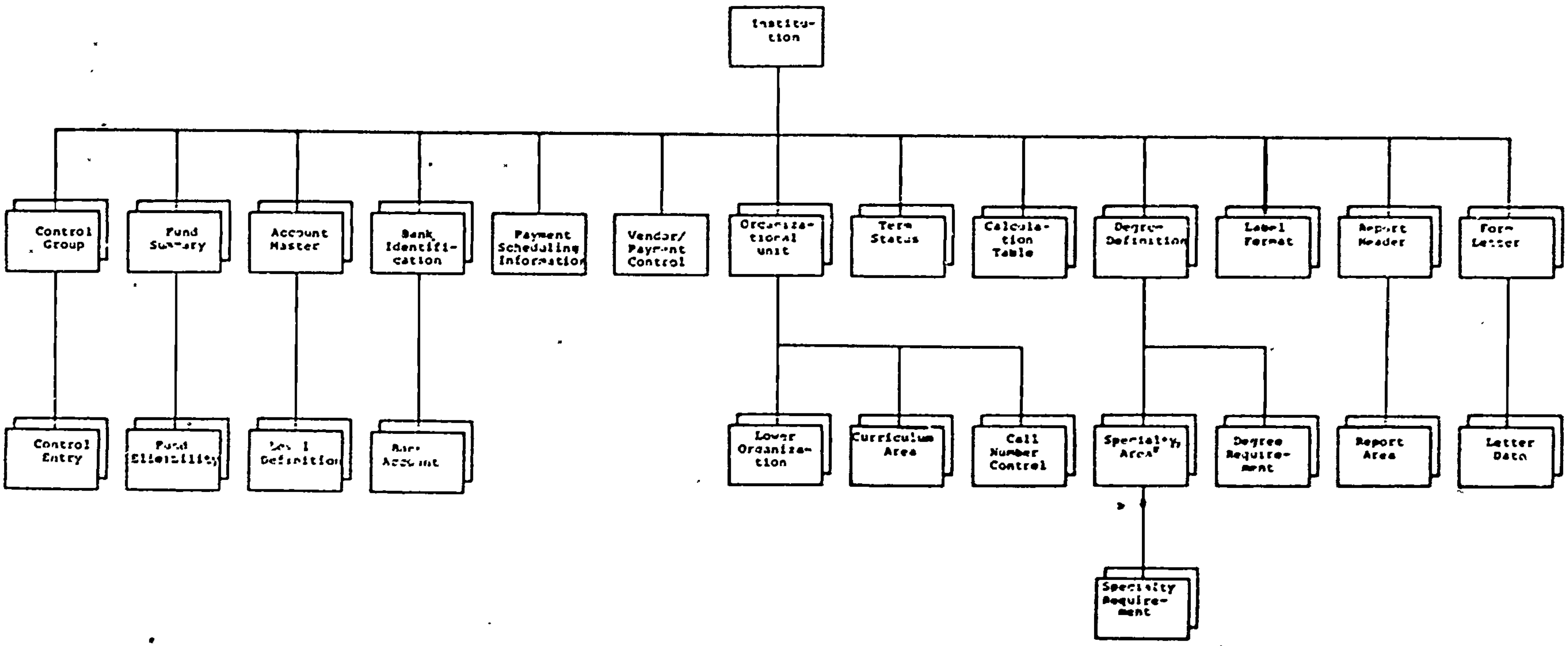
The hierarchical data bases illustrated here are designed for the higher education environment. They are data bases that have not yet been implemented as such in a college or university, but represent the current direction of IBM's thinking in the college and university segment of the education industry. While the data base structures discussed here provide an example of the approach presented in the previous section, they should not necessarily be considered as the model or best approach.

General Information Data Base

The General Information Data Base is a different concept in data bases. It is composed of several independently designed, small "data bases" which have been combined into a single, physical data base. Since every application data base requires allocation of real memory and specification of control information, combining data bases in this manner serves to reduce the DL/1 system overhead for many application programs. Part of the General Information Data Base is structured for specific applications, while the remainder of the structure crosses application boundaries. Since nearly every application requires access to the General Information Data Base, it more than any other data base integrates administrative functions across an entire academic institution.

For most institutions the General Information Data Base is relatively small. The prime characteristic of the data base, however, is not its size but the nature of the data. With few exceptions the data within the General Information Data Base describes institutionally-defined parameters (structures, options, formats, etc.) rather than reflecting the results of processing (counters, totals, etc.). This in effect means that the data base is highly static and that once loaded few changes will be necessary, except as new applications are added and except for the few rarely occurring volatile data elements within the data base (e.g., call number control, vendor/payment control, and financial aid fund summary).

GENERAL INFORMATION DATA BASE



One of the major benefits of the General Information Data Base is that it allows a high degree of code independence for the user in that parameters may be maintained on-line rather than embedded in control cards or application programs. These traditional methods of embedding tables and codes within processing programs can only serve to cause future maintenance problems as institutional requirements change.

Another benefit of the General Information Data Base is the ability to distribute maintenance of processing logic to the user rather than having to concentrate it within the data processing or data base administration function. With the use of the General Information Data Base, the Registrar, Admissions Office, Department Chairman or other end user may, thus, take responsibility for that data which originates in their office.

A third major benefit is the ability to tailor applications across multiple campuses within an institution or state-wide system. The support of multiple academic institutions by using a single set of data bases has been made possible by the design of the General Information Data Base. Those institutions sharing the system may be different colleges within a university, different colleges and universities within a state, or a set of small colleges and junior colleges sharing facilities with a host university, each institution maintaining its own set of procedures and data responsibility.

It is recommended that the General Information Data Base be implemented in an incremental fashion as applications become available. Cross application oriented segments should first be implemented with special emphasis on the Control Group and Control Entry Segments. These segments form the heart of the editing, encoding and decoding processes and should be used in every application. The use of these segments in the recommended fashion will prove to be a valuable tool in separating data from the processing programs. Although the remainder of the cross application oriented segments are not necessary to specific processes, maintaining this data within the General Information Data Base serves to enhance the maintainability of the data, while causing a minimum of overhead.

Application oriented segments have been placed within the General Information Data Base to support admissions, financial aids, registration and scheduling, degree auditing, and budget/finance applications. Since most of the data for a student system is collected during admissions, it is likely that this application will be installed first. The calculation table is the only segment within the General Information Data Base which is specifically defined for the admissions application. This segment defines data which assists in predicting success for incoming students according to an elected major. The Fund Summary and Fund Eligibility Segments support a financial aids application. The data in these segments defines the available funds in terms of the appropriate dollar amounts and student eligibility. The Term Status Segment is most useful in a registration or scheduling application as it defines parameters associated with specific academic terms. The Call Number Control Segment makes automatic assignment of unique section numbers possible. The Curriculum Area Segment provides a means of relating each course within the curriculum to the responsible organizational unit. The organizational unit and lower organization segments should be used together to define the organizational structure within an institution academically, administratively and fiscally. It is necessary to maintain this structure for both registration and degree auditing applications.

Four segments are maintained specifically for the degree auditing application. The Degree Definition Segment defines the degrees to be awarded within an institution whereas the Degree Requirement Segment defines the requirements necessary in order to be awarded a degree. The Specialty Area Segment defines the majors and minors that may be awarded within each degree; and the Specialty Requirement Segment defines the requirements necessary to be awarded a major or minor.

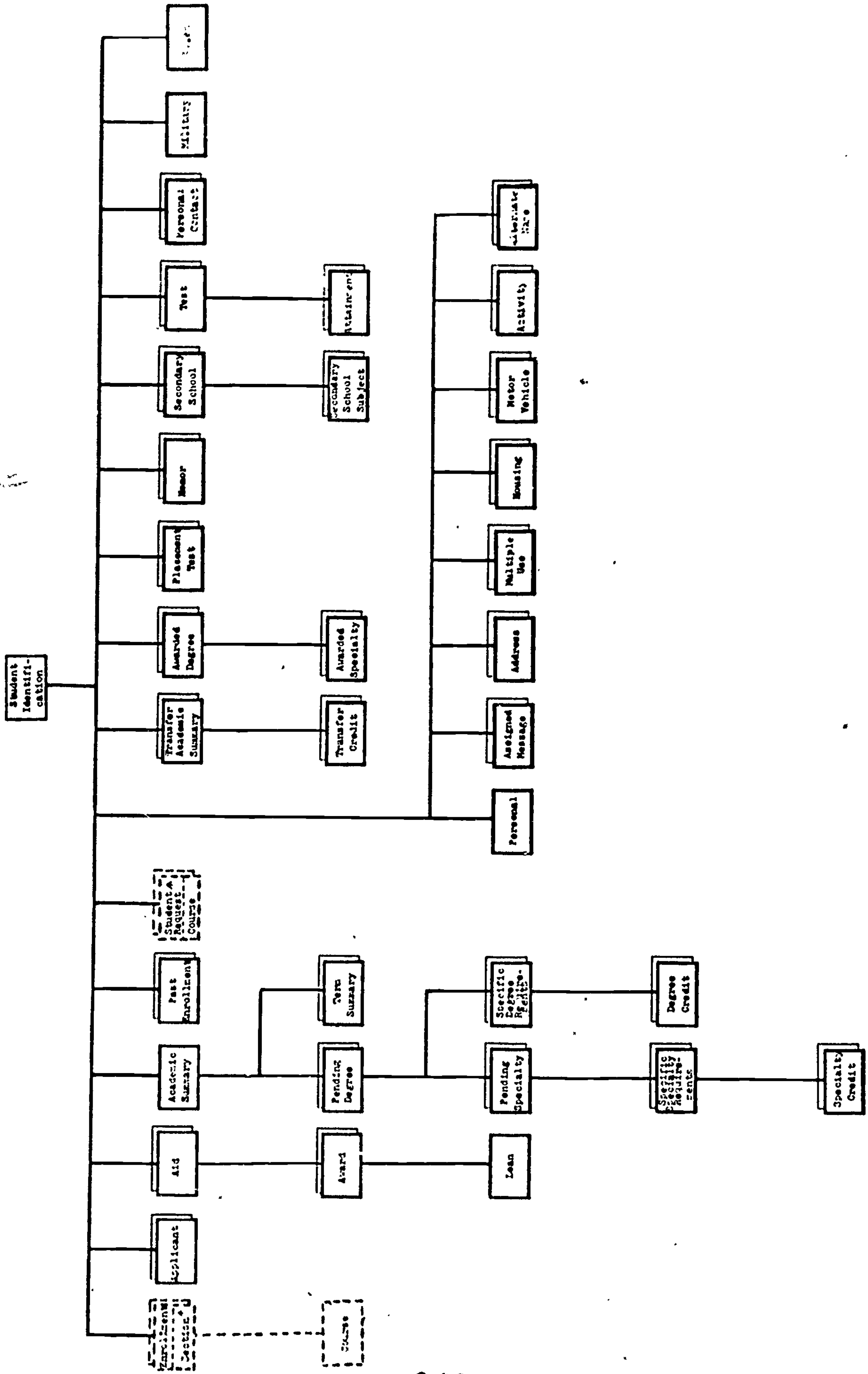
The Account Master Segment identifies the fiscal period and other control information, such as ASN option and parameters used for maintenance of the account code book. In addition, this segment completely defines the account code structure and chart of accounts for a given institution. A key benefit of this design is that application programs can be developed which are not tied to a specific chart of accounts or account code structure or description. This permits shared use of the data base facility by different operating units that may have different account code structures.

The Bank Identification, Bank Account and Payment Scheduling Segments provide information necessary for development of an automatic accounts payable system. All banks and bank accounts from which payments will be made and payment-type priorities are identified within these segments. The Vendor/Payment Control Segment provides data elements for vendor and payment reference numbers.

Student Data Base

The design of any data base must begin with the applications which are to be supported. The Student Data Base outlined here is designed to support admissions, financial aids, registration and scheduling, degree auditing,

STUDENT DATA BASE



motor vehicle registration, and housing assignment. Several segments appear in the data base which cross application areas. The root segment (Identification) includes the student's name and birthdate, as well as non-classified data pertaining to the student. Data which has a higher degree of sensitivity is placed within the Personal Segment. The Address Segment can store multiple address types (e.g., permanent address, local address, address to which grades should be sent, etc.) in a single segment type. A student's maiden name, nickname, aliases, and former married names may be stored on the Name Segment. The Assigned Message Segment may indicate that a student has an outstanding library book, an unpaid motor vehicle violation, or unpaid tuition, and may be used in such circumstances to restrict the registration of the student. It may also be used to indicate an information-only message to be directed to the student (e.g., student should report to Dean's Office before registering). The Multiple Use Segment is designed to store data that rarely occurs, but is of significant value to be stored on the data base when it does occur. This segment is redefined for each type of usage. This segment design represents a compromise between requiring the programmer to be concerned with the physical storage of data and allowing the data management system to completely handle data storage. Although compromises of this nature are often discouraged, infrequently occuring data can sometimes best be handled in this manner.

Since much of the student administrative data is collected during admissions, this application may be the first to be installed. Although the Student Data Base as recommended for admissions contains 24 segment types, the initial installation of an admissions application may require as few as six segment types (Student Identification, Applicant, Academic Summary, Personal, Address, and Transfer Academic Summary). Other segments may be added as new programming modules are inserted into the system. Segments associated only with financial aid would not normally be added until after an admissions system is installed. Once this has been accomplished, it may be possible to install a financial aid system with the addition of a single segment type, the Aid Segment. This minimum financial aid system could be used to collect data from students while programming is in progress to utilize the Award and Loan Segments. To install a minimum student registration system, it will be necessary to form a logical relationship between the Student Data Base and the Curriculum Data Base, thereby giving programmers access to data concerning a student's enrollment in classes. If computer sectioning is preferred over registration, a logical relationship could be established between the Student Data Base and the Curriculum Data Base giving the programmer access to student request data. Transcripts can be more adequately produced if the Term Summary Segment is made available to the programmer.

In most institutions where the traditional off-line method of degree auditing is performed, several days and nights each year become a nightmare for the few people who are required to perform this operation. As grades trickle in, these people review all of the courses that a student has taken together with the requirements for the appropriate degree to determine if all requirements have been met. This operation must usually be performed by a very few people, sometimes only one, often for several thousand students and in a short amount of time. This type of operation often results in several students being informed at the last moment that they cannot graduate when, in fact, they have met the requirements for graduation. Many academic institutions are now placing this application at the top of their priority list to be computerized. Six segments have been inserted into the Student Data Base to support this application. The structure of these six segments is roughly the same as those segments within the General Information Data Base which relate to degree auditing. Within the Student Data Base two additional segments have been added to indicate the credits that have been awarded toward fulfilling the requirements of the degree and the pending specialty (major and minor).

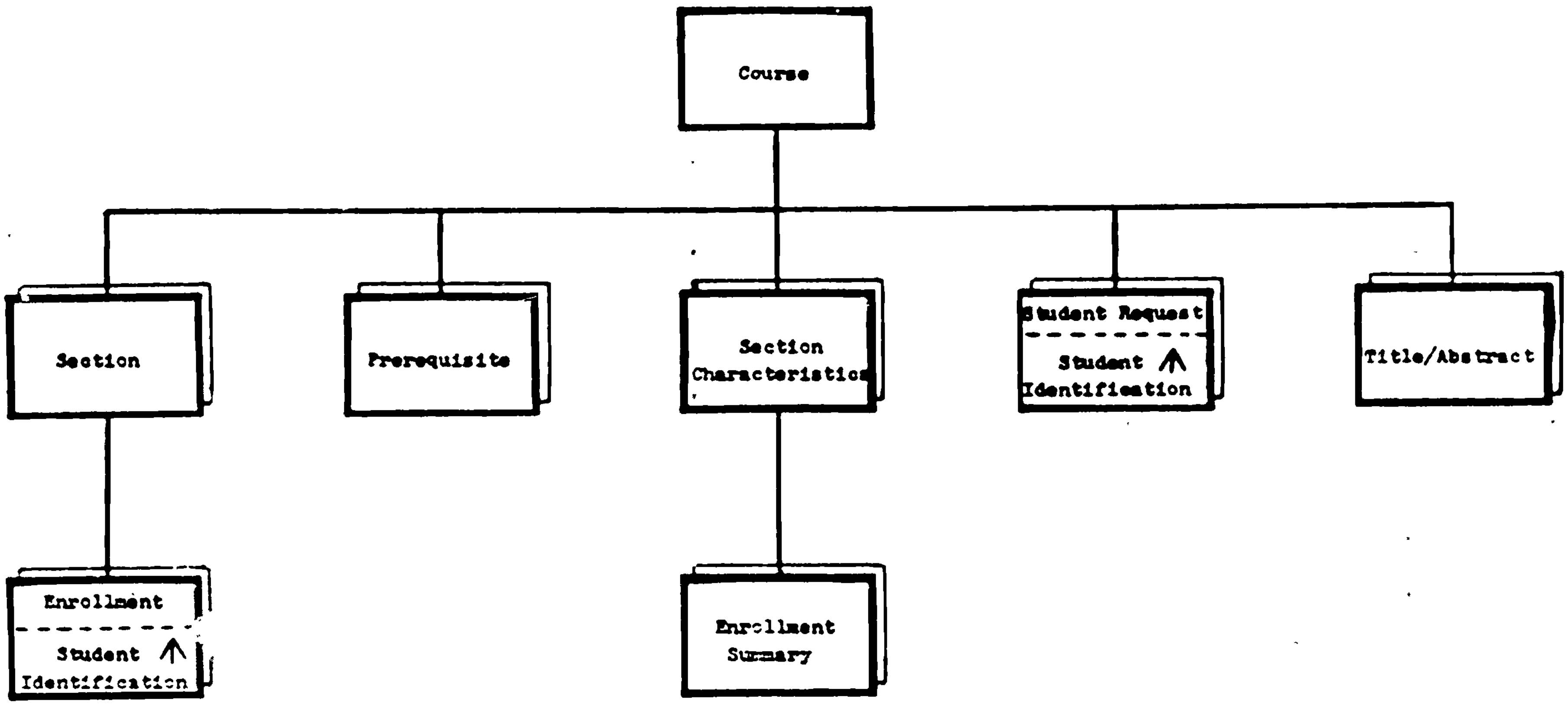
An added feature of this structure is that the same process used to perform a degree audit can also be used to perform a check of an underclassmen's progress toward a degree. This function is normally performed by counselors or is the responsibility of the student. If utilized properly, not only could a programming system perform this function, but it could also perform the function of determining unmet requirements for alternative majors and minors not yet elected by the student.

Curriculum Data Base

The Curriculum Data Base is constructed by superimposing two "logical" data bases. The first data base might be called the Course Master Data Base, and the second the Master Schedule Data Base. The Course Master Data Base contains data pertaining to the curriculum as defined in the institutional catalog, together with a summary of enrollment history and projection information. This logical data base should be used as the curriculum master for generating a master schedule for each term.

The Master Schedule Data Base, although containing much the same type of data as in the Course Master Data Base, contains data pertaining to specific classes within predefined terms. This is the data base that is used for registration and scheduling and contains all detailed enrollment information for a given term.

CURRICULUM DATA BASE

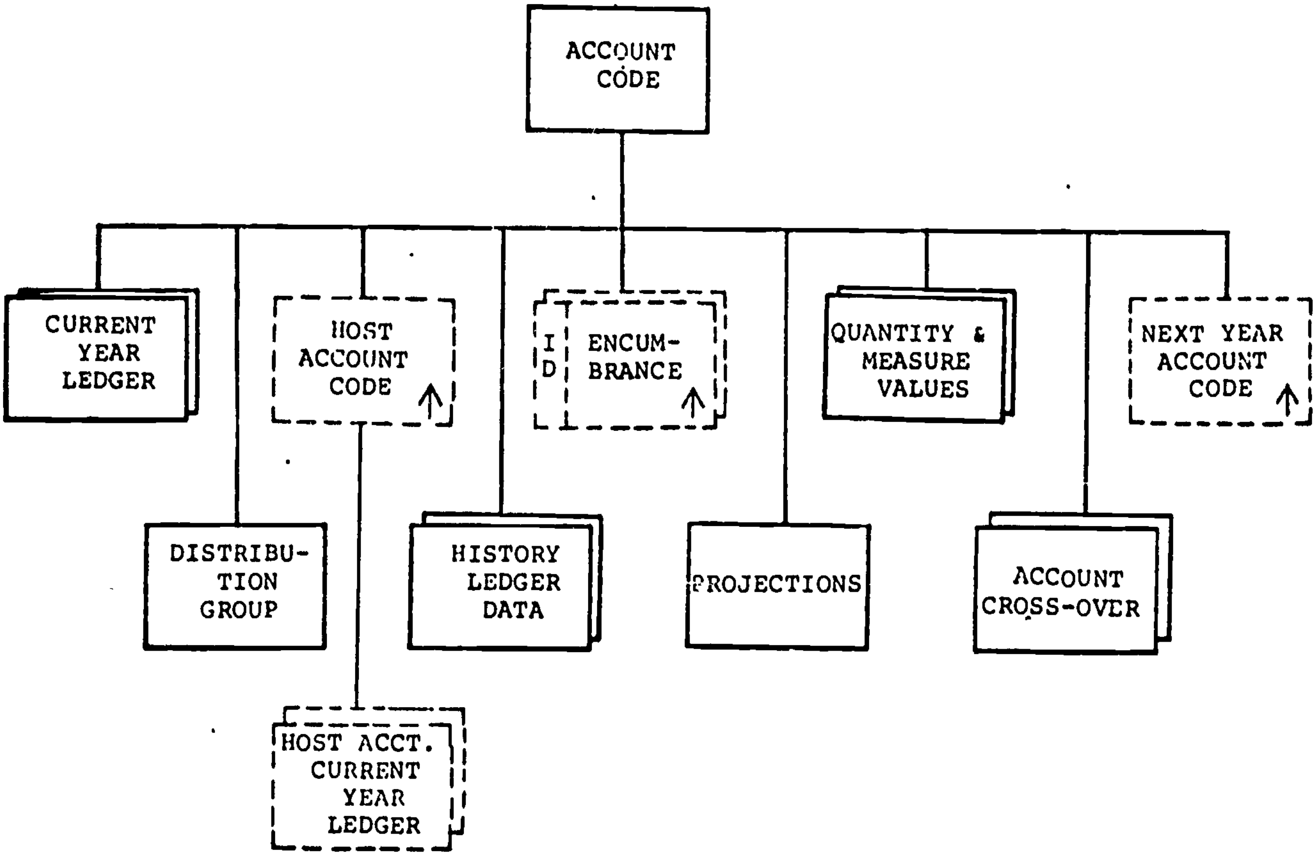


These two logical data bases can be easily superimposed since the root segment (Course) requires identical information, except that a scheduled course requires a term identifier whereas the Course Master Segment does not. This distinction then is used in distinguishing the two types of segments, since the term identifier is part of the key of the root segment. If the term identified is forced to blanks for the Course Master Segment, the two logical data bases can be superimposed.

One other distinction between the two data bases exists. The Course Master Data Base requires two segments not required by the Master Schedule Data Base, the Section Characteristics Segment and the Enrollment Summary Segment. Conversely, the Master Schedule Data Base requires two segments not required by the Course Master Data Base, the Section Segment and the Enrollment Segment together with the logical relationship to the Student Data Base. All of these segments appear as separate and distinct segments in the resulting Curriculum Data Base.

When initially installing the Curriculum Data Base, it would be wise to only install a portion of the Master Schedule Data Base, especially, the Scheduled Course Segment, the Section Segment, and the Enrollment Segment together with the logical relationship to the Student Data Base. If computer sectioning is used, then the Student Request Segment together with its logical relationship to the Student Data Base must also be installed. With only these segments a full registration and/or computer sectioning program would be possible. The next logical segments to be implemented would be the Section Characteristics Segment and the Enrollment Summary Segment. With the addition of these two segments, the system would be able to assist in building, if not completely generate, the Master Schedule for new terms. The Prerequisite Segment and the Title/Abstract Segment could later be added as desired.

ACCOUNT MASTER DATA BASE

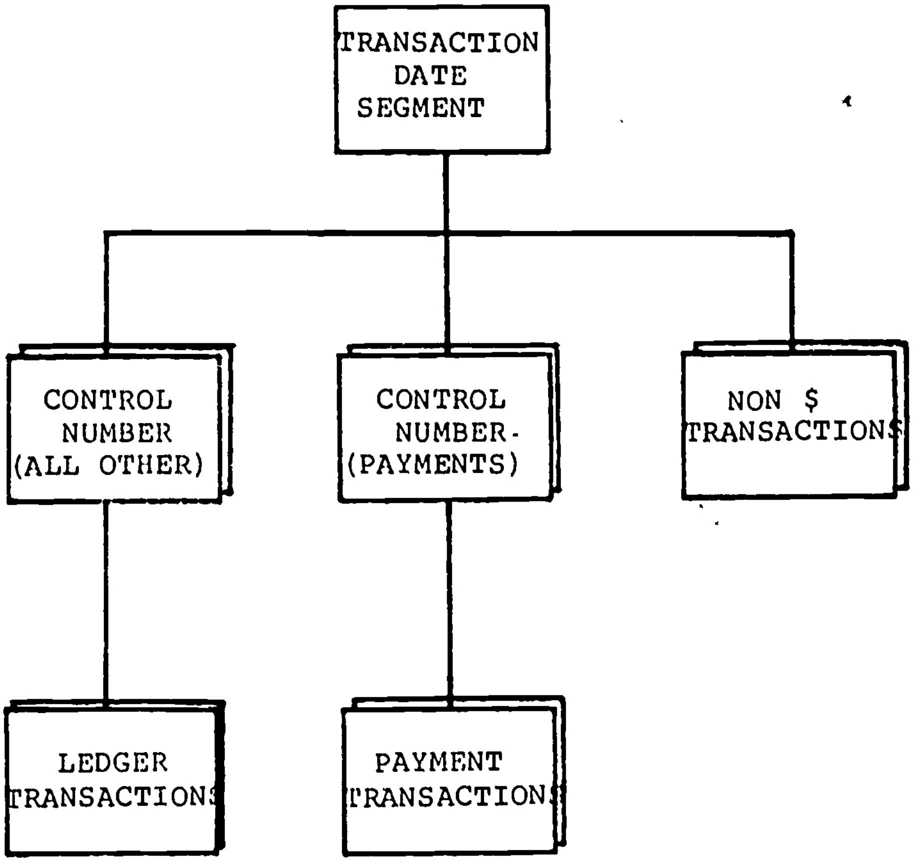


Account Master Data Base

The Account Master Data Base serves as a repository for financial information relating to the educational institution's accounts; i.e., assets, liabilities, revenue, expense, fund balance, etc. The data base is designed to be accessed by the user defined account code structure, although an optional facility is provided for accessing accounts by an assigned serial number (ASN) if the educational institution so desires. Segements have been defined in this data base to support functions as follows:

- Recording of account code descriptions for all aggregate and detail levels of the account code structure
- Tentative ledger segments to facilitate on-line access and update of up-to-date ledger fields
- Actual ledger segments to facilitate periodic batch update and reconciliation of tentative ledger segments
- Spreading charges over a number of accounts via distribution groups
- Budget transfers from host accounts to covered accounts
- Retention of history ledger data to be used for projections, comparative analysis, and program budgeting
- Linking of outstanding encumbrances to applicable accounts supports --
    - Viewing all outstanding encumbrances for a particular account
    - Preventing the user from issuing encumbrances against deactivated accounts
    - Preventing the user from deactivating accounts having outstanding encumbrances

TRANSACTION DATA BASE



- Projection and Quantity/Measure Segments allow required data to be carried for program budgeting activities and for planning future academic programs
- Account Cross-Over Segments to support translation of ledger data to external classification structures (i.e., WICHE, state and federal, etc.)
- Next Year Account Code Segments in conjunction with account distribution of ledger history (when required) supports addition and/or modification of accounts for the coming fiscal year transition

The functions outlined above are accomplished by utilizing a number of IMS DL/1 capabilities such as --

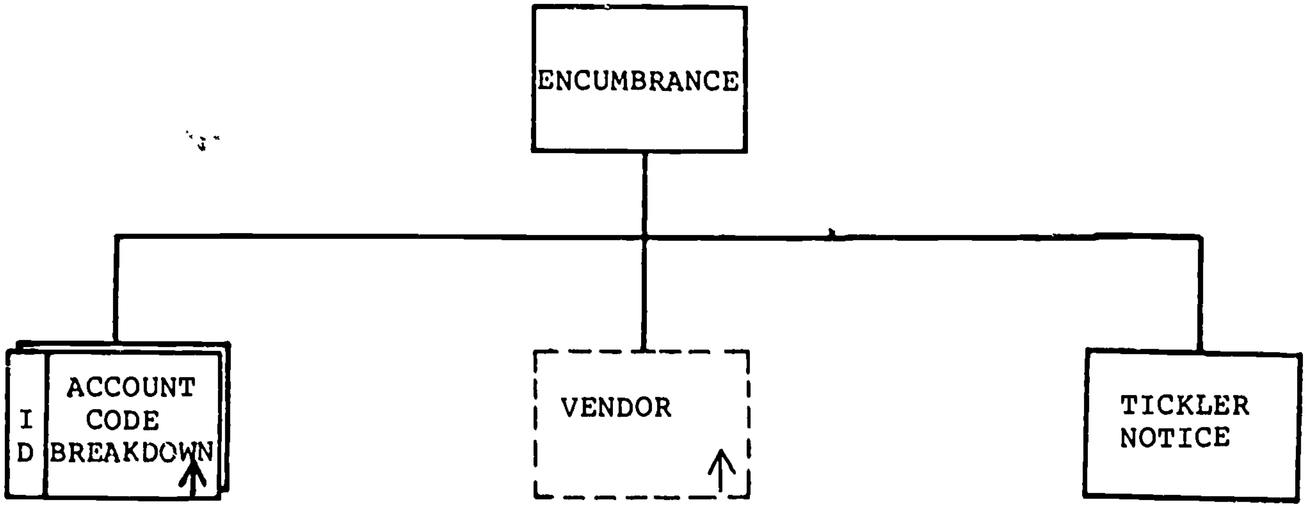
- Secondary indexes defined on ASN Number, Distribution Group Number, and Account Classification Code
- Logical relationship to the Encumbrance Data Base
- Logical relationships (Root-to-Root) within the Account Master Data Base in the case of Host Account and Next Year Account Code Segments

Transaction Data Base

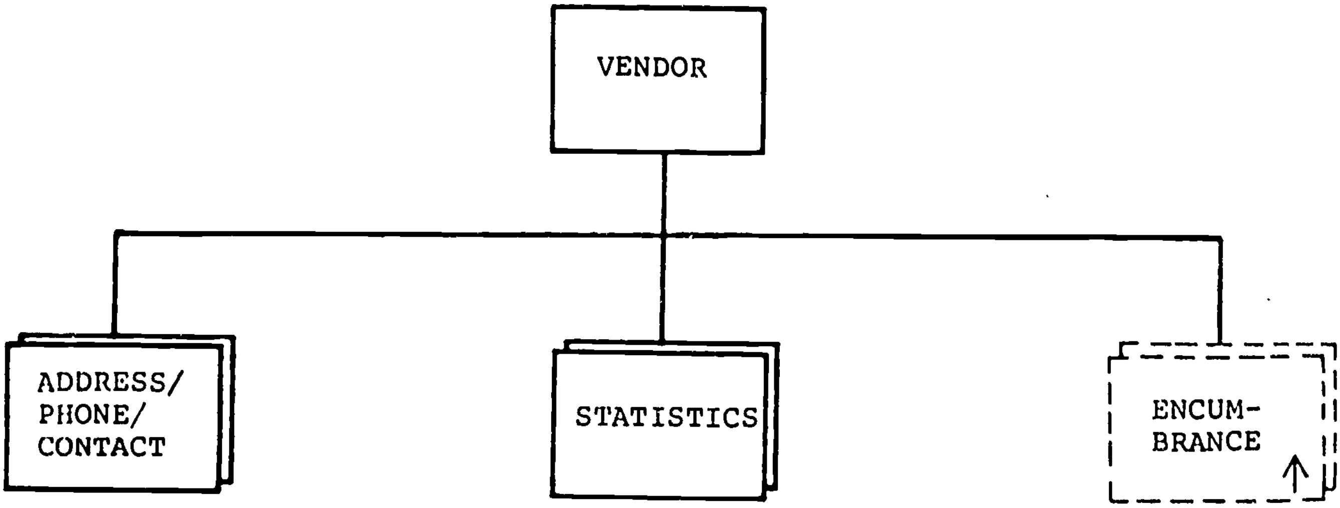
The Transaction Data Base supports the functions of controlling and reconciling the daily transaction processing, and providing the historical audit trail for the system. These functions are supported in three modes --

1. Batch input
2. Terminal input queued batch
3. On-line update

ENCUMBRANCE DATA BASE



VENDOR DATA BASE



In the on-line update mode the terminal operator performs a pseudo on-line update to tentative ledger segments with true balances. Regardless of the input mode, all transactions will be accumulated in this data base for eventual batch update (daily, weekly, etc.) to actual ledger segments. These transactions remain on the data base after processing to leave a permanent transaction audit trail. The data base is designed to accommodate journal transactions, payment transactions, and non-dollar type transactions.

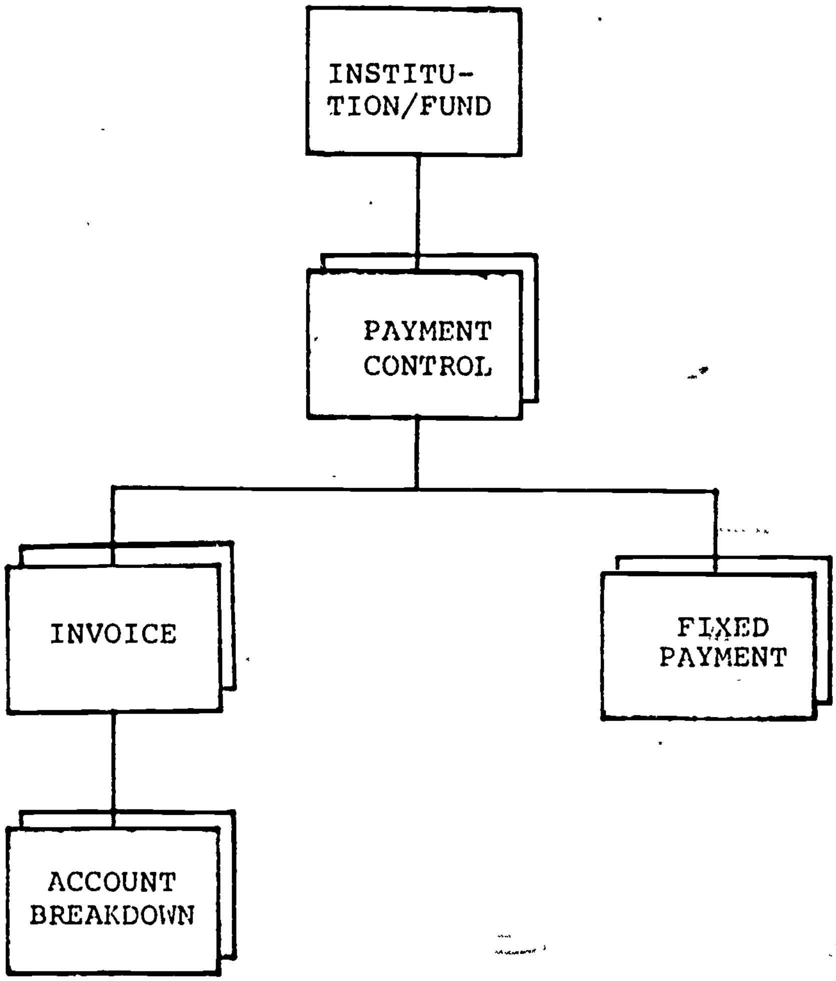
Encumbrance Data Base

The Encumbrance Data Base serves as a repository for all outstanding financial obligations encumbered by the educational institution. Encumbrance is used to describe this data base in the generic sense where encumbrance may mean a purchase order, fixed payment, rental contract, payroll commitment, etc. A broader benefit of this data base is the possibility of using it for applications on the income side as well as the expense side, where an encumbrance would be analogous to a pledge and vendor would be analogous to a donor or outright contributor. The data base design facilitates functions such as partial payments, spreading encumbrances over multiple accounts, relating encumbrances to vendors, and notification for lack of action against the various encumbrances.

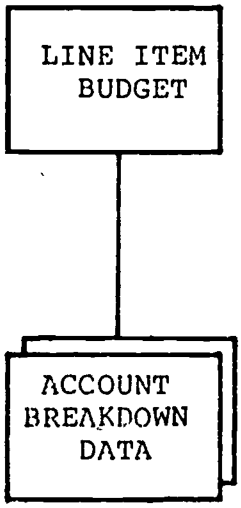
Vendor Data Base

The primary function of the Vendor Data Base is to store the vital statistics, payment policies, and contact information of vendors. In addition, a logical relationship to the Encumbrance Data Base relates outstanding encumbrances to the applicable vendor. The data base was

PAYABLES DATA BASE



LINE ITEM BUDGET DATA BASE



designed to handle vendors that supply goods and/or services, although the data base could lend itself to implementation of an external employee business expense application. For example, a Vendor Segment could be created for the applicable employee and travel expense data could be entered in the Payables Data Base. Employee reimbursement could then be handled by an accounts payable application. The name/address technique utilized for this data base is consistent with the Student: Name Address Data Base. The Vendor Data Base design provides a substantial amount of data required to support a sophisticated payment scheduling application.

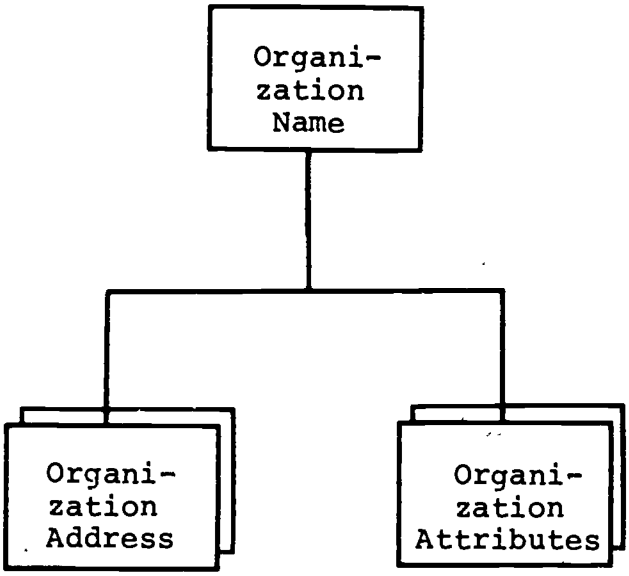
Payables Data Base

The Payables Data Base serves as a repository for all invoices, statements, fixed payments, etc., prior to payment. The Payables Data Base is a multi-function data base that is designed to handle several modes of operation as follows:

1. Payment of a single invoice from multiple funds
2. Payment of a single invoice from a single fund
3. Payment of a statement for multiple encumbrances from one or more funds
4. Automatic payment of recurring fixed payments such as mortgages and IBM leases
5. For all of the above, within a fund obtaining cash from one or more bank accounts

The Institution/Fund root segment allows operational choice of funds from which payments are to be made. It also facilitates keeping track of cash requirements by individual fund. Vendor Number in the Payment Control Segment is defined as a secondary index to allow access to payments by

ADDRESS DATA BASE



vendor. Bank Identification Number and Bank Account Number have been defined as a secondary index to allow access of the data base in the sequence required for printing checks.

Line Item Budget Data Base

The purpose of the Line Item Budget Data Base is to support user development of future budgets. It supports development of the annual budget or with multiple copies, biennial budgeting. Primary sequence of the data base is by line item budget number, although the use of secondary indexing allows access by account number as well. The data base design supports development of application programs which produce comprehensive budget development reports, as well as automatic transferral of the developed budget to become the adopted budget.

Address Data Base

The Address Data Base is designed to reduce the size of other data bases and to reduce the programming effort necessary to access address data by centralizing the storage and maintenance of addresses. The Address Data Base may be used to maintain names and addresses of secondary schools, colleges, vendors, alumni, contributors, and inter-institutional organizational units (departments, divisions, etc.). If the volume of addresses is large, or if because of a desire for a higher level of security it becomes an advantage to physically separate the various usages of the Address Data Base, it is possible to make a separate physical data base for each use (e.g., School Address Data Base, Organizational Unit Address Data Base, etc). However, the advantages of the Address Data Base are still present, since a single program can be used to access any of the physical data bases.

Unlike the Student and Curriculum Data Bases, the Address Data Base does not include an institution identifier as part of the key of the root segment. This implies that all data within the data base belongs to all institutions which have access to the data base. Since the primary usage of this data base is for secondary schools and institutions of higher education, it is felt that this data can easily be shared by all institutions using the data base. However, if the data base is used for other purposes, such as, inter-institutional organizational units, this may not be appropriate. At least three means of handling a separation of data are available:

1. Use separate physical Address Data Bases for each institution.
2. Use a type of institutional identifier as part of the organization code in the root segment.
3. Use the Organization Attribute Segment to define those institutions having access to the data. This will allow sharing of appropriate addresses while allowing private access to other addresses, but may degrade performance.

A SUCCESSFUL DATA BASE SYSTEM TRANSPLANT

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This paper describes the process whereby the needs of one institution in the area of research grants administration were met by the "transplant" of a "Project Administrative Support System" from Cornell University to the University of Alabama in Birmingham.

This case study briefly describes the University's need for a Project Administration Support System and the Cornell IMS Data Base solution to the problem. Major emphasis is placed upon those aspects of system exchange which are probably of most interest and concern to potential users of exchange systems. The details of negotiations and conditions for release and installation of the system are discussed. In addition, the status and usefulness of both technical and user oriented documentation provided as a part of the package are described and illustrated. Solutions to the problems of systems and data base compatibility are provided. The paper concludes with a summary of benefits derived by the University of Alabama in Birmingham from the exchange of this particular system.

Perhaps the most satisfying and challenging aspect in the world of computing and data processing is the atmosphere of change and the search for new techniques and improved methods for meeting our responsibilities.

A review of recent data processing literature is indicative of the direction of changes currently abroad in the world of data processing.

There is considerable interest in the mini computer and in distributed computing, significant interest in data base management systems and the long term impact of these systems. Interest in new techniques is evident by an emphasis upon structured programming. The performance of the Computer Center is subjected to more rigorous review by both data processing and executive management. Performance monitoring and the establishment of acceptable criteria for the measurement and evaluation of this performance is much in evidence.

There seem to be two evolutionary themes running through these areas of current interest.

First, a new awareness of the computer user and of the necessity to take the computer and computing to the user on terms which he can understand, and in a context to which he can relate. For example, the influx of interactive systems with packaged easy to use statistical procedures, program promotors, etc.

Secondly, there seems to be more managerial insistance upon an objective appraisal of the performance of the data processing function. Emphasis upon a cost effective performance is hopefully more the rule than the exception. Others much more qualified may predict the future course of the dynamic world of data processing. It is sufficient to say here that we at the Central Computing Facility at the University of Alabama in Birmingham are increasingly aware of our responsibilities in these two areas.

In recognition of these responsibilities, we have attempted in several ways to service the needs of our user community more responsibly and at the same time maintain a more cost effective posture.

One of the strategies we have adopted in this regard is to set aside our inhibitions toward N.I.H. software (not invented here) and when appropriate to the users need, install programs and/or packaged software written by others.

In pursuit of this strategy, we have on occasion purchased existing code from another institution to form the basic framework for our own systems design efforts. We have acquired several software support packages from computer manufacturers and from commercial software vendors. The University is currently engaged in a major student system definition process through contractural arrangements with a major software firm.

In addition, we have utilized system documentation available through the CAUSE system exchange on many occasions as a source of ideas and information relative to our system development needs.

Two systems from the CAUSE Library have been installed at the UAB.

The Continuing Education Information System was installed with considerable modification to meet local requirements. The second installed CAUSE system, a Grants Administration package, is to be the subject of the discussion today.

The University of Alabama in Birmingham

Before proceeding with the discussion of this particular system implementation, it seems appropriate to provide a brief overview of the University of Alabama in Birmingham and the environment in which this system was installed.

The UAB attained full University status ten years ago. The decade that followed has been one of uninterrupted growth in both physical facilities and enrollment. The present student enrollment is now in excess of 10,000 and still growing.

The UAB has a strong health services orientation. The campus includes schools of Medicine, Dentistry, Optometry, Nursing, and training programs for various medical technology specialities.

The UAB budget in excess of $100 million is the largest of the three institutions comprising the University of Alabama System. This ten year period of dramatic growth and expansion of the UAB has been evident in the Grants and Contracts area.

For the fiscal year ending July 1974, the UAB ranked 69th in the nation in total reported expenditures for Research and Development, and 25th in expenditures for Research and Development in the life services. The UAB ranked 38th in the nation as a recipient of Federal obligations for research during this same period.

The Need for a Grants System

With grant funds of this magnitude, there is an obvious need for an Information System capable of supplying a wide variety of information relative to Grants and Contracts. Unfortunately, the system in existence had fallen far short of these requirements.

The system in existence consisted in large part of data maintained in manual files. Some marginal reporting capability emanated from a series of tape files which were largely redundant to the grant accounting data maintained as a part of the University Accounting System.

It should be noted here that the accounting for grant funds is fully integrated into the University computerized accounting system. This system generates several levels of accounting reports and financial statements at varying levels of detail necessary to meet the fiscal reporting needs of the University.

The greatest need in the grants area was to provide for retention and recovery of data relative to grant application data, pre-award data, and to provide continuity of reporting capability through various project phases, departments, projects, investigators, functional areas, and funding sources. These data were not available through the University Accounting System.

There was also a need to provide the capability for reasonable response to unanticipated questions which have a way of arising at the most inopportune time.

The system we envisioned as meeting the University's needs for information availability is shown conceptually in Fig. 1. The blocks labeled "Existing System and Accounting System" represents the machine processable data available from other UAB automated systems. The balance of the data, if available at all, was available only from manual files.

The need for an automated system was obvious. The only question to be answered was whether to "make or buy". Our consideration of the "make or buy" question revealed several key facts:

1) User Department personnel had little or no exposure to or empathy for automated systems.

2) The impetus for installation of an automated system originated outside the User Department and at a higher organizational level.

3) There was very little information available as to the specific requirements an automated system was expected to fulfill.

4) The Grants Department had spent a considerable amount of time in unsuccessful attempts to define an acceptable system.

The critical nature of information requirements in this area, together with the need for a rapid remedy, made it imperative that we consider the quickest implementation.

At the suggestion of the Central Computing Facility management, the User Department contacted several users of similar systems. System description and user documentation was secured and reviewed by the User Department and by the technical staff of the Central Computing Facility.

General System Criteria

Several criteria were established as a basis for determining the acceptability of a system:

1) The system must meet or be modifiable to meet the needs of the User Department.

2) The system must be in an operational status in its present environment.

3) The system must be resonably well documented from both the user and data processing point of view.

4) The system must be written in one of the languages for which local support is available.

The Cornell package, available through the CAUSE systems exchange, seemed to meet all requirements except the language support. The system is written in PL/1, which is not the language of our production environment. There was, however, one additional factor present in the Cornell System which was considered to be of such potential benefit as to override the language requirement. The Cornell System was an IMS Data Base System.

One of our current objectives is the installation of IMS. We felt that installation of this system would provide us with additional experience in implementation and support of IMS.

Additionally, the implementation of an IMS based system would provide us with more flexibility for future application modification.

The Data Administration group at Cornell was concerned that the security of their data base might be compromised to some extent as a result of the transfer. They required that UAB sign an agreement not to disclose or make this information available to any group outside the Central Computing Facility.

Problem Summary

In retrospect, there appear to be several disadvantages and problems which will generally be encountered in such a system transplant.

The User Department did not participate in a systems design effort over an extended period and did not, therefore, develop a feeling of having installed 'their' system.

There continues to be some programmer reluctance to assume maintenance responsibility for outside applications software.

The installation of a data base system from outside may produce some problems in data naming conventions. These may be particularly troublesome when a data/dictionary directory, data element reporting convention employs data element name.

Internal political pressure involving the need and necessity for a system implementation may be exerted from above on the User Department. These internal pressures may be difficult to work around.

TECHNICAL DISCUSSION

Introduction

The Grants System arrived in July 1975. This system arrived in the form of seven PL/1 source programs unloaded on tape, and three documents.

One document, the Cornell Grants and Contract System manual, described:

1) The general contents of the System Data Base
2) The output of the report programs
3) A vocabulary list of technical words used throughout the manual

This main document was an excellent description of the system from a user point of view, but not directed toward the technical aspects of implementing the system.

The second technical manual listed Cornell's accepted abbreviations for various entries on the input form. The third manual, a keypunch document, contained instructions to the group responsible for transferring information on the input documents to punched card format.

Data Base Design

The system is designed as follows:

One IMS physical data base which contains -

1. The root segment - PRJROOT containing such information as:

   a) An arbitrary number comprised of the Julian Date and a 2 digit sequence number assigned to each project which uniquely identifies that project

   b) A title of free format TEXT information associated with the project

   c) The Project Administrator associated with the project

   d) The purpose of the project

   e) The kind of project

   f) The starting and ending dates of the project

   g) The college, school, and department with which the project is associated

   h) The sponsor and sub-sponsor of the project

   i) The institution allocated and sponsor allocated personnel associated with the project

2. A BUDGET Segment - Each occurrence of this segment details monies distributed through specific categories of the project budget during a recorded time period.

3. The INDIRECT Cost Segment contains information relating to Indirect Costs associated with a budget period.

4. The DIRECT Cost Segment is similar to the Indirect Cost Segment, but deals with Direct Costs.

5. The FOOTNOTE Segment contains any TEXT information associated with the project the user wishes to enter.

6. The SUSPENSE Segment contains TEXT information associated with a required action pertaining to the project, and a control date for that action.

7. The DISCIP Segment contains the general field of knowledge associated with the project.

8. The SPECLTY Segment further defines the DISCIP Segment.

9. The HISTORY Segment contains information dealing with the history of the project.

10. The Staff Segment contains the Social Security numbers of the Principal Investigator and other key personnel associated with the project. The purpose of this segment in the Cornell System is to use this information to access the Cornell Personnel Data Base and create another file containing Personnel information of staff to be used by the various report programs.

It was discovered very soon that the DBD of the described data base was not part of the included documentation. In order to implement the system as written, the DBD had to be generated.

Cornell was contacted and they explained that the DBD was deliberately omitted for security reasons. There were two alternatives: all the programs could be deciphered in the hope of obtaining enough information to construct the DBD, or persuade Cornell to reconsider. Cornell was contacted and they agreed to send the DBD.

Program Functions

The purpose of the Grants Program is to update the described data base and, from this data base, output the following kinds of batch reports: 1) A report listing detailed information about a project changed or created since some input date. 2) Various reports summarizing the Activity of Projects based on input beginning and end dates. For example, one report sums monies budgeted in the various categories by department within school within college. Another reports the same information but sorted by Sponsor and Subsponsor. Still another reports projects active by principal investigator.

Objectives

Our objective was to implement the system as written with no initial modifications, and to produce reports using sample data supplied by the UAB Grants and Contracts Department. The sample reports produced would be used as one input for evaluation of this package. Specifically, this involved compiling and linking the programs; developing JCL for the programs; writing an in-house interface program which would create an ISAM file containing information about key personnel associated with the project; working with the Grants Department in filling out the input forms; and finally, testing the programs with the sample data. Working with the user to get the forms filled out turned out to be the most laborious.

The technical problems were trival. It only took about forty person hours to get the system up and running from the time the data sets were loaded to the time output reports were produced. The programs were well documented and presented minimum problems in implementation.

Problems

The biggest obstacle to implementing the system was working with the user to get the input forms filled out. The first batch of forms, which documented ten projects, took four weeks to complete. There was a substantial communication problem between the analyst and the user. The analy,t had to implement a Grant System and knew nothing about grants - did not understand the vocabulary - did not understand the needs of the Grants Department, and had not the faintest idea whether the numbers produced by the reports were logically correct.

The Grants people on the other hand did not understand computers, i.e., did not understand why the input forms required picayunish meticulousness. The Grants people wanted the analyst to tell them what to enter on the input form, but the analyst did notunderstand the kinds of information the input forms were asking. Note that when a system is designed in-house, both the analyst and the user grow slowly to understand the vocabulary and needs of the other. When a system is transplanted there is an instant need for complete communication, yet the foundation for such communication has not been built.

This input form completion can best be described by the word 'grovel'. The analyst, out of desperation, embarked upon a crash course in Grant and Contracts concepts and vocabulary. This course succeeded in providing an impetus to progress in this communication area. However, the tutor for this course was not the user. Hindsight indicates that the selection of a tutor outside the user department was unwise. Encouraging the user to tutor the analyst may have resulted in the user becoming more involved with the system at an earlier date and accepting more responsibility for its implementation.

Through this period, these same input forms were submitted three times. Through this process, the user and the analyst came to understand the system they were working with. There is security in entering information and anticipating what will later happen to that information. Certainly from a technical viewpoint, the implementation of the Grants System is considered a success.

Benefits Long and Short Range

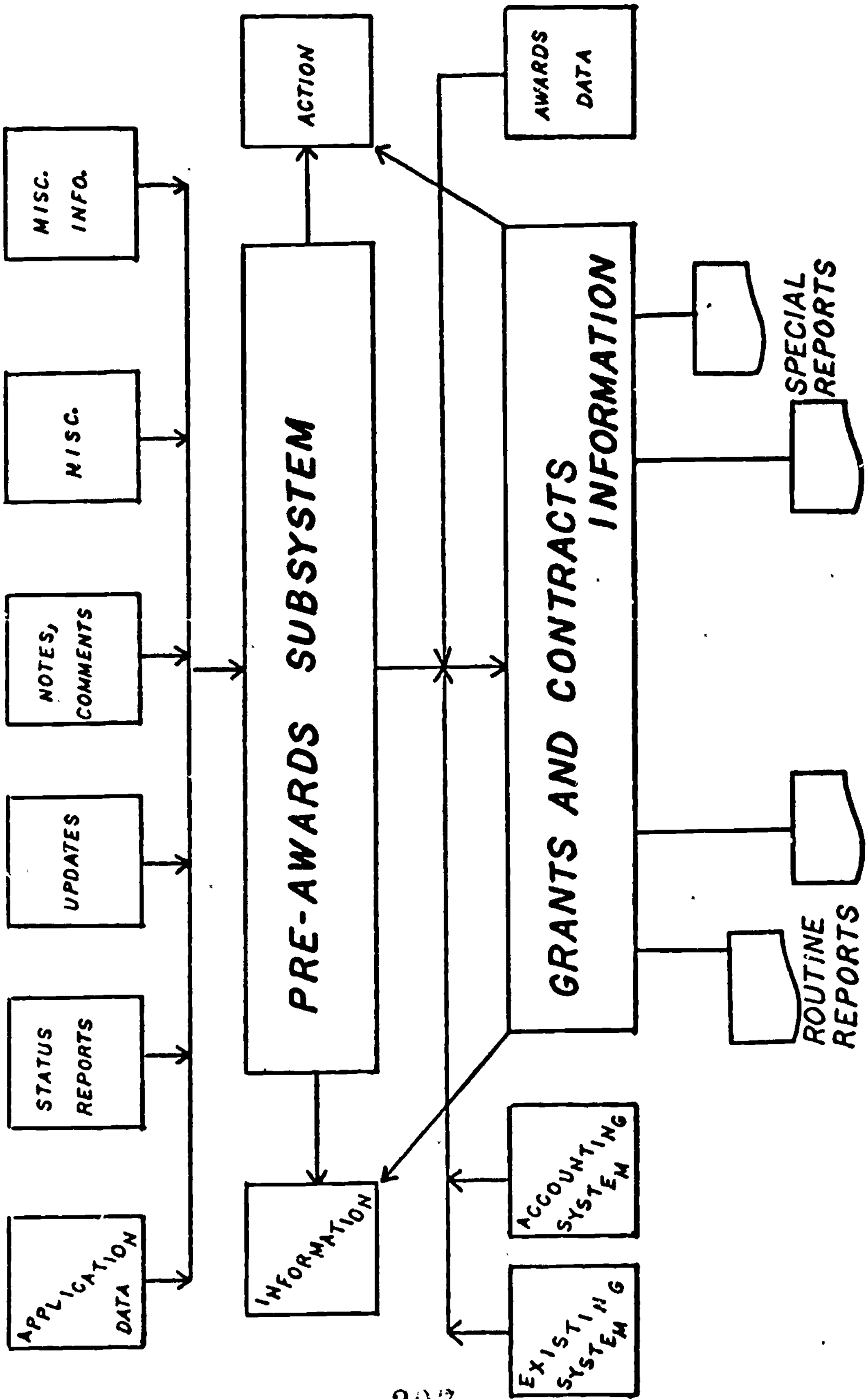
First, if one were to choose a system based on price alone, it would be difficult for any other system to be priced competitive with the Cornell System. We think we can justifiably say there were definite and substantial dollar savings associated with the implementation of the Cornell Grants and Contracts System.

Secondly, there were no development delays in meeting the needs of the user.

Thirdly, because this system is an IMS based system, it provided the UAB CCF with an opportunity to obtain additional IMS experience. UAB CCF implemented IMS about a year ago and have only recently completed an in-house education program for analysts and programmers in regards to IMS. Programmers and Analysts assuming support for this system can use the experience beneficially in a continuation of their IMS education.

The UAB did not implement this system as the total answer for meeting the needs of the UAB Grants and Conracts Department. It does partially meet those needs. Yet, it can play a greater role by giving the user experience in working with a totally computerized system. It is hoped that after a year's experience with this system, the USER may be able to specifically define his needs and produce a problem definition for a system tailor-made for the UAB Grants and Contracts Department. Implementation of such a tailor-made system should be relatively straightforward since all data associated with a project will already be in machine processable format.

Finally, if a system will be enhanced at some future date, nothing could offer more flexibility than starting with an IMS based system. Segment TYPES can be added at a future date, the IMS access method may be changed, a moderate amount of file restructuring can be accomplished and on-line data base activity can be implemented with no impact on existing programs accessing that data base.



APPLICATION DATA
STATUS REPORTS
UPDATES
NOTES, COMMENTS
MISC.
MISC. INFO.
PRE-AWARDS SUBSYSTEM
INFORMATION
ACTION
GRANTS AND CONTRACTS INFORMATION
AWARDS DATA
ACCOUNTING SYSTEM
EXISTING SYSTEM
ROUTINE REPORTS
SPECIAL REPORTS

FIG. 1

MATCHING STUDENT DEMAND TO THE MASTER SCHEDULE

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This paper is concerned with the improvement in the building of the Master Class Schedule based on the advanced collection of student class requests which allow only the course abbreviation and course number to be specified along with a time specification. Students specify time in large increments (morning, afternoon, evening - 3 days, 2 days, 5 days a week) and are able to make time exclusions in the same manner. The System is a combination of a batch scheduler of students' courses and an on-line Drop/Add system as a follow-up to the scheduler. A batch management reporting system highlights potential class conflicts and required adjustments to the master class schedule.

Although the topic of this presentation is oriented toward the management uses of student demand data to modify the master course schedule, it would seem appropriate to describe Miami-Dade Community College, how this project developed including its management, the on-line system that supports the registration effort and the batch scheduling system.

Miami-Dade is a large, metropolitan commuting college that supports many comprehensive educational programs including not only the traditional freshman and sophomore transfer degree programs but also one and two year certificate programs ranging from technical studies to mortuary science. Three major campuses are now in operation with the fourth, the Medical Center Campus, being constructed now. In addition, we teach programs at various centers throughout the county from Homestead Air Force Base to the Dade County Jail.

This diversity of objectives in educational plans and the multitude of class locations puts a burden on data processing in two ways: first, the time that it takes to coordinate the definition of a project and to complete its implementation is multiplied by a geometric, not an arithmetic factor and, second, each autonomous operation tends to want to develop the system to meet its specific needs and objectives. I often marvel at how some of the smaller colleges with less equipment and resources can design and implement systems considerably faster than we can -- what I fail to recall is that we used to do the same thing ten years ago when we were considerably smaller and less complex.

To provide some statistics about our college let me quote the following: The Fall 1975-76 showed 37,669 students enrolling for 379,644 credit hours or a full-time equivalency of 25,310. Non-credit registrations added 5,885 students to the above figures. The computer files show 110,000 student biographical records, 211,000 student course records covering five terms and over 5,000 course sections for the Fall term. There are also 111,794 current students in the active cumulative transcript system which was started in 1972 and 56,346 in the inactive transcript file. Since our opening in 1960 some 232,731 students have attended Miami-Dade.

Project Background

The college administration has been interested in developing a computer sectioning program as far back as ten years ago, but because of other priorities specific work on the project did not begin until the Summer of 1971. At that time we contacted several outside vendors to investigate the current marketplace, but we were also working internally to design the necessary tables and their structure should we opt to build the schedular* ourselves. By September I was satisfied enough with the scheduling program to submit an internal bid for the construction of the schedular which was reviewed along with three external bids by the college. Obviously, we chose to build our own and the project started early in 1972.

The most important thing about this decision from a data processing point of view was the college's recognition that large, comprehensive systems cannot be undertaken by a data processing staff already struggling to maintain the existing systems. Included in the bid was a staffing request for four (later expanded to five) new people to devote solely to the project.

*I prefer this spelling to scheduler in order to emphasize that the schedular is inanimate.

This decision ultimately led to the creation of a separate data processing division whose responsibility is large, project oriented systems. Presently, twelve data processing personnel are engaged in the development of Registration and Personnel/Payroll systems.

The registration project team was controlled by a committee of five -- the registrars from the then existing three campuses and one project analyst and myself representing the data processing function. In my view, the selection of this very small committee was most important to the project. It placed the responsibility for the development of the project directly in the hands of those most qualified to define the specifications but more significantly it was placed directly in the hands of those who would have to live with it in their day-to-day operations.

The Total Registration System

After the specifications for the schedular were completed, the committee felt strongly that additional computer systems were needed to enable the college to control the number of seats in the master schedule during the drop/add activity that would follow the running of the batch schedular. This problem became known as "seat recovery" and led into the development of an on-line admissions/drop/add/schedule maintenance system. This was, of course, a project considerably larger than our first charge of developing the batch schedular. Needless to say, the implementation time table increased dramatically. In April 1975, the Spring semester was used to test the system fully by depending upon the complete, new system. Subsequently, the Summer, Fall and Winter semesters have been run giving us one full year of operation to proof, critique and revise the system.

Functions of the On-line System

The on-line system supports the following functions:

1. Entry of a new student to the file.
2. Maintenance of all student data.
3. Entry and maintenance of the Master College Catalog.
4. Entry and maintenance of the Master Course Schedule.
5. Entry and maintenance of Student Course Requests.

All of these functions are processed by key-driven, cathode ray terminals staffed by registration personnel.

Each drop/add transaction checks for an available seat in an add request, returns the seat for a drop, conflict checks each transaction, prints a current student schedule in the Registrar's area and punches a fee card in the Bursar's office. Although it greatly increases the system overhead, the system always maintains the current seat (enrollment) count in every course section. This feature was a prime need and justification for the on-line system as the committee felt that losing control over the seat counts after spending much time and energy in collecting student course demand data, manipulating the master course schedule and assigning students to course sections by computer reduced most of the advantages of scheduling. Controlling the average class size is viewed as extremely important by the college administration as it relates directly to instructional costs and is also an integral part of each courses "instructional plan". To paraphrase a statement made by the college administration at Miami-Dade -- "Registration is the easiest process through which the college can lose money".

The Scheduling Process

The student may request courses from the batch schedular by specifying only course abbreviation and course number. Time is specified in large blocks such as morning, afternoon, evening, on two, three or five days per week. During this phase, the students cannot request a particular section. This approach was possible because of the large number of students who enroll in general education, multi-section classes. Provisions are made for the exclusion of time blocks, alternate course requests and a box is provided to allow the student to state whether class meeting times are more important than primary courses. This last decision tells the schedular which path to take if the primary course requests cannot be satisfied at the first choice of time -- try alternate course at first time choice or primary courses at an alternate time.

Exhibits #1 through #4 show the results of the four scheduling runs. Full schedules ran from 73.4% for this coming Winter to 80.9% for last Summer. The factors that influence these numbers are many and even vary from campus to campus. External influences also affect the results. For example, last Spring more students were processed by the schedular than were anticipated for that entire term with a resulting 75.2% full schedules. Fall's run produced 79.8% full schedules with about two thirds of the students processed.

Modifying the Master Schedule

Trying to match student demand to campus facilities and teacher availability is, I am sorry to report, still an art, not a science. But some progress has been made in reducing the amount of data to be examined, pointing out potential problems (sometimes suggesting solutions) and confirming what we suspect with facts and figures.

In the hands of a capable and effective administrator the data that this system presents can be used to modify the master schedule very effectively. During our committee's conceptualization of this segment of the system, the role of this individual, the Scheduling Officer, became clearly defined to all even though we recognized the problems of implementing the concept on our own diverse, individually managed, reasonably autonomous four campuses. Never-the-less, we charged forward on our course to try to improve the building of the master schedule by providing new reports and aids.

Step 1 - Building the Interim Schedule

Since many of the same courses are taught at the same time and in the same rooms for the equivalent semesters, the first step in building the master schedule is to copy forward the ending master schedule from the previous like term; that is, last Fall is used to create next Fall or Winter to create Winter. A simple batch program is used to copy the selected data, changing the year while deleting the old semester from the file.

After the file has been created, a Room Utilization Report is generated to show the load on the campus if all of the seats in the master schedule were taken. This report has two purposes, first to make sure that the maximum load on the campus during any time period does not exceed 3,000 students and second, at the division level, to make sure each has an appropriate proportion of 7:00 a.m. and later afternoon classes. (Exhibits #5 and #6)

The remarks made herein concern our South Campus' use of this system, and perhaps some comments concerning its organization and administration would be in order here. The control of the master schedule is ideally placed in the Vice-President's office where the scheduling officer reports directly to the Vice-President and also serves as his assistant. This is not to say that the department chairmen have little or no say in the building of the master schedule, but rather that, when a difference arises, it can be settled using a campus perspective.

Average class size plays an important role in the decision making process at Miami-Dade in that each course must specify the expected average class size before it is approved by the curriculum committee. As you might expect, the average class size varies widely from the general education courses to the narrow range courses such as in technical courses. It is through the establishment and adherence of the average class size that Miami-Dade is able to meet the educational demands and needs of the community.

The South Campus Vice-President has established a target load ratio between morning and afternoon classes at 58% and 42% respectively. Exhibit #7 shows the humanities division ranging from 56% to 60% in the morning with 20% to 47% in the afternoon. This gives a 61% to 39% ratio, a somewhat high figure which will be changing before the schedule is fixed.

The 3,000 students per hour on campus maximum takes into consideration available classroom seats, parking spaces, carpooling, buses, and oncoming and departing students. Its validity was tested when it was allowed to rise to around 3200/hour this Fall and, although the campus has the classroom seats available, the parking lots overflowed until students had to park on the grass -- we will return to the 3,000 limit.

Step 2 - Collection of Student Course Requests

The students use the Course Request Form (Exhibit #8) to specify primary and alternate courses, time preferences and time exclusions and other necessary data.

The data is entered on-line by terminal operators, fully edited and cross-checked and stored in a semester-oriented course record. We have entered this data both with the student standing by the terminal and after the student has left. Of course, no known data entry errors remained if the student waited, although some 8% to 10% were encountered if the student were not available for questioning. Many of these errors were due to problems not directly relating to course selection such as library or financial obligations, but which are included in the system because it is a common processing point. Excluding the first and last day of entering requests, the average wait time was about ten minutes or less in any one line.

Step 3 - Summary of Student Enrollment Requests

After a reasonable amount of student requests have been entered the Summary of Student Enrollment Requests Report is run (Exhibit #9). This program uses as input the projected number of students and the projected student semester hours -- both by campus and division. The projections are supplied regularly by Institutional Research. This report shows 48.0% of the expected number of students for this campus have been entered into the request system and they account for 55.7% of the expected student semester hours. The same calculations are made based on expectations at the division level. Although one would logically expect the division level statistics to be more accurate, experience has shown the South Campus Registrar that the campus figures are more reliable.

In the body of the report, column A represents the campus time block configuration. Examining the report closely, one can find an overlap between 1:00 a.m. and 2:00 p.m. This is not an error but the creation of a bridge so that single section courses may be placed in a time common to and available to both the morning and afternoon student. A copy of the specific instructions is provided in Exhibit #9 for your review. For our purposes here columns G and H are the most significant. This report shows 50 more seats needed in the morning and 17 more needed in the afternoon and 36 less needed at night -- a net increase of 31 seats. Since the last line (average class size based on total seats in the master schedule) is the planned class size according to the instructional plan, one more daytime section is clearly warrented.

If this report indicates the master schedule should be changed, then the Scheduling Guidelines Report is consulted next (Exhibit #11). This shows the enrollment count for the last seven semesters. If, as in the case of APD 120, this report shows a change trend (hopefully the same) and in this case it does: 191 to 212 for Fall to Fall; 129 to 150 (from column C) expected for Winter. The daytime enrollment already has 88.5 seats taken (E) which is 98.33% (F) of the total seats in the master schedule. One would feel comfortable under these circumstances in adding another daytime section with around only half of the expected students in the system.

Exhibit #12 shows a projected need of 89 daytime seats, but only 1 section of 30 was added. Exhibit #13 shows 23 seats needed, but none were added. Exhibit #14 shows 280 seats in the schedule but many in the wrong time. Each course is an individual circumstance and must not be considered in a vacuum. For instance, AHA 161 (Exhibit #13) is a nursing course and is severly restricted because of clinical facilities. The projections are wrong here because a larger than average share (57 of a planned load of 60) have already requested courses. LAE 160 (Exhibit #14) shows that 88 seats should be deleted, but only 104 of 280 students have requested this course.

In total then this phase of the operation provides the scheduling officer with a course by course status of enrollment projections. Exceptions beyond a limit are flagged by an asterisk in column G with the final decision being made by the individuals concerned.

Step 4 - Conflict Analysis for Single Time Course Requests

Thanks to Miami University (Ohio) we were able to adapt a conflict analysis report of theirs to our needs. This report not only identifies which courses are single sections, but also provides a list and count of all other courses that students who have requested this course have requested. Exhibits #15 and #16 identify two courses, LAE 162 and LAE 262 who conflict with each other and there are six students who will receive partial schedules if nothing is changed.

Additionally, a time matrix is provided to guide the scheduling officer in moving one of the courses into a time which would eliminate the original conflict and not create others. Any time indicated zero would satisfy all requests -- perhaps MWF at 9:00 a.m. or 10:00 a.m. or 1:00 p.m.

This conflict analysis step completes the change cycle before the schedular is run. Of course, the iteration may be run as many times as is necessary depending on the availability of time.

Reviewing the System

In this part of the presentation, I shall try to evaluate the current status of the system in terms of its success and acceptance including some of the problems we encountered, both solved and unsolved.

The Scheduling System

After the batch schedular was run for the Fall semester (the third time for real, but the first large term), 79.8% of 23,504 students received full schedules 54.8% of which got their primary courses at their first choice of time, 19.8% got their primary courses at an alternate choice of time, 3.7% got primary and alternates at first time choice and 1.5% got primary and alternate courses in an alternate time choice. On the surface, this means that the schedular satisfied four out of five students within the course and time parameters submitted by the student.

However, the following problems worked against those totals.

1. The length of time from when the request was made until the start of class. (May to August)
2. Over 25% of the students specified some time exclusion parameter.
3. An error in the program allowed night students to be scheduled into the daytime if the request could not be filled at night thus increasing the number of full schedules.

In an effort to measure student satisfaction using something other than subjective criteria, we wrote a program to tally the number of times students changed their schedule. We hoped that the statistics could show at least two facts:

1. Was the drop/add pattern different between a student who was registered by the schedular and those registered afterward by the drop/add program?

2. What was the lowest level of student satisfaction? This could be shown by counting those students who made no changes to their schedule at all. Although this measurement ignores the reason for change (the schedular produced an unacceptable schedule vs. a change in the student's circumstances), no change clearly indicates satisfaction enough not to warrent the student's processing a drop/add request.

The results from this study were not conclusive because of some transactions were processed without recording the date and time of the change. It did show that 42% of the students who received full schedules by the schedular did not change (7,787 of 18,586). Students who registered later did better with 62% no changes after about six weeks of classes. Conclusions are hard to reach from this data because of many interacting factors.

We were able to plug the holes in collecting the data so that the Winter report will be more accurate and hopefully more conclusive.

The schedular run for the Winter showed a reduction in the percentage of full schedules to 73.4 with the other figures being 51.4, 16.6, 4.3, and 1.7%. Since we fixed the error in the program a reduction in the number of full schedules was not surprising. The remaining percentages do not vary too widely from the Fall.

Probably the biggest problem encountered, and not yet resolved, in installing a scheduling program is the feeling of uncertainty. We spent many hours testing the computer side of the system only to experience major problems in the people processing. All of the problems concerned with people processing and the management of lines have the capability of being improved, except for this one complaint: "I requested courses on the first day of pre-registration and I did not get what I needed". Truthfully, I know of no good answer to that question, but it does highlight a much larger question that concerns the basic problem that we are trying to solve: the allocation of resources and who is first. What should we try to do? For whom? (students, faculty, college) and how much should we spend?

The On-line System

The on-line part of the system was well received and is subject to the same criticisms as any other on-line system:

1. What do you do when the system is down?
2. The terminals respond too slowly.
3. It is costly!
4. Why must students stand in line?
5. The printers get too far behind.

We have made significant improvements in both the reliability and response times, but we can still make some improvements. It would seem that the responses time reaches about three or four different levels depending upon the load. To provide some idea of the system load, Exhibit #18 may be helpful. There is obviously a narrow point of transaction processing that should not be exceeded. The most drop/add transactions that have been processed in a day exceeded 9000.

The November 1975 issue of Datamation had a two page article on "The Ten Laws of Teleprocessing" by David Herbditch. I found it both factual and entertaining. It confirmed some of my own feelings, verbalized some of my intuitions and read much like my own experiences. I urge you to read it in depth.

Conclusions

The impact of this kind of system upon the main computer system is dramatic and exceedingly hard to predict except to say that it is significant. The change from batch files to direct access, non-data redundant, coordinated files costs additional processing time, eliminates many problems associated with batch processing and changes the mode of operation of the computer center. This is an exceedingly complex system, made of many individual and interrelated parts. We have only started to use the potential of the system and it will take us a long time to adapt its best features to the operating mode of each of our campuses.

Is the system is worth the cost? It is still too early to judge for it is a system that changes the operating mode of people and that is a slow, adaptive process. One fact is obvious -- that what we had was not satisfactory. Raising the average class size by one over the whole college will easily pay for the system. The risk/reward ratio in that statement opens a myriad of possibilities and gives one something to think about.

MIAMI-DADE COMMUNITY COLLEGE
RESULTS OF THIS SCHEDULING RUN

ALL CAMPUSES--YEAR & TERM 74-3

TOTAL NUMBER OF STUDENTS PROCESSED 21,044

THOSE STUDENTS REQUESTING TIME OVER COURSE PREFERENCE	11,026
THOSE STUDENTS REQUESTING COURSE OVER TIME PREFERENCE	5,887

NUMBER & PERCENTAGE OF STUDENTS WITH COMPLETE SCHEDULES			NUMBER & PERCENTAGE OF STUDENTS WITH PARTIAL SCHEDULES	
15,822	75.2%	OVERALL TOTAL	3,691	17.5%
11,582	55.0%	WITH PRIMARY COURSES AT FIRST TIME CHOICE	180	00.9%
2,519	12.0%	WITH PRIMARY COURSES AT ALTERNATE TIME CHOICE	3,466	16.5%
1,454	06.9%	WITH PRIMARY & ALT. COURSES AT FIRST TIME CHOICE	1	00.0%
267	01.3%	WITH PRIMARY & ALT COURSES AT ALTERNATE TIME CHOICE	44	00.2%

STUDENTS DENIED FULL SCHEDULES DUE TO COURSE CONFLICTS	1,876	08.9%
STUDENTS DENIED FULL SCHEDULES DUE TO COURSES BEING CLOSED OR NOT OFFERED AT REQUESTED TIME	1,668	07.9%
STUDENTS DENIED FULL SCHEDULES DUE TO COMBINATION OF ABOVE TWO REASONS	147	00.7%
STUDENTS NOT SCHEDULED DUE TO CLOSED COURSES OR COURSES NOT OFFERED AT TIME REQUESTED	1,531	07.3%

EXHIBIT 1

MIAMI-DADE COMMUNITY COLLEGE
RESULTS OF THIS SCHEDULING RUN

ALL CAMPUSES--YEAR & TERM 74-4

TOTAL NUMBER OF STUDENTS PROCESSED 10,832

THOSE STUDENTS REQUESTING TIME OVER COURSE PREFERENCE	5,784
THOSE STUDENTS REQUESTING COURSE OVER TIME PREFERENCE	3,131

NUMBER & PERCENTAGE OF STUDENTS WITH COMPLETE SCHEDULES			NUMBER & PERCENTAGE OF STUDENTS WITH PARTIAL SCHEDULES	
8,762	80.9%	OVERALL TOTAL	1,501	13.9%
7,470	69.0%	WITH PRIMARY COURSES AT FIRST TIME CHOICE	234	02.2%
789	07.3%	WITH PRIMARY COURSES AT ALTERNATE TIME CHOICE	1,240	11.4%
431	04.0%	WITH PRIMARY & ALT. COURSES AT FIRST TIME CHOICE	3	00.0%
72	00.7%	WITH PRIMARY & ALT COURSES AT ALTERNATE TIME CHOICE	24	00.2%

STUDENTS DENIED FULL SCHEDULES DUE TO COURSE CONFLICTS	774	07.1%
STUDENTS DENIED FULL SCHEDULES DUE TO COURSES BEING CLOSED OR NOT OFFERED AT REQUESTED TIME	666	06.1%
STUDENTS DENIED FULL SCHEDULES DUE TO COMBINATION OF ABOVE TWO REASONS	61	00.6%
STUDENTS NOT SCHEDULED DUE TO CLOSED COURSES OR COURSES NOT OFFERED AT TIME REQUESTED	569	05.3%

EXHIBIT 2

MIAMI-DADE COMMUNITY COLLEGE
RESULTS OF THIS SCHEDULING RUN

ALL CAMPUSES--YEAR & TERM 75-1

TOTAL NUMBER OF STUDENTS PROCESSED 23,504

THOSE STUDENTS REQUESTING TIME OVER COURSE PREFERENCE	9,234
THOSE STUDENTS REQUESTING COURSE OVER TIME PREFERENCE	6,940

NUMBER & PERCENTAGE OF STUDENTS WITH COMPLETE SCHEDULES			NUMBER & PERCENTAGE OF STUDENTS WITH PARTIAL SCHEDULES	
18,761	79.8%	OVERALL TOTAL	4,168	17.7%
12,873	54.8%	WITH PRIMARY COURSES AT FIRST TIME CHOICE	362	01.5%
4,655	19.8%	WITH PRIMARY COURSES AT ALTERNATE TIME CHOICE	3,759	16.0%
881	03.7%	WITH PRIMARY & ALT. COURSES AT FIRST TIME CHOICE	3	00.0%
352	01.5%	WITH PRIMARY & ALT COURSES AT ALTERNATE TIME CHOICE	44	00.2%

STUDENTS DENIED FULL SCHEDULES DUE TO COURSE CONFLICTS	1,251	05.3%
STUDENTS DENIED FULL SCHEDULES DUE TO COURSES BEING CLOSED OR NOT OFFERED AT REQUESTED TIME	2,326	09.9%
STUDENTS DENIED FULL SCHEDULES DUE TO COMBINATION OF ABOVE TWO REASONS	591	02.5%
STUDENTS NOT SCHEDULED DUE TO CLOSED COURSES OR COURSES NOT OFFERED AT TIME REQUESTED	575	02.4%
STUDENTS NOT SCHEDULED DUE TO NON-PAYMENT OF DEPOSIT	3,971	

EXHIBIT 3

MIAMI-DADE COMMUNITY COLLEGE
RESULTS OF THIS SCHEDULING RUN

ALL CAMPUSES--YEAR & TERM 75-2

TOTAL NUMBER OF STUDENTS PROCESSED 18,977

THOSE STUDENTS REQUESTING TIME OVER COURSE PREFERENCE	5,661
THOSE STUDENTS REQUESTING COURSE OVER TIME PREFERENCE	4,499

NUMBER & PERCENTAGE OF STUDENTS WITH COMPLETE SCHEDULES			NUMBER & PERCENTAGE OF STUDENTS WITH PARTIAL SCHEDULES	
13,930	73.4%	OVERALL TOTAL	4,647	24.5%
9,750	51.4%	WITH PRIMARY COURSES AT FIRST TIME CHOICE	199	01.0%
3,044	16.0%	WITH PRIMARY COURSES AT ALTERNATE TIME CHOICE	4,403	23.2%
815	04.3%	WITH PRIMARY & ALT. COURSES AT FIRST TIME CHOICE	3	00.0%
321	01.7%	WITH PRIMARY & ALT COURSES AT ALTERNATE TIME CHOICE	42	00.2%

STUDENTS DENIED FULL SCHEDULES DUE TO COURSE CONFLICTS	1,395	07.4%
STUDENTS DENIED FULL SCHEDULES DUE TO COURSES BEING CLOSED OR NOT OFFERED AT REQUESTED TIME	2,606	13.7%
STUDENTS DENIED FULL SCHEDULES DUE TO COMBINATION OF ABOVE TWO REASONS	646	03.4%
STUDENTS NOT SCHEDULED DUE TO CLOSED COURSES OR COURSES NOT OFFERED AT TIME REQUESTED	400	02.1%

EXHIBIT 4

MIAMI-DADE COMMUNITY COLLEGE
ROOM UTILIZATION REPORT
CUMULATIVE UTILIZATION STATISTICS

	MONDAY			TUESDAY			WEDNESDAY			THURSDAY			FRIDAY			SATURDAY			SUNDAY		
	STDNT COUNT	CUM PCT	CLASS COUNT	STDNT COUNT	CUM PCT	CLASS COUNT	STDNT COUNT	CUM PCT	CLASS COUNT	STDNT COUNT	CUM PCT	CLASS COUNT	STDNT COUNT	CUM PCT	CLASS COUNT	STDNT COUNT	CUM PCT	CLASS COUNT	STDNT COUNT	CUM PCT	CLASS COUNT
0700	1,231	19	31	1,294	20	36	1,216	19	30	1,274	20	35	1,206	19	30	0	0	0	0	0	0
0730	1,231	19	31	1,304	20	37	1,246	19	33	1,274	20	35	1,216	19	31	0	0	0	0	0	0
0300	2,729	43	72	1,622	25	47	2,804	44	76	1,577	25	46	2,545	40	70	98	1	4	0	0	0
0830	2,754	43	73	2,992	47	84	2,829	45	77	2,927	46	82	2,545	40	70	652	10	20	0	0	0
0900	2,747	43	77	3,187	50	90	3,034	48	85	3,087	49	87	2,901	46	79	692	11	21	0	0	0
0930	2,787	44	78	2,516	40	72	2,984	47	84	2,479	39	70	2,906	46	79	692	11	21	0	0	0
1000	3,027	48	88	3,071	49	88	2,877	45	84	2,964	47	84	2,511	40	71	692	11	21	0	0	0
1030	2,982	47	86	2,971	47	85	2,832	45	82	2,864	45	81	2,466	39	69	692	11	21	0	0	0
1100	2,945	47	81	2,579	41	75	2,781	44	78	2,607	41	76	680	10	19	692	11	21	0	0	0
1130	2,910	46	80	2,940	46	83	2,781	44	78	2,914	46	82	680	10	19	167	2	7	0	0	0
1200	2,164	34	62	2,940	46	83	2,219	35	62	2,914	46	82	740	11	21	442	7	13	0	0	0
1230	2,873	45	71	2,434	38	66	2,948	47	71	2,428	38	65	690	11	19	473	7	14	0	0	0
0100	3,097	49	76	2,850	45	77	3,038	48	75	2,835	45	76	690	11	19	473	7	14	0	0	0
0130	2,947	47	71	2,793	44	75	2,923	46	71	2,730	43	72	690	11	19	473	7	14	0	0	0
0200	2,202	35	59	531	8	16	2,203	35	61	562	8	16	1,938	30	52	400	6	11	0	0	0
0230	2,302	36	62	2,949	47	78	2,283	36	62	2,949	47	78	1,938	30	52	375	5	10	0	0	0
0300	2,166	34	59	2,646	42	68	2,187	34	61	2,919	46	70	1,796	28	48	20	0	1	0	0	0
0330	1,961	31	52	1,413	22	40	1,982	31	54	1,728	27	43	1,731	27	45	20	0	1	0	0	0
0400	1,089	17	32	1,383	22	39	1,065	17	31	1,650	26	40	828	13	22	0	0	0	0	0	0
0430	1,044	16	31	1,243	19	34	1,020	16	30	1,510	24	35	783	12	21	0	0	0	0	0	0
0500	594	9	20	642	10	22	530	8	17	602	9	20	94	1	4	0	0	0	0	0	0
0530	534	8	17	557	8	18	470	7	14	533	8	17	49	0	2	0	0	0	0	0	0
0600	568	9	17	682	10	21	544	8	16	617	9	19	0	0	0	0	0	0	0	0	0
0630	2,568	41	68	2,532	40	66	2,532	40	66	2,575	41	67	2,421	38	64	0	0	0	0	0	0
0700	2,938	46	80	2,912	46	78	2,915	46	78	2,801	44	76	0	0	0	0	0	0	0	0	0
0730	2,932	46	80	2,850	45	77	2,909	46	78	2,739	43	75	0	0	0	0	0	0	0	0	0
0800	2,690	42	83	2,755	44	76	2,801	44	81	2,543	40	74	0	0	0	0	0	0	0	0	0
0830	2,667	42	82	2,705	43	75	2,802	44	81	2,519	40	73	0	0	0	0	0	0	0	0	0
0900	2,428	38	74	2,545	40	70	2,539	40	72	2,359	37	68	0	0	0	0	0	0	0	0	0
0930	1,201	19	40	1,451	23	41	1,271	20	37	1,235	19	38	0	0	0	0	0	0	0	0	0
1000	881	14	29	1,021	16	27	971	15	27	910	14	27	0	0	0	0	0	0	0	0	0
1030	74	1	3	50	0	2	50	0	2	50	0	2	0	0	0	0	0	0	0	0	0
1100	24	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1130	24	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1200	24	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1230	24	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

EXHIBIT 5

MIAMI-DADE COMMUNITY COLLEGE
ROOM UTILIZATION REPORT
UTILIZATION STATISTICS FOR HUMANITIES

	MONDAY			TUESDAY			WEDNESDAY			THURSDAY			FRIDAY			SATURDAY			SUNDAY		
	STDNT COUNT	CUM PCT	CLASS COUNT	STDNT COUNT	CUM PCT	CLASS COUNT	STDNT COUNT	CUM PCT	CLASS COUNT	STDNT COUNT	CUM PCT	CLASS COUNT	STDNT COUNT	CUM PCT	CLASS COUNT	STDNT COUNT	CUM PCT	CLASS COUNT	STDNT COUNT	CUM PCT	CLASS COUNT
0700	250	8	7	320	10	9	250	8	7	320	10	9	250	8	7	0	0	0	0	0	0
0730	250	8	7	320	10	9	250	8	7	320	10	9	250	8	7	0	0	0	0	0	0
0800	645	20	17	415	13	12	645	20	17	415	13	12	610	19	16	0	0	0	0	0	0
0830	645	20	17	695	22	23	645	20	17	695	22	23	610	19	16	75	2	2	0	0	0
0900	759	24	24	825	26	27	759	24	24	825	26	27	747	24	23	75	2	2	0	0	0
0930	764	24	24	688	22	22	764	24	24	688	22	22	752	24	23	75	2	2	0	0	0
1000	717	23	23	741	23	24	717	23	23	741	23	24	642	20	20	75	2	2	0	0	0
1030	717	23	23	641	20	21	717	23	23	641	20	21	642	20	20	75	2	2	0	0	0
1100	831	26	22	661	21	21	831	26	22	661	21	21	340	10	9	75	2	2	0	0	0
1130	831	26	22	843	27	24	831	26	22	843	27	24	340	10	9	0	0	0	0	0	0
1200	669	21	20	843	27	24	819	26	21	843	27	24	340	10	9	190	6	5	0	0	0
1230	724	23	20	828	26	23	874	28	21	828	26	23	340	10	9	190	6	5	0	0	0
0100	754	24	21	688	22	21	754	24	21	688	22	21	340	10	9	190	6	5	0	0	0
0130	729	23	20	653	21	20	729	23	20	653	21	20	340	10	9	190	6	5	0	0	0
0200	635	20	20	80	2	3	635	20	20	80	2	3	635	20	20	190	6	5	0	0	0
0230	635	20	20	797	25	21	635	20	20	797	25	21	635	20	20	190	6	5	0	0	0
0300	800	25	21	760	24	19	800	25	21	760	24	19	765	24	20	0	0	0	0	0	0
0330	805	25	21	75	2	3	805	25	21	75	2	3	770	24	20	0	0	0	0	0	0
0400	145	4	5	75	2	3	145	4	5	75	2	3	115	3	4	0	0	0	0	0	0
0430	145	4	5	30	0	1	145	4	5	30	0	1	115	3	4	0	0	0	0	0	0
0500	140	4	4	152	4	6	140	4	4	152	4	6	0	0	0	0	0	0	0	0	0
0530	140	4	4	122	3	5	140	4	4	122	3	5	0	0	0	0	0	0	0	0	0
0600	170	5	5	140	4	5	170	5	5	140	4	5	0	0	0	0	0	0	0	0	0
0630	740	23	19	655	21	17	740	23	19	655	21	17	0	0	0	0	0	0	0	0	0
0700	800	25	21	755	25	21	800	25	21	775	25	21	0	0	0	0	0	0	0	0	0
0730	770	24	20	805	25	22	770	24	20	805	25	22	0	0	0	0	0	0	0	0	0
0800	562	18	19	668	21	19	582	18	19	584	18	18	0	0	0	0	0	0	0	0	0
0830	562	18	19	668	21	19	582	18	19	584	18	18	0	0	0	0	0	0	0	0	0
0900	550	17	18	608	19	17	570	18	18	524	16	16	0	0	0	0	0	0	0	0	0
0930	355	11	12	433	13	12	375	12	12	349	11	11	0	0	0	0	0	0	0	0	0
1000	295	9	10	313	10	8	315	10	10	229	7	7	0	0	0	0	0	0	0	0	0
1030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1130	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1230	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

EXHIBIT 6

MIAMI-DADE COMMUNITY COLLEGE
OFFICE OF REGISTRAR - SOUTH
DISTRIBUTION OF COURSE ENROLLMENTS BY DIVISION AND TIME OF CLASS (CREDIT ONLY)
WINTER TERM 1975-76 AS OF 10/21/75

TIME OF CLASS	# HUM	% HUM	# NSC	% NSC	# SSC	% SSC	# PED	% PED	# O.ED.	% O.ED.	TOTAL NUMBER OF STUDENTS ON CAMPUS	
A - 7	250		375		210		-		326		1,231	
B - 7	320		271		255		-		343		1,294	
C - 8	645		571		475		290		541		2,804	
D - 8:30	695		589		395		415		548		2,992	
F - 9	759		595		290		380		685		3,034	
G - 10	741		494		405		465		612		3,071	
H - 10	717		621		660		345		579		3,027	
SUB TOTAL BLK I	4127	60	3516	53	2690	55	1895	80	3634	60	17,453	61
J - 11	831		430		290		525		819		2,945	
K - 11:30	843		560		455		255		757		2,940	
L - 1	874		930		500		130		663		3,097	
M - 1	688		493		455		290		789		2,850	
SUB TOTAL BRIDGE												
N - 2	635		934		-		200		477		2,203	
O - 2:30	797		673		610		45		684		2,949	
P - 3	800		95		650		150		387		2,187	
Q - 3:30	75		561		520		-		275		1,728	
R - 4	145		381		210		70		307		1,089	
S - 5	152		256		130		-		104		642	
T - 5	140		212		90		-		152		594	
SUB TOTAL BLK II	2744	40	3112	47	2210	45	465	20	2386	40	11,392	39
E1 - 6:30	740		630		460		-		733		2,575	
E2 - 8	582		480		585		-		1197		2,801	
E3 - 9:30	375		149		205		-		606		1,271	
E4 - 6:30	655		428		505		80		864		2,532	
E5 - 8	668		504		553		85		984		2,755	
E6 - 9:30	433		265		155		85		548		1,451	
SUB TOTAL - EVE												
W1 - 9	75		184		115		-		318		692	
W2 - NOON	190		69		45		-		138		442	
SUB TOTAL WKND												
CAMPUS												

EXHIBIT 7

MIAMI-DADE COMMUNITY COLLEGE
COURSE REQUEST FORM
FALL -- WINTER TERMS

STUDENT NUMBER

STUDENT NAME (PRINT) ______ LAST ______ FIRST ______ MIDDLE

TERM: FALL [ ] WINTER [ ]

SOCIAL SECURITY NO.

STEP ONE

(TRANSFER THE CODE NUMBERS FROM THE EDUCATIONAL...VOCATIONAL GOALS SURVEY FORM IN BACK OF REGISTRATION HANDBOOK)

PART I: DEGREE AND/OR ENROLLMENT INTENT — MATRICULATION, PROGRAM CODE, UNCERTAIN 1 CERTAIN 2

PART II: FUTURE EDUCATIONAL AND/OR VOCATIONAL PLANS — PLANS, UNCERTAIN 1 CERTAIN 2

HOME CAMPUS (X) ONE

LOCATION CODE: NORTH 100, SOUTH 200, DOWNTOWN 300, MEDICAL CENTER 400

STEP TWO COURSE REQUEST

NOW LIST EACH COURSE YOU WISH TO TAKE IN THE FIRST COLUMN (UNDER PRIMARY COURSES) IN ORDER OF IMPORTANCE TO YOU. DO NOT FILL IN THE LOCATION COLUMN UNLESS YOU WISH TO TAKE THE COURSE AT A LOCATION OTHER THAN THE HOME CAMPUS YOU HAVE CHECKED AT THE TOP OF THE FORM.

	PRIMARY COURSES						FIRST ALTERNATE COURSES							SECOND ALTERNATE COURSES				
	COURSE ABB	COURSE NO	SUF	LOCATION	CR			COURSE ABB	COURSE NO	SUF	LOCATION	CR			COURSE ABB	COURSE NO	SUF	LOCATION	CR
1						→	1						→	1					
2						→	2						→	2					
3						→	3						→	3					
4						→	4						→	4					
5						→	5						→	5					
6						→	6						→	6					
7						→	7						→	7					
8						→	8						→	8					
9						→	9						→	9					

LOCATION CODE LEGEND
- 100 North Campus
- 110 - North Campus Outreach
- 140 Open College North Campus
- 200 South Campus
- 220 - South Campus Outreach
- 221 - Homestead AFB
- 222 - South Dade High School
- 240 Open College South Campus
- 300 - Downtown Campus
- 330 - Downtown Campus Outreach
- 331 - Carver Community School
- 332 - Marine Science Facility
- 333 Belen Jesuit Preparatory School
- 340 - Open College - Downtown Campus
- 400 - Medical Center Campus
- 440 - Open College - Medical Center Campus

TOTAL CREDITS [ ]

ADVISOR CODE (Use 9999 if self advised) ______ ADVISOR'S SIGNATURE ______

STEP THREE TIME BLOCK PREFERENCE:

List in order of preference the time block codes for the times that you wish to attend classes. For example, if your first choice is MWF afternoon then list 3 and_. If you would rather spread your courses to five afternoons per week then list 3 and 4 as your first choice.

CODE	TIME BLOCK CHART
1	MWF morning
2	TUTH morning
3	MWF afternoon
4	TUTH afternoon
5	MW evening
6	TUTH evening
7	Saturday
	CHECK HERE IF YOU WISH TO HAVE NO CLASSES SCHEDULED DURING ACTIVITY HOUR ON FRIDAYS 11:00 AM - 2:00 PM

FIRST CHOICE ____ and ____.

SECOND CHOICE ____ and ____.

THIRD CHOICE ____ and ____.

FOURTH CHOICE ____ and ____.

STEP FOUR TIME BLOCK EXCLUSIONS (OPTIONAL):

If there are times that you cannot accept classes, then cross out those codes in the TIME BLOCK CHART above (Step III). Be sure you do not cross out the times that you have selected as preferences. Remember the more time you exclude, the less likely you will be able to get the courses you want!

STEP FIVE TIME OR COURSE PREFERENCE (OPTIONAL):

If it is not possible to give me all my first choices of courses at my first preference of time

[ ] give me my first preference of time using alternate courses, if necessary

or

[ ] give me my primary courses at another preference of time, if necessary.

______ Date ______ Student's Signature

SS Form 1 1/75

MIAMI-DADE COMMUNITY COLLEGE
KEY TO INTERPRETATION OF STUDENT DEMAND REPORT

THE REPORT WHICH FOLLOWS IS A SUMMARY OF COURSES REQUESTED BY STUDENTS FOR THE TERM SHOWN AT THE UPPER LEFT OF THE REPORT.

THERE ARE SEVERAL TYPES OF REPORTS BUT THE FORMAT IS THE SAME FOR ALL. THERE IS A REPORT BY COURSE AND SUFFIX, A SUMMARY REPORT BY DEPARTMENT. A SUMMARY REPORT BY DIVISION, AND A SUMMARY REPORT BY CAMPUS/CENTER.

THE TOP TWO LINES OF THE DATA SECTION OF THE REPORT SHOW THE TOTAL NUMBER OF STUDENTS WHO HAVE REGISTERED FOR THE TERM AT THE CAMPUS/CENTER SHOWN.

THE THIRD LINE IS THE ENROLLMENT THAT IS PROJECTED FOR THE CAMPUS BASED ON DATA PROVIDED BY THE OFFICE OF INSTITUTIONAL RESEARCH.

THE FOURTH LINE SHOWS WHAT PERCENT OF THE EXPECTED ENROLLMENT HAS BEEN PROCESSED.

THE NEXT FOUR LINES SHOW THE SAME INFORMATION FOR THE ACADEMIC DIVISION.

IN THE BODY OF THE REPORT THERE ARE NINE COLUMNS, THE FIRST EIGHT OF WHICH ARE DESIGNATED BY A LETTER.

COLUMN A SHOWS THE BREAKDOWN OF THE TIME BLOCKS IN WHICH STUDENTS ARE ALLOWED TO REQUEST CLASSES. IF THERE IS A CLASS SCHEDULED SO THAT IT OVERLAPS MORE THAN TWO TIME BLOCKS, OR IF IT IS TBA, THE SEQUENCE NUMBER WILL APPEAR JUST ABOVE THE TOTAL LINE.

COLUMN B SHOWS THE NUMBER OF CLASSES IN THE MASTER SCHEDULE IN THE TIME BLOCK. IF A CLASS OVERLAPS TWO TIME BLOCKS, IT WILL APPEAR AS 0.500 SECTIONS IN EACH TIME BLOCK.

COLUMN C SHOWS THE TOTAL NUMBER OF SEATS IN THE MASTER SCHEDULE BY TIME BLOCK. IF, FOR EXAMPLE, A CLASS HAS 40 SEATS AND IT IS SCHEDULED SO THAT IT CROSSES TWO TIME BLCOKS, 20 SEATS WILL APPEAR UNDER EACH TIME BLOCK.

COLUMN D IS ONLY USED IF A CLASS BEGAN IN A PRIOR TERM AND STUDENTS ARE ALLOWED TO ALSO REGISTER FOR IT THIS TERM. IN THIS CASE, IT WILL SHOW THE STUDENTS STILL ENROLLED FROM THE PRIOR TERM.

COLUMN E SHOWS THE NUMBER OF STUDENT REQUESTS. ONLY THE STUDENTS FIRST CHOICE OF TIME IS CONSIDERED AND ALTERNATE COURSES ARE NOT CONSIDERED.

COLUMN F SHOWS THE SUM OF COLUMN D & E DIVIDED BY COLUMN C AND CONVERTED TO A %.

COLUMN G AND H ARE COMPUTED BY DIVIDING COLUMN E BY THE PERCENT OF STUDENT SEMESTER HOURS PROCESSED FOR THE DIVISION ON THE EIGHTH LINE OF THE REPORT. THIS QUOTIENT GIVES THE EXPECTED FINAL ENROLLMENT. THE DIFFERENCE BETWEEN THIS QUOTIENT AND COLUMN C-D IS THE NUMBER OF SEATS THAT SHOULD BE ADDED TO (COLUMN G) OR SUBTRACTED FROM (COLUMN H) THE MASTER SCHEDULE.
THE FINAL COLUMN CARRIES AN * IF THERE IS A WIDE VARIATION BETWEEN PROJECTED ENROLLMENT AND SEATS IN THE SCHEDULE.
THE LAST THREE LINES OF THE REPORT SHOW THREE COMPUTATIONS OF AVERAGE CLASS SIZE.

EXHIBIT 9

MIAMI-DADE COMMUNITY COLLEGE
SUMMARY OF STUDENT ENROLLMENT REQUESTS

TERM: 75-2 CAMPUS/CENTER: 200
DEAN/DIV:1B DEPARTMENT: B COURSE: APD120

TOTAL NO. OF STUDENTS PROCESSED FOR THIS CAMPUS/CENTER:			6,893
TOTAL NO. OF SEMESTER HOURS REQUESTED FOR THIS CAMPUS/CENTER:			81,107
FINAL TOTAL PROJECTED:	STUDENTS 14,360	STUDENT SEMESTER HOURS	145,500
PRCNT TOTAL PROCESSED:	STUDENTS 48.0%	STUDENT SEMESTER HOURS	55.7%

TOTAL NO. OF STUDENT COURSE REQUESTS PROCESSED FOR THIS DIVISION:			6,714
TOTAL NO OF SEMESTER HOURS REQUESTED FOR THIS DIVISION:			19,394
FINAL TOTAL PROJECTED FOR THIS DIVISION:	STUDENTS 11,960	STUDENT SEMESTER HOURS	34,426
PRCNT TOTAL PROCESSED FOR THIS DIVISION:	STUDENTS 56.1%	STUDENT SEMESTER HOURS	56.3%

A STUDENT TIME BLOCK MTWRFSUB	START END	B NO OF SECTS IN MSTR SCHED	C TOT SEATS IN MSTR SCHED	D SEATS TAKEN IN MSTR SCHED	E NO. REQUESTS 1ST CHOICE OF TIME	F PRCNT OF TOT SEATS REQUESTED	G BASED ON THE PROJECTED ADD SEATS	H FINAL TOTAL REQUESTS DELETE SEATS	IF COL. G OR COL H DIV BY COL (C-D) IS >THAN 50.0%
1-M W F	0700AM 0155PM	2.00	60.00		72.00	120.00	68+		*
2- T R	0700AM 0155PM	1.00	30.00		7.00			18-	*
SUB-TOTAL OF MORNING		3.00	90.00		79.00	85.50	50+		*
3-M W F	1100AM 0630PM				9.50		17+		*
SUB-TOTAL OF AFTERNOON					9.50		17+		*
SUB-TOTAL ALL DAYTIME		3.00	90.00		88.50	98.33	67+		
5-M W	0530PM 1130PM	1.00	30.00		5.50	18.33		20-	*
6- T R	0530PM 1130PM	1.00	30.00		8.00	26.66		16-	*
SUB-TOTAL ALL EVENING		2.00	60.00		13.50	22.50		36-	*
TOTAL		5.00	150.00		102.00	68.00	31+		

AVERAGE CLASS SIZE BASED ON ACTUAL REQUESTS RECEIVED THIS FAR	20.4
AVERAGE CLASS SIZE BASED ON FINAL PROJECTED ENROLLMENT	36.2
AVERAGE CLASS SIZE BASED ON TOTAL SEATS IN MASTER SCHEDULE	30.0

EXHIBIT 10

MIAMI-DADE COMMUNITY COLLEGE
SCHEDULING GUIDELINE STATISTICS

TIME-BLK	73-3	73-4	74-1	74-2	74-3	74-4	75-1
APD120							
700AM-1159AM	28	0	92	67	21	0	114
1200NN- 459PM	0	0	51	31	0	0	68
500PM-1159PM	0	0	48	31	0	0	30
SATURDAY AM	0	0	0	0	0	0	0
SATURDAY PM	0	0	0	0	0	0	0
TBA BLOCK	0	0	0	0	0	0	0
COURSE TOTAL	28	0	191	129	21	0	212
APD121							
700AM-1159AM	0	16	21	25	18	19	16
1200NN- 459PM	0	0	24	23	0	0	0
500PM-1159PM	0	0	0	15	0	0	0
SATURDAY AM	0	0	0	0	0	0	0
SATURDAY PM	0	0	0	0	0	0	0
TBA BLOCK	0	0	0	0	0	0	0
COURSE TOTAL	0	16	45	63	18	19	16

EXHIBIT 11

MIAMI-DADE COMMUNITY COLLEGE
SUMMARY OF STUDENT ENROLLMENT REQUESTS

TERM: 75-2 CAMPUS/CENTER: 200
DEAN/DIV:1B DEPARTMENT: B COURSE: ART187

TOTAL NO. OF STUDENTS PROCESSED FOR THIS CAMPUS/CENTER: 6,893
TOTAL NO. OF SEMESTER HOURS REQUESTED FOR THIS CAMPUS/CENTER: 81,107
FINAL TOTAL PROJECTED: STUDENTS 14,360 STUDENT SEMESTER HOURS 145,500
PRCNT TOTAL PROCESSED: STUDENTS 48.0% STUDENT SEMESTER HOURS 55.7%

TOTAL NO. OF STUDENT COURSE REQUESTS PROCESSED FOR THIS DIVISION: 6,714
TOTAL NO OF SEMESTER HOURS REQUESTED FOR THIS DIVISION: 19,394
FINAL TOTAL PROJECTED FOR THIS DIVISION: STUDENTS 11,960 STUDENT SEMESTER HOURS 34,426
PRCNT TOTAL PROCESSED FOR THIS DIVISION: STUDENTS 56.1% STUDENT SEMESTER HOURS 56.3%

A STUDENT TIME BLOCK MTWRFSUB START END	B NO OF SECTS IN MSTR SCHED	C TOTAL SEATS IN MSTR SCHED	D SEATS TAKEN IN MSTR SCHED	E NO. REQUESTS 1ST CHOICE OF TIME	F PRCNT OF TOT SEATS REQUESTED	G BASED ON THE PROJECTED ADD SEATS	H FINAL TOTAL REQUESTS DELETE SEATS	IF COL. G OR COL H DIV BY COL (C-D) IS >THAN 50.0%
1-M W F 0700AM 0150PM	1.50	45.00		83.00	184.44	102+		*
2- T R 0700AM 0155PM	1.00	30.00		5.50	18.33		20-	*
SUB-TOTAL OF MORNING	2.50	75.00		88.50	113.00	82+		*
3-M W F 1100AM 0630PM				3.50		6+		*
4- T R 1115AM 0630PM				.50		1+		*
SUB-TOTAL OF AFTERNOON				4.00		7+		
SUB-TOTAL ALL DAYTIME	2.50	75.00		92.50	123.33	89+		*
5-M W 0530PM 1130PM	1.00	30.00		7.50	25.00		17-	*
6- T R 0530PM 1130PM	.50	15.00		6.00	40.00		4-	
SUB-TOTAL ALL EVENING	1.50	45.00		13.50	30.00		21-	
TOTAL	4.00	120.00		106.00	88.33	68+		*

AVERAGE CLASS SIZE BASED ON ACTUAL REQUESTS RECEIVED THIS FAR 26.5
AVERAGE CLASS SIZE BASED ON FINAL PROJECTED ENROLLMENT 47.0
AVERAGE CLASS SIZE BASED ON TOTAL SEATS IN MASTER SCHEDULE 30.0

EXHIBIT 12

MIAMI-DADE COMMUNITY COLLEGE
SUMMARY OF STUDENT ENROLLMENT REQUESTS

TERM: 75-2 CAMPUS/CENTER: 200
DEAN/DIV: IF DEPARTMENT: H COURSE: AHA161

TOTAL NO. OF STUDENTS PROCESSED FOR THIS CAMPUS/CENTER:	6,893
TOTAL NO. OF SEMESTER HOURS REQUESTED FOR THIS CAMPUS/CENTER:	81,107
FINAL TOTAL PROJECTED: STUDENTS 14,360 STUDENT SEMESTER HOURS	145,500
PRCNT TOTAL PROCESSED: STUDENTS 48.0% STUDENT SEMESTER HOURS	55.7%

TOTAL NO. OF STUDENT COURSE REQUESTS PROCESSED FOR THIS DIVISION:	6,446
TOTAL NO OF SEMESTER HOURS REQUESTED FOR THIS DIVISION:	18,875
FINAL TOTAL PROJECTED FOR THIS DIVISION: STUDENTS 11,619 STUDENT SEMESTER HOURS	34,284
PRCNT TOTAL PROCESSED FOR THIS DIVISION: STUDENTS 55.4% STUDENT SEMESTER HOURS	55.0%

A STUDENT TIME BLOCK MTWRFSUB START END	B NO OF SECTS IN MSTR SCHED	C TOTAL SEATS IN MSTR SCHED	D SEATS TAKEN IN MSTR SCHED	E NO. REQUESTS 1ST CHOICE OF TIME	F PRCNT OF TOT SEATS REQUESTED	G BASED ON THE PROJECTED ADD SEATS	H FINAL TOTAL REQUESTS DELETE SEATS	IF COL. G OR COL H DIV BY COL (C-D) IS >THAN 50.0%
1-M W F 0700AM 0150PM	1.00	60.00		37.50	62.50	8+		
2- T R 0700AM 0155PM				3.00		5+		*
SUB-TOTAL OF MORNING	1.00	60.00		40.50	67.50	13+		
3-M W F 1100AM 0630PM				5.50		10+		*
SUB-TOTAL OF AFTERNOON				5.50		10+		
SUB-TOTAL ALL DAYTIME	1.00	60.00		46.00	76.66	23+		
5-M W 0530PM 1130PM				5.50		10+		*
6- T R 0530PM 1130PM				5.50		10+		*
SUB-TOTAL ALL EVENING				11.00		20+		*
TOTAL	1.00	60.00		57.00	95.00	43+		*

AVERAGE CLASS SIZE BASED ON ACTUAL REQUESTS RECEIVED THIS FAR	57.0
AVERAGE CLASS SIZE BASED ON FINAL PROJECTED ENROLLMENT	103.6
AVERAGE CLASS SIZE BASED ON TOTAL SEATS IN MASTER SCHEDULE	60.0

EXHIBIT 13

MIAMI-DADE COMMUNITY COLLEGE
SUMMARY OF STUDENT ENROLLMENT REQUESTS
YEAR-TERM 75-2
SOUTH CAMPUS

TERM: 75-2 CAMPUS/CENTER: 200
DEAN/DIV: IF DEPARTMENT: J COURSE: LAE160

TOTAL NO. OF STUDENTS PROCESSED FOR THIS CAMPUS/CENTER:			6,893
TOTAL NO. OF SEMESTER HOURS REQUESTED FOR THIS CAMPUS/CENTER:			81,107
FINAL TOTAL PROJECTED:	STUDENTS 14,360	STUDENT SEMESTER HOURS	145,500
PRCNT TOTAL PROCESSED:	STUDENTS 48.0%	STUDENT SEMESTER HOURS	55.7%

TOTAL NO. OF STUDENT COURSE REQUESTS PROCESSED FOR THIS DIVISION:			6,446
TOTAL NO. OF SEMESTER HOURS REQUESTED FOR THIS DIVISION:			18,875
FINAL TOTAL PROJECTED FOR THIS DIVISION:	STUDENTS 11,619	STUDENT SEMESTER HOURS	34,284
PRCNT TOTAL PROCESSED FOR THIS DIVISION:	STUDENTS 55.4%	STUDENT SEMESTER HOURS	55.0%

A STUDENT TIME BLOCK MTWRFSUB START END	B NO OF SECTS IN MSTR SCHED	C TOT SEATS IN MSTR SCHED	D SEATS TAKEN IN MSTR SCHED	E NO. REQUESTS 1ST CHOICE OF TIME	F PRCNT OF TOT SEATS REQUESTED	G BASED ON THE FINAL TOTAL PROJECTED REQUESTS ADD SEATS	H DELETE SEATS	IF COL. G OR COL H DIV BY COL (C-D) IS >THAN 50.0%
1-M W F 0700AM 0150PM	1.00	80.00		59.00		27+		
2- T R 0700AM 0155PM				15.00		27+		*
SUB-TOTAL OF MORNING	1.00	80.00		74.00	95.00	54+		
3-M W F 1100AM 0630PM	1.00	120.00		14.50			94-	*
4- T R 1115AM 0630PM				1.00		2+		*
SUB-TOTAL OF AFTERNOON	1.00	120.00		15.50	12.91		92-	
SUB-TOTAL ALL DAYTIME	2.00	200.00		89.00	44.05		36-	*
5-M W 0530PM 1130PM	1.00	80.00		9.50			63-	*
6- T R 0530PM 1130PM				5.00		9+		*
SUB-TOTAL ALL EVENING	1.00	80.00		14.50	18.13		52-	*
TOTAL	3.00	280.00		104.00	37.14		88-	

AVERAGE CLASS SIZE BASED ON ACTUAL REQUESTS RECEIVED THIS FAR	34.6
AVERAGE CLASS SIZE BASED ON FINAL PROJECTED ENROLLMENT	63.0
AVERAGE CLASS SIZE BASED ON TOTAL SEATS IN MASTER SCHEDULE	93.3

EXHIBIT 14

MIAMI-DADE COMMUNITY COLLEGE
CONFLICT ANALYSIS FOR SINGLE TIME COURSE REQUESTS
YEAR-TERM 75-2
SOUTH CAMPUS

***** S I N G L E T I M E C O U R S E *******

COURSE ABR NBR S	CAPAC	TOTAL REQUESTS	DAYS MTWRFSUB	START TIME	END TIME
LAE 162	45	19	M W F	800A	850A

****************************** P A I R E D C O U R S E **********************

COURSE ABR NBR	TIME/NBR	COURSE ABR NBR	TIME/NBR	COURSE ABR NBR	TIME/NBR	COURSE ABR NBR	TIME/NBR
BDP 167	MLT 1	BDP 178	MLT 1	BIO 102	MLT 3	ENG 120	MLT 2
ENG 121	MLT 4	GEY 101	MLT 2	HEN 210	MLT 1	HUM 201	MLT 1
HUM 202	MLT 3	LAE 161	MLT 4	LAE 180	SNG 4	LAE 261	SNG 1
LAE 262	*** 6	LAE 263	SNG 1	LAE 264	SNG 1	LAE 265	MLT 2
LAE 266	SNG 3	LAE 280	MLT 3	LAE 294	MLT 3	LIT 244	SNG 1
MAT 101	MLT 1	MAT 201	MLT 1	MET 102	MLT 1	MIS 202	MLT 1
MIS 202 L	SNG 1	OCE 101	MLT 1	PED 110	MLT 1	PED 114	MLT 1
PED 125	MLT 3	PED 145	MLT 1	PHI 110	MLT 1	PSY 211	MLT 1
REA 101 D	MLT 1	SOC 201	MLT 3	SOC 201 A	MLT 1	SOP 210	MLT 1
SPA 102	MLT 1	SPA 210 C	SNG 1	SPA 211 C	SNG 1	SSS 101	MLT 1
SSS 102	MLT 5						

LAE 162 CONFLICTS WITH LAE 262

	700	800	900	1000	1100	1200	100	200	300	400	500	600	700	800	900	1000	1100
MON	1	6*	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0
TUE	0	4	4	0	3	2	0	0	0	0	0	0	0	0	0	0	0
WED	1	6*	0	0	3	2	0	0	0	0	0	0	4	4	4	4	0
THU	0	4	4	0	3	2	0	0	1	1	0	0	0	0	0	0	0
FRI	1	6*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SAT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

EXHIBIT 15

MIAMI-DADE COMMUNITY COLLEGE
CONFLICT ANALYSIS FOR SINGLE TIME COURSE REQUESTS
YEAR-TERM 75-2
SOUTH CAMPUS

*******S I N G L E T I M E C O U R S E*******

COURSE ABR NBR S	CAPAC	TOTAL REQUESTS	DAYS MTWRFSUB	START TIME	END TIME
LAE 262	50	23	M W F	800A	850A

****************************P A I R E D C O U R S E**************************

COURSE ABR NBR	TIME/NBR		COURSE ABR NBR	TIME/NBR		COURSE ABR/NBR	TIME/NBR		COURSE ABR NBR	TIME/NBR	
BDP 167	MLT	1	BDP 178	MLT	1	BIO 102	MLT	2	BIO 170	MLT	1
CHE 112	MLT	1	CHE 174	MLT	1	ECO 210	MLT	1	ENG 120	MLT	1
ENG 121	MLT	7	GEY 101	MLT	1	HEN 210	MLT	2	HIS 208	MLT	1
HUM 201	MLT	5	HUM 202	MLT	4	LAE 161	MLT	4	LAE 162	****	6
LAE 180	SNG	5	LAE 261	SNG	2	LAE 264	SNG	2	LAE 265	MLT	3
LAE 266	SNG	2	LAE 280	MLT	5	LAE 294	MLT	2	MAT 101	MLT	3
MAT 201	MLT	2	MET 102	MLT	2	MET 160	SNG	1	PED 114	MLT	1
PED 117	MLT	1	PED 118	MLT	1	PED 125	MLT	2	PSY 211	MLT	1
PSY 212	MLT	2	SOC 201	MLT	2	SPA 101	MLT	1	SPA 102	MLT	1
SSS 101	MLT	2	SSS 102	MLT	6	STS 164	MLT	1			

LAE 262 CONFLICTS WITH LAE 162

	700	800	900	1000	1100	1200	100	200	300	400	500	600	700	800	900	1000	1100
MON	0	6*	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0
TUE	0	5	5	0	2	2	0	1	1	0	0	0	0	0	0	0	0
WED	0	6*	0	0	2	2	0	0	0	0	0	0	2	2	2	2	0
THU	0	5	5	0	2	2	0	1	1	0	0	0	0	0	0	0	0
FRI	0	6*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SAT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

EXHIBIT 16

MIAMI-DADE COMMUNITY COLLEGE
ANALYSIS OF COURSE REGISTRATIONS BY CAMPUS 200 YR-TM: 75-1

DEANSHIP/	.......SEATS............			...CREDITS.....		...........SECTIONS.............				AVERAGE CLASS SIZE ....BASED ON...........	
DIV/DEPT	IN SCHED	TAKEN	PAID	TAKEN	PAID	IN SCHED	CLOSED	CANCELLED	OPEN	SEATS TAKEN	PAID SEATS TAKEN
1BB	3,294	2,020	2,011	6,060.0	6,033.0	70	2	4	64	30.6	30.5
1BC	5,516	2,338	2,332	5,558.0	5,543.0	115	13	3	99	20.9	20.8
1BD	7,602	4,216	4,207	12,648.0	12,621.0	144	10	1	133	29.5	29.4
1BE	6,006	1,581	1,575	4,743.0	4,725.0	67	2	3	62	24.7	24.6
1BF	3,219	1,933	1,932	5,721.0	5,718.0	60	2	0	58	32.2	32.2
DIV TOTALS:	25,637	12,088	12,057	34,730.0	34,640.0	456	29	11	416	27.2	27.1
CAMPUS TOTALS:	116,881	54,014	53,924	147,900.0	147,652.0	1772	139	70	1562	31.8	31.7

TOTAL REGISTERED FOR THIS CAMPUS = 14990 TOTAL PAID = 14964 TOTAL UNPAID = 26

EXHIBIT 17

Type of Activity	Operator Response Time	Transaction Activity		System Elapsed Transaction Times		Schedules Printed	Cards Punched	Highest Drop/Add Activity	
		Total System	Drop/Add Program	Average	High			Hour	Count
Light	3-6	12,811	1,061	2.8	8.7	532	170	11-12	164
Moderate	7-15	15,119	3,626	4.1	18.1	3,812	1,489	11-12	581
Heavy	30-45	20,976	5,068	3.7	15.9	5,037	2,039	11-12	573
Extremely Heavy	60+	24,879	6,944	3.6	15.3	6,161	2,082	11-12	765

Operator Response Time = Time calculated from the instant the operator depresses the entry key until the transaction has returned the screen for the next transaction.

Elapsed Transaction Time = Time calculated starting when the first instruction is executed until the last instruction is finished. Includes the CPU processing time as well as I/O wait time for both programs and user data. Does not include data transmission time.

EXHIBIT 18

EARLY RETIREMENT SYSTEMS:
A CHALLENGE FOR THE FUTURE

Raymond N. Kieft
Director
Institutional Research
Central Michigan University

In order to proceed with any early retirement program, an institution needs to determine the program's financial impact. The program must be "costed" -- specific enough so that any individual who might be encouraged to participate can "see" his or her own financial profile regarding early retirement and comprehensive enough to enable the institution to determine the total resource impact on the institution.

This paper presents guidelines and formats necessary for a computerized early retirement costing system. A particular system has been developed at Central Michigan University (Kieft, College Management, February 1974) and the software has become part of the CAUSE Exchange Library. This paper details that system as well as provides direction for developing other systems.

Just a few short years ago, a discussion of early retirement possibilities for employees in institutions of higher education would have been viewed as unmerited and of little worth. Increasing enrollments and expanding budgets meant that program flexibility was available through natural attrition and additional hiring of employees. I don't need to tell you that that world has now changed. Decleration of growth and/or actual decline of both enrollments and budgets is the current mode. The future spells more of the same. Fear about program inflexibility is gripping the campuses of the country to such an extent that major national studies are being focused on solutions to the problem.

To cite one of these national studies, I refer to the text entitled More Than Survival, written by the Carnegie Foundation for the Advancement of Teaching. In the chapter entitled, "What Institutions Can Do," the Foundation presents some strategies and recommendations for achieving program flexibility. They suggest careful planning in the replacement of faculty in order to avoid rigidity and specifically recommend such procedures as:

> "Providing opportunities for early retirement on a full- or part-time basis." (1)

This discussion will focus on this topic by sharing what one institution has done in the development of early retirement possibilities. The institution is the one I currently serve--Central Michigan University. To furnish you with the proper context for this discussion of early retirement, I offer some brief comments about Central.

Some of you may recognize the name Central Michigan University because of our recent athletic endeavors. A smaller number of you, I'm sure, recognize the name because of the institution's involvement in collective bargaining. In 1969, Central became the first single campus, public four-year institution of higher education in the United States to enter into a collective bargaining agreement with its faculty. Since that time, two consecutive three-year contracts have been reached. The first for the years 1971-1974 and the second for the years 1974-1977. Central has a faculty of approximately 700 serving a student body of almost 16,000 residential students. It is not a "small" school and consequently, the successful agreement on three separate occasions--without any major conflicts--between the faculty union and the University suggests that Central has done its collective bargaining well. I believe that some of this success is attributable to the continual exploration of alternative staffing possibilities, one of which is early retirement.

During the negotiations that led to the 1971-1974 agreement, the bargaining process was considering the entire faculty retrenchment problem. The University and the faculty union were investigating early retirement because if early retirement could be stimulated, faculty positions would become available for young, promising faculty who otherwise would have to be terminated in a possible time of faculty retrenchment. As discussions concerning early retirement took place throughout the University community, one question kept surfacing which demanded a response. What are the financial implications for an individual assuming that person would retire early? Both the University and the faculty union knew that the potential for acceptance or rejection of any type of an early retirement program hinged on the answer to this question.

WHAT THE QUESTIONS AND ASSUMPTIONS ARE

The question concerning the financial implications of early retirement for an individual can be restructured into two related questions which can be answered by developing a computerized model. These two questions are:

(1) What is the difference between net take home pay at a given age for a person who is working as compared with one who has retired?, and

(2) What would be the difference in annual retirement income between a person who is working and one who has taken early retirement?

The first question can be thought of as short-range--the second as long-range. The first represents a "dollars in the pocket" question while the second concerns the potential financial return over a period of time.

In order to address these questions adequately, a computer program, in the sense of a costing model, needed to be developed. The model would serve as a first step in assessing the financial impact of early retirement on any individual. Based upon this initial costing analysis, in-depth individual counseling would follow which could ultimately lead to a decision, made by the individual, regarding early retirement.

To develop an appropriate computing program, certain assumptions are needed. These assumptions for the computer model I am describing are:

(1) An individual's salary represents payment to an individual for a base period (10 months for faculty, 12 months for administrators). Additional income as part of base salary can be input if identifiable.

(2) Federal income tax deduction is the standard deduction of 15% of the base salary with a maximum of $2,000. Personal exemptions are based upon whether the individual is single or married, under or over 65. Each exemption has a value of $750.

(3) State income tax deduction is 4.6% of base salary. Personal exemptions have a value of $1,500 with the exemption doubling at age 65.

(4) The mandatory retirement contribution by the individual is 5% of the base salary.

(5) Social Security benefits and deductions are as reported in the Social Security tables. The January 1, 1976 rate of 5.85% of the first 15,300 is used along with the announced rate increase to 6.05% beginning January 1, 1977. The computer program has the ability to accept this input as a variable quantity.

(6) Base salaries are assumed to increase at an average percentage per year.

(7) There is no state income tax on retirement benefits. The federal income tax is shown, although in all probability, there will be little if any federal tax on the first year of benefits since the individual would first receive back personal contributions.

THE COSTING MODEL

NET PAY

The first portion of the model deals with the net pay for an individual under the assumptions previously described if the individual were to continue employment. Table 1 is a sample output from this portion of the model. Individual #50 is a male, currently 59 years old, who will be receiving a 5% annual increase to base salary for each additional year of employment. Presently, that base salary is $17,755. Utilizing the model's assumptions regarding deductions (i.e., Federal, State, retirement, Social Security), the net pay for each year is determined.

To alleviate any possible misunderstanding of the data, a review of the first complete line of data in Table 1 is warranted. The first complete line of data shows that at age 60, individual #50 will have a base salary of $18,643. The 15% standard deduction (Federal) is $2,796, the 4.6% deduction for state income tax is $720 (4.6% of 15,643 since it will be later shown that individual #50 has two exemptions totaling $3,000), the individual's 5% mandatory contribution to the retirement program is $932, and the FICA contribution is $895 in 1976 (5.85% of the first $15,300 in 1976) and $927 for each subsequent year. Subtracting each of these values from base salary results in net pay of 13,300.

TABLE 1

BASE SALARY AND NET PAY

I.D. NO. (0050) SEX (M) MARITAL (M) % INCREASE (5)

AGE	BASE SALARY	DEDUCTIONS FEDERAL	STATE	RETIREMENT	FICA	NET PAY
59	17,755	-------	---	---	---	------
60	18,643	2,796	720	932	895	13,300
61	19,575	2,936	762	979	927	13,971
62	20,554	3,083	807	1,028	927	14,709
63	21,582	3,237	855	1,079	927	15,484
64	22,661	3,399	904	1,133	927	16,298
65	23,794	3,569	818	1,190	927	17,290
66	24,984	3,748	873	1,249	927	18,187
67	26,233	3,935	931	1,312	927	19,128
68	27,545	4,132	991	1,377	927	20,118

RETIREMENT BENEFITS

The second portion of the model deals with the determination of retirement beneifts. Table 2 provides the data necessary to determine retirement benefits for individuals within the State of Michigan. The data necessary for this portion of the model will vary from institution to institution depending upon the retirement program operative at the institution. Consequently, the data displayed in these tables are illustrative and not dogmatic. Each state has differing retirement programs and the specifics of the particular program that are necessary to determine retirement benefits are what should be entered into this portion of the model.

TABLE 2

RETIREMENT BENEFITS

AGE	SERVICE YEARS	SPOUSE'S AGE	AVERAGE SALARY	ANNUAL RETIREMENT BENEFITS
59	36	59	-------	--------
60	37	60	16,066	8,140
61	38	61	16,902	8,854
62	39	62	17,773	9,594
63	40	63	18,679	10,360
64	41	64	19,622	11,193
65	42	65	20,603	12,096
66	43	66	21,633	13,029
67	44	67	22,715	14,080
68	45	68	23,851	15,165

Retirement benefits within the Michigan retirement program are determined as follows:

(1) Determine the average base salary for the best five consecutive years.

(2) Take 1% of the first $4,200 of that average.

(3) Take 1½% of the remainder, if there is any.

(4) Add (2) and (3), and multiply that amount by the total years and fractions of a year service in the Michigan program.

This provides the annual retirement benefit. To qualify for it, an individual must have 10 years of service and be 60 years of age.

Returning to Table 2, individual #50 at age 60 has an average salary for the previous five consecutive years of $16,066. Thus, his annual retirement allowance from the Michigan retirement program is $8,140. Allow me to emphasize the word <u>annual</u>. <u>Annual retirement allowance</u> means that the retirement benefit is the same for each year of retirement. Individual #50, if he retired at age 60, would receive $8,140 each year for the rest of his retirement years.

RETIREMENT INCOME

Retirement benefit income is not the only direct income to an individual during retirement. Another direct source of income is Social Security benefits beginning at age 62. These two sources of income, retirement benefits and Social Security benefits represent an individual's direct retirement income. Any particular individual may have sources of retirement income other than these two sources but the model only utilizes these two direct sources of retirement income.

Table 3 presents the flow to arrive at net retirement income. The second column of the table lists the annual retirement benfits from Table 2. The third column lists the Federal tax on the annual retirement benefit. Column 4 is the difference of these two values--net retirement benefit after taxes. The fifth column lists Social Security benefits beginning with age 62. The amount of Social Security benefits is taken directly from the appropriate FICA tables and formulas. Finally, the last column of Table 3 is the sum of columns 4 and 5 and represents net retirement income.

TABLE 3

NET RETIREMENT INCOME

Age	Annual Retirement Benefit	Federal Tax	Net After Taxes	Social Security Benefits	Net Retirement Income
59	--------	-------	-----	--------	----------
60	8,140	858	7,282	--------	7,282
61	8,854	791	7,883	--------	7,883
62	9,594	1,091	8,503	4,550	13,053
63	10,360	1,215	9,145	4,929	14,074
64	11,193	1,350	9,843	5,309	15,152
65	12,096	1,188	10,908	5,688	16,596
66	13,029	1,340	11,689	5,722	17,411
67	14,080	1,510	12,570	5,757	18,327
68	15,165	1,739	13,426	5,792	19,218

INCOME LOSS (GAIN) FROM WORKING

If we refresh our memory concerning the purpose for the model, we remember that it was to help answer two questions:

(1) What is the difference between net take home pay at a given age for a person who is working as compared with one who has retired?, and

(2) What would be the difference in annual retirement income between a person who is working and one who has taken early retirement?

The first question can be answered by comparing the last column of Table 1 with the last column of Table 3. This is a comparison of net pay, assuming the individual is working, with net retirement income, assuming the individual has retired. For any one year, the difference between these two values determines the difference between take home pay at a given age for a person who is working with retirement income--if retired. Table 4 presents this difference.

TABLE 4

NET GAIN (LOSS) FROM WORKING

Age	Net Pay If Working (Table 1)	Net Retirement Income If Retired (Table 3)	Difference Net Gain (Loss) From Working
59	---------	---------	---------
60	13,300	7,282	6,018
61	13,971	7,883	6,088
62	14,709	13,053	1,656
63	15,484	14,074	1,410
64	16,298	15,152	1,146
65	17,290	16,596	694
66	18,187	17,411	776
67	19,128	18,327	801
68	20,118	19,218	900

WHEN SOCIAL SECURITY BEGINS

Since social security benefits are assumed to begin at age 62, Table 4 shows that at age 62 the net gain that year from working instead of retiring is $1,656, where the base salary for the year is $20,554. This is due to the fact that an additional $4,550 in retirement income becomes available at age 62 through social security benefits. The annual results for working additional years become more sobering when the net gain from working instead of retiring becomes less than $1,000! At age 65, for example, individual #50 has worked for a net income gain of only $694!

LONG RANGE IMPACT OF RETIREMENT

The second question we are considering focuses on the long range financial aspects of early retirement. When an individual retires at age X, the retirement benefits appropriate to the individual at age X from the individual's retirement program are fixed at that level and remain at this level for each year of retirement. Consequently, the Federal tax would remain constant (one change at age 65) as well as the retirement benefit. Social security benefits would be unaffected.

Instead of building another table, the amount of annual retirement income for each year of retirement can be approximated quite well using the previously listed tables. By fixing the annual retirement income to be the net retirement income amount listed in Table 3 for the initial age of retirement, a close approximation can be made.

If, for example, individual #50 retired at age 62, his annual retirement income for each year of his retirement would be approximately $13,053. At age 66, his total retirement income would be $52.212 for the four years.

Suppose that individual #50 worked these four years instead of retiring. His gain (loss) from working would be the difference between the total amount of net pay (Table 1) for these four years (15,484 + 16,298 + 17,290 + 18,187) and the total retirement income ($52,212) for these four years. This difference is $15,047 or approximately $3,760 per year. It is interesting to note that individual #50's total base salary (Table 1) for the four year period was $93,021. Thus, individual #50 worked four years for only about 16 percent of total base salary!

By working these four more years, individual #50 has increased his annual retirement income for each year of his retirement. That is, since his initial year of retirement is now at age 66, his annual net retirement income (Table 3) will be $17,411 instead of $13,053. Thus, individual #50 would have worked four more years for an additional $4,358 per year for the rest of his life.

POTENTIAL USE OF THE COSTING MODEL

The purpose for the development of a computerized early retirement costing model is to provide a base estimation of the financial impact of early retirement for any single employee of the institution. Some of the assumptions used to build such a general model might not be valid for particular individuals and consequently, the model should only be used to stimulate discussion and not to be definitive. The changing nature of tax laws, FICA contributions, state and local income tax levies will all impact in various ways on net pay estimations (Table 1). Differing retirement contributions and benefit structures will result in changing retirement benefits (Table 2). Increasing social security benefits will lead to increases in net retirement income (Table 3). For all these reasons, plus others, a costing model should therefore be used as a source of information to be further refined through individual treatment.

Lest I appear to be minimizing the value of a model, allow me to state that I feel just the opposite way. I am probably biased due to having observed the positive results through the use of the model at Central Michigan University. I fondly remember individual #50 and his zest for life when he realized that early retirement for him was a definite possibility rather than a financial disaster. I also recall the University's pleasure in being able to retain a young promising faculty member as a replacement for the happily retired individual #50. It is in circumstances like these individual's lives that the model finds its worth.

The early retirement costing computer program that I have described is available through the CAUSE library. I encourage any institution to obtain and modify the program to its own situation as a way to initiate early retirement discussions.

BIBLIOGRAPHY

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(2) Kieft, Raymond N., "Financial Implications of Early Retirement", College Management, February, 1974, pp 18-19.

A CASE IN DISTRIBUTED COMPUTING: PHYSICAL FACILITIES

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The University of South Carolina Physical Facilities Accounting System was designed with these objectives: (1) to provide a complete cost accounting inventory control system; (2) to eliminate duplicate or redundant records; (3) to save valuable management and clerical time; and (4) to allow flexibility for future expansion.

The system utilizes the data base and teleprocessing facilities of IBM's Information Management System. To the University of South Carolina, the key feature of IMS is the collection of logically interrelated but non-redundant data items which may be processed from a number of different application viewpoints.

This system is discussed in terms of six major areas of activity; work requests, warehouse inventory, outside purchasing, motor vehicles, personnel, and overall accounting. Three methods of accessing the IMS data bases are included in the system; on-line, batch message, and retrieval package.

Chartered in 1801, the University of South Carolina is one of the oldest state universities in the country. Today, there are nearly 25,000 active students per year with growth centered in upper division undergraduate and post baculearate levels. A faculty of 1200 serves the main campus in Columbia; statewide, there are 5500 additional students at eight regional campuses. The University is composed of fifteen schools and colleges offering degrees at the associate, baccalureate, master's, and doctoral levels.

USC has been involved in electronic data processing for many years, and its usage has expanded as the technology expanded. Today, the central computer is an IBM System/370 Model 168 located on the Columbia campus - almost at the geographical center of the state. Because of the University's own regional campus system plus commitments to other educational institutions in the state, USC has become the focal point of a comprehensive terminal network statewide. This network includes both batch and interactive elements.

As hardware growth neared its full potential, attention turned to software as the significant key. USC's 370/168 operates under IBM's new MVS (Multiple Virtual Storage) operating system. In addition, new applications are being implemented under IBM's IMS (Information Management System). The purpose of this paper is to describe the organization and functioning of the new Physical Facilities System which represents USC's latest operational IMS System.

Purpose

The University of South Carolina Physical Facilities Accounting System was designed with these objectives:

1. To provide a complete cost accounting/inventory control system covering all areas of USC purchasing, maintenance, and physical plant service.

2. To eliminate duplicate or redundant file records, and to provide comprehensive cross-checking to insure an accurate continuing flow of information in all areas.

3. To save valuable time through computer handling of tedious, repetitive calculations and report generation.

4. To allow flexibility for future expansion, especially through compatibility with the University's Data Base Accounting System currently being developed.

Structure

The Physical Facilities System under the data base structure makes extensive use of the facilities of IMS which makes it a departure from what has been, more or less, the traditional approach to computer programming.

The key is integrated data management, the basic goal of which is the data base, a collection of logically related but non-redundant data items. Under the IMS data base management system, for example, only one billing record is maintained for each university departmental account. This one record reflects all activities charged to a given account from a motor pool rental to labor for a work request. The methodology, minimizes the chance of either omission or double billing on any charge, and it provides a complete, up-to-date total of all charges to the departmental account.

Besides being non-redundant, each data item may be accessed from a number of different application view points. A graphic representation of multiple application view point can be drawn from two of the Physical Facilities data bases. Figures 1 and 2 show the vendor and inventory data bases which are logically related under IMS.

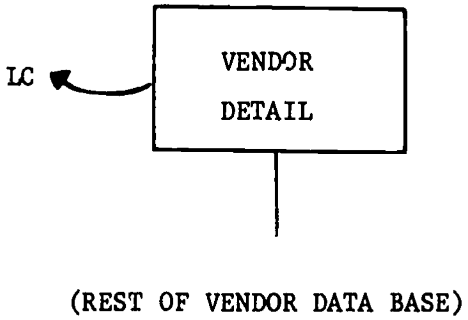

FIGURE 1 PARTIAL PHYSICAL VENDOR DATA BASE

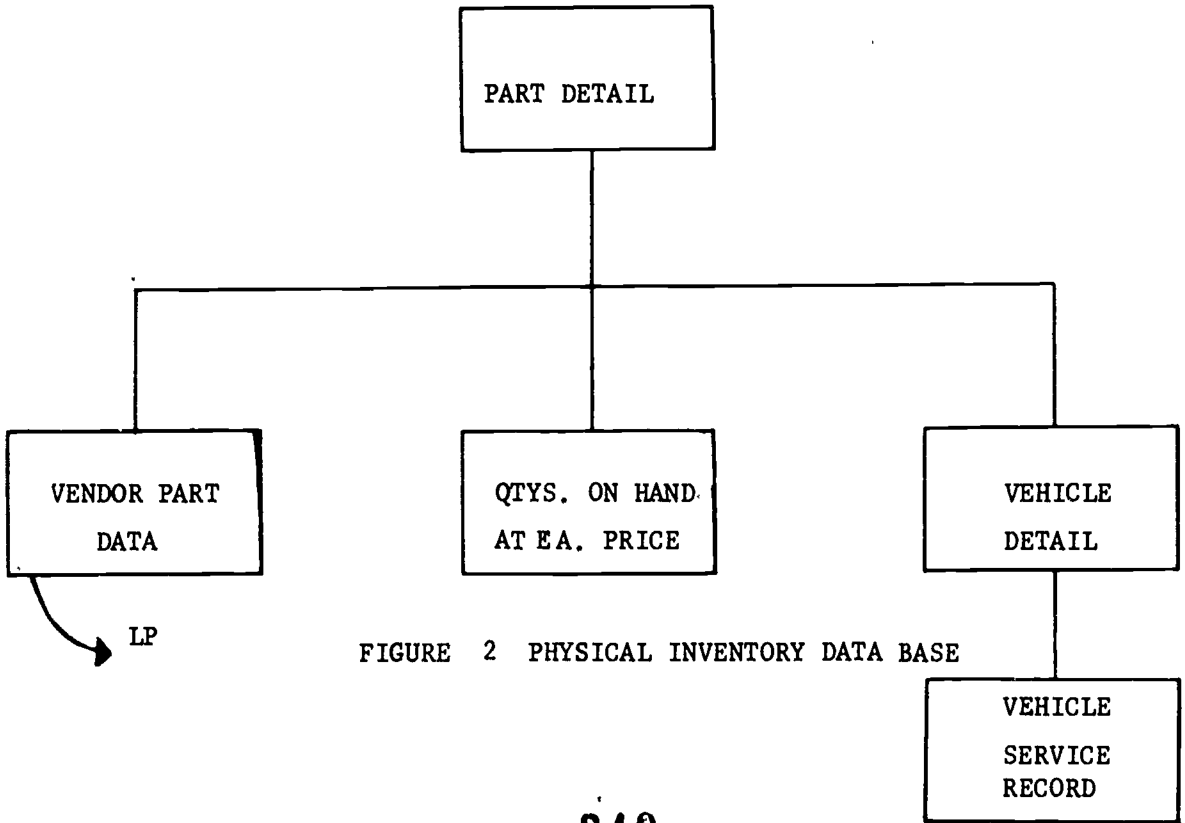

FIGURE 2 PHYSICAL INVENTORY DATA BASE

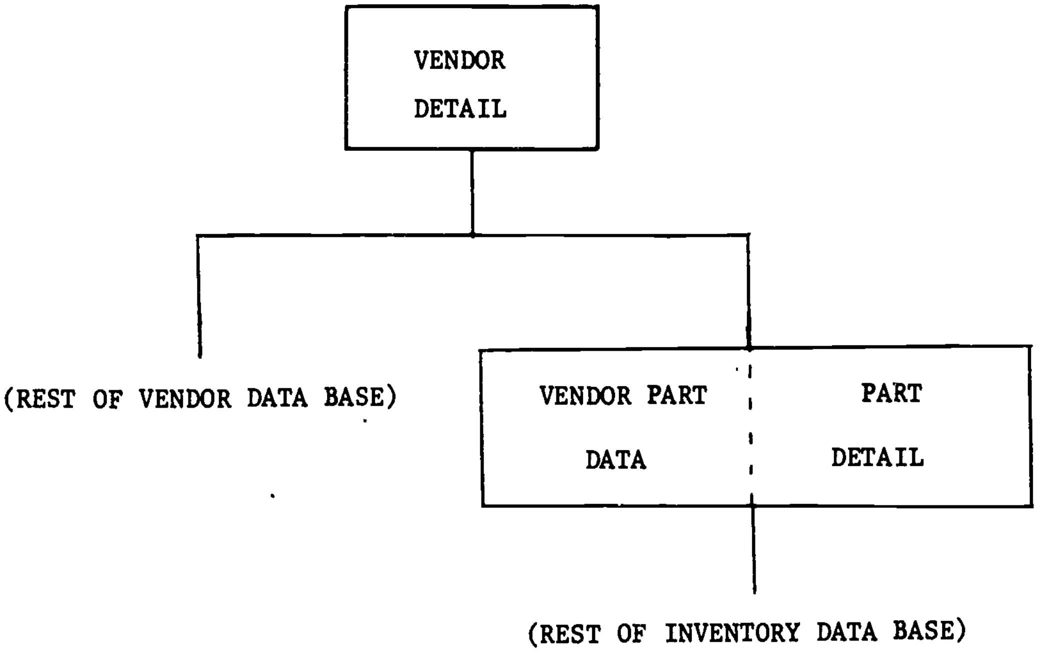

FIGURE 3 LOGICAL VENDOR DATA BASE

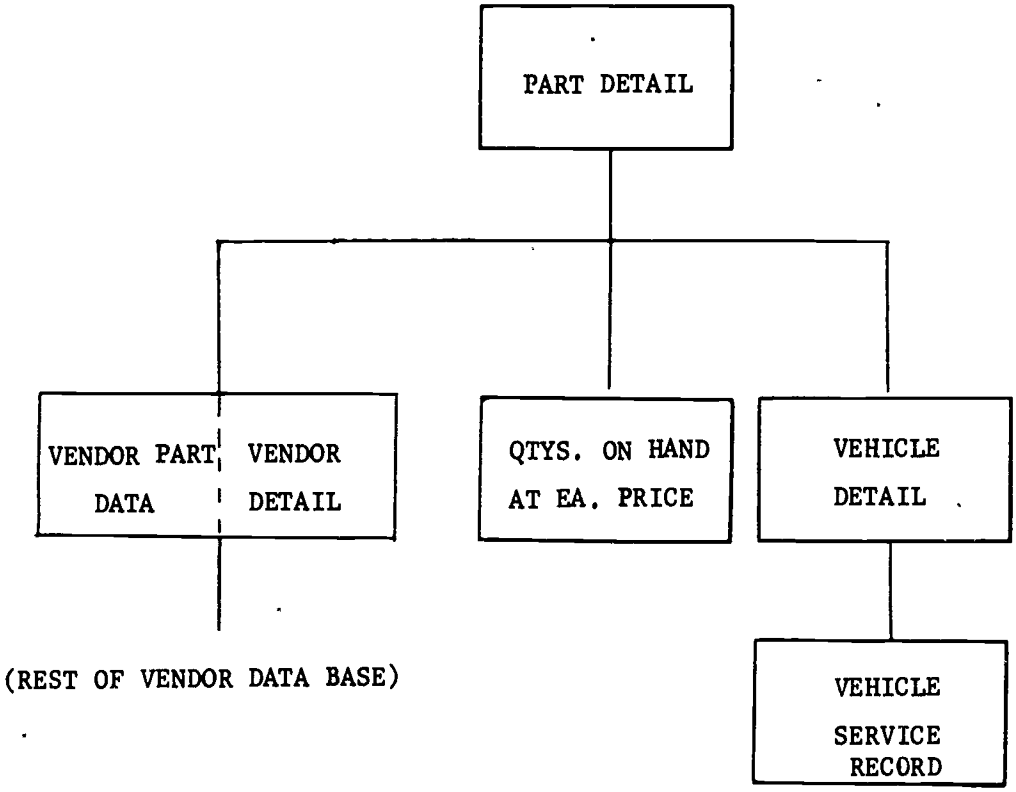

FIGURE 4 LOGICAL INVENTORY DATA BASE

Figures 3 and 4, however, show the logical data bases. Figure 3 shows the inventory data viewed from the vendor side. This structure might be used if we wished to discover which parts a certain vendor supplies. Conversely, Figure 4 shows the vendor data base from the inventory side. Such a view would be useful for discovering which vendors currently supply a certain part. In the six data bases that make up the Physical Facilities System, there are seven logical relationships allowing almost complete freedom of access. Certainly, the impact of this concept over the more traditional methods of developing data files cannot be minimized.

Three methods of accessing the IMS data bases are included in the Physical Facilities System: On-line programs, batch message programs, and a batch retrieval package. All records on the Physical Facilities data base are immediately available to the user through on-line programs via CRT terminals located in the maintenance and physical plant accounting offices. These on-line programs, which comprise approximately 40% of the system, also provide for continuous updating of the data bases. Our experience has shown us that on-line updating is probably more beneficial to the user than on-line inquiry. This is due to the instantaneous cross-checking and inherent correctability of the on-line data entry process when compared with batched update entry. On-line entry allows the breaking of the sluggish batch cycle of data preparation, batch processing, output delivery, and error reconciliation. Each transaction is completely processed one at a time. Truely, the user has full control of the data.

However, the benefits of an on-line system are not without costs. Regardless of the hardware involved, data entry time is longer with on-line systems. Because of this IMS batch message processing is used to handle large volume data entry. For example, gasoline tickets issued by motor pool are batched and sent to the computer center. However, most of the error reconciliation of the batch work is done on-line. Batch message programming accounts for another 40% of the system. Besides updating many of the reports are produced in batch mode.

The final 20% of the system utilizes The Data Analyzer by Program Products, Inc. This generalized retrieval package has an IMS interface, and it was extensively used in the final phases of the project to produce reports and audit trails. In addition to the application programming, extensive use was made of the back-up and recovery procedures of IMS for the Physical Facilities data bases.

Operation

The Physical Facilities System's operation can be discussed in terms of six major areas of activity: work requests, warehouse inventory, outside purchasing, motor vehicle, personnel, and overall accounting. The accounting data base serves as the focal point for this activity and is shown in Figure 5. All labor, warehouse supplies, and outside purchase orders, as they are needed to complete the project, are charged to the work requests. The key point here is immediate entry of data items, and entry that need only be done once. For example, the old system accumulated some data and entered it only monthly or semi-monthly. Other data had to be entered as many as four or five times because of file redundancies. Examples of the CRT screens used in typical online updates are shown in Figures 6, 7, and 8.

These charges are itemized under the request and then recapped in the detailed monthly statement sent to each department requesting service. In fact, comprehensive reports are printed each month covering all work requests. These include a work request detail report, listing all labor, warehouse supplies, and outside purchase orders for all work requests with control totals at all levels of the report, and a work-in-progress report giving work requests started, carried over, and completed during the past month, plus the status and percent of completion of each work request on the data base.

Data base records for each item in the warehouse inventory include item description, quantity-on-hand, weighted average cost, reorder point, and usage level for each month elapsed in the current fiscal year. When a new shipment of any item is added to inventory, the date, purchase order number, original quantity, quantity remaining, and cost of the shipment are placed on record. Each supplies requisition entered into the Physical Facilities System then depletes inventory according to the

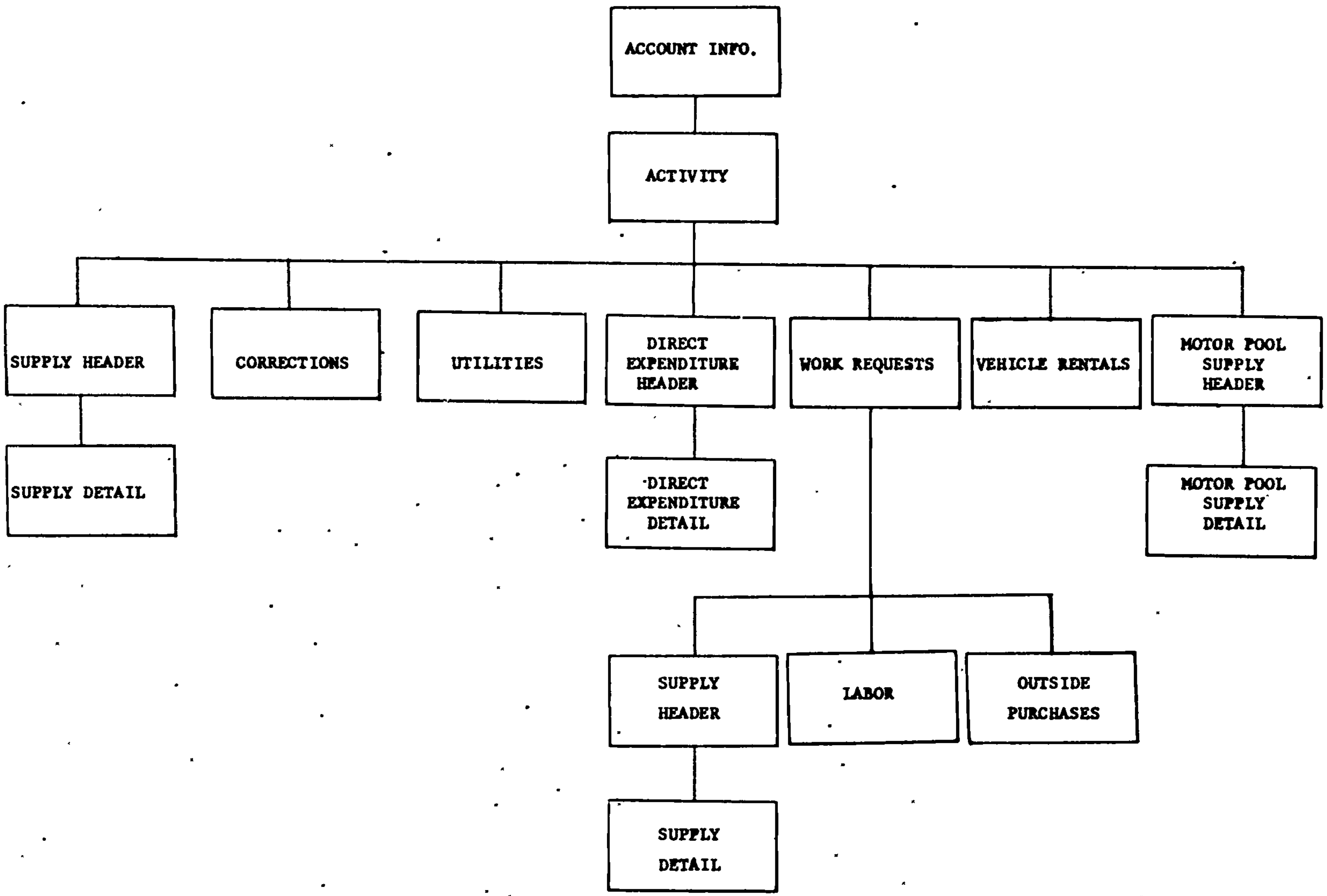

FIGURE 5 PHYSICAL ACCOUNTING DATA BASE

DEPT NO. 65200 A001 52308 ACTION I WORK REQUEST

WORK REQUEST NO. W7502983 DATE 10 04 75 TIME 10:28:04

DESCRIPTION: INSTALL PARTITION

REQUESTOR: SCHMIDT, DAVID F. BLDG 0145 ROOM 207

PHONE: 7775211 STARTING DATE 10 09 75 STATUS: INCOMP.

PROMISED COMPLETION DATE 12 01 75 ACTUAL COMPLETION DATE __ __ __

SUPV IN CHARGE: DEWITT, JACK WORK TYPE: 27 AREA: __

TOTAL LABOR	100.00
TOTAL SUPPLIES	148.72
TOTAL CONTRACT	128.76
TOTAL OF REQUEST	377.48

ESTIMATED COST OF REQUEST 250.00

REPLIES FROM PROGRAM: MSG #07 INQUIRY COMPLETE.

FIGURE 6 SUMMARY INFORMATION FOR A WORK REQUEST

DEPT NO. ____ ____ ____ ________ WR NO. W7502983 ACTION A

REQUISITION NO. 00005621 DATE 11 07 75 STATUS UNPAID

APPROVED BY MC CULLOUGH, WAYNE E. TOTAL $4.51

AREA NO. __ BLDG NO. ____.

ITEM #	QUANTITY	-------DESCRIPTION-------	PART #	UNIT COST	UNIT TOTAL COST
01	00002	1/4" X 4' X 8' PLYWOOD	012257	1.97	1.97
02	00001	PAINT, GREEN 1 QT.	025350	1.57	1.57
	____		____		
	____		____		
	____		____		
	____		____		

REPLIES FROM PROGRAM: MSG #23 ADDITION COMPLETE.

FIGURE 7 ADDITION OF SUPPLIES USED FOR A WORK REQUEST

DEPT NO. 65200 A001 52308 ACTION I

CORRECTION NO. 00000048

DESCRIPTION ADJUSTMENT FOR WORK ORDER W7502983

CORRECTION DATE 11 01 75

CORRECTION AMOUNT 128.76

CORRECTION STATUS UNPAID

CHARGE TO DEPT NO. 50000 A000 27501

REPLIES FROM PROGRAM: MSG #09 INQUIRY COMPLETE

FIGURE 8 A CORRECTION ADJUSTING THE AMOUNT TO BE CHARGED A CERTAIN DEPARTMENT

LIFO (last in - first out) method, that is, the supplies are subtracted from quantity remaining of the most recently received purchase and the most current unit cost is used to compute charges. Quantity-on-hand information for all warehouse stock may be updated using a batch message program. A listing of current quantity on record for all items is requested; this listing is then used as a turnaround document for file updating after physical inventory is taken. An inventory transaction report and a reorder list are produced weekly. The transaction report includes beginning and ending quantity of each item, plus each transaction, such as purchase order receipt, supplies requisition, or record correction, affecting the quantity on record for that item during the past week. The reorder list includes each inventory item whose quantity-on-hand fell below the reorder point during the week, plus cost history information for each vendor of the item.

Purchase orders for items outside warehouse stock are paid from Maintenance Department accounts; these "commitments" are charged in turn to the end user's department, either directly or through work requests. The commitment amount, charges to the department, and charges outstanding for each purchase order may be updated on-line. Direct expenditure vouchers for needed items are also recorded and charged to the department concerned, as are utility bills for gas and electricity consumed by the University.

Each motor vehicle owned by the University of South Carolina is part of an auto inventory which, together with Motor Pool supplies, forms a Physical Facilities subsystem similar to that of warehouse inventory. Descriptive information, and serial, registration and license numbers are placed on record for each vehicle. Total vehicle mileage, service cost, and current, highest and lowest gasoline mileage are also recorded; these figures are updated monthly from Motor Pool supplies requisitions and oil company credit card purchases entered into the data base. Motor vehicle rental requisitions are also entered into the system. Rental charges are calculated, including labor cost if a driver for the vehicle was supplied, and appear on the monthly statement of charges to user's accounts along with charges for Motor Pool supplies and credit card purchase tickets. A monthly gasoline consumption report is produced, giving usage totals by motor vehicle and also by vehicle within department owning or using that vehicle. A motor vehicle maintenance report is also printed monthly; this report lists all supplies and repairs obtained for each vehicle, hopefully enabling the user to identify those vehicles whose maintenance costs are excessive.

Three types of personnel activity are included in the Physical Facilities System. The first is the recording of job classifications and specific position "slots" of each classification available to employees of the University of South Carolina in the purchasing, maintenance, and physical plant services divisions. Maximum and minimum yearly salary and hourly pay-rate are recorded for each class/slot. The second activity is the assignment of each employee to a particular class/slot, and maintaining current salary, home department, department paid from, and sick and annual leave earned information on the data base for each employee. Finally, the working hours of each employee must be entered into the system each week. Time cards are computer printed for each employee with name, social security number, home department, and week ending date, as well as current sick and annual leave time earned. Each time card is completed by filling in the number of hours spent by the employee on sick leave, annual leave, leave without pay, general work, and assigned work orders during each day of the week ended; this information is entered into the data bases from the CRT terminals. All leave hours taken are subtracted from leave accumulated data on record for each employee. The number of hours spent on each assigned work order is multiplied by the employee's hourly pay rate, to obtain labor costs which are then charged to the work request. Personnel reports produced by the Physical Facilities System include a class/slot listing, a listing of employee information, and a listing of each period of leave taken by an employee.

The key feature of the general accounting function of the Physical Facilities system, and perhaps the most important product of the entire system, is the monthly statement. This itemized listing of all charges incurred by each department's account since the previous billing date gives a detailed record of each individual transaction charged to the department, with control totals at all levels of the statement. Provision has been made to enter accounting corrections into the system from the CRT terminals. The exact amount to be added to or subtracted from the total charges to a department, the department to which a credit will be charged, and the reason for the correction, such as data-entry error or return of surplus supplies, are placed on record for each correction and will appear on the next monthly statement produced. This provision insures complete documentation of all flow of funds into and out of the accounts governed by the Physical Facilities System.

In parallel with the program development, a concerted effort was made in the user documentation and education areas. The user's guide alone contains over 370 pages. A series of meetings and presentations were held to enlist managerial and grass roots support for the system and gather potential system enhancements. When implementation time came, temporary staff members were added to ease the burden. As much as possible, user requested modifications in the early days of the system were accommodated.

SUB-SYSTEM INTEGRATION FOR STUDENT RECORDS: FOREGROUND AND BACKGROUND PROCESSING

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A general discussion of development philosophies for student records at VPI & SU includes each module as developed and the interdependencies among the system functions. Specific, but non-technical examples of foreground events triggering other events later in the system are used to describe an integrated student records system.

The abstract of this paper is included for the interest of the reader. Unfortunately, the full paper was not received in time for publication. However, it is available through the CAUSE Exchange Library.

AN INNOVATIVE APPROACH TO REMOTE TERMINAL PROCESSING

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This paper describes Villanova University's approach to remote terminal processing. The University has a 144K IBM model 135 mainframe and operates in a five partition environment under DOS/VS. One of the five partitions houses a 10K remote DOS to HASP program called RMTDOS which links the Model 135 to an IBM 370 Model 168 at a nearby university-college consortium. This permits the Model 135 to act as a front-end processor while four other partitions are locally processing a DOS/VS version of WATFIV, COURSEWRITER III, the University administrative data processing applications and the latest IBM version of POWER. This DOS system simultaneously supports remote job entry, batch processing and low speed terminal processing.

INTRODUCTION

When we think of remote terminal processing, we tend to think in terms of an independent, small scale digital computer that has been dedicated to perform one or more control and/or processing functions in a data communications network. This workstation unit usually includes several line adaptors, an interface with a central, large scale computer system and on line peripheral devices such as a card reader and a high speed printer. Most often, it is controlled by flexible and easily modified software.

Villanova University's definition of remote terminal processing closely approximates the above definition of what a remote unit should be like with but one notable exception. There are no terminals nor stand alone digital computers on the campus dedicated to the sole purpose of remote batch processing. Instead, the University has a 144K IBM 370 Model 135 mainframe which operates in a five partition environment under DOS/VS. One of these five partitions houses a 10K remote DOS to HASP program, called RMTDOS. This program links the Model 135 to an IBM 370 Model 168 at a nearby university-college consortium.

It is RMTDOS which enables the Model 135 to do the work of a front end processor while its four other partitions are locally processing a DOS/VS version of WATFIV, COURSEWRITER III, POWER and the University administrative data processing application. This innovative DOS/VS system simultaneously supports remote job entry, batch processing and low speed terminal processing, all in a 144K environment.

DECISION WHICH LED TO A REMOTE COMMUNICATIONS CONCEPT

The RMTDOS package might sound like a new approach to front end processing, but for Villanova and some thirty other academic and commercial users of the system, the idea is hardly new. In fact the idea originated several years ago when the University installed a 360 Model 30 for the purpose of sharing the academic and administrative computer workload. It was this decision to share one computer for both instructional and administrative purposes that finally led to the creation of the RMTDOS concept.

THE NEED FOR MORE COMPUTING CAPACITY

Villanova's need for more academic computing capacity and its commitment to the use of computers in academic research were the two most influential factors in the decision to join the network consortium at the University of Pennsylvania in 1968. There was not enough justification to install its own large scale computer, and a previous decision to centralize computer centers meant that a second computer would not be installed for academic purposes only.

Based on these circumstances, the 360 Model 65 at the University of Pennsylvania appeared to be the most attractive computing package for the faculty, students and researchers of the institution. The large memory and disk storage capacity attracted the research user who needed extremely large segments of memory for his matrix oriented FORTRAN manipulations. Engineering software packages such as MIT's ICES loomed attractive to the Engineering faculty since only large computers such as the Model 65 of the day could run them. And, the students would benefit by the use of an extremely fast, efficient and inexpensive student FORTRAN compiler called WATFOR. In fact, some WATFOR jobs were compiled so fast that some student programs were compiled and executed in milliseconds -- a period too fast to be recorded and billed in earlier days.

All of these enticements combined with the relatively inexpensive means of procuring these services convinced the University administration to establish the communications link with the University of Pennsylvania. This ultimate decision, then, paved the way for the necessity of a communications processor or workstation.

USING THE MODEL 30 AS A REMOTE WORKSTATION

The early transmission of data from Villanova to the Model 65 was completed via an IBM communications software package called RMT360. RMT360 was a stand alone program which required that the 360 Model 30 be dedicated to the function of a remote workstation for HASP/RJE. One detriment to this mode of processing was that while RMT360 was operating, the University's administrative computer workload had to wait until the academic programs were completed. Multi-programming was not possible with RMT360. (See figure 1).

Initially, this did not create a major problem, since runs to the Model 65 seldom took more than one hour. But, with the increasing influx and sophistication of the faculty and student programs, the Model 30 very soon remained linked to the network for over five hours a day. This did not settle well with the administrative users who had already become impatient with the prolonged periods of interruption and delay.

Another problem also became more evident with the extended use of the Model 30 as a workstation. It was a much too expensive piece of equipment to be used so inefficiently for such long periods of time.

THE SEARCH FOR A DOS TO HASP SOFTWARE PACKAGE

Because of these problems, a decision was made to search for a software package that would permit the Model 30 to give simultaneous service to the academic and administrative communities. By running the communications software in the foreground partition while the background partition produced the administrative updates and reports, everyone would be satisfied.

It was first thought that the IBM POWER package of that period would provide the capacity to do this, but POWER had no communication provisions programmed into it at that time. A search for other IBM software and for software created by other users indicated that no package existed which would allow a DOS system to communicate with a HASP/RJE system while operating in a multi-programming mode.

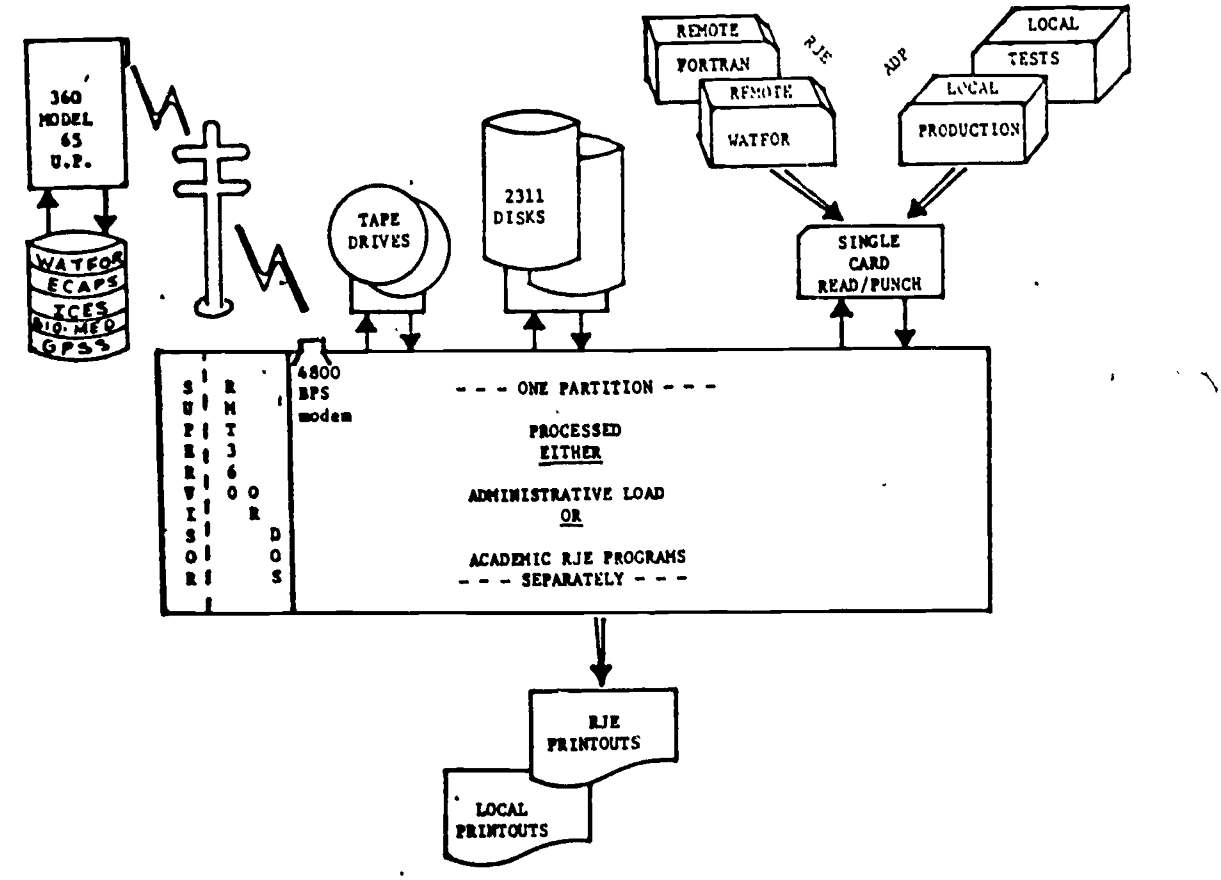
The problem was eventually resolved when the University compiled a set of specifications and contracted to have the package written especially for its needs. The University named the package RMTDOS.

RMTDOS IN A TWO PARTITION ENVIRONMENT

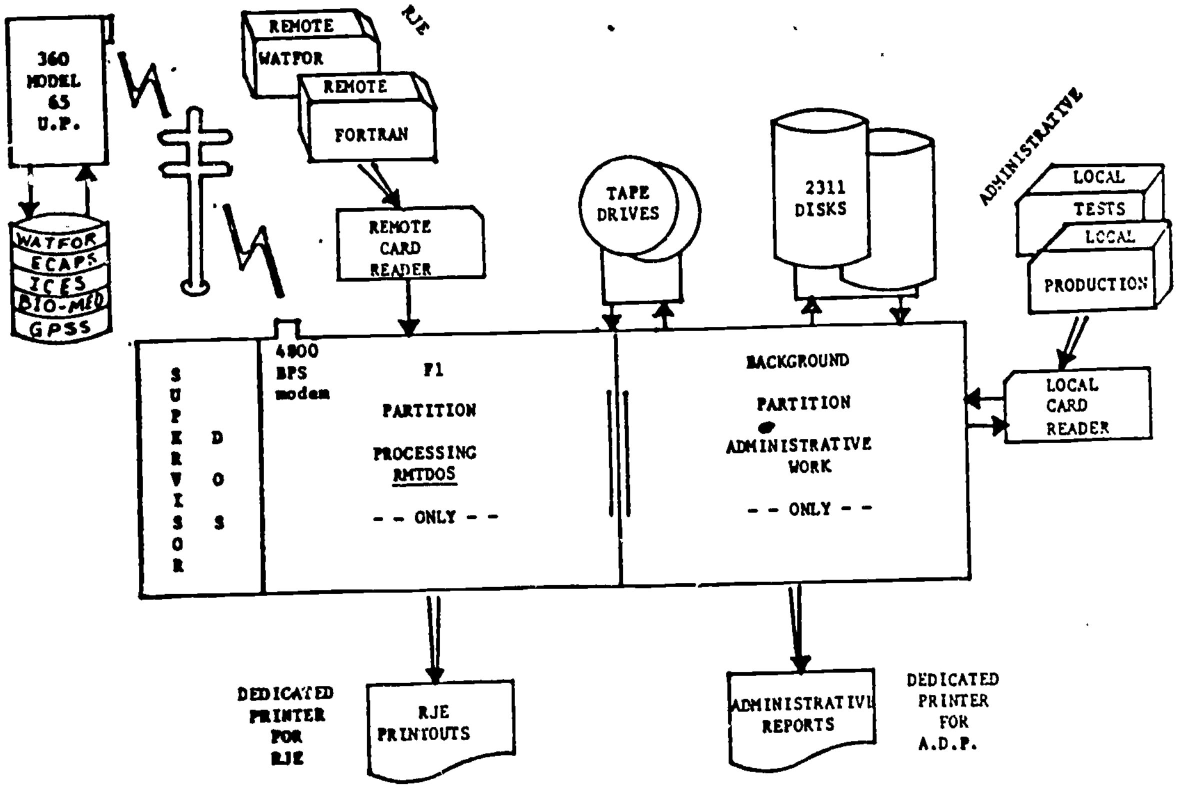
When RMTDOS was initially installed at Villanova, it presented an entirely different concept of processing. To be effective, RMTDOS had to have top priority, hence it was assigned to the F1 partition while all local processing was assigned to the background partition. The logistics of submitting and returning RJE decks and listings presented few problems in the beginning.

Decks were submitted by student and faculty programmers to a dispatch clerk who in turn processed them in a batch mode on a single card reader where both ADP and RJE jobs were read serially. Jobs processed through RMTDOS at the University of Pennsylvania were returned and printed on a single high speed printer which was shared by both partitions.

A problem soon arose as to what priorities would be assigned to which users' print jobs. Long ADP listings would tie the printer up for extended periods of time. Meanwhile, RJE jobs were backing up in the queue on the Model 65, waiting for the long ADP jobs to finish. As one might imagine, neither user was willing to stand



(Figure 1) 360 MODEL 30 BEFORE RMTDOS



(Figure 2) 360 MODEL 30 AFTER RMTDOS

aside for the other.

After a careful study of the problem, a decision was made to install a second printer and dedicate it entirely to the F1 partition under the control of RMTDOS. A 1403 II printer was ordered for that purpose in 1972, and an improvement in the timely dispatch of reports for both users was immediately evident.

There was still one other problem to be resolved, however. And, that was the matching of the submitted deck for RJE runs with the printed output from that program. This presented a sticky logics problem which was eventually resolved by the installation of a dedication 2501 card reader.

The second card reader was not installed inside the computer room as was the second printer. Instead, it was placed inside the student data preparation room. It too was under the direct control of RMTDOS in the F1 partition, as was the 1403 II printer, but the significant difference was that the student had hands on access to this peripheral device. This allowed him to retrieve his deck from the output hopper seconds after submission. His printout was returned separately, usually within two to five minutes, but a 30 second turnaround was not uncommon on less busy days. (See figure 2).

This type of card reader was termed a "hot reader." It received its name from the fact that it was active throughout the day so long as RMTDOS was up and running. This same procedure exists in the Villanova center today, and it has proven very popular with both the student and faculty programmers.

RMTDOS AT VILLANOVA UNDER DOS/VS

Villanova's present version of RMTDOS runs under DOS/VS in one 10K partition of a five partition Model 135. Through this package, research and academic programs are submitted for processing to a 370 Model 168 OS/HASP system at the UNI-COLL Corporation in Philadelphia.

The package is connected to one of four active ports on an integrated communications adaptor (ICA).. A 4800 bits per second dedicated line allows uninterrupted transmission for a full twenty-four hours a day. The peripherals it supports are the same 2501 card "hot reader" and the 1403 II printer mentioned previously. One additional peripheral enhancement has been the capability of accessing the 2540 card punch.

A further enhancement and a unique aspect of the Villanova system is that the user has the option to send his program and data to either the OS/HASP Model 168 or to instruct the Model 135 to process his FORTRAN, PL/1 or WATFIV job locally via the Model 135 compilers. This feature is not an inherent part of RMTDOS, however. It has been made possible through special programming efforts of the Villanova systems programmers. Still, it does highlight the system and eliminates a considerable amount of manual manipulation. All output from jobs submitted through the 2501 card reader are automatically routed to the 1403 II printer, which like the 2501, is reserved for faculty and student use.

Another feature of RMTDOS is its flexibility. Should the 2501 card reader or the 1403 II printer malfunction at any time, the programs and data can be submitted and output retrieved via the 2540 card reader and the 1403 N1 printer, respectively. These latter two devices are normally reserved exclusively for the large administrative data processing volumes.

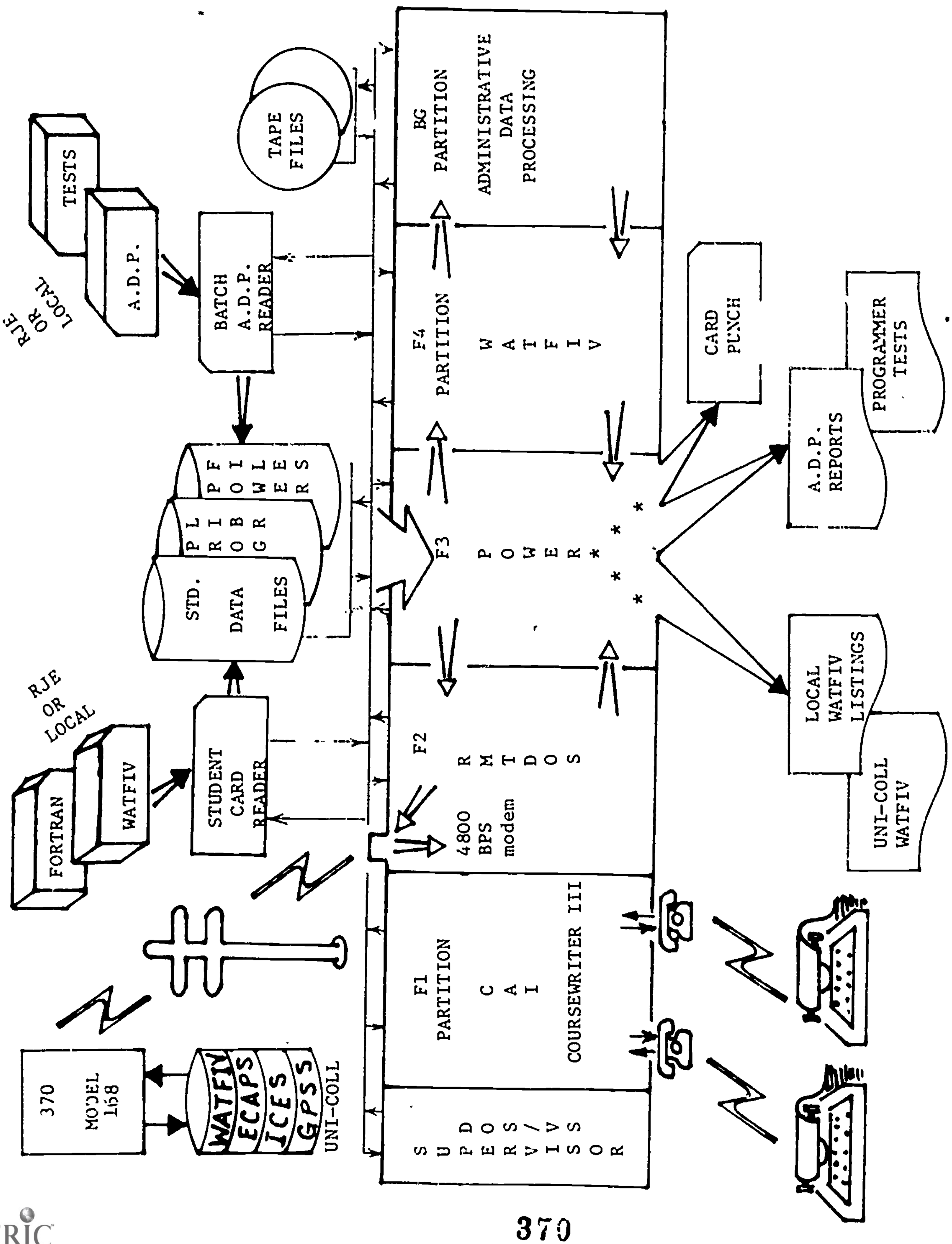
A GENERAL APPROACH TO TELECOMMUNICATIONS AT VILLANOVA

Undoubtedly, it is the RMTDOS package which makes Villanova's approach to telecommunications innovative and somewhat unique for medium scale DOS systems. (See figure 3). With RMTDOS, Villanova has the capacity to:

1. batch process locally
2. process remotely from a DOS system to a HASP/RJE system
3. process over low speed telephone lines to terminals throughout the University.

Batch processing is permitted through two card readers, simultaneously. Administrative data processing applications are normally activated through the 2540 reader, and the vast majority of this processing is done in the background partition. The 2501 "hot reader" is also used for local batching, and the majority of its input is for the student and professor programs, most of which are WATFIV jobs. These jobs are processed in the F4 partition. Up to 1300 jobs have been batch processed in these two partitions in a

(Figure 3)



MODEL 135 EQUIPMENT CONFIGURATION

single workday.

Remote processing has been described thoroughly in previous paragraphs, but it should be mentioned here that RMTDOS resides in the F2 partition of memory. All jobs processed in the F2, F4 and Background partitions are under the control of POWER which resides in partition F3 and uses a Model 3330 disk drive for the collection and distribution of programs and data.

Low speed terminals are driven through the IBM software package called COURSEWRITER III. This package which is the author language and supervisor for computer based tutorial instruction functions resides alone in the F1 partition. The primary user of COURSEWRITER III is the Chemistry department, but one local high school has effectively tied into the Model 135. One other terminal is available in the student consulting area of the Computer Center for general use.

All of this activity is under the supervision of the DOS/VS monitor in 144K of real memory. The types of jobs run daily on the Model 135, the partitions in which they are normally run along with the partition priorities and the anticipated turn-around times are best summarized in figure 4.

TYPE OF JOB	RESIDENT PARTITION	PARTITION PRIORITY	VIRTUAL CORE	TURN AROUND	DISPOSITION OF DATA
WATFIV LOCAL	F4	3rd	154K	1 min-30 min	Deck in to print return
WATFIV REMOTE	F2	4th	64K	1 min-30 min	Deck in to print return
PL/1 LOCAL	F4	3rd	154K	5 min- 1 hr	Deck in to print return
PL/1 REMOTE	F2	4th	64K	5 min- 1 hr	Deck in to print return
FORTRAN LOCAL	F4	3rd	154K	5 min- 1 hr	Deck in to print return
FORTRAN REMOTE	F2	4th	64K	5 min- 1 hr	Deck in to print return
COBOL COMPILES	BKG	5th	70K	5 min- 1 hr	Deck in to print return
COURSEWRITER III	F1	1st	102K	2-5 Secs.	From attn. to response
PRODUCTION (ADP)	BKG	5th	70K	to 12 hrs	Into Operations-to mail
POWER	F3	2nd	64K	N.A.	N.A.
SUPERVISOR	N.A.	N.A.	44K*	N.A.	*Uses 44K of real core

Figure 4

TYPES OF JOBS RUN DAILY ON MODEL 135

PRESENT JUSTIFICATION OF THE RMTDOS PACKAGE

The primary justification of the RMTDOS package is based on the "one computer for all" concept of processing in the University. Initially, the original package was compared to the price and performance of the IBM 1130 and Model 20 communication processors. Both price and performance influenced the start of the concept at that time.

After the first few years of performance by RMTDOS, it was once again compared with the performance of three other independent remote workstations: the Data 100, University Computer Corporation's COPE, and a unit marketed by the SCI-TECK Corporation of Delaware. Although these units performed very capably, the RMTDOS concept still maintained the favor of the students and faculty of Villanova.

OUTSIDE RECOGNITION OF RMTDOS

RMTDOS first received recognition outside of the University when the Philadelphia Community College adopted it for its mode of communication with the Model 65 at the University of Pennsylvania. Next the University of Pennsylvania's administrative data processing operation recognized it for the same purpose.

The package received its first formal recognition in an article produced in Datamation magazine of February 1, 1971. As a result of that publicity several commercial and institutional organizations acquired the program and began using it in their processing operations

In the July 12, 1972 issue of Computerworld, RMTDOS once again received recognition. This also attracted inquiries about the program, and again several copies were distributed. As recently as September, 1974, the enhanced version of RMTDOS was publicized once again in Computerworld. This article emphasized the package's tape support and its capabilities under DOS/VS.

As a result of this publicity and the reputation it received in the field, over 30 versions of RMTDOS are now operating in the United States, Europe, and Canada. Among the major corporations using it are Bell Telephone, Western Electric, Montsano, and Hallmark Cards. Major universities using it are: Rutgers University, Penn State University, and the University of Missouri.

RMTDOS is a proprietary package of Villanova University, and as a result the University has asked a retainer price for its use. Special considerations have been afforded to non-profit and educational institutions.

THE FUTURE OF WORKSTATION PROCESSING

The trends toward centralizing and decentralizing computer facilities have vacillated over the past two decades. Emerging hardware technology has probably had the most dramatic effect on these trends, and this will probably continue to be the case in the future.

Most recently, the availability of mini computers has emerged as a leading influence in future planning. Their low cost and their adaptability to network computing have made them attractive to industry and education alike. They are more and more a part of the automated industrial process and of the laboratory experiment which requires a computer device to be physically present on site.

These mini computers are no longer mere workstation devices which serve as data exchangers or distributive computer units. They are "stand-alone" units which have the capacity to be united into one or more supporting networks.

There is a cost effectiveness in this type of processing especially since the "minies" can be kept to minimal configurations. Cost effectiveness is lost on these units when there is a proliferation of peripheral I/O devices at each local site, that is when each mini goes out of its realm and attempts to perform independently of all other units.

One futuristic trend using minies in a three level hierarchy network was recently developed by the University of Chicago and supported by the National Science Foundation. The network consists of a series of mini-computers at the lower end of the network, an independent processor with high speed peripherals (disks, tapes and printers) at the intermediate end, and a central, large scale computer at the high end of the network.

It is at the intermediate level of this network that the maximum service is provided at the lowest cost to the mini-computer user. It can provide operational services to these "minies" with minimal configurations and communications services to those users with substantial configurations that normally function with their own operating systems. The intermediate unit can also provide transfer of information freely between numerous sites other than the local, central computer.

Villanova is contemplating a venture somewhat similar to this three level hierarchical network in the near future. Installed in the Chemistry department of the University is a Nova 1200 mini computer. Future plans are to use this Nova computer to interface with instrumentation in the department for the rapid collection of data.

Data accumulated will be then sent to the Model 135 over a hard wire line where it will be stored for subsequent processing. After condensation, manipulation or synthesization of the data has been performed, a decision can be made to send the data back to the Nova 1200 or to send it to the large Model 168 via RMTDOS. From the Model 168, it can be returned once again through the Model 135 where it can be printed on the intermediate high speed printer or switched directly to the Nova 1200 plotter unit. In this manner, the Model 135 acts as an intermediary between the mini and the maxi, allowing for options which would not be available with interaction between the mini and the large computer alone.

CONCLUSION

RMTDOS is still a viable and effective communications package. Its concept was recently emphasized by an October, 1974 IBM release of a DOS/VS Remote Job Entry Workstation Program. This IBM package, released five years after the original concept of RMTDOS, is a possible harbinger of the intent of the computer industry to adopt this concept of workstation processing.

The interest is still high with regards to requests for more information on the specifications of RMTDOS. And, it is encouraging to note that the most ardent supporters of the package have been and still appear to be the users of the system for the past number of years. Among these supporters, are the faculty and student programmers of Villanova University, itself.

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MIS FOR COLLEGES: A NEW APPROACH

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This paper describes Concordia College's development of an integrated data base by using systems provided through the CAUSE Exchange Library and other sources, combined with data base software and ANSI COBOL. The institution is doing very little new development, but is utilizing systems already working by modifying them, structuring programs, inserting data base software and new concepts.

College administrators unhappy with DP results

As a former coordinator of MIS for 12 private colleges in Minnesota, I found that there were severe conflicts between the administrators of the colleges and the data processing departments.

There are indications that the administrators do not feel that their administrative data processing department is meeting the needs of their institution--especially in the areas that surround new concepts of accountability suggested by WICHE and the recommendations of The Joint Accounting Group (JAG). Also, the powers to be do not feel that the EDP departments have kept current in new technology (i.e.: modular programming, data bases, structured programming, and communications). In addition, management does not feel that they are receiving useful management reporting (such as : program oriented budgeting and accounting, fund accounting, interrelationships to other systems like payroll/personnel, admissions, capabilities to interface with software developed for measuring college resource requirements) for comparative analysis with other institutions such as the RRPM model developed by WICHE.

Administrative data processing unwilling or unable to meet needs of institution

The most ardent reasons given by the data processing management staff for combating the administrative accusations seem to be: 1) the lack of funds for new staff, 2) the lack of funds for new software, 3) the lack of funds for new hardware--in other words, it boils down to the lack of funds. To this I say "BAULDERDASH!"

The cost of computer hardware is decreasing while the cost of personnel is severly increasing; therefore, we must find new ways of implementing MIS systems on new and cheaper computers using less staff.

There may be two completely different sets of circumstances: ONE, there may already be an established data processing department--as inept possibly as it may or may not be. And TWO, it may be a new installation with new hardware, software and personnel.

If data processing is already established, chances are it has evolved through many generations of changes in computer technology. The EDP staff and the users are weary of change and who can blame them. Also within these generations of changes, many of the personnel involved in the EDP areas are becoming "fed up" with change. Their attitudes are now saying "it's doing a job--leave it alone." The EDP personnel with this attitude are allowing themselves to become archaic in the approaches to problem solving and when management does want information to make decisions by, the staff either says it cannot be done with their current equipment or they don't know how to do it, or they need new hardware or software. So nothing happens.

A sad state of affairs.

The intent of this paper is to speak about a seemingly impossible task: To successfully implement a total management information system with a new installation, a new computer, a new staff, and a limited budget.

An inexpensive yet powerful computer configuration at Concordia

First, a needs analysis was performed to determine the administrative and academic needs of the college. Since the administration had not had the opportunity to utilize computing powers, it was decided that the new computer configuration should meet their needs first and yet be able to initally handle the basic needs of the academic departments. Also, it was decided that the computer must be upgradeable to the addition of data communications for the academic and administrative areas.

Based on the feasibility study we decided to purchase the following: (note: there were contractual agreements for allowing upgrading)

Hardware

Burroughs B-1716 computer (65K memory)
2 - disk drives 87M ea (removeable packs)
2 - tape drives
1 - card reader (400 CPM)
1 - card/read/punch
1 printer (300 LPM)
virtual storage

Software

Basic compiler
Fortran compiler
RPG/2 compiler
Cobol compiler
Forte'/2 (data base management system)
Reporter (data base report extractor)
sophisticated master control program allowing multi-programming, spooling, etc.

This configuration has the capabilities to move into a time-sharing environment and to interface to the Minnesota state time-sharing network. Through the state time-sharing network, the academic departments can utilize large systems with vast memory for modeling, simulation, and large number crunching jobs.

Computer center staff

As was pointed out earlier, the immediate use of the center was to service the administrative departments. The staffing requirement will only speak to those needs.

First, a director of the center was hired to manage the computer resources and to provide leadership in the development of a college management information system.

Justification for added personnel (programmers, analysts, keypunch operators) can only be accomplished by the phasing out of positions in the various user departments as we add these departments to the system. This way each department will have a direct-vested interest in their part of the management information system (MIS) because part of their budget is providing the computer center with personnel.

Since our budget for new staffing is limited, it is necessary for us to search for new ways to provide the college with a management information system. This causes us to look at the availability of existing systems.

Resources for available user software

There are a number of available resources to obtain software.

If enough funds are available there are many corporations that specialize in software packages and, usually for a fee, will modify programs to fit the user needs. Although this may be the expedient way to go, it would be the most costly because 1) the software and modifications are expensive, and 2) if the package is installed by the manufacturer, the user has little knowledge about the innerworkings of the system. Later they must rely on the software house for changes and enhancements--again expensive.

Another alternative depends upon the amount of funds available--and that is to develop a management information system in-house. This means hiring professionals--system analysts and programmers--for the development effort. Not only does one have a built-in staff (overhead), but the development effort will take many years to complete. With this alternative, you do have a tailored system for your institution and it will serve your institution well. But, can you afford this exorbitant cost just to reinvent the wheel?

A third alternative is to search for systems that are already operational at other colleges, universities, and other sources such as at state and federal governments. This approach is a difficult one as it is not an easy task to determine whether a system will work for your institution. In order for this method to work you must be able to use at least 85 percent of the system as it stands. Also, the source institution must be cooperative to the point of consulting with your staff as to how their system works. If these two conditions cannot be met, chances of a successful conversion will be very slight.

An organization such as CAUSE serves as a very good resource as it is attempting to pool available software from many institutions and is providing a shopping list for potential users of these software packages.

A successful implementation of a financial information system

The state of Minnesota spent over a million dollars for research in developing a program-oriented budget and accounting system. This system includes the following sub-systems:

1) fund accounting (self balancing of each fund)
2) accounts payable including check writing
3) job costing
4) perpetual inventory control
5) encumbrances
6) an interface to a payroll/personnel system

Since the private colleges are a part of the Minnesota Educational Computing Consortium (MECC), this package was available to our institution at no cost. Concordia was the first private college to implement this system. We had to be careful not to allow this system to dictate, by its design, financial policy.

These are the steps we took in implementing this comprehensive accounting system:

1) We developed a (14 digit) chart of accounts adhering to the recommendations of WICHE, JAG, and our auditing firm

2) We exchanged the data base software with our Forte'/2

3) The chart of accounts was tested with data

4) The data base was built and,

5) In six months we were completely operational.

This accounting system presently has the capabilities of extracting and reporting up to 120 management reports and 40 detail transaction reports.

For Concordia, the price of the system was right, and a six-month installation time even surprised our auditing firm!

Also, we obtained a payroll/personnel system from the state of Minnesota which interfaces with the financial information system. This system has been converted to our use as it utilizes the same data base as the accounting system. Priorities, however, have not allowed us to implement this system.

A first look decision--second look reversal

Concordia College's next administrative priority was to implement an alumni-development system. To locate this system, we used the shopping list of available software systems provided by CAUSE.

Our development and EDP staff indentified four systems that could meet the needs of Concordia. Further study of our needs and the available systems narrowed our search to two systems.

Proprietary problems

System A not only would meet the needs of the development office, but it was conceptually designed with a data base approach. It also used the simplistic approach of a report-writer. Everything we were looking for. The problem? The data base software and the report-writer were proprietary software packages. Our conclusion was then, that it would be easier to upgrade a tape-oriented system to a data base design rather than to replace one data base system with another.

This decision was a mistake, although not a costly one because we were not far enough along in the redesign phase of system B to see that we were looking at a major overhaul.

Our first decision to use system A, and our change--to use system B--could have been a very costly error in judgement if it were not for the complete cooperation of the institutions that developed the systems. Without the help of their staffs in understanding how each system worked, our decision might have been made much later; and possibly too late to allow us to change course.

Replacing one data base management system with another

One of the first things to find out is how the original data base system is managing the files. This includes identifying the structure of the files, the access methods, keys, and which files are chained and/or linked together. In dealing with proprietary software as we were, there probably won't be any reference information available to you. This was true in our case.

Therefore, to identify solutions to problems, you must rely heavily on the user institution. Without their commitment to your success, your chances of success are almost nil.

Next, how will our data base system manage the files as the other system did? Where do we replace Cobol working storage access element relationships and the call or access routines in the procedure division. Once these are defined you can proceed to replace one DBMS with another. In addition, you may wish to modify or add file relatioships during the conversion. This will be possible because you will have control of the DBMS replacement.

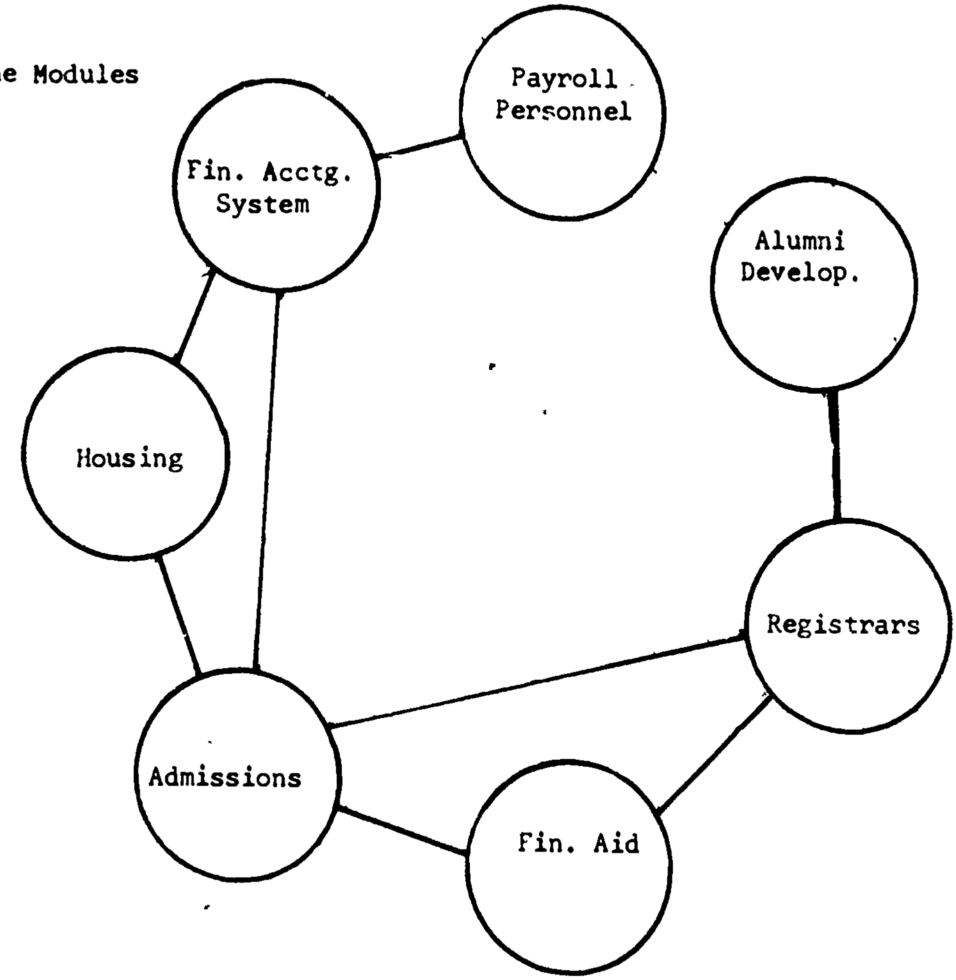
As far as the report-writer is concerned, with our own data base report-writer all we had to do was review the generated reports and write our own parameters for their generation.

Interfacing foreign systems to your DBMS

Whether you have an existing DBMS or are creating a new one, the interfacing of new systems to your existing DBMS is a most difficult procedure. Obviously, the system that has been chosen will not meet 100 percent of the needs of the department. Access numbers such as student number, general ledger number, purchase order number and so on may be different size fields than you need. Also record sizes may have to be adjusted, and files may have to be added or deleted.

At Concordia, we are in phase one (figure 1) in developing our new DBMS by identifying existing systems, and with enhancements and modifications, implementing these systems as stand alone modules. These modules do have duplicate data elements at this time. These elements have been agreed upon by a user task group so that continuity will be maintained in the total development effort.

Figure 1
Phase-One
Stand Alone Modules



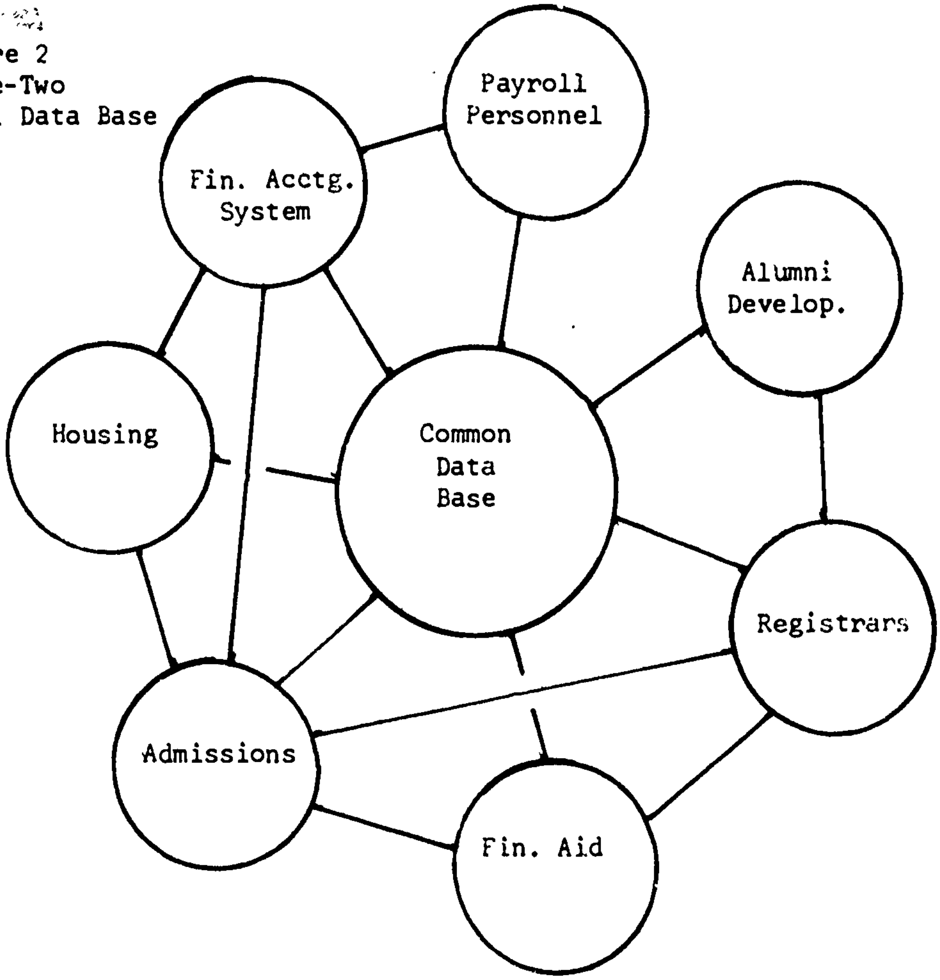
Data is passed between these modules externally, in other words, one module will create a file to be used by another module. There will be no intent of directly updating multiple data elements in multiple files within the data base.

In one year's time we have implemented a programmed oriented budget and accounting system, converted a payroll/personnel system, and identified an alumni-development system. We have yet to identify five other major systems. Tentatively, we have located two possibilities through CAUSE.

Interfacing modules with a common data base

The individual modules once they are operational can now have their duplicate data elements removed. This means the creation of a data base of elements common to the other data bases. (See figure 2) The management of the total data base is critical to the success of this phase of the DBMS. Quite often at this stage a data base administrator is hired to manage the data base. This administrator acts as the coordinator of all user departments identifying responsibility for the maintenance of data elements in the data base. Even though all common data elements are now contained in one data base, each module will continue to stand alone. Data will continue to be passed externally.

Figure 2
Phase-Two
Total Data Base



Summary

By utilizing software houses, other independent sources such as state and local government sources, and organizations such as CAUSE, there is no reason why the data processing department cannot provide its institution with useful management reporting.

If funding is a problem, using a little ingenuity to identify systems and following through with obtaining these systems can still provide your institution with an excellent MIS.

It can be done, it is being done, and at Concordia we plan to have one of the finest data base management systems in the country. Our two auditing firms also agree that our approach is sound.

COURSE PLANNING ASSISTANCE SYSTEM

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In the period of adjustment to the "steady state" considerable changes will occur within the institution that will affect the demand for courses. These changes are a result of fluctuations in the mix of students. The institution will have less flexibility to adjust to these perturbations because of limited finances. In this situation, course planning becomes a critical function of Academic Management. This paper discusses a Course Planning Assistance system that integrates historical course consumption patterns with forecasted student population distribution. The system indicates to academic management how the changing student population is likely to affect the demand for their courses.

Future economic conditions will require academic administrators to better plan to meet student course demands with stable or decreasing resources. To assist this planning process, data is needed to provde "help" for the decisions which must be made in the academic department and college offices. Hopefully, with better information, the planning process will change from one of intuition and guesses to an analytical process based on the factual framework of history and the forecast and analysis of likely future conditions.

There are a number of factors which influence student demand for courses. Among the factors effecting course demand which we have been able to quantify are: (1) the way in which each major (student group) consumes credits in the course offerings of the University and (2) the type and number of students the University admits and subsequently enrolls in each major. In past years, perturbations to traditional patterns of either of these factors were dealt with by adding new funds to meet unanticipated needs. In an attempt to assist academic departments with course scheduling and planning, the Course Planning Assistance (CPA) System methodology was proposed and implemented at Penn Stare. The CPA System integrates a historical course consumption factor (induced course load factor) with forecasted student population, by major and level of enrollment, to derive an estimate of student credit-hour demand for individual courses. The concepts embraced by this methodology are similar to the NCHEMS approach to developing induced course load co-efficients <u>except</u> this method attempts to develop the credit loading on individual courses rather than aggregated by course level as seen in the NCHEMS models.

Background

The requirement for development of this system was derived from these separate, yet interrelated, management concerns: (a) the increase in student course demand was not being adequately met by a corresponding increase in course offerings by the academic departments; (b) academic departments were articulating strong needs for better information on historical course consumption and for the first time were articulating the need for assistance in determining future demand for their courses; and (c) the preregistration/registration process was believed to be less effective than desired, in part as a result of inadequate planning for course offerings; and (d) incremental financial resources for additional faculty would be approved only where sufficient documentation of need and subsequent satisfaction of student demand was provided. Therefore, the academic department is required to document it's utilization of existing faculty resources before new instructional funds can be granted and must show its anticipated instructional workload based on some rationalized planning information. The CPA System is a rational, although not precise, methodology for developing credit demand information to assist in addressing each of those management problems.

The Broader Context

While this paper is primarily intended to describe the system and methodology for arriving at estimates of student credit-hour demand for courses, the methodology is only a part of a broader process depicted in Figure 1, for reviewing and analyzing faculty resource needs. The broader process is intended to permit rationalization of requirements for additional instructional faculty.

The process for determination of requirements for instructional faculty is intended to provide for involvement of academic administrators at the department (Department Head), college (Dean) and University (Provost) levels of administrative responsibilities. An organizational paradigm of the units of academic administration is shown in Appendix A. These, then, are the academic units involved in planning, reviewing and evaluating the needs for faculty resources to meet student demand, as projected or anticipated. The academic administrator is essential to <u>this process</u> and it's acceptability and credibility.

In any decision-making process where analytical models are used as an integral part of the process, it is necessary for the decision-maker, in this case the academic administrator, to be involved in: (1) the selection or approval of the analytical models; (2) the iteration through possible solutions to the models: (3) the interpretation of the data generated from the models and (4) the application of the dataas an integral part of the analytical process, and subsequent decision-making. Conversely, the analyst needs to be involved in the management process with the academic administrator so as to assist in: (1) formulation of the appropriate analytical models; (2) identification of the data required to drive the models; (3) analysis of model(s) output; (4) adjustment of the model(s) as required; and (5) the necessary testing of the model output.

The interaction between analyst and academic administrator allows for the conscious iteration toward a workable and useful system for projecting student demands for courses. Furthermore, this interaction permits the academic administrator the option of holding certain managerial variables outside the systematized process. For example, such management variables as section size,

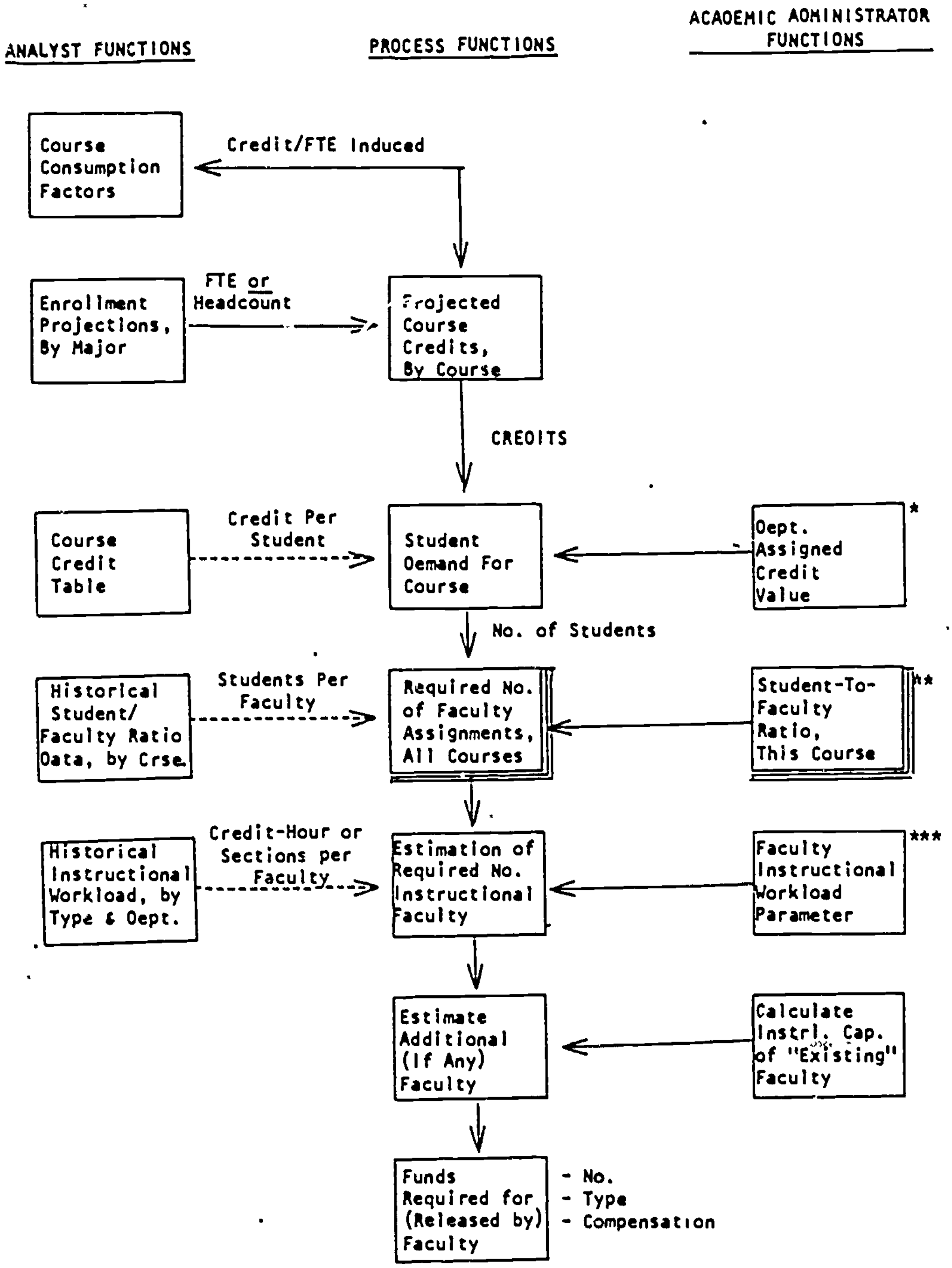

FIGURE 1: A PROCESS TO DETERMINE REQUIREMENTS FOR INSTRUCTIONAL FACULTY

-------------- HISTORICAL DATA COMPUTATION

* - Normally established by Faculty Senate.

** - Normally established by Academic Department

*** - Established Either by University Policy, Collective Gargaining or by Dean & Department Head.

faculty instructional workload, and methods for reacting to increased or decreased student demand can be left where it rightfully belongs---in the hands of the academic administrator. The process, as visualized, allows for calculating or assuming these variables based on historical values for section size and faculty workload, but should not be restricted to using only values derived from historical data. Furthermore, workload variables such as section size, number of sections assigned per faculty member are usually matters of academic policy or collective bargaining and as such subject to negotiation and change. However, as stated, the overall process permits either calculation (based on historical data) <u>or</u> designation of the workload variables by the academic administrator.

The Course Planning Assistance System

System Concept

The Course Planning Assistance (CPA) System began with early attempts to use the NCHEMS-developed Induced Course Load Matrix to address information needs of our academic departments pertinent to credit consumption (by majors) and credit production (by department/courses). In addition to NCHEMS, others[1] have developed models for projecting credit-hour demand. The NCHEMS/ICLM, while efficient and easy to implement, did not provide the level of detail necessary for projection and planning at the individual course. One of the cell dimensions of the NCHEMS/Induced Course Load Matrix is course level (e.g. lower division, upper division, graduate) rather than an individual course dimension. Individual course consumption

[1] Harden, Warren R; Tcheng, Mike T; and Williams, Stan E., "A Course Load Projection Model, Illinois State University, Normal, Illinois, April, 1972

could be calculated using historical distribution factors and then applying those factors to the NCHEMS/ICLM output. However, the historical distibution would add still another element of reliance on history as a predictor of the future and would have required processing the same files to arrive at the factors as required to develop individual course consumption coefficients. Therefore, for these reasons we opted for a "new" induced course load matrix which is named Course Consumption Matrix (CCM).

Further, the Penn State course numbering system is inconsistent in relation to the course-level categorization of individual courses. Due to the inherent inadequacy of the NCHEMS/ICLM to operate directly on the individual course and our own inconsistent course numbering structure, we developed the CCM utilizing the ICLM concepts of full-time equivalent (FTE) students and student level; but introducing a further level of detail and dissaggregation. The CCM, then, computes the induced course load coefficients on each course. This approach has been used by the University of Georgia[2] at Athens. In the course planning assistance system, the induced course load coefficient, measured in credit-hours per FTE student, is one of two independent variables required for estimating course enrollment or credit hour demand.

The second independent variable is the estimated or projected enrollment for each major degree program in the University. The conceptual interaction of these variables in the CPA system is shown in Figure 2. The enrollment projection is derived from a Penn State-designed student flow model.[3] The student flow model simulates the flow of students through the campuses and colleges which are the organizational elements of Penn State University.

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[2]Steins, A. A. and Wise, Fred H., "The Concept and Implementation of the University of Georgia Course Consumption Matrix", University of Georgia, Athens, Georgia.

[3]B. M. Tallman and R. D. Newton, "A Student Flow Model for Projection of Enrollment in a Multi-Campus University", Published by the Office of Budget and Planning, The Pennsylvania State University; July 24, 1973.

The model, SFM-1, assumes that it is reasonable to define a set of students each possessing a set of common and institutionally meaningful characteristics which distinguish that set as unique from all others. SFM-1 is comprised of two separate modules; (1) the admissions module which projects the flow of new students by campus, college, degree category (associate, baccalaureate, graduate, etc.) and student level (freshman, sophomore, etc.) and (2) the enrollment module which simulates the flow of both new and existing students among the campuses and colleges for each degree category and at each student-level. For further details of the workings of SFM-1, see Reference 3. The derivation of the transition coefficients and the concept of student flow is described in Appendix B.

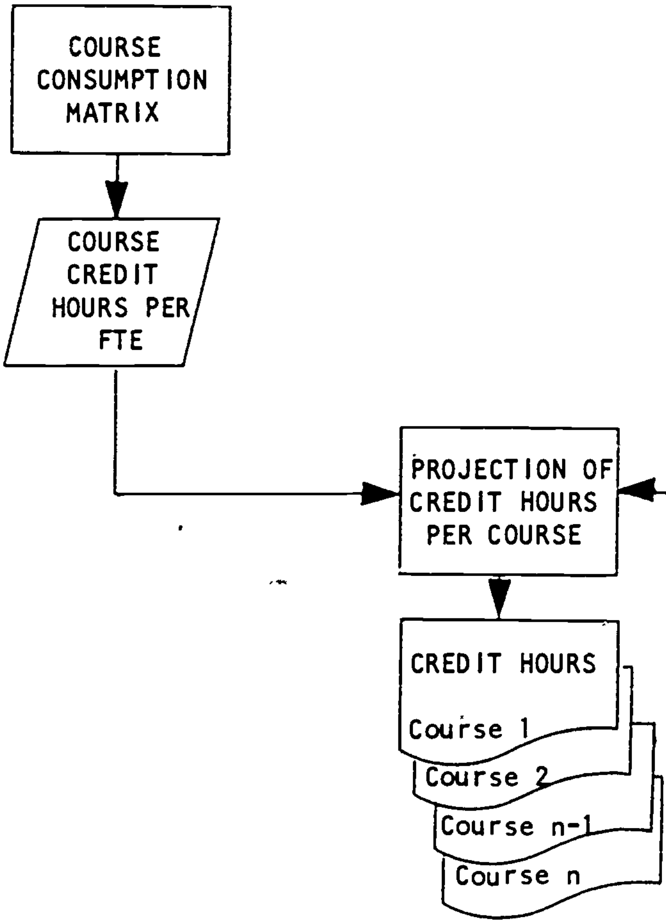


FIGURE 2: MAJOR COMPONENTS OF THE CONCEPTUAL SYSTEM

System Design

The system is designed to: (1) provide concise historical information about the consumers (students who take the course) of a course and (2) rough estimates, based on the analytical model, of the demand that may materialize for each course the following year.

The Computational Steps

The computational flow is discussed in the following paragraphs and depicted in Figure 3. Further explanation of the computations involved can be found in Appendix C.

Step 1 is to determine the induced course credit coefficient on a course for each subset of students. A subset of students are those students who share a common major and student level (term standing).[1] The induced course load coefficient for a course is derived by dividing the student enrollment in a given subset of students into the credits consumed in that course by those students.

Step 2 is to compute the weighted Induced Course Credit Coefficient that will be used for projecting purposes. The decision to use several years history of ICCC's and to weight them was based on the following judgments.

1) The most recent year's history was too sensitive to temporary changes in consumption patterns or course availability (i.e., a specific course was not offered because the faculty member normally assigned was on sabbatical).
2) The most recent year should be more heavily weighted than previous years so that the model will react to changes in consumption patterns. Including prior year's history will tend to dampen the effect of a change.

[1] In the model developed for Penn State, because of a multi-campus system, location is an additional attribute that describes a student subset. For purposes of explanation, however, this will be ignored in further discussions.

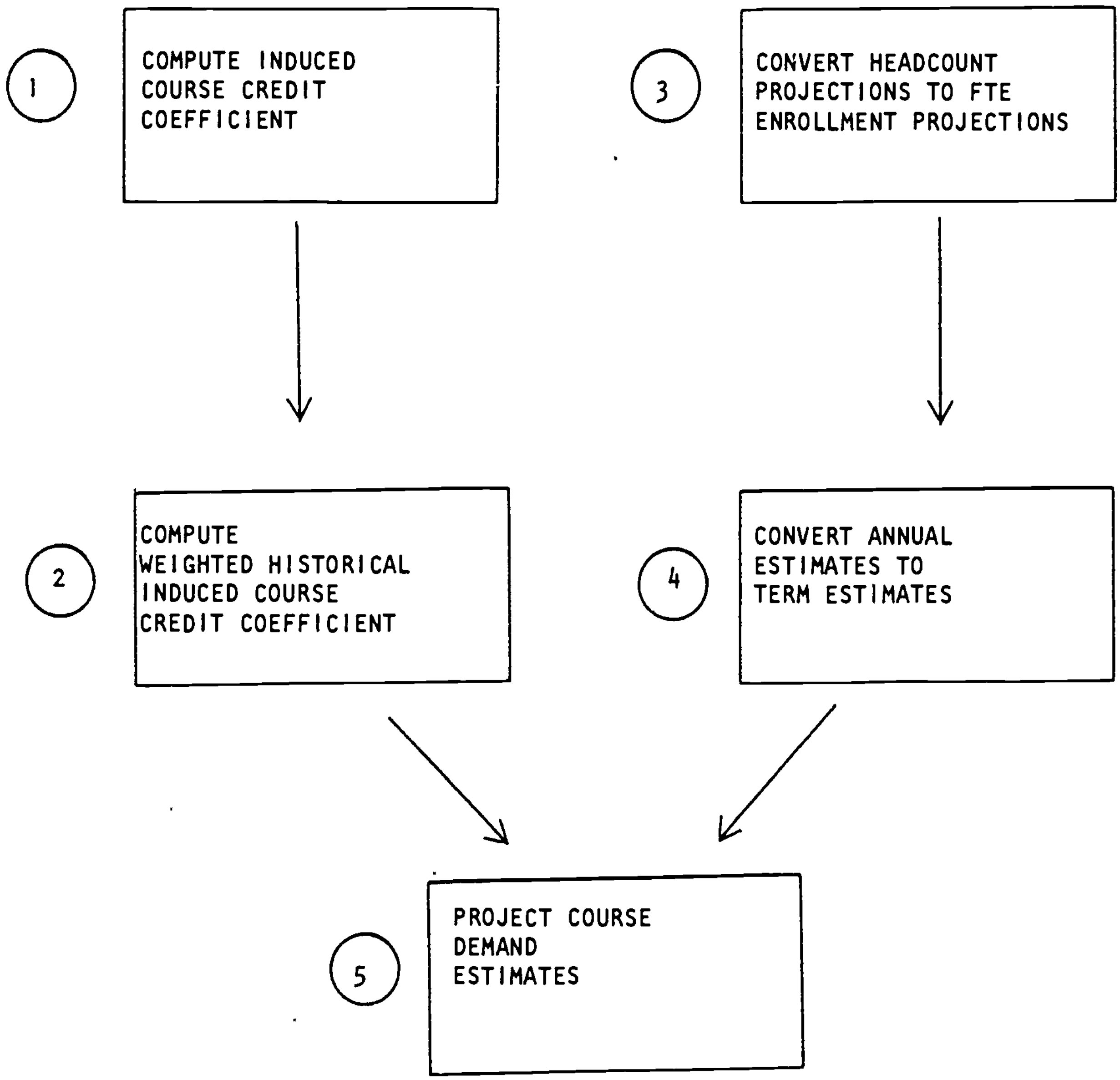


Figure 3. Computational steps to project course demand estimates

One may conclude from the above discussion that the computation of the ICCC is a compromise----it is. Using a weighted induced course credit coefficient while mitigating some problems introduces others which will be discussed in a subsequent section.

The computation of the weighted ICCC is a fundamental scheme of summing the products of the coefficient and the corresponding weight and dividing by the sum of the weights. The weights are parameters provided to the system externally.

Step 3 is necessary due to an inconsistency between the two modules used in this system, i.e., the student flow model and the course consumption matrix. The student flow model projects headcount students and the course consumption matrix (which develops the Induced Course Credit Coefficients (ICCC) uses the FTE student measure. The CPA system uses historical ratios to connect headcount projections to full-time equivalent enrollment. The conversion of the headcount projection to a full-time equivalent enrollment projection is accomplished by developing a historical ratio between the two numbers at points in time consistent with point of time being estimated by the student flow model.

Step 4 is required due to the manner by which the student flow model develops enrollment projections. The enrollment projections are point estimates of enrollments for a given year. In the case of the Penn State student flow model, the point of the estimate was opening Fall Term enrollments. These estimates are not valid for all other terms of the year. Fall Term, on the aggregate, is the largest enrollment for the year. During the year, some subsets of students increase in numbers, some decrease and the overall effect is a net decrease in the number of students. Again, a ratio based on historical data was derived to express the relationship between the term estimated by the student flow model and each of the other terms in the academic year.

Step 5 projects the course credit consumption for each course. The two essential factors for this projection are the weighted induced course credit coefficient (ICCC') and the full-time equivalent enrollment projection. The credits induced on a course is first evaluated by each student subset by future term and those credits are summed to derive a total credit load projection.

The Processing System

The processing system is comprised of three basic subsystems as depicted in Figure 4. The student flow model produces projections of students by year, major, student level and location based on historical transfer ratios and admissions quotas derived from historical factors and University goals.

The CCM process abstracts essential information from the operational files of the University to compute the induced course credit coefficients and to derive the enrollment summaries. The CCM process is done for an individual term and merged with historical data for further processing.

The course demand projection system brings these sources of data together to arrive at a projection of demand. The printed report consists of both historical consumption and projected demand.

The detailed systems design is described in Appendix D.

Future Design Directions

As a result of having built the CPA system and attempting to integrate the system into the management environment of the academic administrators, it was noted that the estimates of credit-hour demand from the CPA system are very sensitive to the accuracy of the student flow model. Further, voids in the projection system were discovered when attempting to project credit consumption where courses or programs or both are no longer offered but were part of the program/course offerings contributing to the historical student flow. Conversely, it was noted that historical consumption of credits is not possible for new courses and programs.

Hopefully these, as well as others, lessons-learned during the implementation

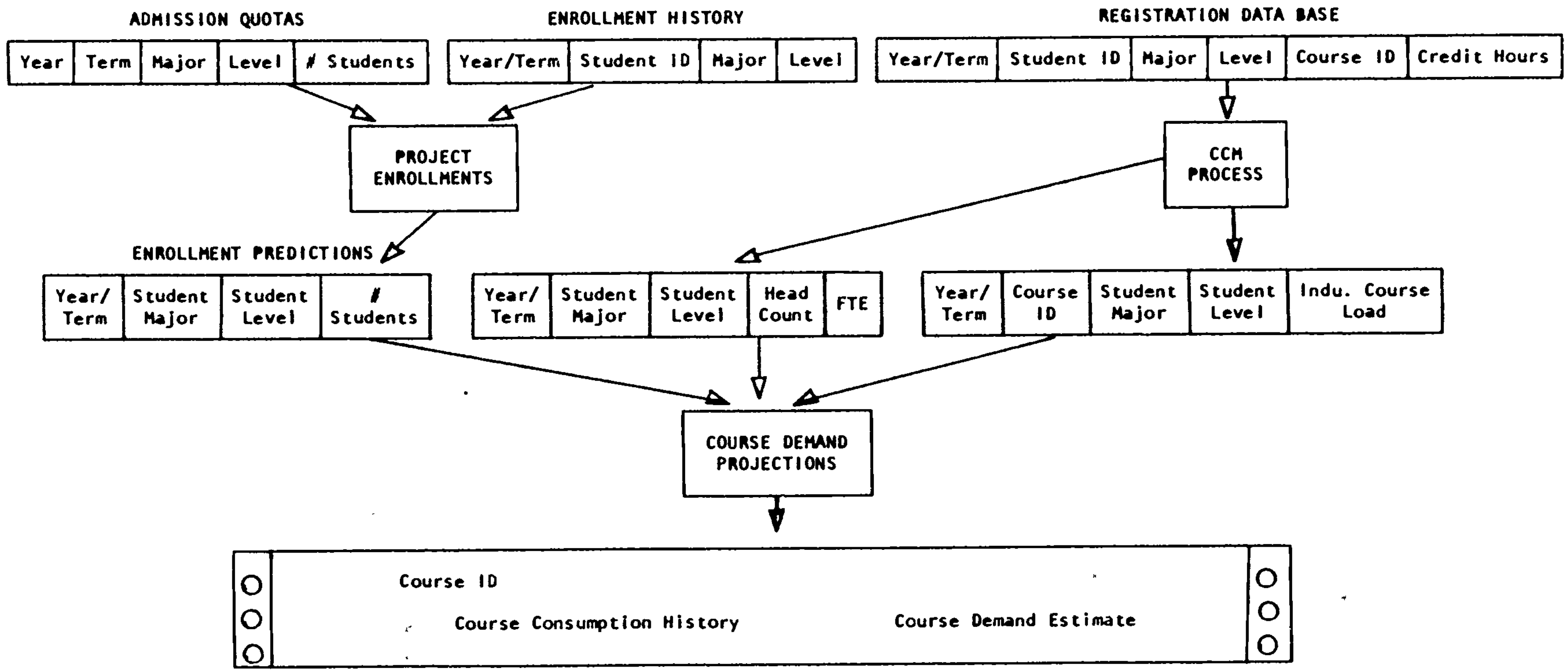


FIGURE 4: COURSE DEMAND ESTIMATION OVERVIEW

of the CPA system will stimulate enhancements to make the system more meaningful and useful to academic planners. Many cosmetic modifications have already been suggested, e.g. column headings, output format, and detail of displayed data in the output reports. Those type of enhancements need not be elaborated on further. Of interest, however, are the enhancements necessary to overcome design limitations of the present system or introduce additional helpful planning data to the academic decision-maker. The two system modifications planned for the immediate future are: (1) course demand estimates for an extended planning horizon and (2) the incorporation of stated, but unmet demand. While other changes may also be desirable these two should provide the most improvement for the least investment.

Extended Planning Horizon for Course Demand Estimates

The CPA system estimates future demand for four academic terms. This time frame is adequate for modifying or adjusting a course offering program, but inadequate for driving or creating the initial plan. Budgets for academic resources are normally submitted on a fiscal year basis, a year in advance of the actual term or academic term or academic year for which a plan is derived. Further, the academic department now prepares a schedule of course offerings nine months in advance of actual publication of the timetable. Considering the time required for making adjustments to faculty resources, the availability of planning data only one year in advance is inadequate. The next evolution of the CPA system should provide annual demand estimates from one to five years. Planning assistance information for the first year of the planning period should be available on a term-by-term basis. The second through the fifth years projections would be on an academic year basis only.

Stated, but Unmet, Demand

The current estimating algorithms assume demand has always been satisfied. In many cases limited facilities and/or faculty has resulted in unmet demand. Demand, here, being defined as what the student "wants" to take rather than what the faculty "wants" to offer. The data, about the amount of demand unsatisfied by the registration process, is a by-product of the current registration system and could be captured in the future and subsequently included in the CPA system design.

Unstated, Unmet, Demand

An additional dimension of demand that has been neglected is unstated demand. The course scheduling process constrains the student demand for a given course; i.e., if a course is not published as being offered in a particular term, the demand for that course is not known and therefore the data about that demand is not captured. The demand for courses which are not offered in a specific term could be ascertained if a registration system collected annual course planning data provided by the student or a degree audit system could provide the data on what the student "wants" or "needs" for his degree program. Such data could be used to analyze unmet demand. In an annual course planning system, students select courses they either need or in the case of electives, would like to take, on an annual basis from a comprehensive menu of all courses approved for University offering. Other universities around the country are either using or have experimented with annual course planning systems.

The exact methodology for determining stated or unstated but unmet demand is not known, but it is felt that a clearer picture of "real" demand is required in order to improve the integrity of the course demand projection. Next steps in the CPA system design will be oriented toward these improvements.

Summary

The CPA system was designed to help address a number of academic administration and management issues related to course planning such as:

(1) the development of course offering plans (timetables or schedule of classes) for each future academic term. Both historical credit consumption and projected course consumption data are required. The academic administrator may then convert credit data to headcount demand by course and section.

(2) the justification of requests for additional faculty resources to meet increased student demand for courses. Current University policy requires all identifiable student demand be met. Estimates of student demand are required for courses for which additional faculty resources are requested. The academic department head through the Dean of the college may use the credit hour demand data generated by the CPA system or utilize data generated by any rational method.

(3) the implementation of academic program review on a regular, periodic basis. Review of both the departmental course offerings and the students' academic programs (majors) in each department require historical data on: (a) the mix of students who take offered courses; and (b) the articulation (when and in what sequence) and program requirements (courses required by student' in the program) of the academic programs of each departmental major. The Course Consumption Matrix Module of the CPA system provides this data for any term or academic year.

(4) the comparative evaluation of courses based on either student credit hour (SCH) production on full-time equivalent enrollment. Data generated as a by-product of the pre-processing for the CCM results in the ability to: (1) rank all courses according to SCH-produced and

(2) rank all majors according to SCH-consumed (taken). The ranking can be accomplished by major academic unit (college), by location (campus), or by all-University. This data have been used in comparative analyses of credit hour production and consumption.

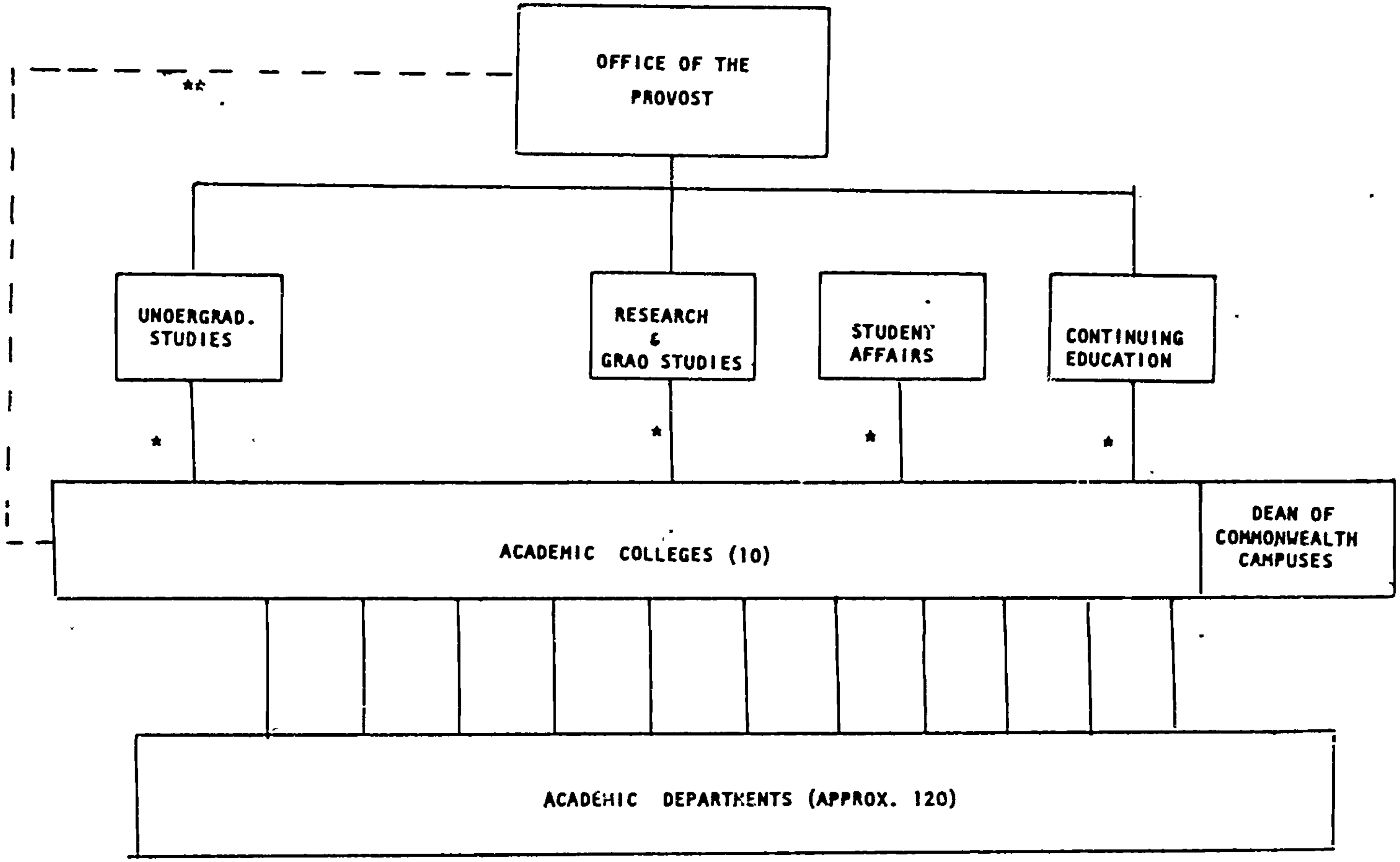
The CPA system, then, has attempted to use existing capabilities to address pertinent, relevant academic administration concerns and issues. The significance of the CPA systems approach is not so much in the analytical techniques used as in the interactive nature of the CPA system with the academic administrators using the system. With the information systems analyst serving as catalyst between the technical capabilities of the system and the data needs of the academic administrator, the system hopefully can evolve to a more useful tool through a systematic process of design, utilization, feedback, and redesign or modification. The needs of the academic administrator will dictate the next steps to be taken in the enhancement of the CPA system, while the systems analysis effort can be geared to simultaneously exploring new technical approaches and interpreting the feedback from the academic community as to the utility of the existing system.

APPENDIX A

General Academic Organization

The intent of this appendix is to generally describe the management environment within which the CPA system must fit. Referring to Figure A-1 the system is intended to provide credit-hour demand data to: (1) the academic department, (2) the College, and (3) the Vice President for Undergraduate Studies (representing the Provost). One goal is to provide commonly-derived data on student demand to the department head and the College Dean to facilitate planning of course offerings and determination of quantitative requirements for instructional faculty. A second goal is to provide the Provost with the same demand data for: (1) monitoring the policy of "meeting student demand" and (2) pointing out requirements for additional financial resources in advance of the actual need.

The data resulting from the Course Planning Assistance system is not intended to represent "official" University projections, but rather data around which discussion and negotiation can take place within the academic organization. The commonality of data available at the three organizational levels (Department, College, and University) should serve to permit the decision-maker to concentrate on the academic implications of meeting student demand and adjusting resources rather than being concerned with reconciliation of two or more sets of independently-derived data. At the same time if the data is determined to be inadequate or inaccurate only one system would need to be modified to make the necessary corrections. An essential part of the utility of this system does, then, depend on the feedback to the analyst or system designer on both the merits and deficiencies of the system from the point of view of the academic administrator.



*Operational Matters

**Policy Matters

FIGURE A-1: ORGANIZATION OF ACADEMIC UNITS

APPENDIX B

REQUIREMENTS FOR COMPUTATION OF TRANSITION CO-EFFICIENT AND STUDENT FLOWS

To formulate a student-flow model using a Markov-type process, reasonably accurate chronological student records must be available. Each student's academic level, field of study and, campus location (for a multi-campus institution) must be recorded. Given this data it is possible to determine:

1) the enrollment of students categorized by unique combinations of academic level, field of study, and location at some historical point in time, such as the start of the Fall term;
2) for the students categorized into each of these origin states, the enrollments at the <u>next</u> point in time, in this case the following Fall term, in each suitably categorized next or terminal state; and
3) by dividing the enrollment in each terminal state by that appropriate to its origin state, a set of transition rates can be developed.

The model assumes the future enrollment depends on the probabilities of students moving from one state, at time t, to other states, at time t + 1. The probabilities are expressed by means of transition rates between states. Once a student enters the system, there is a finite number of paths over which the individual can move either from state-to-state within the system until graduation or withdrawal (goes "OUT").

<u>Transition Matrix</u>

Figure B-1 shows how data, of the type described, can be used to derive probability rates for the transition matrix. For illustration purposes hypothetical example in Figure B-1 is simplified and delimited to a single-campus institution. Assume the hypothetical institution has students enrolled in two different fields of specialization: Letters and Arts; Science at two student-levels (first and second year) - within an associate degree-level program. Under such a structure, all returning and new students must be categorized within one of the following four origin states:

Letters - 1st year

Letters - 2nd year

Applied Sciences - 1st year

Applied Sciences - 2nd year

One year later, all of these students must be categorized within one of the following six terminal states:

Letters and Arts - 1st year

Letters and Arts - 2nd year

Science - 1st year

Science - 2nd year

$\left.\begin{array}{l}\text{Graduated}\\ \text{Withdrawn}\end{array}\right\}$ "OUT"

Further assume we can determine, at a specific point in time that there were 100 students enrolled as first-year students in Letters and Arts. One year later, these same students were distributed as follows: 10 in first-year Letters and Arts, 60 in second-year Letters and Arts, 10 in first-year Science, and 5 in second-year Science. In addition, 15 went "OUT" of the institution. The flow of students between the one origin state, at time, t, and all possible states at time, t + 1, are shown in Figure B-1. In order to determine the transition rates between the origin and terminal states, the enrollment in each terminal state is divided by the enrollment in their common origin state.

These fractions account for the entire flow from the origin state to all possible terminal states between the two points in time. As a consequence, the summation of the rates from any one origin state must equal 1.0.

Similarly, the various student flows, in the hypothetical case, the origin states at time t and the possible terminal states at time, t + 1 can be depicted as shown in Figure B-2.

FIGURE B-1: COMPUTATION OF TRANSITION COEFFICIENTS

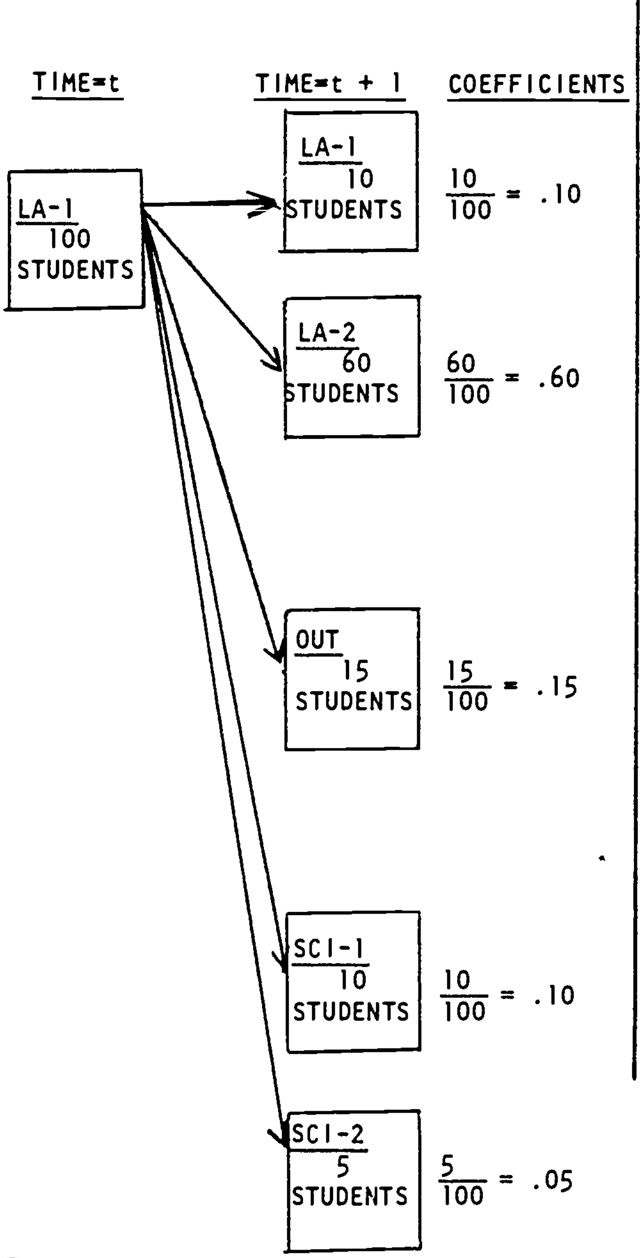
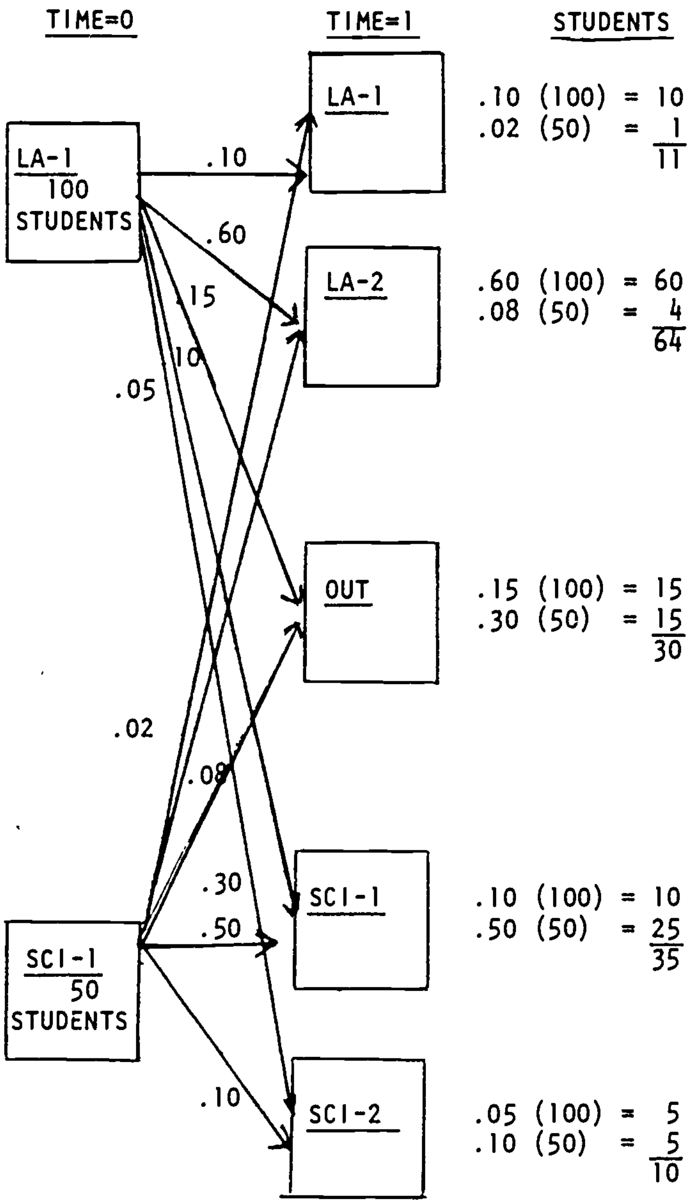


FIGURE B-2: COMPUTATION OF STUDENT FLOWS



Projection Model

If the transition rates are stable over time, those rates and the transition matrix may be employed, together with the enrollment of continuing students and a given forecast of new admissions, to generate projections of the enrollment of returning students at a next point in time. This is done by multiplying the sum of enrollment of returning students and of new admissions for each year by the appropriate rates in the transition matrix and then aggregating the products over common states to derive the enrollment values for the following period of time. The process is then reiterated until projections are developed for the entire projected time-frame.

To illustrate how the student flow model works, assume an input of returning students for time-period, 1, and forecasts of new admissions for time-periods 1, 2, and 3 and the application of the transition matrix. The steps involved in developing enrollment projections for the three time-periods are depicted in Table B-1.

The number of possible student-flows has been purposely limited in an attempt to easily describe the steps involved in the process. Conceptually the steps described in the example are applicable to any student-flow problem regardless of the number of dimensions (academic levels, fields of specialization, and locations) used to describe origin and terminal states.

APPENDIX C: COMPUTATION BASIS FOR COURSE CREDIT DEMAND ESTIMATION

The following steps are necessary to compute the estimated course credit demand.

Step I

Compute the induced course credits coefficients on a course for each subset of students. A subset of students are those students who share a major and a student level.[1] The computation for the induced course credits coefficients (ICCC) is expressed by the following formula:

$$ICCC_{(c,y,t,m,l)} = CC_{(c,y,t,m,l)} \Big/ \left(\sum_{\text{all } c} CC_{(y,t,m,l)} \Big/ FTC_{(m,l)} \right)$$

WHERE:

$ICCC_{(c,y,t,m,l)}$ = Induced course credit coefficient - course credits induced or course c in year y term t by one student of major m and level l.

$CC_{(c,y,t,m,l)}$ = Course credits taken in course c in year y, term t by students of major m and level l.

$\sum_{\text{all } c} CC_{(y,t,m,l)}$ = Course credits taken in all courses in year y in term t, by students of major m and level l.

$FTC_{(m,l)}$ = Full time credits - the value chosen that expresses the normal credit hour load of a full time student of major m and level l.

Note: the expression $\sum_{\text{all } c} CC_{(y,t,m,l)} \Big/ FTC_{(m,l)}$

is the formula for computing full time equivalent enrollments of students in major m and level l.

[1] In the model developed for Penn State, because of a multi-campus system, location is an additional attribute that describes a student subset. For purposes of explanation, however, this will be ignored in further discussions.

Step 2

Compute the weighted induced course credit coefficient that will be used for projecting purposes.

The weighted induced course credit coefficient is as follows:

$$ICCC'_{(c,t,m,l)} = (ICCC_{(c,y,t,m,l)} \times W_y) + (ICCC_{(c,y-i,t,m,l)} \times W_{y-i}) + \ldots\ldots + (ICCC_{(c,y-n,t,m,l)} \times W_{(y-n)} \Big/ \sum W$$

WHERE:

$ICCC'_{(c,t,m,l)}$ = Weighted Induced course credit coefficients for course c, in term t by students of major m and level l.

$ICCC'_{(c,y-n,t,m,l)}$ = Induced course credit coefficient for course c, in year y, term t, by student of major m and level l.

$W_{(y-n)}$ = the weighting factor assigned where W is the weight assigned the most recent year.

Step 3

Convert projected headcount enrollment to full-time equivalent enrollment (FTE). This computation is caused by an inconsistency between systems at Penn State. The student flow model projects headcount students and the Course Consumption Matrix system (which develops the induced course credit coefficients (ICCC)) is based on an FTE student. The following formula was used to convert the headcount projection to a full-time equivalent projection:

$$FTE_{(y+1,t,m,l)} = HCT_{(y+1,t,m,l)} \Big/ \left(\frac{HCT_{(y,t,m,l)} + HCT_{(y-1,t,m,l)} + \ldots HCT_{(y-n,t,m,l)}}{FTE_{(y,t,m,l)} + FTE_{(y-1,t,m,l)} + \ldots FTE_{(y-n,t,m,l)}} \right)$$

WHERE:

$FTE_{(y,t,m,l)}$ = Full-time equivalent students enrolled in year y, term t, major m and level l.

$HCT_{(y,t,m,l)}$ = Headcount enrollment of students in year y, term t, major m, and level l.

Note: t is held constant at the term which is used for the headcount projection.

Step 4

Convert one term enrollment projection to multi-term enrollment projections. The flow model projections are point estimates of enrollments for a given year. In the case of the Penn State student flow model, this point estimate was for opening Fall enrollments. These estimates obviously are not valid for all other terms of the year. A historical ratio was derived to express the relationship between the term estimated by the flow model and each of the other terms of the academic year.

The following formula describes the computation of the student enrollment projections for future terms.

$$FTE_{(y+1,t,m,l)} = FTE_{(y+1,t,m,l)} * \left(\frac{FTE_{(y,t,m,l)} + FTE_{(y-1,t,m,l)} + \ldots FTE_{(y-n,t,m,l)}}{FTE_{(y,t,m,l)} + FTE_{(y-1,t,m,l)} + \ldots FTE_{(y-n,t,m,l)}} \right)$$

WHERE:

$FTE_{(y,t,m,l)}$ = Full-time equivalent enrollment for year y, term t, students of major m and level l.

$FTE_{(y,t,m,l)}$ = Full-time equivalent enrollment for year y, term t, students of major m and level l.

t = is the term upon which the student enrollment forecast is based.

Step 5

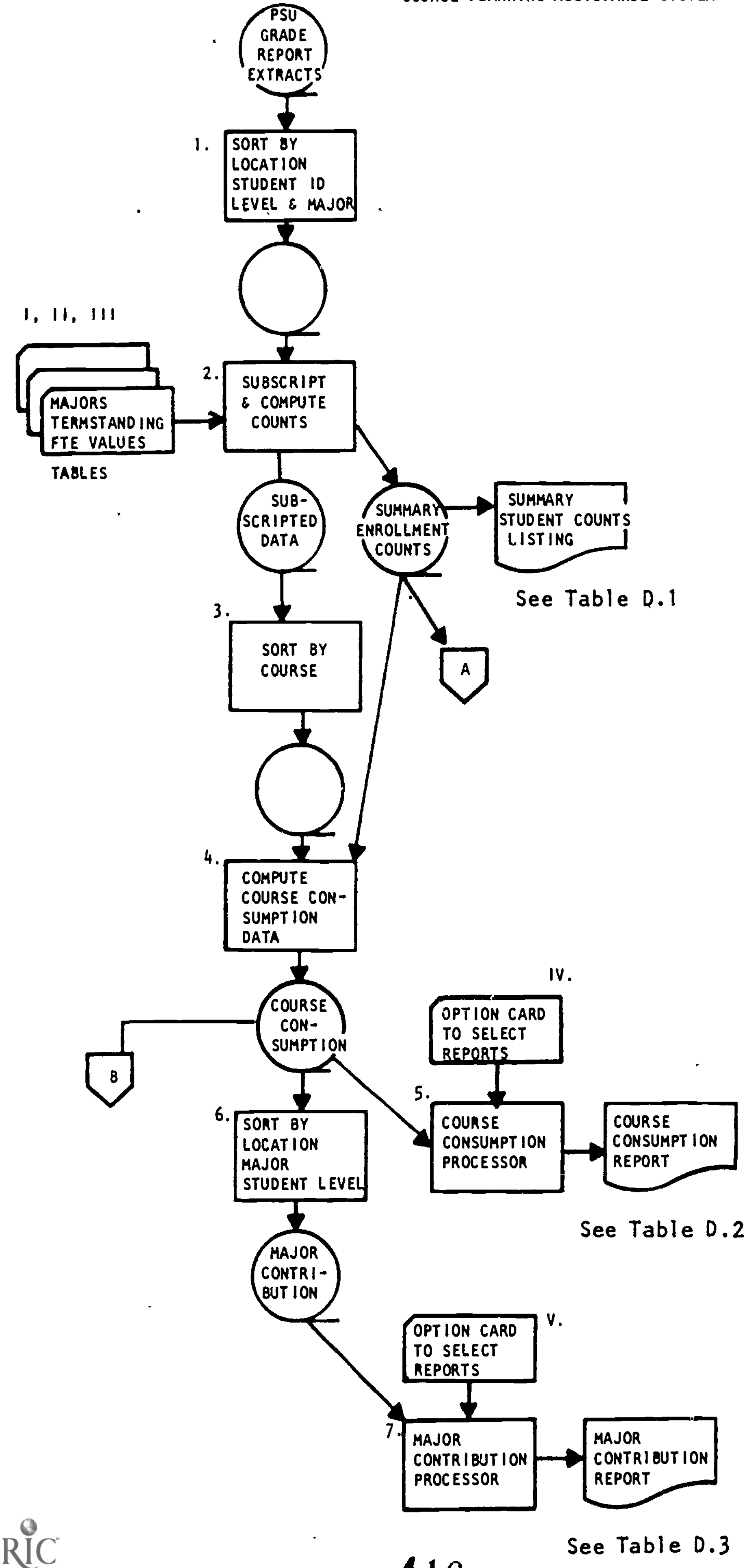
Project credit demand for each course. The two essential factors for this projection are the weighted induced course credit coefficient (ICCC') and the full-time equivalent enrollment projection. The credits induced on a course is first evaluated by each student subset by future term and those credits are summed to derive a total credit load projection. The expression for accomplishing this is as follows:

$$CC_{(c,y+1,t)} = \sum_{\text{all } m} \sum_{\text{all } l} \left(ICCC'_{(m,l)} \times FTE_{(y+1,t,m,l)} \right)$$

WHERE:

$CC_{(c,y+1,t)}$ = Course credits projected in course c, in year $y+1$, term t.

$ICCC'_{(c,m,l)}$ = The induced course credit coefficient in course c, by students of major m and level l.



1. The registration file is sorted by location, student identification, student level and major.

2. Majors and student level are validated and assigned subscript values in accordance to parameter cards. Subscripted course registrations are written on a file for further processing. Headcount and full-time equivalent enrollments are summarixed and retained on a summary file.

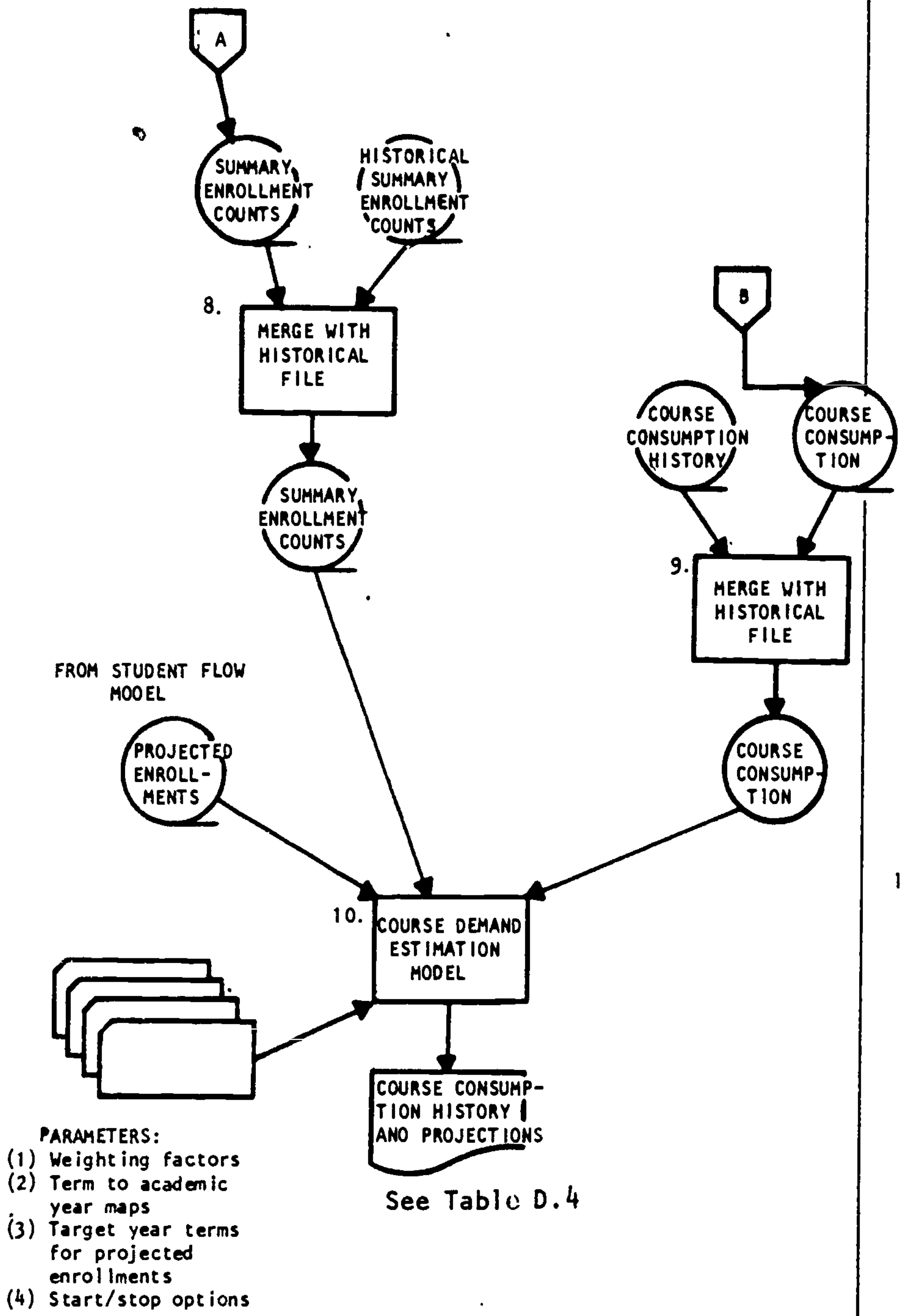
3. Subscripted data is sorted by course.

4. Credit consumption data for a course is summarized by the major and level of the consuming students. Induced credit consumption coefficients are computed based on credit hours consumed by students of a given major in a given student level. A record is created for each subset of students who took a course.

5. Course consumption data for a course is available. A subset can be selected through use of an option card.

6. The course consumption file is sorted by major and student level.

7. Courses consumed by students of a given major and student level can be printed through a request submitted on an option card.



See Table D.4

8. The summary of enrollment counts file is merged with similar data from previous terms.

9. The induced course credit coefficients file is merged with similar data from previous terms.

10. This step performs the following functions:

(a) Compute weighted induced course credit coefficient.

(b) Convert projected headcounts to FTE projection.

(c) Compute projected enrollments (FTE basis) for all terms in future year.

(d) Compute induced credit load by each student subset.

(e) Sum induced credits to arrive at total estimated credit hour demand.

PERIOD COVERED: SPRING TERM 1975 DATE:09/08/75 PAGE: 74

LOCATION	MAJOR NAME CODE	STUDENT LEVEL	TOTAL CREDITS	NUMBER OF STUDENTS	AVERAGE CREDIT/STU	EQUIVALENT FULL-TIME STU VALUE	EQUIVALENT FULL-TIME STUDENTS
UP	SCIEN S00	BACC*1-3	6372	571	11,1	10,0	637,2
UP	SCIEN S00	BACC*4-6	7342	652	11,2	10,0	734,2
		BACC*7-9	9917	991	11,0	10,0	991,7
		BACC*>9	8551	814	10,5	10,0	855,1
		ASSC*1-3	4	1	4,0	10,0	,4
		ADJUNCTS	9	1	9,0	10,0	,9
		GRADS	3969	546	7,2	8,0	496,1
	TOTAL COLLEGE OF SCIENCE	BACC*1-3	6372	571	11,1		637,2
		BACC*4-6	7342	652	11,2		734,2
		BACC*7-9	9917	991	11,0		991,7
		BACC*>9	8551	814	10,5		855,1
		ASSC*1-3	4	1	4,0		,4
		ADJUNCTS	9	1	9,0		,9
		GRADS	3969	546	7,2		496,1
		ALL LEVELS	36164	3456	10,3		3715,6
UP	D U S T00	BACC*1-3	3311	305	10,8	10,0	331,1
UP	D U S T00	BACC*4-6	2660	247	10,7	10,0	266,0
		BACC*7-9	749	68	11,0	10,0	74,9
		BACC*>9	93	9	10,3	10,0	9,3
		ASSC*1-3	20	7	2,8	10,0	2,0
		ASSC*>3	28	4	7,0	10,0	2,8
	TOTAL COLLEGE OF DIV UGR ST	BACC*1-3	3311	306	10,8		331,1
		BACC*4-6	2660	247	10,7		266,0
		BACC*7-9	749	68	11,0		74,9
		BACC*>9	93	9	10,3		9,3
		ASSC*1-3	20	7	2,8		2,0
		ASSC*>3	28	4	7,0		2,8
		ALL LEVELS	6861	641	10,7		686,1
UP	INTER V00	GRADS	1570	224	7,0	8,0	196,3
	TOTAL COLLEGE OF INTER DISC						

TABLE D.1: SUMMARY OF STUDENT COUNTS AND CREDIT CONSUMPTION

COURSE CONSUMPTION BY COURSE

PERIOD COVERED: ACADEMIC YEAR 1972-73 0001310 DATE:11/21/75 PAGE: 1

COURSE IDENT (A)	TOTAL CREDITS TAUGHT (B)	NUMBER OF STUDENTS (C)	STUDENTS MAJOR NAME/LOC (D)	STUDENT LEVEL (E)	EQUIVALENT FULL-TIME STU IN MAJ/SL (F)	STUDENTS OF THIS MAJ IN THIS COURSE (G)	CREDITS TAKEN (H)	% OF COURSE CONSUMED BY THIS MAJOR (I)	% OF MAJOR CREDITS TAKEN IN THIS COURSE (J)	CREDITS PER EQUIVALENT FULL-TIME STU (K)
UP HIST 012	381	127	AGRIC UP	BACC•4-6	382,3	3	9,0	2,36	0,07	0,023 L34
			AGRIC UP	BACC•7-9	446,1	2	6,0	1,57	0,04	0,013 L34
			A & A UP	BACC•4-6	348,0	1	3,0	0,78	0,02	0,008 L34
			BUSIN UP	BACC•1-3	388,1	11	33,0	8,66	0,28	0,085 L34
			BUSIN UP	BACC•4-6	621,7	2	6,0	1,57	0,03	0,009 L34
			BUSIN UP	BACC•7-9	1080,9	9	27,0	7,08	0,08	0,024 L34
			BUSIN UP	BACC•>9	840,2	13	39,0	10,23	0,15	0,046 L34
			E M S UP	BACC•1-3	129,6	1	3,0	0,78	0,07	0,023 L34
			EDUC UP	BACC•1-3	439,2	2	6,0	1,57	0,04	0,013 L34
			EDUC UP	BACC•4-6	814,3	2	6,0	1,57	0,02	0,007 L34
			EDUC UP	BACC•7-9	1520,0	9	27,0	7,08	0,05	0,017 L34
			EDUC UP	BACC•>9	1216,1	6	18,0	4,72	0,04	0,014 L34
			ENGIN UP	BACC•1-3	577,5	5	15,0	3,93	0,08	0,025 L34
			ENGIN UP	BACC•4-6	471,3	1	3,0	0,78	0,02	0,006 L34
			ENGIN UP	BACC•7-9	815,2	1	3,0	0,78	0,01	0,003 L34
			ENGIN UP	BACC•>9	748,8	1	3,0	0,78	0,01	0,004 L34
			H P E UP	BACC•4-6	347,5	1	3,0	0,78	0,02	0,008 L34
			H P E UP	BACC•>9	231,0	2	6,0	1,57	0,08	0,025 L34
			H-DEV UP	BACC•1-3	447,1	1	3,0	0,78	0,02	0,006 L34
			H-DEV UP	BACC•4-6	1086,5	3	9,0	2,36	0,02	0,008 L34
			H-DEV UP	BACC•7-9	1167,4	2	6,0	1,57	0,01	0,005 L34
			L-ART UP	BACC•1-3	1149,9	10	30,0	7,87	0,08	0,026 L34
			L-ART UP	BACC•4-6	1160,8	6	18,0	4,72	0,05	0,015 L34
			L-ART UP	BACC•7-9	1729,0	9	27,0	7,08	0,05	0,015 L34
			L-ART UP	BACC•>9	1435,4	10	30,0	7,87	0,06	0,020 L34
			SCIEN UP	BACC•1-3	873,9	2	6,0	1,57	0,02	0,006 L34
			SCIEN UP	BACC•4-6	867,9	3	9,0	2,36	0,03	0,010 L34
			SCIEN UP	BACC•7-9	1011,1	1	3,0	0,78	0,00	0,002 L34
			D U S UP	BACC•1-3	219,1	2	6,0	1,57	0,09	0,027 L34
			D U S UP	BACC•4-6	244,8	2	6,0	1,57	0,08	0,024 L34
			ADJUN UP	BACC•4-6	0,4	1	3,0	0,78	25,00	7,500 L34
			ADJUN UP	ADJUNCTS	165,6	2	6,0	1,57	0,12	0,036 L34
			ADJUN UP	GRADS	469,0	1	3,0	0,78	0,02	0,006 L34

TABLE D.2: COURSE CONSUMPTION BY COURSE REPORT

COURSE CONSUMPTION BY MAJOR

PERIOD COVERED: FALL 73,WIN&SPR 74 DATE:11/21/75 PAGE: 5

MAJOR NAME/LOC (A)	STUDENT LEVEL (B)	TOTAL STUDENTS IN CATEGORY (C)	CREDITS CONSUMED IN ALL COURSES (D)	EQUIVALENT FULL-TIME STUDENTS (E)	COURSE IDENT (F)	TOTAL COURSE CREDITS PRODUCED (G)	TOTAL STUDENTS ENROLLED IN COURSE (H)
HIST	UP UNGR•>7	205	5154	171,8	UP AG EC 421	264,0	88
					UP HORT 052	954,0	477
					UP ART 120	611,0	305
					UP ART 240	230,0	115
					UP ART 250	308,0	154
					UP ART 380	243,0	81
					UP ART 480	111,0	37
					UP ART H 100	1737,0	579
					UP ART H 110	1248,0	416
					UP ART H 120	408,0	136
					UP ART H 305	525,0	175
					UP ART H 307	162,0	54
					UP ART H 311	111,0	37
					UP ARTS 001	3579,0	1193
					UP MUSIC 005	2808,0	936
					UP MUSIC 006	333,0	111
					UP MUSIC 007	336,0	112
					UP MUSIC 011	645,0	621
					UP MUSIC 089	635,0	629
					UP MUSIC 157	497,0	497
					UP THEA 100	888,0	296
					UP THEA 102	489,0	163
					UP THEA 109	3039,0	1013
					UP THEA 190	8079,0	2693
					UP THEA 240	57,0	19
					UP THEA 429	153,0	144
					UP ACCTG 016	939,0	313
					UP ACCTG 101	3558,0	1186
					UP ACCTG 102	2430,0	810
					UP ACCTG 206	1485,0	495
					UP B LAW 243	3957,0	1319

COURSE IDENT (F)	STUDENTS OF THIS MAJ IN THIS COURSE (I)	CREDITS TAKEN (J)	% OF COURSE CONSUMED BY THIS MAJOR (K)	% OF MAJORS CREDITS TAKEN IN THIS COURSE (L)		CREDITS PER EQU F-T STUDENT (M)
UP AG EC 421	1	3,0	1,13	0,05	L34	0,017
UP HORT 052	5	10,0	1,04	0,19	L34	0,058
UP ART 120	1	2,0	0,32	0,03	L34	0,011
UP ART 240	1	2,0	0,86	0,03	L34	0,011
UP ART 250	1	2,0	0,64	0,03	L34	0,011
UP ART 380	2	6,0	2,46	0,11	L34	0,034
UP ART 480	1	3,0	2,70	0,05	L34	0,017
UP ART H 100	6	18,0	1,03	0,34	L34	0,104
UP ART H 110	5	15,0	1,20	0,29	L34	0,087
UP ART H 120	6	18,0	4,41	0,34	L34	0,104
UP ART H 305	1	3,0	0,57	0,05	L34	0,017
UP ART H 307	1	3,0	1,85	0,05	L34	0,017
UP ART H 311	1	3,0	2,70	0,05	L34	0,017
UP ARTS 001	10	30,0	0,83	0,58	L34	0,174
UP MUSIC 005	12	36,0	1,28	0,69	L34	0,209
UP MUSIC 006	4	12,0	3,60	0,23	L34	0,069
UP MUSIC 007	1	3,0	0,89	0,05	L34	0,017
UP MUSIC 011	5	5,0	0,77	0,09	L34	0,029
UP MUSIC 089	13	13,0	2,04	0,25	L34	0,075
UP MUSIC 157	8	8,0	1,60	0,15	L34	0,046
UP THEA 100	7	21,0	2,36	0,40	L34	0,122
UP THEA 102	1	3,0	0,61	0,05	L34	0,017
UP THEA 109	12	36,0	1,18	0,69	L34	0,209
UP THEA 190	20	60,0	0,74	1,16	L34	0,349
UP THEA 240	2	6,0	10,52	0,11	L34	0,034
UP THEA 429	2	2,0	1,30	0,03	L34	0,011
UP ACCTG 016	8	24,0	2,55	0,46	L34	0,139
UP ACCTG 101	7	21,0	0,59	0,40	L34	0,122
UP ACCTG 102	2	6,0	0,24	0,11	L34	0,034
UP ACCTG 206	1	3,0	0,20	0,05	L34	0,017
UP B LAW 243	8	24,0	0,60	0,46	L34	0,139

TABLE D.3: COURSE CONSUMPTION BY MAJOR REPORT

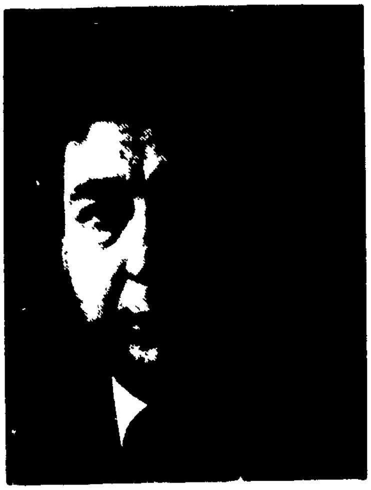
COURSE CONSUMPTION HISTORY AND PROJECTION BASIS — PAGE 307 — DATE 07/17/75

LOCATION- UP — COLLEGE- EARTH & MINERAL SCIENCES — COURSE- GEOLOGICAL SCIENCES COURSE NUMBER- 071 — MICRO-CODE- UP-N32-071

	SU-72 A	SU-73 A	SU-74 A	SU-75 E	FA-72 A	FA-73 A	FA-74 A	FA-75 E	WN-73 A	WN-74 A	WN-75 A	WN-76 E	SP-73 A	SP-74 A	SP-75 A	SP-76 E	FY-73 A	FY-74 A	FY-75 A	FY-76 E
COL/MAJOR- ARTS & ARCH — LEVEL- BACCAL ABOVE9																				
HEAD COUNT-	82	72	72	90	353	288	263	361	364	310	296	387	352	308	309	386				
FTE/ENROLL -	65	57	56	71	400	326	294	407	416	372	332	447	379	345	336	423	420	367	339	450
CRDS CONSUM-															3	1			3	1
CONSUMP/FTE-															.008	.003			.008	.002
COL/MAJOR- ENGINEERING — LEVEL- BACCAL 4 TO 6																				
HEAD COUNT-	44	47	61	70	408	482	599	689	347	408	527	593	302	399	501	556				
FTE/ENROLL -	45	40	59	67	472	563	697	801	413	509	629	717	352	462	585	648	428	524	657	744
CRDS CONSUM-													9	15	15	18	9	15	15	18
CONSUMP/FTE-													.025	.032	.025	.027	.021	.028	.022	.024
COL/MAJOR- ENGINEERING — LEVEL- BACAL 7 TO 9																				
HEAD COUNT-	89	66	73	89	666	597	670	761	609	565	667	724	575	523	642	684				
FTE/ENROLL -	87	53	70	83	779	705	792	896	727	679	800	868	684	617	753	809	759	685	805	885
CRDS CONSUM-													258	315	282	336	258	315	282	336
CONSUMP/FTE-													.376	.510	.374	.415	.339	.459	.349	.379
COL/MAJOR- ENGINEERING — LEVEL- BACCAL ABOVE9																				
HEAD COUNT-	166	158	140	152	718	683	621	663	696	668	606	645	715	659	633	658				
FTE/ENROLL -	160	134	132	139	833	794	724	771	815	792	712	760	815	746	718	747	874	822	762	806
CRDS CONSUM-													123	99	81	96	123	99	81	98
CONSUMP/FTE-													.150	.132	.112	.129	.140	.120	.106	.119
COL/MAJOR- ENGINEERING — LEVEL- GRADUATE																				
HEAD COUNT-	361	304	300	294	474	445	409	405	442	419	376	377	412	384	347	348				
FTE/ENROLL -	289	226	242	231	416	378	332	343	382	383	309	327	354	342	273	295	480	443	385	399
CRDS CONSUM-														3	3	2		3	3	2
CONSUMP/FTE-														.008	.010	.007		.006	.007	.005
COL/MAJOR- EARTH & M S — LEVEL- BACCAL 1 TO 3																				
HEAD COUNT-	28	18	24	21	118	130	136	119	104	125	130	111	89	117	112	98				
FTE/ENROLL -	32	18	24	23	133	151	158	137	118	152	149	130	98	132	124	109	127	151	152	133
CRDS CONSUM-														6	9	5		6	9	5
CONSUMP/FTE-														.045	.072	.047		.039	.059	.037
COL/MAJOR- EARTH & M S — LEVEL- BACCAL 4 TO 6																				
HEAD COUNT-	23	17	17	19	132	133	196	160	106	136	185	148	110	128	178	144				
FTE/ENROLL -	24	15	15	19	147	151	219	180	118	160	210	169	121	145	199	161	137	157	214	176
CRDS CONSUM-														6	27	13		6	27	13
CONSUMP/FTE-														.041	.135	.081		.038	.125	.073
COL/MAJOR- SCIENCE — LEVEL- BACAL 7 TO 9																				
HEAD COUNT-	140	120	131	151	857	933	1014	1090	822	931	964	1055	779	860	901	987				
FTE/ENROLL -	140	99	129	143	941	1021	1102	1191	928	1117	1065	1209	851	963	991	1091	954	1067	1096	1211
CRDS CONSUM-														3		1		3		1
CONSUMP/FTE-														.003		.001		.002		
SUMMARY																				
HEAD COUNT-	10288	10128	10250	15590	28281	29023	31032	31624	27295	27920	30103	30547	25935	26792	28896	30464				
FTE/ENROLL -	9549	8418	9239	11266	30912	31959	33588	34497	29858	31861	32710	33835	27844	29016	30646	32841	32718	33748	35391	37476
CRDS CONSUM-													390	450	438	483	390	450	438	483
CONSUMP/FTE-													.014	.015	.014	.014	.011	.013	.012	.012

TABLE D.4: COURSE CONSUMPTION HISTORY AND DEMAND PROJECTION

TRACK III
MIXED PRESENTATIONS



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SOME THOUGHTS ON THE MANAGEMENT PROBLEMS OF INFORMATION SYSTEMS AND CHANGE

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Education in the United States has become a large component of the economy. The current set of financial and social problems in this country is forcing more attention upon improved management and, therefore, upon management systems. The development of the so-called management information systems to support the called-for efficiencies produces new problems for educational administration. Some of the more global problems include: (1) the perceived value of such systems by the many constituents of higher education, (2) the different roles and relations of the technical aspects of data processing, and (3) the overall organizational problems in implementing such new processes. Some thoughts on the management problems of information systems and change are addressed in this paper.

SECTION I

THE NATURE OF THE CHANGES

Education in the United States is big business. Although there are varying estimates of the exact scope, and although there are different descriptions of the so-called "education industry," it seems apparent that a large share of Gross National Product is devoted to the costs of providing a wide variety of educational services. Higher education alone accounts for some $11.6 billion[1] in outlays for education, exclusive of foregone income of students. Much of the conventional descriptions of the state of the economy of higher education speaks of the dramatic growth and affluence of higher education during the last decade and of the slowdown of financial support for the next decade.

Much of this wisdom is probably correct and, if anything, optimistic about the financial outlook. Higher education faces a combination of problems. First is the inherent structure of higher education isolated from the other societal issues. In this environment education faces the projected decline in the number of traditional students, the aging of physical plant, the increased cost of operations from inflation, the increased cost per student generated from wider access and social legislation, the decline in federal support, and the shrinking market for graduates. Certain segments of the educational community also face internal distribution problems as public community colleges and alternative forms of traditional education take up some

[1] Higher Education: Who Pays? Who Benefits? Who Should Pay? The Carnegie Commission on Higher Education, June 1973.

of the demand. The summation of these factors has led some writers to describe a steady state enrollment and steady state financing (in constant dollars) as the "real world."

This condition is not the current situation for large segments of higher education. We are not generally receiving steady state -- constant dollar financing. In general, faculty and staff salaries have not kept pace with inflation. Maintenance has been deferred, and expenditures for books and equipment have been curtailed.

One reason why the pessimistic prognostications of steady state are becoming optimistic is, of course, the recession of the mid-1970's. But even more important has been the growth of other social programs as a share of public expenditures. Not only are programs like welfare and public health growing, but the deferred problems of debt service on massive capital bonding programs and the current service levels of unfunded retirement programs are moving from deferred to current. The New York City issues are much more widespread than is generally accepted.

Any reasonable projection of state revenues versus built in state expenditures produces a defeat. The amount is related to the projections of inflation and of productivity and employment; but the differences between favorable and unfavorable projections only changes the magnitude of the defeat. The absolute conclusion -- that is, the inescapable outcome -- is that unless taxes go up services will go down. Education is generally described as one which can go down.

The first set of problems of educational finance, coupled with the public sector problems, and sprinkled liberally with the attitudes of the public about higher education, do not produce a hopeful picture.

There will be, in my opinion, a reduction in the constant state financing for higher education each year for the forseeable future. It may well be differentiated by State, by University, and by special programs; but overall it will be down.

This condition has and is forcing higher education to accommodate hard choices. We cannot do all the things that we argue need to be done. We certainly cannot do all things at all campuses of all systems and all universities. We will have to learn how to share resources and to cooperate with other institutions. We will have to streamline programs and to modernize our administrative processes. We will also need to become even more entrepreneurial in our quest for resources by a variety of activities -- including fees for certain services, the commerical development of technology, investment of funds, and other money-making activities. We also need to improve our instructional delivery costs through better delivery systems and through eliminating and modifying some of the traditional activities.

These changes will occur. The question is at what speed and by whom?

Regardless of the outcome of the question of by whom, the need and the inevitability of the changes will create the demand for information and the need for methods to explore alternatives and control activities after changes have been determined. This generates the whole subject of management information systems, and with it a whole set of problems with regard to the management of such developments.

The first question in the administration of the development of the technological support lies in the different perceptions of the value of such activities.

SECTION II

THE PERCEPTION OF VALUE OF INFORMATION SYSTEMS

To help complicate the issue of change, there are many different constituents in higher education, each of whom views these changes differently. Each of these constituents has a different view of the worth of, in this case, MIS. In fact, at least some of the relevant constituents even have completely different objectives for the outcome of the MIS development. It is not uncommon to hear one constituent group argue that a management information system is really needed to demonstrate how financing for higher education can be reduced, while another group argues for the same system to substantiate how underfunded higher education has become.

In other words, we must first determine from whose perspective do the objectives and the determination of success in meeting objectives come. Secondly we must determine how each of the other constituencies sees the accomplishment of outcomes, as viewed successful, by the primary constituency. To simplify this discussion, I am assuming that the focus for describing the success or failure for the MIS under discussion falls under the administration of a college or university. Although certainly not universally true, presently, at least, most of the development is in this sphere of interest. The other constituencies, then, are:

. . . the federal government
. . . the state government
. . . coordinating boards
. . . governing boards
. . . faculty

. . . students
. . . alumni/friends
. . . local community (including employees)
. . . business/industry

I immediately plead guilty to great oversimplification. The government, for example, is obviously not a monolithic entity. The differences between the Office of Management and Budget (in the féderal goverment) and the Office of Education are vast and real. Likewise with the various legislative and executive staffs. The same kinds of simple-minded omissions are valid for all of the other constituents. Nevertheless, to keep the concept manageable (which may well have already failed), these nine constituent groups have been classed along with the administration as the relevant groups upon which to test the perception of worth as described above. In the next few minutes, I will attempt to do this in a highly subjective and somewhat unusual manner. First, I want to stipulate what a management information system is for this purpose. A management information system is defined to be a set of policies, procedures, policies, and systems (assuming the technical capability), which, from the standpoint of the administration, successfully accomplishes four definite objectives:

1. Developes a management or administrative overview of the functional processes, and with it the ability to plan, evaluate, and control.
2. Improves the allocation of scarce resources to achieve accomplishment of objectives.
3. Promotes optimal utilization of available and allocated resources to achieve goals.

4. Improves the <u>acquisition of resources</u> so that certain objectives can be achieved.

To develop this point of view, it must be stressed that, for the moment, I want to simply assume that the definition of MIS is that which successfully accomplishes the above from the perspective of the administration. Other constituent groups might differ on the desired objectives, and clearly would differ in the perception of success. Therefore, this discussion assumes a focus based on the perceived (versus real) success of the management information system as defined. <u>In other words, if the administration perceives that the "MIS" has improved the acquisition of resources, success is assumed even if other constituents do not perceive the same success</u>. A concrete example of such a case would be when the administration is convinced that a salary increase of "X" per cent was achieved only by the availability of data and comparative analysis, and without this (the administration believes) the increase would have been less than "X" per cent, ergo, success of MIS. At the same time, however, the faculty may perceive failure, or at least not absolute success, if an increase of more than "X" per cent was expected.

One way to illustrate this set of perceptions is to array the constituents with respect to the objectives and assign some subjective value points. The attached table does this, where the assumed highest value is 10 and the lowest value is 1. Each element in the matrix is my own assessment of what value each constituent would assign to the accomplishment of each MIS object <u>as perceived by the administration</u>. In other words, cell 1, 1 (federal government, management control and planning) shows a value of 5. This represents (my own subjective) the value that the federal government would place on a management information system that accomplishes the objective of "management control and planning" as perceived successful by the university administration.

Another way of looking at this matrix, a way designed to introduce the question of "worth," is to imagine that someone has a management information system guaranteed to be successful in the eyes of the administration, and that to fund the implementation each constituent is asked to contribute to the required need. Under the rules of this game, the maximum is $10.00 and the minimum is $1.00. Each cell, then, represents my predictions on the contributions one would garner -- which is also, obviously, a subjective measure of worth. Some examples for further clarification (or confusion) are as follows:

<u>Example 1</u>

A coordinating board might view the values of an MIS-improved acquisition of resources at a value of 6 (or $6.00 in the funding game), because the friction between a university and a coordinating board is lessened if the administration perceives that a successful "acquisition of resources" foray has been accomplished. To the extent that such a view minimizes conflicts, and thereby permits better coordination, the system that produced the feeling of satisfaction has value.

<u>Example 2</u>

The community might place a fairly low value of 3 (or $3.00) on the administration's claim that "improved allocation of resources" had been achieved, because any

TABLE I

VALUE OF A MANAGEMENT INFORMATION SYSTEM

Constituents	(1) Management Control and Planning	(2) Improved Allocation of Resources	(3) Improved Utilization of Resources	(4) Improved Acquisition of Resources
Federal government	5	3	4	1
State government	7	4	5	1
Coordinating boards	8	5	4	6
Governing boards	9	9	10	8
Administration	10	10	10	10
Faculty	1	3	5	10
Students	1	2	4	7
Alumni/friends	5	3	3	7
Local community	5	3	3	7
Business/industry	4	5	5	3
Total	55	47	53	60

change in the community (real or perceived) brought about by any changes in internal allocations would typically be very small. The only value (in fact) may well come from the visceral satisfaction of hearing the president of the university expound about this accomplishment at chamber of commerce luncheons.

Example 3

The faculty may well place an extremely low value of 1 (or $1.00) on the successful accomplishment of management control, as viewed by the administration, because faculty generally view the objective itself as deficient. Therefore, the value attached to accomplishing that objective is quite small, while, at the same time, the objective of improved acquisition is viewed as quite valuable even as perceived by the administration.

Enough examples: The values may certainly be debated, but the concept is fairly clear.

Several interesting observations can be extracted from this table. First, it is clear that, given the set of assumptions that contain this little model, the highest constituent value accures to the administration. That is, obviously, a given. However, the only other constituent groups with fairly high values are the governing board and the coordinating board. I contend that this is supported in actuality by the actions of such boards, and of the relevant associations having some affinity with the boards (SHEO, AGB, NCHEMS, etc.). The function showing the largest value is "improved acquisition of resources," which is the more interesting if the low values shown for state and federal government are valid. In fact, it is somewhat paradoxical that the defined success of a management information system in achieving additional resources as perceived by the administration has the highest constituent value support from all but the suppliers of additional resources -- state and federal government. In my judgment, these two consituents do not place a very high value at all on the success of MIS (remember -- as perceived by the administration, not by themselves). This kind of analysis can go on somewhat indefinitely, and may, in fact, even contribute to the state of confusion about MIS which has been evident for some time.

However, to return to the subject at hand, "The Value of MIS."

For a moment, visualize the matrix as a hard and fast believer in MIS would argue it should be filled out -- all 10's. The argument is, obviously, that all constituents should (if infinitely rational) believe that the objectives are universal and that the fulfillment of the true objectives will best be accomplished by hard facts, solid analysis, and true evaluation of alternatives. Now, if we make the further assumption that all 10's produce a value of $400, and that the cost of the MIS is also $400, we have a buy. But if the value as perceived (as shown) is only $213, and the cost is $400, we do not.

If there is any insight into the real world value system from this hopelessly simplistic model, there should be some relationship between those activities of MIS which have been more fully developed and those cells having a value close to 10. Let us look at the matrix with only the high values shown in Table II.

The message from Table II is clear (possibly even accurate). The value is perceived to be larger by the "administrative/coordinating/government" constituents, and the object of "Improved Acquisition of Resources" is perceived to be of the greatest value if looked at by the "highest levels" shown by Table II or even if summed overall constituents as shown by Table I. Does this table give any insight into reality?

My general opinion is that it does. It seems fairly clear that the major support for MIS (as described) does come from the constituents shown. It is also equally clear that the perceived value of the other constituents is, in fact, very low, and, as an outgrowth, the "worth" to them is small indeed. Also, it seems clear that the value of improving resource acquisition is very large from virtually all of the "inside the University" constituents. However, the aspect of this, which I find fascinating, is that the major objective of a management information system (as described) under "Improved Acquisition of Resources" is the area of MIS that seems to have received the most attention and the most development. If one looks at the outputs of the MIS systems currently in existence, etc., it is my opinion that many of them are products designed to function to this specified end. We have salary comparisons, enrollment projections, and deficiency studies about libraries, physical plant, and equipment needs. We have new program analyses about health-care needs, legal education, special education, and the expanding market for nontraditional or continuous education. In fact, the visable products generated by such analyses, and using data bases in existence produced largely by the administrative process, are all largely "macro" tools directed at the acquisition of resources. Those outputs which are not so oriented are largely in the other areas of "Management Control and Planning," such as budget control systems, program budget displays, or detailed descriptive data concerning profiles. I think it is true that very little has really been accomplished that addresses "improved allocations" or "improved utilization" at the university level, and particularly with respect to MIS outputs. What is being done (if anything) about these issues is being done by smaller organizational units (campuses, colleges, departments), and largely by processes independent of the MIS. In fact, one of the consistent complaints about MIS developments on the campuses is that the outputs are not very useful at the departmental level. It is not surprising, therefore, that little perceived value accures to such products. It does appear, however, that the currently perceived value is determining the areas of developments.

TABLE II

VALUE OF A MANAGEMENT INFORMATION SYSTEM
Selected High Values Only

Constituents	(1) Management Control and Planning	(2) Improved Allocation of Resources	(3) Improved Utilization of Resources	(4) Improved Acquisition of Resources
Federal government				
State government	7			
Coordinating boards	8			
Governing boards	9	9	10	8
Administration	10	10	10	10
Faculty				10
Students				7
Alumni/friends				7
Local community				7
Business/industry				
Total	34	19	20	49

SECTION III

POSSIBLE ROLES FOR ADMINISTRATIVE DATA PROCESSING IN THE CHANGING ENVIRONMENT

Four Roles

An administrative data processing (ADP) unit can fill one or more of these four institutional roles:

. . . as a service bureau for users.

. . . to support more efficient institutional operations.

. . . to support a management information system.

. . . as an extension of the activities of operational and top-level management.

In this hierarchy, the first two roles are well documented by institutional experience, and the third is expressed as a goal by many institutions. The fourth is postulated to be the best use that can be made of ADP in serving operational and management needs. The possible roles in the hierarchy are differentiated by the extent to which top-level management is involved in decisions about the uses found for ADP in an institution, as the following examinations of each role will show.

Service Bureau

In the service bureau concept, user need largely determines the variety of services provided, hardware configuration, staff size, and priorities for automation. Since a user's relative need for service is not a criterion in determining service priorities, users with the best imagination and ability to pay will be best served. Whether users with the greatest need receive the best service is largely a matter of luck. When, for example, dairy herd testing and automated student grade reporting operations compete for the same computing services, dollar clout typically decides the priority question. Since service bureau users call the shots in this way, they are very likely to participate in the planning of the ADP unit's expansion to provide extended or different services. The pure service bureau concept has its counterpart in industry. It is easiest to justify in a decentralized organization and requires the least involvement of top-level administrators. It can be placed in any neutral organizational slot and, with some base-level funding and an entrepreneurial leader, can support itself by providing services that knowledgeable users find profitable.

Whatever institutional advantages accrue when the ADP unit assumes the character of a service bureau, this role proves inadequate for any institution with these concerns:

. . . costs of redundant data lodged in different systems.

. . . consistency of data definitions used in the various systems.

. . . a balanced approach to the automation of the records of various organizational units.

. . . minimizing total costs of information processing.

. . . developing integrated systems to serve ultimate and intermediate providers and users of data.

Because of these concerns, most institutions have assigned a role to administrative data processing that is more specifically related to institutional goals than a service bureau can assume. At the same time, it should be recognized that the cost awareness and user involvement benefits inherent in the service bureau concept are important to the success of any administrative data processing effort.

More Efficient Operations

Administrative data processing units have most often been employed to support more efficient institutional operations. Although economists have yet to produce a precise definition of "efficiency," in this context the general hope has been that through automation, the institution could meet growing needs for data in various operations without increasing the cost of those data. Typically large-volume transactional operations such as processing registration records, student grade reports, payrolls, and expenditure accounting get first attention. In these operations, efficiency usually is regarded as the ability to handle greatly increased volumes of work with a modestly increased staff. To handle the rapid growth in enrollments in the 1960's, many operational offices would have had to contend with wall-to-wall staffing situations had they not automated.

In developing administrative data processing to improve operational efficiency, central administration involvement usually has been limited to making the budgetary decisions required to establish a data processing center and assigning automation priorities to various institutional operations. The budgetary decisions are largely concerned with what hardware to acquire and on what terms. Top-level administrators seldom address such important issues as personnel costs, data conversion costs, data redundancy costs, cost of developing new data processing applications versus costs of maintaining existing applications, and dollar benefits that can be expected from automation. They tend to take it on faith that more efficient operations will somehow result if they verbally support automation, provide adequate hardware, and authorize the hiring of technical computer staff where needed.

Clearly, the "more efficient institutional operations" approach will produce a large number of significant improvements. One- and two-day turnaround on grades, transcripts, payroll checks, scheduling, and month-end accounting is not at all unusual. Transaction volume has doubled and tripled in areas where staff increases have been most modest. Communications potentials have increased dramatically: for example, labels for students, alumni parents, and staff can be printed in a matter of minutes.

However, this "more efficient institutional operations" approach to administrative data processing also inevitably results in:

. . . a relatively large number of independent applications.

. . . such high demands by users upon existing resources that new applications keep being postponed.

. . . more visible data redundancy because the data processing center maintains many files that appear quite similar in content.

. . . increasing demand for hardware and personnel expansion at the central site accompanied by decreased user awareness of what actually is needed to meet their automation needs.

. . . top-management frustration about the general difficulties of getting answers to questions in information areas that they know are "on the computer."

Numbers of institutions have carried the "more efficient operations" approach a step further, developing operational data systems that link allied applications. For instance, a system may be developed by linking admissions, registration, fee assessment, grade processing, transcripts, and student loan applications.

Frequently these linkings are given the rubric Management Information System (MIS). However, we view them rather as logical extensions of the "more efficient operations" approach and reserve MIS for the more restricted use defined in the following section. An operational data system in a given applications area, characterized by shared data bases, common definitions, modularly related applications programs, and nonredundant maintenance responsibilities, most certainly requires more management involvement than do isolated applications. Developing operational data systems also requires more technical expertise and generally places increased responsibilities on the administrative data processing staff.

Many times, the large number of programs that logically fall together contain so many built-in restrictions on linking that the data processors consider it easier to develop a new operational data system from scratch. At the same time, they will want to design a system that will serve institutional operations not currently using data processing and provide information not because the proposal for the new operational data system is likely to entail the acquisition of new hardware and the purchase or lease of software, and also require decisions about jurisdictional boundaries between institutional units. With top-management approval, operational data systems can be developed that will eliminate significant data redundancy, balance automation efforts and achieve data consistency within major operational area, permit better control of total information costs, and promote first-stage integration of data for ultimate providers and users of data.

Just as automated applications can improve the efficiency of institutional operations, data systems can improve the efficiency of automated applications. But even when applications have been linked into operational data systems, the institution will find that it cannot satisfy top-management needs for integrated and projected information. Awareness of this deficiency leads to the concept of ADP as a support for a true management information system.

At this point we have established a series of arguments that leads us into the obvious position of advocating a role for the technologist in developing MIS, and beyond that into extending the form of administration. It is at this point, however, that a look back to Section II -- "The Perception of Value of Information Systems" needs to be taken. A great deal of the difficulty of developing MIS comes from the failure to comprehend the constituent perceptions. It is also important at this point to remark that the next section tries to outline the very large problems with respect to organizational changes required to move into the expanded role possibilities.

For this paper, the MIS focus is on institutional administrators as managers of resources, organized in relatively traditional structures. Our specific assumptions about administrators, their data needs, and organizational relationships are discussed in subsequent chapters. For now, we assume that an ADP unit that supports an MIS serving institutional administrators will at a minimum be expected to provide:

. . . historical and current profile information regarding the resources, users/sponsors/patrons, and programs of the institution.

. . . methods for integrating this information across traditional organizational boundaries.

. . . computational support to various analytical and projection techniques.

Considerable top-level management involvement is required if an ADP unit is to assume these functions. Budget and ADP service priorities are still important, but top-level administrators also participate in defining the structure of the MIS and determining relationships of components and the time and content requirements for the different kinds of information needed by administrators.

Agreeing on a structure for the MIS is just the first step. Common data definitions and interrelationships must be agreed upon and careful information analysis is required to determine what management tools and data will be provided, to whom, and when.

It is possible to develop an MIS that is not supported by operational data systems. In fact, numerous federal and statewide requirements for institutional management information can be met without using such systems, and they are not necessary to the use of most generalized forecasting and resource analysis models now available. Often it is easier to get management information if the complexities of operational data systems are avoided. Institutional research, planning, or budget office analysts generally can come up with enough data to operate almost any forecasting or costing model. Usually they can do it in less time than it would take to develop or convert an operational data system for the purpose. We contend, however, that the traditional way of generating management information has mainly short-run advantages. We believe that in the long run, automation is best used when basic planning information is largely a by-product of operational data system information and decisions are translated into controls that can be employed in such systems, and when the same systems serve management information needs at all levels in an organization. In this perspective, ADP becomes an extension of both operational and top-level management.

ADP as an Extension of Management

Data processing can assist unit managers in their unique tasks and also can aggregate information to meet various anticipated as well as unexpected needs for management information. In its best use, ADP will support three kinds of activities:

. . . basic transaction processing and control, through operational data systems, to meet the specific needs of individual unit managers.

. . . comprehensive profile and exceptions reporting, to help program managers see the interrelationships, history, and status of data from a variety of related units, and to meet needs for external reporting requirements.

. . . projection information processing, to help planners evaluate likely futures and policy alternatives by applying forecasting, simulation, and other analytical tools to profile data derived from transactional processing systems.

These activities directly support the critical top-management functions of planning and control, and of course require significant top-level involvement. Systems can be developed that will also support day-to-day operational processes. But while good management information systems and good operational data processing systems are compatible, they never will be synonymous. No management information system will automatically evolve as a by-product of even a good data processing system. Both require planning, both require organization, both require a high level of technical and administrative skills. And in postsecondary education, both require inordinate patience, political aptitude, and resources.

To recapitulate, ADP has at least four possible functions -- as a service bureau, as a support to more efficient operations, as a support to a management information system, and as an extension of operational and top-level institutional management. Individually or in any combination, these services can be valuable. But the new demands for information today and the new capabilities of analytical and data processing technology make it both feasible and advisable to develop data processing systems that function as an extension of management.

Higher education is moving from an era of growth and production orientation to a more stable era of cost orientation. University administrators are under myriad pressures to elicit quantitative rationalizations of the process of higher education. Employment and salary patterns, unit costs, inflation impacts, energy use alternatives, minority goals and achievements, faculty work loads, and tenure attrition models are just a few of the "nontraditional" data items that administrators are supposed to have available and, furthermore, to use in day-to-day operations.

There is both need and a great opportunity for administrators in higher education to use administrative data processing as an extension of their management activities. Obviously, this takes considerable executive involvement. In succeeding chapters, we consider why that involvement is necessary, identify the organizational areas that can be helped by that involvement, look at what some institutions are doing, examine the various roles that ADP should undertake, and consider how ADP performance should be measured.

SECTION IV

SOME CONCEPTS OF ORGANIZATION

General

Even in the changing world, discussed above, the fundamental element is still people. I believe that any senior administrator would argue that most of his or her time, that is not spent on financial concerns, is spent on people concerns. No matter how much technology is available, and regardless of the funds spent on sophisticated hardware, the success or failure of the University to accommodate the changes needed in the changing world of higher education administration is a function of the perceptions of the people involved with the many constituencies. Perhaps, the single more important aspect in managing the perceptions is the organizational structure, as related to the administrative activities. Let me expand on this.

Function versus Activity

In general, most of the organizations, within the broad category of "administration," are characterized by a collection of activities. These activities have names like payroll, accounting, grants and contracts, purchasing, stores and receiving, bursar operations, data processing, affirmative action, insurance, etc. It is not unclear how these activities grew in complexity and, thereby, stimulated specialization and even produced an organization. We even classified people the same way: accounts, payroll clerks, stores clerks, etc. The compartmentalizing of these activities into organizations influenced the design of forms, the paper flow, and, yes, in fact the information systems. The same principles apply with, equal fevor, to student records, alumni records, hospital admissions, and so on throughout the organization.

From the "outside," and apart from the biases of many years of involvement, the systems analyst armed with computer technology and advanced data base concepts finds the world described above as unintelligible -- "it does not compute."

It is true! The organization and the associated paper flow is not very sensible. In the past, many things were tried. To satisfy the payroll, process payroll systems were designed -- often driving both the departmental secretary and the vice president equally bananas, but for different reasons. Or, on occasion an analyst succeeded in designing an "overall" system which probably never functioned the way it was designed because the units (sometimes called users) did not respond to changes in activities required. My opinion has been, for many years, that the data processors will never solve the fundamental problem without hand-in-glove progress with senior management -- the fundamental organization must be changed as a parallel process with improved systems. You cannot change the organizational patterns until new attitudes have been "created" or until the new systems can operate to support the new organization. You can, also, not implement new comprehensive-functional systems until the organizational changes are ready. The paradox, of course, is that nothing can change if this describes reality. In fact, nothing much will change unless a carefully orchestrated program of incremental moves, involving both systems and people, and characterized by a judicious use of both "carrots and sticks" is developed. The latter, in my opinion, can only be achieved by the development of a team of major administrators of the to-be-developed functional areas -- one functional area being administrative computing services.

To illustrate my position, without going into excruciating detail, let me pose the following hypothetical functional organization for the administrative side of a large multi-campus university:

Senior Office of Administration

1. Personnel Administration
2. Financial Affairs Administration
3. Facilities Administration
4. Planning and Analysis
5. Administrative Computing Services
6. Management Information Systems

It seems fairly obvious that with such an organization major systems could be described, but that also a number of organization changes would typically be required.

The major point of all this is that if the functional areas can be delineated (as described as in example), and then if the team of managers can be organized and inspired, major breakthroughs can be achieved. Conversely, if this is not done, no amount of persuading by the data processors or ranting by the senior administrators will accomplish change.

Mutual Interdependence

Another aspect of organization considerations is the purposeful creation of mutual interdependence of the major functional components. It always seems a little trite to bring up the athletic departments "let's all pull for the team" speech, but it is appropriate. In any large organization there is a natural tendency toward self-sufficiency. Most departments or units try to achieve some degree of control over the forces that affect them. If possible, they would create their own printing, duplicating, and computing capability. The motivating forces are very clear. Each manager views his or her success as a function of performance. The very essence of the managerial adage "produce results not problems" leads middle managers to the conclusion that independence is needed to produce results. In the "team" illustration above, the apparent conflict of self-determination and team specialization has been largely resolved. The incentive system, which seems to function, places a great deal of attention on the ability to perform a specific mission within the context of a larger objective. Part of the reason (it seems to me) that this works is the creation of mutual interdependence. A quarterback is not effective without pass protection. But even more important, it is obvious to the participants that the review mechanism pays attention to the team mechanics. In our administrative structures we, too, often pay attention and reward on the basis of individual performances, which when viewed as to process rather than product may even be counter-productive.

In the process of organizing the hierarchy into functional process, it is also possible, and in my opinion highly desirable, to build into the relations organized interdependence. This can be done to the extent that the entire structure cannot function if any major component fails. Clearly, this is "overkill." Nevertheless, and in particular, with regard to data processing, it is necessary that each area feel that they are dependent upon the files, the processes, and the outputs to do business. Again, we see the partnership required between management and the data processor, which if operated effectively can produce a new partnership of all the areas.

Consolidated Processing

A purpose of the above -- which, like mutual interdependence, is a difficult management problem -- is to develop organized control and planning for the functional activities. To develop such single focus planning for all of the administrative processes, it is necessary to determine an "organizing principle." Two digressions are in order before developing this point.

First, it is common to meet great resistance from the widely desperate departments, groups, etc., with a complicated organization such as a university. In fact, vast amounts of rhetoric can be gathered to show that the single biggest problem in accommodating the changes of which we speak is this issue. Some of the arguments are valid -- there is a potential danger of loss of individuality and of the possible burdensome and stifling systems created by "central" organizations. All one has to do is to look around at the bureaucratic mess we have created in the State and Federal Government to be convinced. Some of the arguments are petty and self-serving because units like autonomy for its own sake. Regardless of the valid versus self-serving arguments, what are the alternatives? Every unit cannot go its own way with regard to expensive and complicated legal and financial systems development. The only possible outcome of a much longer argument about this conflict, is care. Care must be exercised to prevent the technologist from reshaping society into binary recognition patterns. Care must also and equally be exercised to prevent the problems from overwhelming the development of the necessary economics.

The second digression is about control. A second source of concern about systematic developments and planning for adequate systems comes not from the technocrat who wants to do his own thing, but from the people who are supposed to be served -- the faculty, the students, and the educational community in general. It is often said, for example, that information is power and, therefore, those who control the information systems will have the power. The first part of the statement is partially true. Knowledge is a powerful attribute in any decision process and information certainly can contribute to knowledge. The second part is not necessarily true. There is a fundamental difference between the logistical control of an information system and the decision process. It takes only a very few fundamental, organizational, and process decision to assume that the technological processes do not get out of hand. My personal opinion is that most of the very loud voices crying out against systematic developments come from people who want the right to make arbitrary decisions.

Now to the main point. The "organizing principle," which I find the most viable, is the consolidation of administrative computing resources as one of the fundamental functional elements of administration. This means, at least in my view, as establishing the concept that data processing is not a service bureau for other functions and activities, nor is it the leader, motivator, or beacon light to a better world. It is a fundamental "leg" of the administrative "stool;" equal to, but not more important than, the others. The reason that ADP is chosen as the organizing principle is that the information process can best be planned and, if necessary, controlled by the organization that processes the data. And, it is absolutely necessary to "get there from here" to develop a mechanism to force change. Centralizing the data processing capability is a good way of beginning the development of consistent, efficient, and reliable administrative processes and systems.

Data Base/Data Communications

Bringing all of the above elements into reality requires not only organizational changes and consolidated data processing, it requires a data communication capability to facilitate the consolidated processing and it further requires the use of common data bases. The latter makes possible the interdependence described above and also the efficient development and maintenance of large administrative systems. This audience does not need an extended discussion of the theoretical advantages of and, in fact, requirement for data base/data communication systems.

Process Versus Substance

The final element in the overall conversation of organizational concerns is the understanding of the difference between process versus substance. It can be easily demonstrated that the logistical support systems for producing information and disposing of essential administrative tasks are fundamentally different from the substance of a decision. Such systems can produce valid salary comparisons for example, but not an intelligent recommendation for the amount of next years salary change. This awareness must however be specific and reflected in the organizational arrangements.

Conclusion

This brief paper is titled, "Some Thoughts on the Management Problems of Information Systems and Change." The content can be summarized as:

1. There will be change.
2. The changes will require better planning, evaluation, and control systems.
3. The many constituencies view this need differently.
4. The technology of information processing can fill a part of the need.
5. There are many organizational as well as perceptual problems.

The substance is, therefore, consistant with the title. There are a few thoughts, observations and, hopefully, some insights.

COMPUTER-BASED PLANNING TOOLS FOR STATEWIDE EDUCATION PLANNING

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There are a number of databases and computer based models which are available to the education planner. This paper describes the major areas of current planning issues and describes the databases, computer models, and analytic packages which are available to assist in each of the planning areas. Areas discussed include faculty compensation and assignments, student consumerism, outcomes and institutional roles in the education system, and state and federal education policy-making. Emphasis is given in identifying the specific uses of these models including statewide student flow, RRPM and CAMPUS, the financing models, NCHEMS IEP, and VPI Statewide Planning System, and NEDL data access.

The abstract of this paper is included for the interest of the reader. Unfortunately, the full paper was not received in time for publication. For more information, please contact the author.

USE OF SELECTED NATIONAL DATA BASES FOR HIGHER EDUCATION ANALYSIS

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This paper describes a number of important national data banks that can be used by administrators and researchers for higher educational analysis including the EDSTAT II data base (from HEGIS) operated by the National Center for Educational Statistics and the National Longitudinal Survey of High School Seniors of 1972. The paper will examine these data bases from a user perspective. It will identify the specific kinds of data that are available, discuss user access, describe technical requirements for users, costs and other options associated with data base use. A number of example applications of these data bases will be cited.

Introduction

As the number of requests for higher education data continues to grow, it becomes increasingly important to know that existing sources of data have been well utilized. In recent years, a number of important efforts have been made to improve access of educational data users to a number of national data bases. One of the most notable efforts in this area has been the work of the National Commission on the Financing of Postsecondary Education (NCFPE) in making on-line terminal access available to data sources such as the Higher Education General Information Survey (HEGIS), which previously had only been available in published form, about three to four years after original collection. This paper is intended as a mechanism for increasing potential user awareness of these data bases as well as to acquaint users with some of the options available to them in their decision to access existing national data. We hope that these comments will enable prospective users of these data bases to better evaluate the potential utility of the data in their individual situations.

VALUE OF EXTERNAL DATA

Data available through existing sources are likely to serve higher education institutions and agencies in two major ways. For one, the need often arises for data about other institutions and agencies for comparison purposes. Given the absence of absolute measures for effectiveness and performance in higher education, institutions and states have relied, and most likely will continue to rely, on comparisons and relative indicators as a basis for making decisions. For example, an institution in examining its faculty salaries, tuition charges or cost per square foot of space is likely to want to know these same figures about comparable institutions or groups of institutions (e.g., other public community colleges or for the big ten schools, etc.). Such data provide a context for assessing higher education activities. A second need is for supplementary data, that is, data about the state or region in which an institution resides, about employment trends for specific occupational groups, or about price changes in selected product areas. Many of these kinds of information are not collected by higher education institutions or agencies, but are useful in the context of higher education decision-making. For example, budget projections necessitate information about anticipated state revenues, program review often requires employment data, and cost of living increases for faculty and staff are often made with reference to price index changes. While there is little disagreement about the importance of external data for comparison purposes and as a source of supplementing data, the process of acquiring these data can be costly and time consuming. While a frequent reaction to the identification of a new need for data is an ad hoc telephone search or a full-blown mail survey, it is the intent of this paper to suggest that a number of important alternatives often exist. Use of existing data is frequently less expensive than direct collection and often more timely. While it is recognized that existing data presents a number of attractive opportunities, use of these data can be difficult. For example, the sheer abundance of data that is not prioritized or uniformly sorted contributes to the frequent non-recognition of the existence of these data. Second, the variety of sources of data in different locations and from different agencies also contributes to the difficulty of using existing data. Third, the variety of forms in which data are available can necessitate different technologies for effective use of data. For example, data can be provided in published form, in computer tape or deck form, or on-line from remote terminal to name a few. HEGIS data (the Higher Education General Information Surveys) collected by NCES (National Center for Education Statistics) is a good example of education data that is being disseminated through computer systems (EDSTAT II system). Each of these data forms can necessitate different resources in order to utilize the available information. What is apparent in the foregoing listing of factors that inhibit the use of existing data is the need for conscious efforts and clear strategies to effectively use existing data.

The remaining sections of this paper will list a number of references useful in sorting through selected sets of available data, as well as provide a chronological case example of the developmental experience of the authors in moving along a range of data use from small scale to substantial involvement in the use of existing data sources. This latter description is intended to specifically identify some of the options, costs, and tradeoffs associated with changing data base strategies.

AIDS IN IDENTIFYING EXISTING DATA

Three different starting points for identifying existing data are detailed below. One major source is the Reference Guide to Postsecondary Education Data Sources[1] which identifies and describes publications, articles, and

[1] Katherine H. Allman, A Reference Guide to Postsecondary Education Data Sources, (Boulder: NCHEMS at WICHE, 1975).

data bases that contain data frequently used in higher education analysis. It provides information about: (1) how the data are organized (for example, item-by-item, in tables, by chapters), (2) the kinds of information given (for example, data on personal income, number of high school graduates, enrollments in postsecondary education institutions), (3) the level of aggregation (for example, by region, state, postsecondary education institution), (4) the years for which data are available. This document is a useful reference in sorting through available data. A second compendium of data sources is the Directory of Computerized Data Files and Related Software Available from Federal Agencies[2] which is published by the U.S. Department of Commerce. A third source is the National Education Data Library (NEDL) which has an on-line library of data bases which can be accessed on-line or ordered in tape form. NEDL also produces a Catalogue of Selected Machine-Readable Data Bases for Postsecondary Education which further describes available data bases.[3] In addition to these references a summary listing of a range of data sources that are of potential interest to education data users is provided in Table 1. It should be explicitly noted that a broad range of data sources have been identified below in recognition of the fact that data besides that about institutions, faculty and students is important for education data users. Examples of these other data include the Parnes and Labor Department surveys of employment and the Census surveys of government and population.

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[2] Directory of Computerized Data Files and Related Software Available for Federal Agencies, (National Technical Information Service, U.S. Dept. of Commerce, NTIS-SR-74-01, 1974).

[3] Daryl Carlson, James Farmer, and Catherine D. Sullivan, Catalogue of Selected Machine-Readable Data Bases for Postsecondary Education (Washington, D.C.: NEDL, April, 1975.)

Table 1

Selected Higher Education
Data Sources

- National Center for Education Statistics (NCES)
  - Higher Education General Information Survey (HEGIS)
    - Directory File (Academic Years 1971 - 1975)
    - Institutional Characteristics
    - Opening Fall Enrollment
    - Earned Degrees
    - Financial Characteristics
    - Residency and Migration
    - Advanced Degrees
    - Employees
    - Libraries
    - Facilities
    - Basic Student Charges
    - Adult Education
  - National Longitudinal Survey of High School Seniors 1972
  - Vocational Education Directory

- American Association of University Professors (AAUP)
  - Faculty Salary Survey

- American Council on Education (ACE)
  - (W/Carnegie) Graduate Student File (1969)
  - (W/Carnegie) Faculty Data (1969)
  - Faculty Data File (1972-73)
  - Institutional Survey File of Selected Policies and Practices
  - Institutional Characteristics (1974)
  - Freshman Survey (1966-1973)
  - Longitudinal Student Data Files

- Carnegie Commission (Carnegie)
  - Survey of Private, Technical, Business, Specialized, and Vocational Schools and Colleges

- Center for Human Resources Research (CHRR)
  - Parnes Longitudinal Data Base (Longitudinal Survey over five years of 20,000 individuals in a population to study labor force participation patterns)

- College Entrance Examination Board (CEEB)
  - College Scholarship Service Student Resource Surveys
  - College Locator Institutional File

- Council for Financial Aid to Education (CFAE)
  - Voluntary Support Survey

- Education Commission of the States (ECS)
  - Illustrative NCHEMS IEP Data

- Educational Testing Service (ETS)
  - College Graduate Survey

Table 1 (Cont'd)

- Illinois State Scholarship Commission (ISSC)
  Survey of Financial Aid Recipients

- National Academy of Sciences (NAS)
  Doctoral File
  National Register of Scientific and Technical Personnel

- National Board on Graduate Education (NBGE)
  Survey of Graduate Departments

- National Commission on the Financing of PSE (NCFPE)
  Federal Program Funding Data
  Survey of Postsecondary Career Schools

- National Science Foundation (NSF)
  Federal Support to Universities, Colleges, and Nonprofit Institutions
  Survey of Scientific Activities of Institutions of Higher Education Current, Capital Expenditures for Research, Development and Instruction in the Sciences and Engineering
  Employment of Professional and Technical Personnel in the Sciences and Engineering
  Survey of Graduate Student Science Support and Postdoctorals

- Project Talent (Longitudinal study of college-going decisions)

- U. S. Bureau of the Census (CENSUS)
  Decennial Census
  County and City Data Book
  Current Population Survey
  Census of Governments

- U. S. Bureau of Economic Analysis

- U. S. Bureau of Labor Statistics (USBLS)
  Industry/Occupation Matrix

- U. S. Office of Civil Rights (USOCR)
  Compliance Report of Institutions of Higher Education

Description of EDSTAT II

Because EDSTAT II represents one of the largest data bases about higher education institutions, (over 3,000 institutions) a more detailed description of that data base is included here. The data are principally derived from the annual set of surveys conducted by the National Center for Education Statistics (NCES) that are known collectively as HEGIS (Higher Education General Information Surveys). The series includes, for example, a survey on fall enrollments, earned degrees, financial characteristics, residence and migration of students, employees, and others. While these files have been separately listed in Table 1, a more detailed listing of some of the components within four of these files is provided in Table 2.

Table 2

Detailed EDSTAT II File Description
for Selected Files

INSTITUTIONAL CHARACTERISTICS FILE CONTAINS:

- campus designator
- control
- accreditation
- calendar system
- enrollment
- listing of main administrative officials
- highest degree granted
- types of programs offered

OPENING FALL ENROLLMENT FILE CONTAINS THE HEADCOUNT AND FULL-TIME EQUIVALENT ENROLLMENT OF:

- degree credit resident and extension students by degree program level
- non-bachelor's degree-credit student enrollments by resident and extension
- first-time degree and non-degree enrollments

FINANCIAL STATISTICS FILE CONTAINS:

- current fund revenues
  - educational and general (e.g., from tuition and fees, governmental appropriations, sponsored research, other sponsored programs, etc.)
  - student aid grants
  - major service programs (e.g., hospitals)
  - auxiliary enterprises
- current funds expenditures
  - educational and general (e.g., instruction and departmental research, extension and public service, libraries, etc.)
  - student aid grants
  - major service programs
  - auxiliary enterprises
- physical plant assets (i.e., land, buildings, and equipment)
- indebtedness on physical plant
- endowment by book and market values, earnings, and realized gains

DEGREES GRANTED FILE CONTAINS: Number of degrees granted from July of one year to June of the next, by men and women, and by discipline specialty.

- 1st professional degrees conferred by eight specialties
- bachelor's, master's, and doctor's degrees by two digit HEGIS code for 24 discipline fields
- degrees and awards based on less than four years of work beyond high school for three different degree levels by four major discipline fields

These files are each organized by institution. They can be accessed by remote terminal through the EDSTAT II System operated by INFONET. These data are also available via remote terminal through American Council on Education (ACE) and through National Education Data Library (NEDL). In addition, the tapes can be ordered from the National Center for Education Statistics (NCES) for use as an in-house data base. Some of the tradeoffs associated with remote access versus tape acquisition will be described in the next section.

Case Example in National Data Base Usage

In order to illustrate some of the different external data base usage postures and the costs and tradeoffs associated with these approaches, a case example of a particular user experience will be described. The example describes a continuum of increasing involvement with external data sources experienced by a subset of the NCHEMS staff, including the authors. It illustrates how a variety of factors were important in specifying data base needs, including frequency of use, need to access multiple files simultaneously, cost, and ability to guarantee access (and hence the need to switch computer centers). This example is also useful in pointing out that use of external data is not a unidimensional task, but rather, there are a whole range of options available to users in designing data base strategies. For example, for some users remote terminal access may provide the most cost-effective mode of use. In other cases, where large scale use of data files is intended, acquisition of tapes and the development of an inhouse data base may be more feasible. It is hoped that the following case example will illustrate a number of user options and some of the tradeoffs associated with each option. Some of the factors that have influenced our data base designs include:

- form in which data are available
- extent of use of external data
- frequency of use
- cost
- time allowance between identification of data need and acquisition of data
- degree of control needed over data
- type of use (e.g., need to integrate multiple files, type of statistical analysis)

Specification of user requirements for each of these dimensions is a useful step in designing a data base strategy.

Prior to the advent of the National Commission on Financing Postsecondary Education data base system (which later was named EDSTAT I), NCHEMS staff primarily relied on specialized programming support to secure data tables and reports from existing national education data sources. This strategy, while flexible, was not economical, particularly in light of the wealth of education data resources available and the limited staff capability to access them. The development and changes of the National Commission on the Financing of Postsecondary Education data base, however, did bring about a change in Center strategy related to education data and led to the events described in Step 1 through Step 5. These steps are summarized below and then detailed in Steps 1 through 5 on the following page.

- <u>Step 1</u> EDSTAT I - On-line teletype terminal access
- <u>Step 2</u> EDSTAT II - On-line teletype terminal access
- <u>Step 3</u> In-house special purpose files; keypunched data that was extracted from EDSTAT II
- <u>Step 4</u> Conversion of Step 3 special purpose files to on-line access
- <u>Step 5</u> (Ongoing) Development of integrated in-house data base from data tapes and other published sources

STEP 1

Description (May - December, 1974) - Access of national education data in the National Commission on Financing Postsecondary Education data base comprising approximately 20 on-line public access data files from various sources. This later became called the EDSTAT I System. Access was accomplished using teletype terminals via long distance direct-dial and WATS lines.

Data Management System - DS/3

Computer System - System Development Corporation (IBM 370/158 with OS/HASP/TSO)

Usage Cost - Average $25 per terminal hour plus telephone charges

Reason for Start-up

1. English-format retrieval language (easily learnable)
2. Simplified access to national education data bases

Reason for Discontinuing - The EDSTAT I System was converted by NCES to the INFONET Timesharing System (minus most of the non-NCES data files) and renamed EDSTAT II.

Primary Usage - At this point, the system was a curiosity, and most requests for information resulted from demonstrations or casual questions which could be easily answered.

Analysis - Of all the conversational on-line retrieval systems investigating or used by NCHEMS staff, DS/3 seemed most adequate. On reflection, this fact seems aided substantially by a favorable computer charging (pricing) structure, and (at that time) relatively unsophisticated needs of our staff. Sadly, the data bases constructed by National Commission on Financing Postsecondary Education were not maintained after the Commission itself was discontinued.

STEP 2

Description (January - December, 1975) - Access of national education data through the EDSTAT II national on-line data retrieval system.

Data Management System - System 2000

Computer System - INFONET-Computer Sciences Corporation (UNIVAC 1108/GPS)

Usage Cost - Average $30 per terminal hour for retrieval (not reporting) operations. No telephone charges as a local port was available.

Reason for Start-up - Desire to continue on-line access to national educational data.

Reason for Discontinuing - Although the system is still used for demonstrations, production work has been discontinued due to (1) expense, and (2) inflexibility. See below.

Primary Usage - Production data retrieval and analysis work for several research studies in progress at NCHEMS.

Analysis - While the EDSTAT II System is marginally more difficult to learn and use than EDSTAT I, more substantial drawbacks became apparent.

- The inability of NCES and INFONET to work out a "customer" package that could be implemented quickly and painlessly

- The exceedingly great cost of preparing reports (as opposed to simple accession requests)

- The reduced scope of EDSTAT II data holdings (much of the National Commission on Financing Postsecondary Education data base was scrapped) When combined with the analytical problems (such as not being able to access multiple data bases concurrently), the system became (operationally) infeasible.

STEP 3

Description (February - May, 1975) - Construction and access of specially designed data bases for special NCHEMS research studies.

Data Management Systems - SPSS (Statistical Package for the Social Sciences)

Computer System - University of Colorado Academic Computing System (CDC 6400's/KRONOS 2.1)

Usage Cost - Average $2 per batch request or $3 per on-line request.

Reason for Start-up - Need to dynamically build new data base for special research projects.

Reason for Discontinuing - Lack of flexibility in (1) data entry, and (2) reporting.

Primary Usage - Arithmetic statistical computations such as cross-tabulations, correlations, etc.

Analysis - SPSS is clearly not designed for data management and reporting, but was pressed into service for lack of a reasonable alternative. Since many of our applications clearly did require detailed statistical procedures, the choice was not completely unwarranted.

The problem here was again relating two data bases concurrently. The constructed data bases were primarily state aggregations, but the EDSTAT files were institutionally based and using the two file formats together involved extracting reports from EDSTAT, keypunching the results on cards and reloading the constructed data base.

Of all the on-line systems used, SPSS was perhaps the best documented and least susceptible to errors.

STEP 4

Description (April - May, 1975) - Conversion of the special purpose files constructed in Step 3 for on-line access and reporting.

Data Management System - MARS VI (a CDC Program Product)

Computer System - University of Colorado Computer System (CDC 6400's/ KRONOS 2.1)

Usage Cost - Approximately $25 per on-line hour.

Reason for Start-up - Need to provide more basic data management capabilities than possible with SPSS. Also, wanted on-line access for demonstration purposes and data base integration feature of MARS.

Reason for Discontinuing - The MARS product was poorly supported by the Computer Center staff, and there were many apparent system bugs. Also, more data files were envisioned than the MARS System could support through its data base integration features.

Analysis - This effort was a catastrophe from the outset, primarily because of the product's unreliability as maintained at the CU Center. Information requests were expensive, yet the potential power of the system (as conceived) excited us, primarily because of the data base integration feature.

STEP 5

Description (June - December, 1975) - Acquisition of all data files of current (analytic) interest for use in-house with a major batch data base management system.

Data Management System - MARK IV

Computer System - University of Colorado, ADP Center (IBM 370/145/VS1)

Usage Cost - Average $3 per batch request.

Reason for Start-up - The DBMS had recently been made available for NCHEMS use, and its power and flexibility appeared substantially greater than previous alternatives.

Reason for Discontinuing - This arrangement is still in operation and is being expanded rather than phased out.

Primary Usage - Data management for many national and special purpose educational data bases, and detailed reporting and analysis for NCHEMS and WICHE research and development projects.

Analysis - Two important contributions were added in this step. First, since data tapes were ordered and installed in-house, the production schedules were again in a controllable state. Secondly, the addition of a production-oriented DBMS (with, incidentally, substantial documentation and training) removed much of the burden of accessing and reporting from the staff. An important sideline of this fact is that because training was available, staff knowledge of the DBMS became more distributed rather than residing in one (or few) individual(s).

As cited in Step 5, the current design utilizing the MARK IV Data Base Management System, with acquired in-house data bases, is currently working well and is being expanded in scope. In particular, the OSIRIS statistical package and the TPL table generation language are being implemented as additional analytical tools which (1) extend the basic reporting capability of MARK IV, and (2) operate on the same data files managed by MARK IV.

The lengthy procedure (Steps 1-5) of developing a workable and useful system to support research and development work at NCHEMS has identified several key perceptions which were not clear at the outset.

- We first began by accessing data casually out of general interest, then began using it on a production basis, then began constructing additional data bases of our own to fill special data needs or special reporting requirements. Each of these steps placed increased demands on the data management system being used.

- As our research capability increased, the need for planned, systematic data base integration (physically associating information on one file with corresponding data on a different file) increased. With the on-line systems first used, the integration process consisted of transcribing, by hand, numbers from one data base to another.

- Our need for on-line interactive systems appeared to decrease rather than increase over time. This seems due (1) to an increasing emphasis on report generation rather than quick access, (2) staff participation increased to a point where terminal access was no longer feasible, and (3) none of the currently available on-line systems could support data base integration adequately.

- Partly because of our need to construct special data bases on an ad hoc basis to integrate with existing ones (e.g., HEGIS), and partly because we became production users of education data rather than occasional users, we felt a strong need to increasingly control (i.e., operate ourselves) the data management process. This need became particularly poignant when other agencies and groups managing the data base could not accommodate our scheduling needs.

Conclusion

Our experiences over the last year have left us with some strong convictions regarding the accessibility and use of nationally available data for postsecondary education research and analysis. First, there is a substantial national resource in the form of existing surveys and data files which are publicly available. Partially because of its expanse, and partially because of its diversity, this national resource is essentially undeveloped, although several recent efforts show considerable promise.

Second, and related to the first observation, our continual need of knowing what information is available, where it is available, and so on, suggests the evolving need for information clearinghouses--attempts to summarize the availability of information in one place for use by postsecondary education analysts. We support this type of activity, and urge that more attention be given toward documenting information that is already available.

Finally, we have not been unable to identify any one mechanism for data dissemination and access which seems appropriate in all situations. On the contrary, within a one-year time period, we have experimented with at least five mechanisms, and are still refining a suitable process for our own investigations. We suspect that other researchers will witness continually changing requirements for dissemination and access in their own settings.

THE NATIONAL POSTSECONDARY EDUCATION DATABASE
A PROGRESS REPORT ON ITS SCOPE AND USES

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State agencies, research centers and colleges have been using the national statistical databases of the National Center for Education Statistics -- EDSTAT -- and the National Education Data Library. This paper describes the methods of terminal access, the characteristics of the computer software, the extent of the database, the comparative user costs, and the experiences of the users. Current data, low cost access, and the ability to develop logically complex queries have made these database access and retrieval systems a useful tool for research, program monitoring and planning. New sources of data, reduced costs of operation, and ability to install the databases locally suggest major increases in use of statistical databases in the future.

Over the years, colleges and universities have been overwhelmed with demands for reports on institutional resources and activities while at the same time state and federal government policy makers have complained about the lack of timely and useful information with which to make educational decisions. In the case of federal surveys, the long lead time required to compile reports once the data have been collected has frustrated timely responsiveness to Congress and the education community.

At the CAUSE conference in 1973, a presentation by staff of the National Commission on the Financing of Postsecondary Education reported the development of a postsecondary education database that incorporated federal surveys previously unavailable in machine readable form for practical use. The Commission's database efforts enabled them and later researchers to gain a handle on the large federal survey datafiles as the HEGIS surveys which with computer assistance for the first time could be readily accessed, manipulated and studied.

During the year that followed the Commission's initial development of the database, former Commission members and staff expressed concern for maintaining the currency of the database and access to its data by government analysts and researchers at a reasonable cost. Out of this concern emerged the National Education Data Library, a non-profit organization supported by users, government contracts and the Lilly Endowment.

The Data Library has assumed responsibility for adding to the national postsecondary education database as new surveys are conducted to provide users access to the most currently available sources of machine readable data. Users are afforded access either by ordering magnetic tape copies of databases or by participating in the Data Library's on-line, interactive database system maintained at the University of Illinois. By these means, the Data Library intends to advance the use of machine readable databases in research and program management and policy review by all interested private and public entities.

Databases most often in use since the Data Library began operation include the surveys sponsored by the National Center for Education Statistics and the U.S. Office of Education. NCES sponsors the Higher Education General Information Survey, now in its tenth year and with the cooperation of more than 3000 postsecondary institutions. The Office of Education's most popular survey to date is the Fiscal Operations Report for federal institution-based student aid programs: National Direct Student Loan, Supplemental Educational Opportunity Grant and College Work-Study programs.

New databases continue to come to the attention of the Data Library and will be passed along to researchers interested in studying the spectrum of postsecondary education issues. This broad spectrum of new sources comes as no surprise to those persons at the colleges and schools who have responsibility for responding to the ever increasing volume of surveys and requests for information. However, researchers both public and private typically are unaware of the scope of information already collected that could be utilized in place of initiating yet another survey. An effect then of the Data Library's efforts will be to focus more attention on information already available but previously inaccessable.

The Data Library has published one catalogue which attempted to inventory the available postsecondary education databases stored in machine readable form. Rather than serving as the definitive work on education database sources, the catalogue focused attention for the first time on the concept of a library of machine readable information which in the ensuing months elicited many more sources from persons familiar with a particular database.

NEDL DATABASE ATTRIBUTES

A NEDL database has three major components. These are the data structure, the database defines, and the database directory. The database defines apply mneumonics to the physical locations of data components on the tape or disk. The computer retrieves the component and prints the column heading and the requested element. The user gives the mneumonic to retrieve a data component which is translated into a relative location for the computer; and proscribes a column heading to describe the column in which the data component is reported.

The database directory is a catalogue of the data element menumonics, or component names, brief component descriptions or definitions, a representation of the column heading, the relative physical location of the component and edit characteristics for the component (e.g., preceding dollar sign, commas, number of decimal places, leading zeros, and whether a total or average is to be generated for each data component at the conclusion of the report.

Figure 1 is taken from a NEDL database directory for the HEGIS Finance Report for Fiscal Year 1974.

Illustrations of database retrieval and manipulations are presented in Figures 2 through 5. Figure 2 reports student aid fund balances at year's end as provided in the Fiscal Operations Report. The FICE Code serves as a key or unique identifier to specify Stanford University. The user, once discovering some unspent funds, follows with a query to report the same data components as previously specified. This time, instead of specifying any particular college, records with component values exceeding particular values are called upon.

An arithmetic calculation is specified in Figure 3. A new component is reported that does not exist in the database by dividing one component by another. Type represents colleges with graduate programs and control refers to public or private governance. A similar group of privately controlled colleges is requested in Figure 4 without repeating the component names.

A series of calculations are performed in Figure 5 to generate a report on the parental income of student aid recipients. A summary follows.

Figure 1

DATABASE DIRECTORY

COMPONENT NAME	COMPONENT DESCRIPTION	OUTPUT HEADING	FORMAT
R4EGTUI C# 31	EDUCATIONAL AND GENERAL REVENUES - STUDENT TUITION AND FEES	FISCAL-74 ED & GEN REV TUITION	150-159 10, 0 N$CT
R4EGAPP C# 32	EDUCATIONAL AND GENERAL REVENUES - TOTAL GOVERNMENTAL APPROPRIATIONS	FISCAL-74 ED & GEN REV GOV APP	160-169 10, 0 N$CT
R4EGAFG C# 33	EDUCATIONAL AND GENERAL REVENUES - GOVERNMENTAL APPROPRIATIONS, FEDERAL GOVERNMENT	FISCAL-74 ED & GEN REV FED APP	170-179 10, 0 N$CT

Figure 2

STUDENT AID FUND BALANCES

```
NEXT:
PRINT FICE INSTNAME NSL4CASH74 EOG4UNUSED CWS4UNUSED WH FICE EQ 1305
       80 COLUMNS NEEDED          (F/S/T/#)?
1
  INST           INSTITUTION                NDSL 1973-74   SEOG 1973-74   CW-S 1973-74
  FICE               NAME                   CASH ON HAND    UNEXPENDED       FEDERAL
  CODE                                        6-30-74        BALANCE       UNEXPENDED

   1305 STANFORD UNIVERSITY                       $28,328        $16,231

                                                  $28,328        $16,231              $0

      144 RECORDS READ
        1 RECORDS QUALIFY


NEXT:
PRINT FICE INSTNAME NSL4CASH74 EOG4UNUSED CWS4UNUSED WH NSL4CASH74 GT 100000 $$
$$
OR CWS4UNUSED GT 20000 OR EOG4UNUSED GT 25000
       80 COLUMNS NEEDED          (F/S/T/#)?
F
  INST           INSTITUTION                NDSL 1973-74   SEOG 1973-74   CW-S 1973-74
  FICE               NAME                   CASH ON HAND    UNEXPENDED       FEDERAL
  CODE                                        6-30-74        BALANCE       UNEXPENDED

   1122 BIOLA COLLEGE                            $108,518         $1,159         $10,313
   1137 FULLERTON STATE UNIV                     $117,637        $18,633         $52,938
   1138 HAYWARD STATE UNIV                       $276,947       $248,149         $73,197
   1139 LONG BEACH STATE UNIV                    $200,915         $8,807         $51,548
   1140 LOS ANGELES STATE UNIV                   $127,313        $17,072         $51,503
   1141 DOMINGUEZ HILLS ST COLL                  $106,211        $46,485        $101,269
   1142 SAN BERNARDINO STATE COLL                 $10,526             $0         $27,916
   1144 CAL POLY ST UNIV-POMONA                   $35,350        $28,142         $52,625
   1146 CHICO STATE UNIV                         $108,962        $47,215
   1147 FRESNO STATE UNIV                        $275,534        $42,519         $11,997
   1150 SACREMENTO STATE UNIV                    $130,981        $12,911          $2,533
   1151 SAN DIEGO STATE UNIV                     $388,398        $31,941        $180,548
   1153 NORTHRIDGE STATE UNIV                    $147,806                        $68,958
   1154 SAN FRANCISCO STATE UNIV                  $53,901             $0         $57,099
   1155 SAN JOSE STATE UNIV                      $537,654         $5,965         $98,256
   1158 UNITED STATES INTERNATION                $165,574             $0         $12,586
 STOP
```

Figure 3

GENERATING AVERAGE AWARD

BY ARITHMETIC COMPUTATION

```
NEXT:
PRINT FICE INSTNAME REC4ALLST REC4ALLAT 'FY.74 AVERAGE.AWARD PER.STUDENT' = $$
$$
REC4ALLAT / REC4ALLST WH TYPE EQ 1 AND CONTROL EQ 1
      81 COLUMNS NEEDED         (F/S/T/#)?
5
```

INST FICE CODE	INSTITUTION NAME	RECIPIENTS 1974 ALL PROGRAMS UNDUPL TOTAL	RECIPIENTS 1974 PROGRAMS AMOUNT TOTAL	FY.74 AVERAGE.AWARD PER.STUDENT
1312	UNIV OF CALIF-BERKELEY	3,663	$3,303,188	901.77
1313	UNIV OF CALIF-DAVIS	1,541	$1,314,934	853.30
1314	UNIV OF CALIF-IRVINE	1,203	$961,296	799.08
1315	UNIV OF CALIF-LOS ANGELES	5,079	$5,203,015	1,024.42
1316	UNIV OF CALIF-RIVERSIDE	733	$593,992	810.36

Figure 4

PREPARING SAME REPORT FOR DIFFERENT GROUP OF INSTITUTIONS

```
NEXT:
PRINT SAME WH CONTROL EQ 2 AND REC4ALLST GT 700
      81 COLUMNS NEEDED         (F/S/T/#)?
6
```

INST FICE CODE	INSTITUTION NAME	RECIPIENTS 1974 ALL PROGRAMS UNDUPL TOTAL	RECIPIENTS 1974 PROGRAMS AMOUNT TOTAL	FY.74 AVERAGE.AWARD PER.STUDENT
1158	UNITED STATES INTERNATION	716	$766,182	1,070.09
1305	STANFORD UNIVERSITY	1,250	$1,685,634	1,348.51
1328	UNIVERSITY OF SOUTHERN CA	3,870	$3,789,715	979.25
11649	LOYOLA MARYMOUNT UNIVERSI	787	$878,009	1,115.64
		6,623	$7,119,540	

```
278 RECORDS READ
  4 RECORDS QUALIFY
```

Figure 5

COMPUTING DISTRIBUTION

OF FAMILY INCOME

```
NEXT:
PRINT FICE INSTNAME 'PERCENT FAMILY.INCOME UNDER.$6000' = REC4TOTS15 + REC4TOTS45 / REC4ALLST $$
$$
'PERCENT FAMILY.INCOME $6000-$12000' = REC4TOTS45 + REC4TOTS67 + REC4TOTS100 / REC4ALLST $$
$$
'PERCENT FAMILY.INCOME OVER.$12000" = REC4TOTS120 / REC4TOT!!!ALLST $$
$$
'PERCENT INDEPENDENT STUDENTS' = REC4TOTSIND / REC4ALLST $$
$$
'PERCENT GRADUATE STUDENTS' = REC4TOTSGR / REC4ALLST WH TYPE EQ 1 AND CONTROL EQ 1
      98 COLUMNS NEEDED        (F/S/T/#)?
S
```

INST FICE CODE	INSTITUTION NAME	PERCENT FAMILY.INCOME UNDER.$6000	PERCENT FAMILY.INCOME $6000-$12000	PERCENT FAMILY.INCOME OVER.$12000	PERCENT INDEPENDENT STUDENTS	PERCENT GRADUATE STUDENTS
1312	UNIV OF CALIF-BERKELEY	0.17	0.21	0.06	0.37	0.24
1313	UNIV OF CALIF-DAVIS	0.14	0.26	0.05	0.31	0.27
1314	UNIV OF CALIF-IRVINE	0.17	0.35	0.14	0.31	0.07
1315	UNIV OF CALIF-LOS ANGELES	0.22	0.40	0.05	0.24	0.17
1316	UNIV OF CALIF-RIVERSIDE	0.16	0.23	0.03	0.48	0.15
1317	UNIV OF CALIF-SAN DIEGO	0.21	0.40	0.11	0.33	0.03
1319	UNIV OF CALIF SAN FRAN MD	0.10	0.14	0.08	0.00	0.69
1320	UNIV OF CALIF-SANTA BARB	0.19	0.36	0.19	0.15	0.15

	PERCENT FAMILY.INCOME UNDER.$6000	PERCENT FAMILY.INCOME $6000-$12000	PERCENT FAMILY.INCOME OVER.$12000	PERCENT INDEPENDENT STUDENTS	PERCENT GRADUATE STUDENTS
TOT	1.35	2.36	0.71	2.19	1.78
AVG	0.17	0.29	0.09	0.27	0.22
STD	0.03	0.09	0.05	0.14	0.19
MAX	0.22	0.40	0.19	0.48	0.69
MIN	0.10	0.14	0.03	0.00	0.03
CNT	8.00	8.00	8.00	8.00	8.00
CZR	0.00	0.00	0.00	1.00	0.00

```
278 RECORDS READ
  8 RECORDS QUALIFY
```

Users have access to the database by ordering magnetic tape copies of databases or through the Data Library's on-line interactive database maintained at the University of Illinois computer facility. Users with a telephone and a terminal can dial the database to conduct interactive sessions with enrollment, finance, student aid or other portions of the database.

The Data Library recognized from the outset that many potential users in state and federal agencies, administrators in colleges and researchers could only be reached by offering a non-technical, readily understood command language for terminal users.

The interactive database access and retrieval language employed by the National Education Data Library and many states using the national database at their own computer facilities is geared for the user who needs the computer's power to organize and manipulate large databases quickly and efficiently, but who lack any familiarity with computers or programming. Staff analysts with basic typing skills have been trained to use the basic capabilities of the software at terminals in an interactive mode in about sixty minutes.

These capabilities include retrieving data on a single institution or combination of institutions, selecting colleges based upon one or more data element values, performing arithmetic calculations and creating new data elements on line to report the result of the manipulations, and other requirements to use data in monitoring programs, research, and policy analysis.

The command language's syntax and applications will be illustrated below.

To describe the scope and limitations of the data collected and available in machine readable form, some examples will be given to introduce the concept of national postsecondary education database and some of its uses. It should be noted again that while the Data Library has cooperated with a wide variety of data users and has prepared some computer generated reports, the Data Library is not interested in taking positions on policy issues or in conducting research that includes judgments on the data.

RESEARCH USE: STUDY OF INSTITUTIONAL DEMISE

One research team was interested in collecting and studying information on institutions that are no longer operating or have merged with other institutions. In the case of schools no longer active, it is not possible to prepare a survey instrument, mail it to the college president or institutional research officer and expect a detailed accurate response. Instead, there is no longer a mailing address or anyone responsible for the welfare of the school. Hence, it is necessary to rely upon archives or other means of accessing data. HEGIS reports and OE surveys were determined to provide a means of bringing together comparable information on a large group of schools no longer in existence. A series of data elements were specified to describe the business and financial operations of the school, their enrollments, facilities, and programs.

Figure 6

LIBERAL ARTS COLLEGES

REVENUE SOURCES

INST FICE CODE	INSTITUTION NAME	FISCAL-74 ED & GEN REV TOTAL	FISCAL-74 ED & GEN REV TUITION	FISCAL-74 ED & GEN REV GOV APP
01634	AURORA COLLEGE	$2,123,839	$1,436,854	$71,800
01635	BARAT COLLEGE	$1,487,861	$1,063,324	$50,000
01639	BLACKBURN COLLEGE	$1,394,869	$866,663	$51,963
01663	SPERTUS COLLEGE JUDAICA	$767,268	$65,000	$21,560
01664	SAINT FRANCIS,COLLEGE OF	$1,626,595	$1,239,983	$85,272
01665	COLUMBIA COLLEGE	$1,735,785	$1,597,895	$70,400
01670	DELOURDES COLLEGE	$146,433	$60,130	
01676	ELMHURST COLLEGE	$4,428,327	$4,055,362	$86,288
01678	EUREKA COLLEGE	$1,341,613	$787,782	$57,000
01683	GEORGE WILLIAMS COLLEGE	$2,973,613	$1,773,286	$116,900
01684	GREENVILLE COLLEGE	$1,950,444	$1,418,295	$102,530
01685	HEBREW THEOL COLLEGE	$754,285	$200,985	
01688	ILLINOIS COLLEGE	$1,439,288	$1,084,003	$74,400
01700	JUDSON COLLEGE	$1,364,374	$662,290	$62,353
01704	KNOX COLLEGE	$5,161,927	$3,890,676	$113,300
01706	LAKE FOREST COLLEGE	$4,533,727	$3,113,603	$41,100
01717	MACMURRAY COLLEGE	$2,676,263	$2,039,257	$218,980
01722	MCKENDREE COLLEGE	$1,591,770	$1,197,805	$82,003

Figure 7

DEFUNCT COLLEGES

TUITION AS PERCENT OF REVENUES

INSTITUTION NAME	REVENUES,FY70 RATIO,OF TUI&FEES,TO,TOT
MARYMOUNT COLLEGE	0,68
SAN DIEGO C FOR WOMEN	0,65
DUNBARTON C OF HOLY CROSS	0,81
COLLEGE OF ORLANDO	0,89
NORMAN COLLEGE	0,46
CHURCH COLLEGE OF HAWAII	0,18
MAUNA OLU COLLEGE OF MAUI	0,49
MARYKNOLL COLLEGE	0,25
PESTALOZZI FROEBEL TCHR C	0,96
SAINT DOMINIC COLLEGE	0,07
TOLENTINE COLLEGE	0,07
MIDWESTERN COLLEGE	0,68
PARSONS COLLEGE	0,79
COLLEGE OF EMPORIA	0,97

A series of reports were generated for fifty-nine institutions in the study group providing information on the source of revenues, categories of expenditures, endowments, debts, and assets of the colleges in the realm of financial information, and on enrollments by level and over time using the HEGIS Opening Fall enrollment report. The reports covered Fiscal Years 1970, 1971, 1972, 1973 and 1974, the years in which many small private liberal arts colleges came to their demise. The continuity of data with consistent data definitions afforded the researchers the capability to conduct trend analysis on each individual college and on the composite group of schools.

A control group of liberal arts colleges still in operation was then selected. Twenty variables and ratios were selected and generated for each of the five years. The control group's characteristics could be compared with the similarly sized and financed schools in the study group to conduct an analysis of the similarities and differences to possibly reveal some insights into why some schools were not able to continue to operate, while others have sustained enrollments and a satisfactory financial position.

The researchers in this example had already determined which variables were important to their work. They were familiar with the HEGIS reports, and the institutions in their study.

THE IN-AND-OUT USER: PREPARING CONGRESSIONAL TESTIMONY

Frequently, someone very knowledgable in a postsecondary field will approach the Data Library with an interest in exploring the database but lack a direction as to what kinds of information can be exploited. The administrator of a state student aid loan program was concerned with the default rate in Guaranteed Student Loans. The program was being compared unfavorably with the institution-based National Direct Student Loan program. She was interested in learning more about the repayment activity in the NDSL program at schools in her state to determine whether there were significant differences in study repayments of NDSL at a given school in comparison with repayments of GSL at the same school. The logistics involved in seeking the cooperation of all the schools in her state or eliciting a response from the Office of Education to send copies of all the institution reports on repayment information was too burdensome to consider undertaking the inquiry. However, she was contacted by a legislative staff person who was aware of the Data Library and learned that four years of institution reports on federal student aid programs was maintained in machine readable form.

The first step was to select on the colleges in her state. Then, the database directories were reviewed to identify possible data elements that would indicate the level of loan activity and the repayment of loans. While various studies characterized the NDSL program as having a minute non-repayment loan rate, she began to unravel a rather different set of circumstances. Previous reports utilized only two or three data elements, total amount lent and amount delinquent in repayment. While the Congress was interested in loan principal and other combinations of data elements, she set out to experiment with other data elements and tabulations based upon subsets of the state and national database. For example, selective schools in many instances have fewer students repaying their loans on schedule than many of the regional state colleges. A clear trend emerged that as the average amount of loan principal held by students at a school increased, the percentage of accounts and principal past due and delinquent also increased. She compiled her findings into a series of reports on repayment activity that listed every school in the country and submitted the voluminous material as testimony to a Congressional committee. Committee staff commented that never before had they been able to receive the information she submitted in terms of the scope of information and the detail available, broken down by individual states as well as national totals for over 2000 institutions. While her reports on student loan repayments required several hundred pages, access to information on a single school was made readily available. Schools and colleges were organized by state so that Congresspersons and their staff could examine schools in their own districts and regions. Summaries by state provided further insight to the reports.

Figure 8 was taken from the reports.

Figure 8

NATIONAL DIRECT STUDENT LOAN ACTIVITY

PRINCIPAL AMOUNT FOR TOTAL LOANED, RETIRED, INACTIVE,

OUTSTANDING ON SCHEDULE AND OUTSTANDING PAST DUE

INST FICE CODE	INSTITUTION NAME	NDSL CUM TO 74 ALL BORROWERS TOTAL AMT LENT	NDSL CUM TO 74 LOANS RETIRED AMT LENT	NDSL CUM TO 74 NOT REPAY STAT PRINC OUTSTNDG	NDSL CUM TO 74 REPAY ON SCHED PRINC OUTSTNDG	NDSL 74 PASTD TOTAL PRINC OUTSTND
3210	OREGON STATE UNIVERSITY	$9,569,960	$75,604	$3,395,813	$2,578,832	$961,61
3211	OREGON INST OF TECH	$1,462,245	$170,836	$472,666	$336,841	$63,28
3212	PACIFIC UNIVERSITY	$1,268,583	$116,332	$283,429	$251,349	$373,31
3213	PORTLAND COMMUNITY COLLEG	$608,298	$18,755	$239,584	$143,089	$95,66
3216	PORTLAND STATE UNIVERSITY	$3,495,205	$464,921	$1,550,329	$274,129	$730,87
3217	REED COLLEGE	$77,975		$77,975		
3218	CHEMEKETA COMMUNITY COLLE	$382,689	$33,269	$221,812	$54,080	$53,90
3219	SOUTHERN OREGON COLLEGE	$2,883,521	$359,085	$1,397,007	$520,982	$114,21
3220	SOUTHWESTERN OREGON COMMU	$153,674	$12,839	$56,704	$7,197	$64,98
3221	TREASURE VALLEY COMMUNITY	$425,466	$37,022	$28,077	$74,310	$197,63
3222	UMPQUA COMMUNITY COLLEGE	$141,113	$11,719	$66,864	$13,966	$36,36
3223	UNIVERSITY OF OREGON	$9,720,327	$1,299,358	$2,359,753	$1,598,339	$2,640,10
3224	UNIVERSITY OF PORTLAND	$1,814,622	$244,512	$550,807	$442,095	$110,59

THE POSTSECONDARY EDUCATION COMMISSION: EXPERIENCES AND CAPABILITIES

Another state postsecondary education commission has established its own database system with Data Library tapes using a private computer facility located 70 miles away from the state capitol. By using state lease lines, the cost for telecommunications is insignificant. The private computer facility afforded a simple price algorithm with three cost components in contrast to the state pricing scheme which filled a page with its formulas. In addition, costs have averaged $10 to $15 per hour depending upon the complexity of the calculations and the nature of the effort. The Commission has employed their database for legislative directed studies on the financing of community colleges and the characteristics of student aid recipients in public and private colleges.

The large number of institutions in the state and the reluctance to burden the colleges with additional studies led to discovery of the Fiscal Operations Report as a resource for information on the sex, civil rights category, and family income of student aid recipients and information on the repayment of student loans. While the information related to federal programs, it was decided that institutional use of federal funds was important in determining the need for additional state student aid appropriations.

Taking the most recent year's financial aid report, more than one hundred institutions were divided into six groups. A series of reports were generated for each group. The groups included three public sectors and three private sectors. Not only could individual institutions be identified for scrutiny, but each of the six groups could be compared with any of the other groups; also, a single institution could have its information compared with the averages and distribution for the subpopulation of like institutions.

For example, the parental income distribution of public college student aid recipients could be compared with the distribution of parental income for the private colleges, as shown in Figure 9. Issues in the debate over whether middle income students were favored over lower income students in the public and private sectors could be studied with the additional information not earlier known or available.

The Commission pays on the basis of a simple price structure that includes $1.50 for each Logon to the computer facility using IBM's TSO. A charge of $3.50 for a terminal hour and 25 cents for a CPU second on an IBM 370/158 computer. Costs to date for the database system of the Commission have averaged between ten and fifteen dollars per terminal hour.

DATABASE EXPENSES

Terminal session costs vary according to the expertise of the user, the pricing system of the computer facility used in relation to the types of reports and analysis undertaken. Some computer facilities at major research universities penalize users who emphasize large reports using large databases with relatively little CPU usage. Business facilities for the most part place a more even balance on CPU and

Figure 9

PARENTAL INCOME DISTRIBUTION

FOR STUDENT AID RECIPIENTS

AT PUBLIC AND PRIVATE COLLEGES

INSTITUTION NAME	FEDERAL.AID.74 PERCENT UNDER.$3000	FEDERAL.AID.74 PERCENT $3000-$5999	FEDERAL.AID.74 PERCENT $6000-$7499	FEDERAL.AID.74 PERCENT $7500-$8999	FEDERAL.AID.74 PERCENT $9000-$11999
UNIV OF CALIF-BERKELEY	0.05	0.12	0.03	0.06	0.06
UNIV OF CALIF-DAVIS	0.04	0.11	0.07	0.07	0.09
UNIV OF CALIF-IRVINE	0.04	0.13	0.10	0.09	0.13
UNIV OF CALIF-LOS ANGELES	0.05	0.17	0.10	0.10	0.13
UNIV OF CALIF-RIVERSIDE	0.04	0.11	0.07	0.07	0.05
UNIV OF CALIF-SAN DIEGO	0.05	0.16	0.09	0.09	0.15
UNIV OF CALIF SAN FRAN MD	0.06	0.04	0.06	0.03	0.04
UNIV OF CALIF-SANTA BARB	0.06	0.13	0.09	0.09	0.13

INSTITUTION NAME	FEDERAL.AID.74 PERCENT UNDER.$3000	FEDERAL.AID.74 PERCENT $3000-$5999	FEDERAL.AID.74 PERCENT $6000-$7499	FEDERAL.AID.74 PERCENT $7500-$8999	FEDERAL.AID.74 PERCENT $9000-$11999
BETHANY BIBLE COLLEGE	0.06	0.09	0.08	0.06	0.15
BIOLA COLLEGE	0.13	0.19	0.12	0.15	0.20
CALIFORNIA BAPTIST COLLEG	0.08	0.10	0.04	0.13	0.09
UNITED STATES INTERNATION	0.15	0.34	0.33	0.14	0.12
CLAREMONT MEN'S COLLEGE	0.07	0.24	0.18	0.12	0.21
HARVEY MUDD COLLEGE	0.14	0.33	0.31	0.22	0.28
PITZER COLLEGE	0.13	0.27	0.08	0.12	0.16
POMONA COLLEGE	0.10	0.35	0.15	0.16	0.20
SCRIPPS COLLEGE	0.06	0.11	0.08	0.07	0.17
MARYMOUNT COLLEGE-LOS ANG	0.02	0.15	0.12	0.12	0.24
MENLO COLLEGE	0.33	0.11	[illegible]	0.00	0.11
PACIFIC CHRISTIAN COLLEGE	0.08	0.26	[illegible]	0.18	0.20
PACIFIC COLLEGE OF FRESNO	0.09	0.12	0.11	0.07	0.19
SAN JOSE BIBLE COLLEGE	0.17	0.43	0.09	0.04	0.04
SOUTHERN CALIFORNIA COLLE	0.12	0.20	0.09	0.11	0.27
WESTMONT COLLEGE	0.08	0.14	0.29	0.25	0.19

Input/Output. The user who has prepared his session in advance, written out all of his/her commands, is a skilled typist and has a virtually dedicated machine with fast turnaround, can increase the cost of the terminal session several times. Using the same facility as the National Commission on the Financing of Postsecondary Education, where costs averaged $30 per hour by staff versed in the data and system, one user generated an average cost in excess of $70 per terminal hour by working during a period of low utilization which afforded rapid turnaround and having prepared the session in advance.

A more accurate reflection of costs in using the national postsecondary education database is the cost for preparing a report, or a series of retrievals and analyses.

Typical costs average less than one dollar for a report that includes from one to ten institutions and three to five data elements. The cost of Figures 2 through 5 was less than three dollars at a commercial computer facility using TSO. Costs will increase when institutions on a report are selected on the basis of a data element value or range--which requires additional search procedures.

Users can be classified according to those who utilize the on-line capabilities of the database and those who have their own copies of database files and conduct their work in the batch mode either with database software, statistical packages or specially prepared programs.

On-line users are typically interested in identifying a single institution or small group of schools. A single retrieval that includes four or five data elements on from one to ten institutions will cost less than a dollar.

Users interested in printing large reports will either submit their jobs in a batch or when using a terminal turn on an off-line printer to expedite the printing operation. Printing long reports on-line will increase connect time and adversely affect costs.

Users who rely upon batch processing cannot lose the advantages of interactive processing afforded by the terminal link-up. Many times one query will lead to another, revealing unexpected findings. Spontaneity is reinforced and immediate follow up is made possible when the user has the Data Library's on-line interactive database retrieval and analysis system at his or her disposal. However, users who conducted terminal sessions and developed large report queries find that batch processing is a valuable supplement. Exclusive batch processing is most practical when sheer data extraction is needed for a large group of colleges and schools.

More advanced statistical operations than are possible with a user-oriented system can also be conducted by those who maintain their own copies of NEDL databases. Demand for tape copies of NEDL database originate with researchers conducting large-scale studies.

Frequent database users have found advantages to installing the national database or portions at their own computer facility in combination with NEDL-supported software or other retrieval and statistical packages. Where the local facility supports an interactive language, TSO or CMS, the user can continue to conduct inquiries on-line. Other users rely upon batch processing using the NEDL-type software or a statistical package. A local database can be streamlined to meet the specifications of the user. Several years data can be maintained for only those institutions or states desired for analytical and monitoring purposes. Creating subsets of the database is a straightforward task requiring only a simple utility program to select institutional records based upon state, size, some financial characteristics, public or private, or highest degree awarded.

Private computer facilities can be utilized by state agencies and institutions that do not themselves support TSO or CMS or a similar telecommunications capability. The costs from these facilities can be comparable to NEDL charges. Advantages include the capability to change values for data elements, or to add additional information as several states and researchers have done.

A REGIONAL DATABASE

In Nebraska, the state computing facility charges only a monthly fee for a port and breakeven charge for data storage. The database has been used to date by the staff of the state 1202 commission, the legislative fiscal office, the community college board and the University of Nebraska. The Commission is responsible for maintaining the database, supports information not only on all colleges in Nebraska, but also from the surrounding states popularly described as the "Big Eight." The Commission reasons that maintaining information on similar schools in states recognized as having similar financial and educational objectives helps in understanding what new directions are emerging in enrollments and financing postsecondary education. The comparisons with surrounding states can include the same level of detail as is afforded on Nebraska institutions by utilizing the federally collected information.

The only additional cost involved is for disk storage, which amounts to about $40 per month for the Big Eight states other than Nebraska. In all, the Nebraska 1202 Commission database includes over four hundred institutions with five years of data on enrollments and finances and three years on student financial aid programs. The Commission is currently involved in collecting directly from Nebraska institutions the most recent years HEGIS and OE reports to update their database in advance of the federally prepared tapes. The Commission figures that from six months to a year will be saved by conducting the data conversion themselves and that information on the Big Eight states can be added when the National Education Data Library makes new tapes available. Plans of the Commission also include utilizing the institutions Tripartite application for student financial aid and the Fiscal Operations Report as the basis for allocation of federal State Student Incentive Grants dollars. Utilizing the federal OE reports avoids requiring a separate form from the institutions and permits the institutions to be evaluated on an equal footing.

The total cost of the database amounts to $220 per month for the computer port which is shared with other state agencies interested in utilizing the database and another $50 per month for on-line storage of Big Eight state data. The costs per terminal hour and report are therefore inversely related to the amount of use. For twenty-five hours use per month by the combined state agencies, the cost averages to $11 per terminal connect hour. Obviously, as utilization increases, the average cost will go down.

NATIONAL DATABASE EXPERIENCES

Persons using the national database typically will categorize the 3000 plus institutions according to one or more characteristics, including size, public or private control, highest degree awarded, state, region or some other combination of demographic data elements. The Carnegie Classification is a taxonomy prepared by the Carnegie Council on Policy Studies that recognized some aspects of quality, as well as highest degree to categorizing postsecondary institutions. While the federal tapes do not provide the Carnegie code, the Data Library adds the Carncode to the databases to facilitate comparative analysis by users.

Users of the national database find that response time varies according to the time of day. Users on the East Coast have a relative advantage in the morning hours, and West Coast users find the afternoon to their advantage, after East Coast competition has left the office. Telecommunications have not dealt with any noticeable frustrations, although an occasional transmission error is inevitable when cross-country phone calls are conducted.

COMPUTER TERMINALS FOR INTERACTIVE DATABASE RETRIEVAL AND ANALYSIS

Computer terminals are as varied as the number of manufacturers. The shapes, styles and options indicate that terminals are no longer in the realm of scientific machinery but can be classified as another consumer item with final decision hinging upon color, type style, paper stock and other cosmetic differences.

The basic terminal provides a 30 character per second print speed, and costs about $100 to $150 per month to lease. Portable models generally have eighty character print lines while desk top or free standing terminals will have 132 character widths and can use ordinary computer paper stock rather than heat-sensitive treated paper.

Voice grade telephone lines permit transmission of much faster speeds than 30 characters per second (CPS), the equivalent of 300 words per minutes. Newer terminals can be operated at 60 and 120 characters per second, or 600 and 1200 words per minute. The faster speeds reduce the time required to print reports, thus reducing the connect time for a report, a principal cost component in most pricing schemes. However, not many computer facilities accomodate 60 CPS or faster terminal transmissions. Public and private computer facilities that are currently in use for database systems primarily support the 30 CPS terminals with some still supporting the 15 CPS speeds of the older teletype terminals.

EMERGING TRENDS IN DATABASE USES

As more state agencies rely upon the federally collected information rather than conducting parallel surveys of state institutions, concerns for the exactness of comparisons that can be made have evolved. Many of the definitions in the HEGIS reports lack a definite clarity, permitting institutions to substitute their own conventions and interpretations. While at the national level, these differences are less important than the capability to extract data on such a breadth of colleges, states that make appropriation decisions to individual schools tend to be more interested in the precision of comparison that can be undertaken. This has led some states to issue their own definitions for those federal surveys that afford some ambiguity. For example, in the Opening Fall Enrollment survey, the tenth day of the term is used by all schools in one state responding to HEGIS and other surveys. This permits the state to extract that information needed for state concerns directly from the federal report knowing that state standards are followed in the federal reporting.

Concern has also been expressed by some users that questions on the surveys have been prepared in a policy vacuum. Changing needs may not be readily incorporated into the surveys, and data elements originated several years ago may continue although no use may have ever been made or any yet anticipated. Some of these shortcomings stem from the past inability to access the data after collected. National reports based upon HEGIS data often took two or more years to generate. By the time the report was prepared, the major policy

policy questions had already been tackled and resolved. The lack of capability to respond in a short period of time to new policy questions led the National Commission on the Financing of Postsecondary Education to develop the database originally. The HEGIS reports have still found important use by states interested in historical data and comparisons for state budgetary decisions.

In one state, a major study of state support for postsecondary education focused upon the relative support provided by surrounding states. Both the governor's office and the university in the state utilize an on-line database supported by data from the National Education Data Library.

In another state, the Board of Higher Education prepared a study on the financial status of the private colleges using an on-line database. The report incorporated trend analysis using historical HEGIS files in the detailed study.

With the availability of on-line inquiry into the national database at the present time and the increased used by public and private researchers and program monitors, increased sophistication is evolving in determining what data elements are needed now and in the future in the federal surveys. State influence in preparing some of the federally-sponsored survey questions can reduce the need for parallel and redundant surveys. Concern for the timeliness and relevance of the HEGIS surveys has recently been expressed in a teleconference sponsored by the Lilly Endowment and the Institute for the Future.

The transition of federal surveys from federal archives to a source of on-line, up to the minute, information has been the objective and will continue to be the mission of the National Education Data Library and its users.

APPRAISING THE EFFECTIVENESS OF ADMINISTRATIVE OPERATIONS IN COLLEGES AND UNIVERSITIES

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This paper is based on a study of the operations and effectiveness of the University of California's Quality of Management Program. The QMP is a permanent, systematic, cyclical process of review of administrative operations. The program has been conducted for the past three years by each of the nine University campuses under a University-wide framework. Observations have been made of the effectiveness of techniques used at various campuses, and the processes and experiences that went into the conduct of the evaluations are described. The Guide assesses various techniques used in planning, conducting, implementing, and evaluating administrative appraisal reviews.

The concept of "management audit" or "operations audit" is well-known in private industry, government agencies, and the armed services. Objective appraisal of performance of systems and organizations has been regularly practiced in those sectors. This paper describes an adaptation of those techniques for use in colleges and universities, defines the objective and characteristics of the process, outlines the operations of the process, and discusses ways of adapting it to institutions of differing size.

This paper is based on a study, partially supported by a grant from the National Science Foundation, of the operations and effectiveness of the University of California's Quality of Management Program. The program has been conducted for the past three years by each of the nine University campuses under a Systemwide framework. Observations have been made of the effectiveness of techniques used at various campuses, and the processes and experiences that went into the conduct of operations. In April 1976, we will publish for general institutional use, a Guide which describes and assesses these techniques and experiences.

The Management Appraisal Process

MAP is a process to aid an institution objectively to appraise the effectiveness of its administrative operations and to improve them in a systematic manner. Its fundamental objective is to maximize scarce administrative resources to support learning, teaching and research.

Closely interwoven in the process is the concept of accountability. By this we mean holding somebody accountable for the results of operations, and for bringing about changes necessary to meet institutional objectives for the system or organization undergoing review. Performing management appraisal implies making judgements--judgements about worth and judgements about effectiveness. The very term "appraisal", according to Webster's, means "to give an expert judgement of the value or merit; to estimate; to evaluate."

If done correctly, MAP is also a constructive learning process. In the long-run cycle, practically all elements of the campus may be involved. Through the medium of examining the interfacing and interdependence of various campus systems and organizations, people are encouraged to replace parochial concerns with a campus-wide perspective. Managers are encouraged to engage in self-evaluations of their organizations and to measure the results of their operations.

What MAP Is Not

It is important to understand that the process outlined here is only one arrow in the quiver of a campus' overall appraisal and improvement effort. There is no intention that MAP diminish the role of such things as managerial training, auditing, or other assistance techniques. Organizational Development, Management by Objectives, policy studies, organizational studies, and methods and procedures work all have their places.

Characteristics of MAP

1. MAP is a permanent part of an institution's administrative process. It is designed to be carried on in a continuous, systematic, cyclical manner.

2. The institution is regarded as a system, and each function or organization as a sub-system. For purposes of carrying out effectiveness reviews, the campus is divided into systems, or functional areas.

It should be noted that the functioning of a given service, such as Accounting or Student Financial Aid, is heavily dependent on the administrative activities carried on in schools, academic departments, institutes and laboratories, as well as in the accounting office or financial aid office. It is intended that there be a review of the total function, wherever located, since so much depends upon the effectiveness of the interrelationships among the various organizational units.

3. MAP assumes objective appraisal of performance

--in an impartial manner by peers from a management perspective;

--in relation to the objectives of the system or functional area;

--to some sort of measuring standards;

--with a focus on operations, not people;

--involving judgement and measurement of results.

4. The institution requires action by line managers in response to review recommendations.

5. The institution is interested in and follows up on line managers' progress in bringing about the changes for improvement indicated in the review recommendations.

Campus Organization for MAP

No two campuses are expected to set up identical organizational structures. The number and size of organizational elements making up a MAP depends upon the following factors: size and complexity of the campus; the style of governance and management; the resources available to be devoted to MAP; and the range of objectives one hopes to achieve by appraising management operations.

A "typical" or "model" campus structure consists of the campus Chief Executive, a Steering Committee, a MAP Coordinator, MAP Staff, and ad hoc Review Teams.

The Steering Committee is the chief policy body for MAP and represents the overall campus interests. Among its duties are to select areas for review, approve recommendations made by review teams, and monitor remedial or improvement actions taken in response to recommendations. In effect, it is the embodiment of institutional "clout".

The MAP Coordinator is the principal official for MAP under the Chief Executive and is responsible for day-to-day operations. Generally also a member of the Steering Committee, the Coordinator assists in establishing priorities for reviews, organizes review teams, and keeps the Chief Executive advised of campus progress. This is additional duty for a campus-wide official of relatively high rank.

The MAP Staff may be part-time or full-time personnel, preferably with analytic experience. Usually attached to the MAP Coordinator's organization, they serve two principal functions: to provide administrative support to the Steering Committee and MAP Coordinator, and to provide continuity from review team to review team, since these are ad hoc.

A separate Review Team is organized for the review of each distinct management system, or functional area. It is responsible for reviewing operations, interviewing people, appraising the effectiveness of operations, and developing a written report assessing the degree to which the system or area is meeting its objectives, and making specific recommendations for change.

It should be noted that the basic responsibility for implementation rests with individual line managers and that MAP cannot substitute for this responsibility.

MAP Operations

1. Reviews. Management systems, or functional areas, or organizations are selected for review by the Steering Committee, usually in consultation with the MAP Coordinator and Staff. A schedule for the academic year is useful. The main input is from Steering Committee members and also from requests by line managers. The campus is reviewed in a progressive and cyclical manner, so that over a period of time the main administrative operations will be covered.

2. Review Teams. A team is organized ad hoc for a review.

The MAP Coordinator takes the lead in selecting the team, obtaining their agreement to serve, and securing a temporary release from their regular commitments. A team may consist of from two to seven members (including a MAP staff person) depending upon the projected scope ot the review. Teams represent a combination of managerial skill, technical expertise, and campus knowledge. A strong chairperson, selected with an eye for leadership ability, is a key to a successful review.

3. Guidelines. MAP provides an aid to the work of the review team in the form of questionnaires. Each review uses two questionnaires, the first designed to assist the team in appraising an organization's overall management, and the second directed at the particular functional area, for example, Accounting, Environmental Health and Safety, or Student Health Services. Team members use these to assemble pertinent information about the functional area and to guide their inquiries and observations.

Questions are of several types. Some are designed to highlight the effect of possible weaknesses, others to indicate causes of possible weaknesses. Some are included as very general indicators of good management practices. Still others attempt to lead to an appraisal of the area's service to the institution.

The questions serve only as a guide to the team. Responses can help them decide where they want to apply appraisal time and effort, but the final exercise of judgment must come from the team.

4. Report. The report is the fruit of the team's labor and represents their appraisal and judgment. Recommendations should be made in a clear and concise manner. The team may point to broad avenues to improve effectiveness, but detailed solutions are the line managers' province.

The team forwards its report to the Steering Committee, where it is reviewed. If it wishes, the Committee may confer with the team and line manager(s) before approving the recommendations and forwarding the report to the line manager(s) and their immediate supervisors for action.

5. Action. This is the pay-off for the whole effort. The line manager(s) together with the immediate superiors are responsible for devising a plan of action to implement the MAP report recommendations. This includes the establishment of performance targets to make the necessary changes recommended in the report. Also included is the rationale for any proposed non-action.

Assessing the potential effectiveness of the plan of action is the responsibility of the Steering Committee. They must insure that the plan satisfies the intent of the report findings and recommendations, and that a systematic course of action is proposed.

Once the Steering Committee has approved the plan of action, the committee is an important influence for follow-on. The manner in which this is carried out is not so important as the fact that it is done as a part of the institution's permanent management structure. It may be done informally, or some mechanism to assure results, for example, progress reports at stated intervals, may be established.

How Big a MAP?

The wide range of capabilities, resources and needs among institutions in general exists in microcosm among the nine campuses of the University of California System. They exhibit a wide variety in the scales of their operations and management styles: for example, Berkeley is over 100 years old, large in scale, (over 30,000 students) and fully ramified; Santa Cruz is a cluster of small residential colleges established in 1961 and now enrolling about 5000. Each has made an adaptation of the basic MAP model. The presence of these varied units within the UC System provided us an opportunity to observe problems of implementation in diverse settings.

The organization and instruments of analysis described here may be adapted by an institution to suit its size, resources, character, organization, and management style. Moreover, there is nothing to prevent an institutional subdivision, for example, a school of department, from organizing its own MAP.

Smaller institutions can tailor a MAP to their size and resources. One person can assume the duties of the Steering Committee. Functional areas can be divided into subsystems and the scope of the review narrowed, so that it may be performed by a two-to-three person team in a relatively short time. MAP staff functions can be assigned as additional duty to existing staff. Naturally, the institution's decision that it wants to establish a MAP and accord it a priority among existing resources is a prerequisite.

But Is It Cost-Effective?

There are some key decisions to be made before adopting MAP. A large measure of success depends upon releasing review team members from their regular duties periodically while the team is convened. The kind of people who should be assigned to review teams generally are in demand for other assignments as well. The institution certainly must address this problem of priorities.

While certain review results can clearly be equated with dollar savings, no one would hold out that quantifiable results are generally or always demonstrable. A survey of results thus far in the University of California shows that campuses have benefited significantly in a variety of ways--either in terms of actual dollar savings, better staff utilization, or increased service to the campus. Almost any administrative activity on a campus can benefit from a thoughtful, objective appraisal of its operations, with an eye toward improving the effectiveness of the overall allocation of resources.

EVOLUTION OF A MATERIEL MANAGEMENT INFORMATION SYSTEM

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These papers consist of a brief description of the information system as developed, and explore the experiences of the participants; first at the University of California Riverside Campus, who initiated the effort; subsequently adopted and revised by the Irvine Campus; and finally, the implementation and adoption experiences of the Los Angeles Campus. In addition, the Riverside Campus is now adopting the on-line capabilities which were built into the system for its use at the Irvine Campus. The success of the system and the flexibility which has made it easily useable and extremely useful at the several campuses is due in a large part to the cooperative planning and interaction, at all stages, between the systems designers and the materiel management users.

The University of California Irvine Campus, Materiel Management Department, faced with a 55% workload increase and only 1/2 FTE increase during the past five years, developed an automated purchase order information system to catch up and stay ahead of an ever increasing workload.

We reviewed many systems and decided on the U. C. Riverside Data Base. We designed and developed the system, on a step-by-step, day-by-day basis, by working with the many ordering departments and the action departments; such as, Purchasing, Expediting, Central Records, Receiving and Accounting. We also worked with the Office of the President of the University to assure acceptability of our system interfacing with their many report requirements.

This system furnishes substantial data to the ordering departments, Purchasing, Receiving, Expediting, Accounting and to management. To aid the ordering department, it furnishes the exact processing status of each requisition received by the Purchasing Department. This order status is instantly available on a remote terminal display screen in the department concerned, if they have one, and from a computer printout furnished to the department on a regular scheduled basis. This capability has eliminated many disruptive telephone calls to Purchasing.

This data also allows one to measure the efficiency, or lack of it, in the ordering departments, mail delivery service, Purchasing, Expediting, and the Receiving Department delivery service at any time. It immediately spotlights problem areas if there are any. An outline of the system as it eixsts follows:

Each department on campus is assigned a different block of purchase order numbers. The amount of numbers assigned is based on the size of the department and from past requisition history. They generate a requisition for supplies, equipment or services, assign to it one of their numbers in numerical sequence, date the requisition and send it to the Purchasing Department. When it is received in Purchasing, it is date and time stamped, assigned a buyer who is identified on the requisition by his telephone extension number; i.e., X6510. The requisition then goes to the input operator in Purchasing who feeds the primary data into the terminal.

The requisition is then forwarded to the assigned commodity buyer for processing. Each processed stage is fed into the data base by first entering the purchase order number; for example, if the items have to go out to bid, the printout will then indicate that the items are on a Request for Quotation and the date it is due back to the buyer. If the requisition requires special approvals; such as, Health & Safety, Buildings & Grounds, the Chancellor or a Vice President, it is also indicated and the dates entered.

When an order is released to the vendor, data is input into the system consisting of line items, accounting information, shipping information and vendor information, which is then available for use by any campus department. The system using a printing terminal in the in the Receiving Department, eliminated the maintaining and updating of a purchase order file in that location, and also eliminated a log listing the number of packages received, weight, carrier, freight bill number, vendor, and the filling-out of a load delivery document.

Now when delivery is received, the purchase order number is entered into the terminal, and a printout, on a three-part form, is generated with all the data that is on the purchase order, with the exception of cost information. The form has spaces provided in which to enter all the data required to generate our numerous reports, and also an area for any comments. Receiving personnel pull the packing slip, enter the data on all copies of the printout form, deliver the merchandise, have the receiving slip signed and returned to the terminal operator, where the data base is updated. If when Receiving enters the purchase order number and has received only a partial delivery, the delivery report will then indicate so and show the date the last item was received. This feature immediately indicates duplicate shipments, reduces confusion in the ordering departments and workload in Accounting. It also saves time in the Purchasing Department because all contacts with vendors are through the buyers.

The system has allowed the buyers to perform more purchasing duties with fewer inquiries. It has eliminated the purchase order control logs and the manual compiling of all management required reports. It eliminated the maintaining of a vendor file, and because it furnishes a daily expediting report, it has allowed us to reassign two persons to other duties. In the Receiving Department, it eliminated all manual filing and posting, allowing for reassignment of personnel.

A program has been developed which will eliminate all departmental processing of vendor invoices and will be implemented January 1, 1976.

The system, one and one-half years ago, allowed us to catch up with the almost 60% workload increase, and last year helped us process a 30% dollar increase with 2000 additional purchase actions. We committed almost $10,000,000.00, and were able to save almost $2,000,000.00, which is a good indication that the system is paying off for us.

The accounting system at the University of California is computerized as are all of the accounting functions of the University of California through one of two central data processing centers: one at Berkeley and one at Los Angeles. Once, purchase orders were processed daily to the Data Processing Center South for budgetary liening of orders against departmental accounts. Likewise, the invoices were batched three times weekly for transmission to Data Processing South where they were keypunched and entered into the data processing system. In both cases, the purchase orders and the invoices were massaged manually by the Purchasing Department and the Accounting Office, respectively. Invoice processing consisted of manually matching the invoice to the purchase order, sending one copy out to the department involved for their signature to indicate receipt of the goods, then rematching to the purchase order when it was returned to the Accounting Office, and batching for processing to Data Processing South. Cut off for each monthly period was approximately the 25th of the month and the computerized reports were generated by the Data Processing South and were in the hands of the departments on approximately the 12th of the following month. It does not take much calculation to determine that when the report was received, already some of the information in it was approaching six weeks old. The most up-to-date figures were approximately two weeks behind. As a result of all this, most of the departments used at least a portion of one Full Time Employee to manually keep a set of books on a more timely basis. In addition to this, systems used in the Purchasing Department and Accounting Office were also expensive, time-consuming and inefficient. Since, because of the needs of several functions within the Purchasing Department, three sets of logs were maintained to be able to report on the status at any given point of every requisition received in the office. One of these was the Purchasing Log which showed the status of the purchase order from receipt through release of the purchase order to the vendor. At this point, a second log picked up the status of the purchase order from release to the vendor through any expediting function that might be necessary to receipt of the goods by the Receiving Department. There, a third log was maintained to keep track of incoming shipments and after their receipt, their status through delivery to the department and, then, any returns which had to go back to the vendor, claims, et cetera. In addition to these three, a fourth log was kept in the Accounting Office from the time the purchase order was released by the Purchasing Department through payment of invoice for that phase.

All of this manual logging and entries to record status was expensive and we felt much of it could be better handled by other methods. In 1968, at the request of several of the departments on campus, a study was undertaken under the auspices of the Vice-Chancellor--Business and Finance to try and determine what could be done to improve the system. A committee was formed consisting largely of three key people and, assisting them, several selected members of their own staff. Their job was to consult with the various departments to determine what their needs were, to try to outline a more efficient program, and to program the implementation of any system developed. The key people involved in this study were the Assistant Vice-Chancellor--Business and Finance, Frank Bailey, who also was the Accounting Officer, the Computing Center Director, Jim Henshaw, and myself, the Campus Materiel Manager. By involving these three individuals, it was felt that such coordination assured that the system would, to the greatest extent possible, be responsive to the ideas and capabilities of the three principle administrative offices concerned with accounting activities.

After many hours of committee meetings, consultation with departments concerned, drafting and redrafting of plans, the departmental budget management system was devised. The entire system is generally referred to on the Riverside Campus as DEXPAC, since this acronym is descriptive of the purpose of the whole system.

The entire system went on line as a whole in July, 1972, and has been functioning now for approximately three and one-half years with a high degree of success. Because of a restriction on funds and the pressures on the programming section of the Computing Center, it was felt that the four subsystems each developed to stand alone, tested, and then interfaced with the subsequent system was the best way to go. The systems were generally introduced in one-year segments: one, the account table initiated in September, 1969; two, the recharge billing system initiated in September, 1970; three, the automated purchase order system initiated in September, 1971; and four, DEXPAC, the total system initiated in July, 1972.

In developing the new system, certain objectives were felt to be fundamental. These were: one, eliminate the need for manual accounting in the departments; two, reduce the lag in producing departmental ledgers; three, provide ledgers and summaries which cooincide with University-wide output; four, establish the ability to commit funds mechanically; five, provide an option to record estimated liens; six, reduce the general and specific workloads; seven, standardize all accounting procedures; and, eight, provide a data base from which meaningful management reports could be generated. These objectives would correct the conditions about which the campus departments were complaining and would compliment University-wide systems and would improve the services available to both the departments and management in the accounting system. One other objective which we did not mention above was that the system had to be flexible enough to meet the requirements of both the large and small departments on campus. For instance, it was felt necessary to provide the general ledgers on a weekly, semi-monthly, or monthly basis., at the option of the department. It was also necessary that the system be co-ordinated with the University-wide system since the latter produced monthly general ledgers for all the campuses, but using a departmental account structure that included campus identification, department account, fund, sub-budget, and object code designations. The flexibility we needed was built in. The sub-budget mentioned above allocates the account budget to general expense categories, i.e., salaries, supplies and expense, equipment and facilities, et cetera, and with the use of object codes, further classifying expenses into specific expense distribution within the sub-budget.

I mentioned earlier the total system was developed in four modules. The first module to be developed was the account table. The main function of this sub-system was to provide a method of maintaining a current table of all valid account numbers used on the Riverside Campus. It also acts as a cross-reference file or conversion table from the full 13-digit account fund sub-number, to the four-digit recording number. The use of this four-digit number allowed us to speed up the processing within the computer and it also provided an easy method of recording departmental options available in the system, i.e., weekly or monthly reports, summaries, and so forth.

The second module developed was the recharge billing system. Credit of charges between campus departments were processed as recharge billing. These transactions made between service departments and using departments between any two campus departments or between funds within a department. This system was designed to:

1) Utilize cost centers assigned by the department;

2) Capture data at the point of origin;

3) Initiate the recharge forms with the user and have it completed by the service department;

4) Assign a control number by the using department for service requested;

5) Provide variable data for management reports; and

6) Allow automatic preparation of outside billings.

The variable data input on the recharge form interfaces into the University-wide Automotive Fleet Management, Storehouse, and Central Duplicating system.

Management reports which previously were manually prepared or were non-existent are prepared on either a repetitive or an on-call schedule.

AUTOMATED PURCHASE ORDER SYSTEM

The third module developed was the Purchase Order System. This provides the input to interface with the payment of invoices through computer matching of receival documents, purchase orders, and invoices. Its principal objectives are:

1. Eliminate the need for manual functions, i.e., logging, filing, transcribing, et cetera.
2. Provide the Materiel Manager and staff with timely and accurate listings of the status of requisitions and purchase orders.
3. Provide the Materiel Manager with detail statistics on the workload of the various functions in the Purchasing Department.
4. Provide up-to-date management information on vendor performance.
5. Provide daily expediter report that permits follow up action on orders placed.
6. Provide a report of dollar volume and number of orders in each series of commodity groups.

Each of these objectives has been achieved in the system currently in operation on the campus. Initial entry into the system is achieved through input of the purchase requisition into the Computing Center on the date received in

Purchasing, where it is entered into the file and produces a cumulative log of active orders. The log is updated daily and is delivered to the Purchasing and Accounting offices each morning.

The information recorded in the log at this point is minimal, primarily recording that a requisition has been received and indicating its current status. Requisitions may be coded to record the obligation as an estimated lien in the ledger.

When the purchase order is issued, a copy if forwarded to the Data Processing Center where the details on the log are completed. This additional information includes vendor's name, date of release of the purchase order, the date the material is due, number of the buyer who handled the order, status of the order, and its total dollar amount. The log has sufficient information to answer any departmental inquiry, and it is seldom necessary to pull the purchase order unless some corrective action is needed in connection with the order.

At the time the purchase order information is entered into the computer, a card is generated for use in processing the receipt of the material. This card constitutes the delivery receipt on which the department acknowledges receipt of their order from the Receiving Office. Information is also inserted on this card that is accumulated to generate the Receiving Office Statistical Report.

Additional cards are generated as item cards containing a brief description of the item, the number of items ordered, the purchase order number, blank spaces in which Receiving personnel indicate the packing slip number of the shipment, and the quantity of each item received. Central Receiving records the quantity of each item received. If possible, this number is obtained from the packing slip; if not, Receiving opens the package and, by physical count, determines the number of each item in the package. The departments verify the number of items in the packages against the packing slip and, if there is a discrepancy between the number of items contained and the packing slip, they will notify the Receiving Office within five days after receipt of the shipment. At the end of each day, the delivery receipt and the item cards are delivered to the Data Center, and this information is entered into the file. If a partial shipment has been received, the entire deck of item cards is returned to Data Center, and a new deck showing only those items still outstanding are generated for future deliveries.

Data Processing prints an expediter's report daily covering those items that are one day overdue, two days overdue, and three days overdue. This report goes to the expediting section for daily follow up on all overdue orders and, from the follow up, expediting determines further action--either establishing a new due date for the shipment, or a new follow up date, or returning the file to the buyer for renegotiation. The expediter's daily update of delivery schedules is handled by a computer card generated at the same time as the expediter's report.

Many campus departments have blanket purchase orders which authorize them to order specific materials against a supply agreement, have repairs made on equipment on an emergency basis, have periodic maintenance of their equipment or, in some very limited cases, to make small purchases from various vendors on a daily basis.

These high volume, low value transactions are department responsibilities and are received directly by the departments. For this type of order, UCR developed a sub-purchase order form and procedure to utilize the benefits of the Automated Purchase Order System. The sub-purchase order form is issued by the department and forwarded to Purchasing for review and assignment of commodity code. It is then forwarded to the Data Center for processing.

A copy of the order is held by the department until the materials have been received. This copy of the sub-purchase is annotated as received, signed as proof of delivery, and forwarded to the Accounting Office. There, Accounting batches these daily and sends them to the Data Center. The Accounting Office copy, the original entry from the Purchasing Office, and the invoice are matched by the computer to generate payment.

To prevent our open order log from becoming too voluminous, at the end of each month, the closed orders are removed from the open order file and a closed order log is printed as historical data.

The Materiel Manager receives four management reports. They are:

1. Purchasing Department Activity Report;
2. Vendor Performance;
3. Purchases by Supply Agreement and Commodity Groups; and
4. Receiving Office Statistical Report.

The "Purchasing Department Activity Report" statistically analyzes the activities of the Purchasing Department,

a) by each buyer:

1. Number of requisitions processed;
2. Value of requisitions processed;
3. Dollar Volume;
4. Number of change orders; and
5. Requisitions cancelled.

b) by each department:

1. Number of requisitions issued;
2. Dollar volume; and
3. Number of rush orders.

The report also provides statistical data on the types of orders:

drug, rush, radioactive material, telephone, and special. By receiving this report, we are in a position to evaluate the performance of each buyer, the workload of the buyers, processing time for orders and other valuable statistical data to operate the purchasing functions.

The "Vendor Performance" report lists our vendors to show:

1. Number of orders for each vendor;
2. Dollar volume by vendor for previous quarter;
3. Number of orders completed with dollar volume;
4. Delivery performance; and
5. Outstanding orders by vendor.

This report is especially useful to buyers in making awards of future orders and in discussions of performance with vendor's representatives by the Materiel Manager.

The "Purchase by Supply Agreement and Commodity Groups" satisfies the requirements of the University commodity management program and the commodity manager with:

1. Usage in each of a number of established commodity fields;
2. Quarterly listing by dollar volume of orders by supply agreement within commodity groups;
3. Number of orders by supply agreement within commodity groups; and
4. Totals by commodity groups.

The "Receiving Office Statistical Report" provides a monthly review of the Receiving Office:

1. Number of packages received;
2. Number of purchase orders received;
3. Tonnage for the month;

4. Number of shipments received per purchase order;

5. Average number of packages per purchase order; and

6. Average weight per package.

This report provides the Materiel Manager with statistics on workload trends in the Receiving Office.

The fourth module, Departmental Expense Accounting (DEYPAC), is the sub-system designed to accumulate data from the other sub-systems to produce the ledger. Transfers of funds, financial journals, direct payments and transactions not recorded by the other sub-systems are input through the DEXPAC sub-system. DEXPAC generates two reports for all departments and provides input data to the University general ledger. The two reports are:

Subsidiary Expenditure Ledger (Department option as to frequency: weekly, semi-monthly, or monthly) and the

Expenditure Summary, which is generated monthly.

In designing DEXPAC, we made it flexible enough to meet all the departments' requirements. It was decided to provide several options to best meet the needs of the departments.

1. One of these was to provide options to allow each department to vary their ledgers by fund to meet their needs:

    a) An option as to frequency--weekly, semi-monthly, or monthly.

    b) An option to commit or sub-allocate funds--by cost center only, by object code, or by object code within cost center.

    c) An option to record estimated liens.

    d) An option to record payroll in detail or total by cost centers.

    e) An option to accumulate expenditures by cost centers.

    f) An option to include or exclude estimated liens in percent spent.

2. We were eliminating the need for manual accounting in the departments by:

   a) Providing summaries previously prepared manually and

   b) by printing on convenient 11x8-1/2" ledgers.

As I mentioned earlier, manual accounting was maintained in the departments, because of a lag time in producing the general ledger and because the ledger does not provide a method of distributing expenses by cost center. DEXPAC input is cut off at noon on Friday with a ledger in the department on Monday. By committing funds and recording estimated liens, the ledger reflects the activity and balance in the account comparable to a manual system.

The DEXPAC Subsidiary Expenditure Ledger provides detailed transactions, adjustments to appropriations, balance of appropriations available, estimated and firm liens, balance per the general ledger, and the balance of funds available after considering all funds obligated. Cost center identification by item is also shown on this ledger.

The DEXPAC Expenditure Summary accumulates expenses by cost center and classification expense. If a cost center has not been assigned to an expenditure, the expenditure will be reflected as a general cost center for further distribution at the option of the department.

Also displayed on the Expenditure Summary is a summary of expenses, for the current period and year-to-date, regardless of the cost center.

For complete control of expenditures, the budget may be further committed or sub-allocated to type of expense or cost center. This is the type of manual recordkeeping maintained by departemtns to control budgets.

In developing a system acceptable and of value to the departments, three things must be considered:

1. Sufficient options to allow the department to design the most

useful ledger;

2. Active participation by the departments in the design of the system; and

3. A ledger limited only to the imagination of the department.

The system as we presently have in our operation is designed to interface and compliment all other University common systems. We have been careful to interface with the Fleet Management, Telephone, Storehouse, Physical Plant, and so forth. These systems provide a complete ledger with all the available features.

Data preparation todate has utilized a CMC key-to-disc entry system. As of December 1st, the data entry has been converted to a Sycor 350 Terminal in the Purchasing Department and will operate in batch mode to accumulate data as the purchase orders are punched through the day and will be batch-transmitted once or twice a day directly to the Computing Center.

U.C. Irvine reviewed U.C. Riverside's Accounting/Purchasing System in July of 1973. After a feasibility study, we decided to implement a version of the system with the emphasis on providing more information to campus departments and Materiel Management. We created our data base utilizing the majority of U.C. Riverside's data elements. The data base provides information for management controls; such as, workload trends, and performance evaluations of buyers and vendors. It also provides up-to-date information concerning status of all purchase actions of the various campus departments.

After independent study by UCLA, they found that their requirements would be fulfilled by the UCI system with only minor changes. UCLA is presently using UCI's Campus Computer until they are ready to convert the system to the UCLA Campus Computer.

Expediting reports for use by the campus expediter, and on-line receiving reports for use by the Receiving Department such as delivery tickets, are extracted from the data base. The system provides timely status information; such as, requests for quotation dates, routing for approval of other departments (if needed), Accounting, vendor, and due date information recorded when the order was placed. The ability to generate "ad hoc" reports; such as, lists of all open requisitions over two weeks old, lists of closed orders, and return goods memos are also provided.

The system is written in the Cobol language and is implemented on a Xerox Sigma 7. It requires four million characters of disc storage. Additional off-line tape storage is used to store records of all closed orders. Off-line intelligent terminals are used for data input.

We are exploring the possibility of acquiring an off-line storage device for local storage and a printing unit to provide computer generated printing of purchase orders. We are also exploring the possibility of interfacing the system to the Accounting Department's Accounts Payable System to process invoices using the information provided by the Receiving Department. This would provide faster processing of invoices, more timely payment to vendors, and more opportunities to take advantage of possible discounts.

The system is presently operated by two people; a Coordinator and an Operator who were reassigned from other Materiel Management functions. The Coordinator is familiar with all Purchasing operations and has a working knowledge of campus departmental procedures. The Coordinator interfaces with the internal Purchasing Departments; i.e., Receiving, Expediting and Equipment Management, and knows the purpose of all documents that flow into the system and their effect upon the system.

An operator's manual has been written providing detailed instructions for data input, merging new data into the existing master file, and obtaining reports as needed. Guides are also available to assist in the use of the system by Materiel Management and campus departments.

System documentation should be available by March 1, 1976.

MATERIEL MANAGEMENT INFORMATION SYSTEM

PROJECT REPORT

FEASIBILITY STUDY PROJECT SUMMARY

Objectives and Methodology

The objectives of the project were twofold: (1) to implement early and substantial improvement to the Materiel Management service function on this campus, where appropriate, upgrading existing operational procedures along the way and in a manner compatible with the overall study effort; and (2) to conduct a feasibility study for the purpose of improving existing manual processes in order to increase the overall effectiveness of the department in its service function.

The project effort included emphasis on both near-term operational improvements (policy, administrative, procedural, and clerical) and a longer term analysis or feasibility study of information systems' applications to aid the department. Work had been previously completed in the areas of problem identification and requirements planning for installation of improved operating methods and the project approach was organized in a manner whereby Materiel Management departmental and divisional management could implement the near-term operational improvements during the course of the project while the major effort was centered around identification of information systems requirements and development of data processing applications.

Evolution of Feasibility Study to Pilot Program Test of the Materiel Management Information System (MMIS)

In order to complete the feasibility study effort in a timely and effective manner, the following steps were taken: (1) a rapid overview of existing Materiel Management functions including purchasing, receiving, inventory, and stores operations was completed; (2) detailed functional definitions of UCLA systems requirements were developed; (3) identification and review of other known successful Materiel Management data processing systems were completed; and (4) alternative applications to meet identified UCLA requirements were considered. While this activity was underway, Materiel Management staff continued efforts in the area of near-term operational improvements.

By the end of May, 1974, sufficient information was available to support a recommendation to install and test a Materiel Management Information System (MMIS) on the UCLA campus.

The following report, which recommends full implementation of the Materiel Management Information System (MMIS) at UCLA, details the development, results, and basic recommendations for action which have emerged as a result of the pilot test program. Included are the following areas:

--Materiel Management Information Processing Requirements - A review of the organization's service requirements, management and operational information needs and processing functions.

--Review of Alternatives Approaches to Information Processing Requirements - An analysis of existing alternative systems available to the UCLA Materiel Management Department.

--Review of UC Irvine Campus Purchase Order System (IPOS) - Background, capabilities, and potential for application at UCLA.

--Pilot Test of MMIS at UCLA Campus - Organization of test program, system processing and reports - summary description, assessment of test program period.

--Major Considerations in System Development - Meeting UCLA Materiel Management requirements, overall benefits, interfaces with existing manual procedures, impact on other existing or planned data processing systems.

--Analysis and Recommendations - Summary analysis of MMIS, Cost Analysis, recommendations, and summary implementation plan.

MATERIEL MANAGEMENT - INFORMATION PROCESSING REQUIREMENTS

Materiel Management activities, in order to make an effective contribution to the institution of which they are a part, must be oriented toward the over-all objectives of the campus. The Materiel Management function must also include specific individual objectives that are unique to the division within the Materiel Management organization.

Organization-Service Responsibilities

The Materiel Management Department at UCLA is comprised of four divisions: Equipment Management, Purchasing, Receiving, and Stores, and the Office of Materiel Manager to which each division reports.

The basic purpose of the organization is to purchase and provide the goods and services required by the campus in the most economical and timely manner consistent with the objectives and policies of the University. In order to accomplish this, the following practices and guidelines have been established:

--Determination that the purchase price of the required commodity is reasonable and that requirements for competition have been met.

--Continued development and enhancement of simplified methods of securing low-cost items.

--Utilization of pool purchases and supply agreements wherever possible in order to maximize the advantages and economics in quantity buying.

--Establishment of central storehouses to obtain the economies available from quantity purchasing of common use materials.

--Establishment of central receiving locations for handling incoming and outgoing shipments of University purchased items.

--Centralized inventory control of University property and development of procedures to obtain the fullest possible utilization of equipment.

While Materiel Management is an economic function, it is recognized that service to ordering departments is an important measurement of the over-all effectiveness of the organization and is a consideration in all activities of the department.

In addition to service functions on behalf of the individual campus departments, the Materiel Manager on each campus has some University-wide responsibilities. Under the Planned Purchasing Program, the Materiel Manager, as a Commodity Manager, has the responsibility for negotiating, awarding, and administering supply agreements for assigned commodities. This has included coordination with local department users, other campus Materiel Managers and the University Materiel Manager. Also, there is an attendant extensive reporting responsibility to the University Materiel Manager which, on a periodic basis, requires data on all aspects of the Materiel Management departments' operations. Please refer to Attachment I for detail of these items.

Information Processing Requirements

As a result of this review of the service responsibilities of the UCLA Materiel Manager, these conclusions were reached.

First, it was apparent that the responsiveness of Materiel Management could be improved if more timely information on the status of various workload areas was available to departmental management and staff. Under the existing manual system, information on transactions was difficult to determine. A variety of manual logs and other methods for tracing the current status of requisition and purchase actions exist. There was no central source available to rapidly determine status of an order other than tracking it down through the process flow. Further, if a campus department had a question regarding an order or requested information regarding a vendor's performance, a proper response required a search through the manual cycle. This was a time consuming process which diverted both the professional buyer and the departmental support staff.

Second, and as detailed in Attachment I, there exists a requirement for extensive reporting on Materiel Management operations for management, budgetary, and planning purposes. All statewide reports such as the Material Value and Minority Vendor reports require a tally from the departmental files. Further, information regarding material transactions is needed by the campus Materiel Manager in order to respond to contract and grant audits, develop commodity usage information, develop the Planned Purchasing program, maintain proper inventory control, etc. In addition to these requirements, significant additional information requirements were identified which, if available, could significantly aid the Materiel Manager in meeting his service responsibilities to the campus community. These are detailed in Attachment II.

REVIEW OF ALTERNATIVE APPROACHES TO INFORMATION PROCESSING REQUIREMENTS

In response to these requirements, the study team undertook a review of alternative approaches to information processing for Materiel Management. Within the environment of university information systems development and resources the UCLA Materiel Management department was faced with certain constraints in proceeding. First, unlike several other UC campuses, there exists no localized data processing resource at UCLA dedicated to administrative purposes which could assist the Materiel Management department in its program. Also, in the process of this review, the study team found significant similar needs for information processing among the Materiel Managers of other UC campuses. Accordingly, while the primary focus of the study was directed at solving UCLA's identified problems, the study team maintained a perspective of review which encompassed the Materiel Management function university-wide. Interaction with the Davis, San Francisco, Berkeley, Santa Barbara, Irvine, and San Diego campuses and the UC Materiel Manager occurred during the course of the study.

Under the action plan agreed to, the study team initiated a review of available data processing systems currently existing in industry, at other universities, or within the University of California. While several industrial applications were reviewed, including systems in use at Northrop, Lockheed, and Ampex Corporation, all were rejected because of their emphasis on production management and inventory control applications. Through this process, though, several excellent methods of systems applications to Materiel Management functions were identified for potential inclusion in the projected UCLA system.

Systems either existing or in various stages of development by colleges and universities were also reviewed. These included systems at the University of Illinois, University of Iowa (AMES), and in development at the University of Washington. These systems were reviewed through available documentation and discussion with those principally involved with their development and several of the experiences and approaches of these institutions assisted UCLA in further refining its requirements.

Within the structure of the University of California there existed two Materiel Management systems applications identified for review by the study team: (1) the DEXPAC system operating on the Riverside campus - a component of which is devoted to Materiel Management transactions; and (2) IPOS, or the Irvine Purchase Order System, which at the time of review was operating on a pilot basis on the Irvine campus. After initial inquiry, it was determined that the most appropriate of these two systems for potential adoption at UCLA was IPOS. Accordingly, with the full cooperation of the Irvine campus Materiel Manager and staff of the Physical Sciences Department, a detailed review of the system was initiated.

REVIEW OF IRVINE CAMPUS PURCHASE ORDER SYSTEM (IPOS)

Background and Current Status

The development of a Materiel Management Information System for the Irvine campus was the result of efforts initiated by Rod Rose, then Lab Business Officer of the Physical Sciences Department, and Dave Tomcheck of his staff. In a review of departmental accounting requirements, it was determined that more timely and accurate data on the status of purchasing transactions would be highly desirable. It was also recognized that the Materiel Management department had significant information processing requirements of both a local and university-wide nature and was faced with continued projected increases in departmental workload.

After initial discussions with Earl Ludwick, Irvine Campus Materiel Manager, and Pat Getchell, Assistant Materiel Manager, a joint development effort was initiated to establish a Materiel Management Information System at UC Irvine with the following objectives:

1. To produce management reports and monitor information about campus purchasing activity not previously available or available only through manual means.
2. To make more efficient use of purchasing staff, reduce the overall costs of purchasing, and improve the distribution of the workload in the Purchasing Department.
3. To provide the Purchasing Department with data on purchase order status, expediting, receiving, vendor performance, and other pertinent information.
4. To provide Schools and Departments with a means to access a common information base relative to their purchasing transactions.

IPOS, as designed, was developed to meet the identified requirements of both the campus Materiel Manager as a service organization and the campus departments being served. Upon completion of basic cost-benefit review and a further refinement of requirements, a recommendation was made to Vice Chancellor - Administration L. E. Cox to initiate programming of the system for pilot testing with selected campus departments.

Drawing considerably on the successful UC Riverside DEXPAC system, the IPOS design was completed in the spring of 1973 through the cooperative efforts of the Physical Sciences and Materiel Management Departments. While originally modeled after the UC Riverside system, IPOS differentiated in that it was extensively modified to expand the breadth and scope of the original concept and took advantage of an on-line (terminal oriented) data entry capability available at the Irvine campus. The basic source documents and outputs, however, are essentially the same, with modification of formats and the addition of several reports to enhance the overall usefulness of the system.

The pilot test of IPOS was initiated in October, 1973 and by February, 1974 35% of the campus purchasing activity was in the system. With the approval of the Vice Chancellor - Administration, the system was expanded to full campus operation on July 1, 1974. The system opperates on the campus computer facility's computer via an interactive intelligent terminal located at the Materiel Management Department and a printing terminal at the Receiving Division. IPOS is programmed in COBOL and requires some 24k of core memory utilization. Please see Attachment III, IPOS SYSTEM SUMMARY for further details. A detail of the various reports produced by the system is discussed in the following section and included as Attachment IV to this report.

Review of IPOS Capabilities versus UCLA Requirements - Conclusions

During the course of the UC Irvine pilot test period and subsequent full campus implementation of the system, the UCLA study team worked closely with the Irvine campus staff. Through this period, detailed assessments were made of the information processing requirements identified by UCLA and UC Irvine and the capability of IPOS to meet these requirements in a flexible and economic manner. Other factors in this review were considerations of relative workload volume, the type of purchasing transactions handled by each campus' Materiel Management department and the organizational differences apparent between the two campuses in their Materiel Management structures and the campuses' administrative and academic departmental structures. As a result of this review, the following conclusions were reached:

1. The IPOS system met or exceeded the majority of the identified UCLA systems requirements or had the baseline capability to eventually do so.
2. The system as designed had the potential for relatively easy adoption for successful use at other UC campuses in that it met the common requirements identified by other campus Materiel Managers.
3. The Irvine campus system programming was developed and tested obviating the need for this to be done at UCLA and thus reducing system development costs. Further, IPOS had passed the university-wide development requirements for a single campus

system as a result of a review by the Office of the Vice President - Administration prior to full campus implementation.

4. It was the study team's basic conclusion that the Irvine system was well thought out prior to design, programming, and pilot testing. During the pilot test, the system met the identified information processing requirements and demonstrated the flexibility to respond to additional requirements as they emerged.

A review of the overall similarities and differences between the two campuses revealed that the UCI and UCLA Materiel Management operations are basically similar in organizational structure and responsibilities. The same operational policies and procedures are followed with minor changes implemented to suit unique local requirements. The primary difference between the two organizations is the delegation of purchasing authority. Irvine does not authorize low value (blanket) purchases by campus departments. All purchase orders are processed by the Purchasing Department with the exception of petty cash transactions and urgent requirements picked up by departments with prior approval. Even though the campuses are different in size, the purchasing delegation differences equate to a volume of purchasing transactions handled by the UCLA and UCI Purchasing Departments as almost equal. There is a difference, however, in the volume of complex orders with UCLA processing more high value purchases. With regard to overall campus organizational differences which could possibly impact implementation of IPOS at UCLA the only item determined to be of significance was the fewer number of major departmental organizational sub-units at UCI as opposed to UCLA.

Taking the above conclusions into consideration, it was determined to recommend proceeding with a pilot test of the IPOS system at UCLA. Development of highly realistic cost estimates for such a test was made possible due to the similarities in workload transactions of the two campuses. The internal operating cost data available through IPOS, and the closely monitored expenditure experience of the test at Irvine. The UCLA pilot test recommended for the period of October through December, 1974 was estimated at a cost of $3,300 and the actual total cost experienced was $3,307.77. The planning, organization, and results of the test program, as conducted at UCLA, follow.

PILOT TEST OF MMIS AT UCLA CAMPUS

The initiation of the pilot test program of the Irvine Purchase Order System was based upon the previously referenced recommendations to conduct a three month pilot test program of IPOS utilizing existing systems programming and UCLA supplied terminals interacting between the UCLA Materiel Management Office and the UCI Computer Facility. With the approval of Vice Chancellor Cox, staffs from both campuses developed the details of the test program during the months of August and early September with a target date for test implementation of October 1, 1974.

Prior to the start of the test, preliminary planning at UCLA included interface of IPOS and existing departmental operations, operator familiarization training, departmental training (Purchasing and Receiving), and a comprehensive study of Irvine's procedures and experiences. Formal arrangements were made to use the Computer Facility at Irvine and have print-outs forwarded to UCLA. Equipment and supplies were ordered and arrangements were made for Irvine personnel to assist in UCLA operator training. All phases of planning for test implementation were completed on schedule.

Organization of the Test Program, Participants, and Orientation

Because of campus organizational and operational similarities, the pilot test was organized as close as possible to the on-going Irvine system. This included the utilization of the existing program, computer facilities at Irvine, similar input terminals and similar operating procedures. The only major changes were the inclusion of the alpha portion of the UCLA department I.D. number, assigned by the Accounting Office, and the use of a General Electric Termi Net printing terminal instead of a teletype machine. Irvine generates the department listing of purchase order status by assigning specific blocks of purchase order numbers to departments. UCLA has more departments and the preassigning of blocks of numbers would have been too much of an administrative burden. As an alternative, the study team requested a minor program revision to include the alpha department identification and a report sort by this identifier. It was also thought the teletype used by Irvine was too slow and noisy, indicating a need for a printer which is much faster and quieter. Accordingly, it was recommended that a GE Termi Net printer be utilized. (Irvine has since replaced the teletype with this type of printer.)

The test program was organized and administered within the Office of the Materiel Manager. In view of the fact that the system will serve all divisions of Materiel Management and the data will be utilized by all divisions, as well as by the Materiel Manager, it was felt important to establish the program directly in that office. This fostered and insured coordination of data input and output and provided a central management focus for the pilot test program.

Direct participants included personnel reporting to the Materiel Manager and representatives from Purchasing, Stores, and Receiving. A comprehensive training program was implemented in the department prior to and during the test program. The objective was to explain the test to all personnel within Materiel Management and train personnel for adequate operator back-up and familiarization with all phases of the system.

Implementation was gradual with three representative departments selected to participate initially in the test. These were the Engineering, Chemistry, and Physics departments. The Laboratory of Nuclear Medicine and Physical Plant have subsequently been added to the program. The Laboratory of Nuclear Medicine was selected because of its off-campus delivery address. This offered an opportunity to develop a system for preparing receiving reports for deliveries to addresses other than campus receiving departments. As the participants were selected, meetings were arranged to explain the program to departmental administrative personnel and staff. Presentations were also made to campus administrative departments and numerous off-campus visitors.

MMIS System Test Procedures

MMIS system test procedures for the Materiel Management department were established prior to the receipt and installation of equipment. The Irvine campus procedures were reviewed and, in most cases, were satisfactory for UCLA implementation. The use of the original source document for data input is one of the primary characteristics of the simplicity of MMIS. Irvine and UCLA use the same source documents. These include purchase requisitions, purchase order forms and vendor packing slips for receiving report information. There are some differences in internal paper flow but this had little impact on the data input phase or utilization of system output and reports.

Irvine personnel furnished programming assistance and operator training on site for UCLA staff. Input procedures, with terminal format and operating instructions prepared by Irvine, were used and the CRT terminal master cassette tapes for terminal programming and input formats were recorded from existing Irvine tapes. The net result of the cooperative working relationship between the two campuses was the rapid implementation of the MMIS pilot test program. The UCLA terminals and other equipment were delivered to the campus of September 16 and the test program period commenced as planned beginning October 1, 1974.

System Processing and Reports - Summary Description

The Materiel Management Information System (as it is identified at UCLA) reacts to input stimulus from four principal source documents or reports all entered via the intelligent terminal located at the campus Materiel Management department. These are:

--The Purchase Requisition which includes the basic elements of purchase order number, name of ordering department, date of order receipt by Purchasing Division, a buyer code, campus delivery address, and routing information (necessary approvals, requests for quotations, etc.).

--The Purchase Order, which adds to the file accounting data, vendor data, dates, placed and due, cost data, and items ordered - their description and quantity.

--The Expediting Report, generated automatically by the system as a function of delivery data information, it acts as an input source document to add to the file information regarding the status of orders resulting from inquiries of vendors. Included are the dates of inquiry and any pertinent comments.

--The Receiving Report, generated at the Receiving Division on command, data, from this report when a delivery is complete is entered completing the transaction cycle. This input includes the items received, the carrier, packing slip number, freight bill number, weight and number of packages.

The MMIS processing cycle basically follows the above data input description. The first entry is the requisition data with utilization of the assigned purchase order number as the principal access identifier throughout the remaining data entry and retrieval steps. The final entry completing a transaction record is the receiving data. Under consideration for future utilization of the system is invoice/receiving report matching to reduce invoice processing time and direct input of receiving data via the terminal at the Receiving Division to speed data entry.

The reports and management information which can be produced by the Materiel Management Information System are basically of three types: (1) those reports produced routinely by the system on a scheduled basis; (2) information resulting from on-line inquiry of the data base via the terminal; and (3) additional print-outs such as activity reports as requested sorting the data base to meet the various needs of the Materiel Management staff. Each of the three principal reports produced by the system are discussed below and are included as Attachment IV of this report. Other reports as referenced can be obtained through the UCLA Office of Materiel Management.

--The Daily Listing of Purchase Order Log - This report, printed in numerical purchase order sequence by department, provides the complete status of requisition and purchase transactions underway. Appropriate department, buyer, and due date information is included along with detailed information on the status of the transaction and any pertinent comments. This report is used by both the Materiel Management Department and participating campus departments.

--The Daily Log for Expediting - This report is used by the Materiel Management Department to follow-up orders that have not been delivered and are in a past due status. It can also be used to identify, track, and expedite urgent orders. This report, as indicated above, also acts as an input document for file update. Its most important function is to insure expediting of crucial orders and provide follow-up on outstanding orders improving overall responsiveness and service to campus departments.

--The Receiving Report - Upon demand via the printing terminal at Receiving, a three-part receiving report is printed containing all of the required information to complete delivery of an ordered item to a campus department upon arrival at UCLA Central Receiving. This output document eliminates the need for a manual file search of Purchase Order copies at Receiving and the Receiving copy of the Purchase order.

--On-Line Inquiry - One advantage of the availability of an interactive terminal is the capability to make inquiry of the MMIS data base on demand. While not used extensively, on certain occasions the department has required information regarding the status of purchase transactions on short notice. Also, as changes to transactions underway occur, the file can be updated to reflect modifications to the particular purchase transaction as they take place.

--Additional Printouts - Activity Reports - A variety of reports on all aspects of the Materiel Management Department's operations are also produced by MMIS. Currently, these are: the Buyer's Activity Report detailing the number of orders placed, average transactions; the Vendor Performance Report which gives a monthly cumulative listing of vendors transacting business with UCLA, the total orders and dollar amounts placed with each and their performance in meeting delivery requirements.

Two other reports produced daily are transaction logs in both buyer and purchase order sequence for use in assessment and distribution of workload. Other specialized reports of various typew can be generated by the system on demand such as the History Log which will provide data on all transactions of the department on a quarterly basis for reference purposes.

Analysis of Test Program Period

As data was collected and the first information available under the pilot test program was retrieved, it readily became evident that MMIS could meet the information processing requirements of the UCLA Materiel Management department. The pilot test substantially confirmed in actual operations of the system at UCLA the previous assessments developed in observations of IPOS as it functioned at the Irvine campus. To fully appreciate the ability to immediately know the status of a purchase transaction as provided by MMIS, requires familiarity with the time consuming efforts to manually count numbers of requisitions and orders, dollars commited, and the search of files formerly required in responding to an inquiry.

In certain instances, urgent requests for information were filled by direct computer access using the CRT or printing terminal. Some personnel problems were experienced but these were attributed to concern over the technical aspects of the system; i.e. direct contact with a computer using a terminal. Some existing Materiel Management procedures required improvement. For example, the follow-up system provided in MMIS is more advanced than the one the department had been using. This required some additional training. Overall, these problems did not prove detrimental to the overall test and improvements resulted in current operations within the department.

MMIS is being well received by test campus departments. The system doesn't demand anything more than is currently provided by the departments and the purchase order status information reports will eliminate numerous telephone inquiries from campus departments to Materiel Management. Although a program isn't available at present, several departments have shown an interest in a listing of purchase expenditures by fund source. MMIS reports are generated upon demand and this type of report, for department budget control information, would be more timely than the general ledger and could be easily provided. In another application, the Purchasing Division is interested in a listing of orders in total amounts to be used as a recharge base. At present, this information is collected manually but could be generated through utilization of MMIS. Overall, the pilot test program demonstrated that MMIS could be sucessfully implemented at UCLA and would meet this campus' requirements in an economical and flexible manner.

MAJOR CONSIDERATIONS IN SYSTEM DEVELOPMENT

The success of the pilot test program demonstrated the capability of MMIS to meet the identified information processing requirements of the UCLA Materiel Management Department. However, in formulating final recommendations to proceed with the full implementation of a data processing system for this department the following additional factors required consideration:

--Assessment of the operational and service improvements which would result from implementation of the proposed system.

--The extent to which the proposed system addresses Materiel Management information processing requirements generally (i.e., that the system is not dedicated to the unique local requirements of either UC Irvine or UCLA with little potential for use elsewhere).

--The system's ability to interface with existing manual procedures.

--The relationship and potential impact of the proposed system on other existing or planned data processing systems.

Operational and Service Benefits

The principal objectives of the feasibility study effort centered around the concept of improving the Materiel Management Department's overall responsiveness and service to campus departments. It was concluded that full implementation of the Materiel Management Information System would substantially assist the department in this regard. Included in the projected operation and service benefits are:

--The availability of more complete and up-to-date information to all offices which deal with the purchase order record. Generally, these would include the campus department ordering a particular item or commodity, the Finance Office responsible for accounting and follow-up audit activities, and, of course, Materiel Management.

--The reduction of much of the duplicate record keeping in the Purchasing and Receiving Departments and other departments of Materiel Management through utilization of a centralized open order file accessible by terminal.

--The reduction of clerical workload in record and file maintenance providing for staff utilization in higher priority areas.

--The capability to assess overall Materiel Management departmental effectiveness through a review of management reports not previously available.

--The capability to review certain data on vendor performance for use by management and buyers for vendor selection and improvement of supply sources.

--The capability to analyze commodities being purchased to identify items which could be purchased more economically through the Planned Purchasing Program.

--The potential capability to facilitate early vendor invoice payment through the use of receiving report data. This should result in better vendor relations, reduction in requirements for clerical staff, and fewer vendor inquiries on statements requiring time and effort to respond to.

--The baseline capability to provide future improvements such as high-speed machine generated purchase order typing, interface with the Equipment Management Excess Property and Salvage program, and the availability of a data base to assist in contract and grant supported equipment purchase transactions. Potential applications for the Stores Division are also anticipated.

Potential for General Application of the System

Throughout this study effort, the information processing requirements identified for the UCLA Materiel Management Department were reviewed with other UC campus Materiel Managers and their staffs. This was done in order to benefit from their expertise in these areas and to provide the study team with a perspective of the common information processing needs of University Materiel Management operations. As full implementation of IPOS occurred at Irvine and as the UCLA pilot test became operational, the two programs were reviewed by other campus Materiel Managers and recent interactions with these individuals indicate the following:

--Staff of the Santa Barbara campus have reviewed the Irvine system and the testing of the system at UCLA. Funding has been requested to initiate a pilot test on the Santa Barbara campus.

--Berkeley system examinations included a review of Irvine's system, Riverside's system, and the test at UCLA. Staff of this campus have expressed an intent to request approval for starting a test of the Irvine system.

--San Francisco, having compared the Riverside and Irvine system, has expressed an interest in utilizing the Irvine system.

--The University Materiel Manager has reviewed and has been informed of the status of the Irvine system and its implementation at UCLA. He has expressed approval of the Irvine system as well as approval of the UCLA pilot test and intent to expand it and is currently weighing the compatibility of MMIS with

University-wide systems.

Considerable interest in the system has been generated throughout the University and all other campus Materiel Managers have expressed great interest in pursuing a common MMIS with the features of the Irvine system, including changes incorporated at UCLA, meeting the majority of their identified needs.

Interface with Manual Procedures

The interface of MMIS with the present manual procedures of the Materiel Management Department has been successful. The system design took ongoing systems and procedures into consideration and interface was planned with a minimum of disruption of daily activities as a primary objective. MMIS uses existing source documents and there has been little change in the present paper flow. System input requires an additional step but this will be more than offset by the elimination of manual logs. The receiving report processing is an additional function for the Receiving Division but the Receiving copy of the Purchase Order will not be required with a resultant elimination of files and record keeping. It was concluded that MMIS, due to its systems design which closely reflects and parallels current Materiel Management processing methodology, is highly compatible with departmental manual procedures.

Impact of MMIS on Other Data Processing Systems

Implementation of a successful data processing application for a University of California Materiel Management Department must be considered in the context of other potentially related administrative systems applications either operating or under design. Specific systems with which MMIS may impact or, in some measure, relate to are: (1) the existing Inventory Management and Storehouse EDP systems operating in the Materiel Management Departments of all campuses; (2) the Accounts Payable system and (3) other lesser related systems.

With regard to the existing Inventory Management and Storehouse EDP systems, it is felt that the Materiel Management Information System will work effectively in conjunction with both . Currently, MMIS has the capability to include inventory identifier data in the item description fields augmenting the Inventory Systems record keeping capability. Examination of this use of MMIS for Equipment Management applications and the use of MMIS in applications at the Stores Division (tracking of storehouse requisitions) is currently under study.

A potential is also seen for MMIS to provide benefits to the campus Finance Office. Currently, accounting data is being keypunched from purchase orders for entry into the general ledger system. The MMIS data base has the capability to provide this information indicating a potential reduction in keypunching expenditures. The system is currently capturing all requisition and purchase order transaction data in machine readable form. It would be relatively easy to develop a periodic tape sort (daily, if required) of this data under the required input criteria of the Accounts Payable System.

CONCLUSION - RECOMMENDATIONS, SUMMARY IMPLEMENTATION PLAN

Recommendation

The results of the pilot test program of the Materiel Management Information System as detailed in this report demonstrated that MMIS would: (1) meet the Materiel Management Department's existing and projected requirements for information processing; and (2) assist the department in enhancing its service to the campus community. Further, the system, as designed, has the capability to flexibly meet the information processing requirements identified by other UC campus Materiel Managers and meets the requirements set forth in the recent recommendations of auditor and OMP task force reviews of UC Materiel Management operations. Therefore, in review of these factors, it was recommended that UCLA expand MMIS pilot program to full campus operation of the system.

Summary Implementation Plan

In proceeding with the expansion of the MMIS program at UCLA, several factors required consideration. These included additional equipment and personnel. It was suggested that the full campus implementation of the MMIS program include the following stages:

1. Continuation of operator and departmental training. The majority of this effort had been accomplished and the continuation was directed toward improvements in operating skills and system procedures.
2. Gradual addition of campus departments with a total implementation objective by June 30, 1976.
3. Although the Irvine Computer Facility can handle total UCLA data storage and processing requirements, delays in the receipt

of reports does have an impact on the efficiency of the system. It was recommended that a change to a local computer facility and the programming changes required should proceed at an early date.

4. Further system developments should continue with emphasis on converting the existing purchase order data to tape or other media that will be compatible with the Accounting System. Also, final programming of the purchase order printing component of the system should be completed for full implementation at UCLA

ATTACHMENT I

REPORTS TO UNIVERSITY MATERIEL MANAGER

1. ACTIVITIES (ANNUAL)

   A. Statistical data on Purchasing, Equipment Mangement, Receiving and Storehouse that includes total FTE, total expenditures for salaries and supplies and expense.

   B. Specific information including:

      (1) Equipment acquisitions and dollar amount.

      (2) Number of incoming and outgoing shipments and deliveries to departments from the Storehouse.

      (3) Number of items in Storehouse inventory.

2. VALUE REPORT

   A. Includes target savings, dollars committed, number of purchasing actions, actual savings and types of savings.

   B. Additional information includes major value items, planned objectives and progress. Minority Vendor data and Significant Minority Vendor Development Activity.

3. TIME STUDIES (Requisition Processing Time)

4. COMMODITY PRICE SURVEYS

ATTACHMENT II

INFORMATION PROCESSING IMPROVEMENTS

1. Requisition Status File
    a. Eliminate manual logs
    b. Reduce time in responding to department inquiries regarding status.
    c. Provide automatic evaluation of buyer workload and performance.
    d. Provide automatic evaluation of departmental workload distribution.
    e. Eliminate manual record of total requisitions received.
2. Purchase Order File
    a. Provide automatic follow up system
    b. Generate vendor performance profile
    c. Eliminate manual records
3. Provide reports of department purchases against supply agreements.
4. Improve central file information retreival (Purchasing, Storehouse, Equipment Management)
    a. Supply Agreements
    b. Contract and Grant Terms and Conditions
    c. Vendor information
        (1) Sources
        (2) Minority Business
        (3) Vendor Performance
5. Establish Receiving Report
    a. Input for vendor performance profile
    b. Input for follow-up system

6. Reduce invoice processing time

   a. Invoice/Receiving Report match and payment with built-in delay factor for department inspection.

ATTACHMENT III

SYSTEM SUMMARY

Title:	Irvine Purchase Order System (IPOS)
Application:	Purchasing Information System
Location:	Purchasing Department, UC Irvine
System Designer:	Dave Tomcheck, UC Irvine X6913
Programmer-in-Charge:	Dave Tomcheck, UC Irvine X6913
System Status:	Operational since July 1, 1974
Computer:	Sigma 7
Programming Languages:	Cobol
Core Memory Utilization:	24K
Storage Media:	Magnetic disk and magnetic tape
Input:	From source documents via intelligent terminal
Output:	On-line at terminal; hard copy at Sigma 7
Interface:	This system does not interface with any other EDP system at present. Future interface with University Accounting System is possible.

ATTACHMENT IV

MMIS SYSTEM REPORTS

A. DAILY LISTING OF PURCHASE ORDER LOG

B. UCLA RECEIVING REPORT

C. DAILY LOG FOR EXPEDITING

D. BUYER ACTIVITY REPORT

E. RECEIVING STATISTICAL SUMMARY

F. VENDOR PERFORMANCE

(A)

U. C. L. A. PURCHASING DEPT.
DAILY LISTING OF P.O. L93

RUN DATE: SEP 09, '75

PURCHASE ORDER #	STATUS / TOTAL AMT	DEPARTMENT NAME - PG / ACCT FUND S	FIRST ITEM / REC. & EXP. DATES	# ITEMS	BUYER	DATES:PLACED, DUE / VENDOR NAME
56661-C	ACTIVE 149.23	PP6 120R, U1212 640550 66990 3	PENN CONTROLS #P470A-9 RANGE 0/150#SPDT 8/ 5 0/ 0	1 ITEMS	BUYER: X0115	8/ 6/75 9/ 4/75 BURKE ENGR. CO.
56662-C	CLOSED 970.95	PP3 121KF, X1518 640550 66990 3	N.Y. BLOWER UTILITY SET SIZE 128 W/PLR 8/ 5 0/ 0	2 ITEMS	BUYER: X0115	8/ 8/75 8/29/75 AIR CONDITIONING
56663-C	OPEN 0.00	PP8 118R, M2174	1 S.S. WET & DRY VACUUM #6389 Y 14 8/ 5 0/ 0	0 ITEMS	BUYER: X9155	
56664-C	PARTIAL 335.06	PP8 122H, P2120 640550 66990 3	RUSSWIN KEY BLANKS, 6 H7 P 8/ 5 0/ 0	1 ITEMS	BUYER: X0113	8/14/75 12/22/75 MONTGOMERY HARD.
56665-0	ACTIVE 673.09	PP8 123M, SD262 640550 66990 3	1 GAL. PHENOLINE FLOOR FINISH 300 SERIES 8/ 5 0/ 0	3 ITEMS	BUYER: X0115	8/ 8/75 8/29/75 CAROLINE CO.
56666-5	ACTIVE 1799.88	PP5 119Y, M2174 640505 15900 4	MOTOROLA PAGECOM TONE & VOICE PAGER 8/ 5 0/ 0	1 ITEMS	BUYER: X9156	8/13/75 8/30/75 A-1 PHONE SYSTEMS
56701-0	ACTIVE 1632.40	PP8 125K, A0004 640550 66990 3	FABRICATE ELECTRIC COVER PLATES LISTED: 8/ 5 0/ 0	3 ITEMS	BUYER: X0115	8/ 8/75 8/29/75 CHUCKS ORNAMENTAL
56702-0	BID DUE 8/22/75 0.00	PP8 129H, W3578	2 #R-15-S WITH FIXED TIME DELAY 8/ 5 0/ 0	0 ITEMS	BUYER: X0115	
56825-0	ACTIVE 187.01	PP9 132F, U2130 640550 66990 3	PIPE ALIGNMENT GUIDES MOD. FRS-45, 6 8/ 8 0/ 0	1 ITEMS	BUYER: X0115	8/12/75 9/12/75 ACCESS MFG. CORP.
56826-9	ACTIVE 461.19	PP3 136A, S2174 640501 19900 4	SELECTRIC II #835, 12 PITCH 15 CARRIAGE 8/ 8 0/ 0	2 ITEMS	BUYER: X0114	8/21/75 10/31/75 IBM CORP.
56827-0	ACTIVE 791.29	PP3 137R, U2130 640550 66990 3	EXPANSION JOINT #6237, 6 W/8 TRAVERSE 8/ 8 0/ 0	1 ITEMS	BUYER: X0115	8/12/75 9/26/75 YARWAY CORP.
56828-C	ACTIVE 605.26	PP3 135F, X1518 640550 66990 3	CABINET FAN MODEL T-3 8/ 8 0/ 0	1 ITEMS	BUYER: X0115	8/13/75 9/30/75 THE TRANE COMPANY
56831-0	PARTIAL 1886.60	PP8 131CF, AE128 640550 66990 3	SQ. FT., J.M. ACOUSTICAL CEILING #360 8/ 8 0/ 0	2 ITEMS	BUYER: X0115	8/12/75 8/18/75 DIAMOND W. SUPPLY
56856-C	ACTIVE 1933.44	PP6 124R, U1212 640550 66990 3	NOISE SUPPRESSORS #6835, 4 X8 8/11 0/ 0	1 ITEMS	BUYER: X0115	8/13/75 9/27/75 AEROS INT'L. INC.
56859-C	CLOSED 226.68	PP8 141R, M2184 640550 66990 3	THERMOMETER, POCKET #61046-049, 0 TO 220 8/13 0/ 0	3 ITEMS	BUYER: X0115	8/15/75 9/ 5/75 V&R SCIENTIFIC
56900-0	ACTIVE 75.21	PP3 151EF, X1518 640550 66990 3	DISCONNECT SWITCH SQ. D #H321 8/13 0/ 0	3 ITEMS	BUYER: X0115	9/ 2/75 9/11/75 GRAYBAR ELECTRIC

(B)

U.C.L.A. RECEIVING REPORT

P.O. #: 58353-0
DELIVER TO: 1224 CHEM.
BUYER X:9159

VENDOR NAME: CAL GLASS FOR RES.
DEPARTMENT: CHEM. S&E 124

ITEM	DESCRIPTION	ORDER	RECD
01	ADAPTER, ENLARGING, 14/20-24/40 ML235744	19	19
02	FLASK, BOILING, 14/20, 5ML, #ML1160-704	12	4
03	STIRRER, PRECISION GROUND, #LG9500100	6	

DATE RECD: NOV 19, '75 COMMENT:

PKGS: / WT.: LBS.

CARRIER: UPS AMT:

FRT BILL#: FOB-PT: UCLA

PACKING SLIP: 63685

SIGNATURE:

(C)

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RUN DATE NOV 22,'74                      U. C. L. A.  PURCHASING DEPT.
                                         DAILY LOG FOR EXPLOITING                                                              PAGE    7

VENDOR  NAME          P.O. NO  DEPARTMENT NAME           BUYER     PRICED BY   ----- QUANTITIES -----      ----- DATES ----------  INQUIRY
RUSH  PACKING SLIP     ITEM    DESCRIPTION                                     ORDER   RECD  BACKORD    PLACED      DUE        NEW  CODE

KENTES OF CALIF       7907A-0-000 CHEM                    X:9159    SUE                                  10/18/74   10/23/74          1
                        02      STOPCOCK HIVAC K 845000                          6              6
                                     INQUIRY DATE:                  COMMENT:                             COMMENT:

AMERICAN ALLOY MET    7909A-0-000 ENGR                    X:9157    LOU                                  10/18/74   10/23/74          :
                        01     LBS  12 FT .750 DIA TI-6AL-4V ALLOY               12             12
                                     INQUIRY DATE:                  COMMENT:                             COMMENT:

DUCOMMUN              7917A-0-000 PHYSICS                 X:0115    SHIRLEY                              10/21/74   10/23/74          1
           FIRM     *** 01      STEEL HIGH BEAM                                  9      9
           FIRM     *** 02      CUTTING CHARGE                                   1      1
                        03      STEEL CHANNEL                                    2              2
                        04      CUTTING CHARGE                                   1              1
           FIRM     *** 05      STEEL PLATE                                      4      4
           FIRM     *** 06      CUTTING CHARGE                                   1      1
           FIRM     *** 07      SHEETS ALUMINUM                                  2      2
                                     INQUIRY DATE:                  COMMENT:  DEL DIRECT TO DEPT             COMMENT:

CAL GLASS             7857A-0-000 CHEM                    X:9159    BECKMAN                              10/03/74   10/24/74          1
                        01      COLUMN, CHROM, TEF STOPCOCK                      11             11
                        02      STIRRER,MECHANICAL, BLADE TEFLON                 2              2
                                     INQUIRY DATE:                  COMMENT:                             COMMENT:

INC ISOTOPE           7862A-0-000 CHEM                    X:9157    DIANE                                10/08/74   10/2-/74          1
                        01      MC, 64013 PHOSPHOROUS-32                         10             10
                                     INQUIRY DATE:                  COMMENT:                             COMMENT:

ICN LIFE SCIENCES     7884A-0-000 CHEM                    X:9158    DIANE                                10/10/74   10/24/74          1
                        01       3 KG SILICA GEL                                 5              5
                                     INQUIRY DATE:                  COMMENT:                             COMMENT:

GILMORE LIQUID AIR    7833A-0-000 CHEM                    X:9159    RESA                                 09/24/74   10/25/74          1
                        01      FLASK DEWAR NARROW MOUTH METAL 4 LITER           4              4
                                     INQUIRY DATE:                  COMMENT:                             COMMENT:

CAL TECH              7835A-0-000 ENGINEERING             X:0111    VALDEZ                               0-/25/74   10/25/74          1
                        01      COMPUTER TIME                                    1              1
                                     INQUIRY DATE:  11:3            COMMENT:  CAN DUE DATE                COMMENT:
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(D)

RUN DATE: MAR 11, '75

U. C. L. A. PURCHASING DEPT.
BUYER ACTIVITY REPORT

PAGE 1

BUYER	TOTAL ORDERS	TOTAL $	TOTAL ITEMS	0 - 50 #	0 - 50 $	50-100 #	50-100 $	100-500 #	100-500 $	500-1000 #	500-1000 $	1M-5M #	1M-5M $	OVER 5M #	OVER 5M $	PROCESSING DAYS UNDER $50 #	UNDER $50 DAYS	OVER $50 #	OVER $50 DAYS
CLAY	1	14,300	4	0	0	0	0	0	0	0	0	0	0	1	14,300	0	0	1	1
SERVICE CENTER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
TRAINUM	2	785	5	0	0	0	0	2	785	0	0	0	0	0	0	0	0	2	1
SERVICE CENTER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
TANNER	24	4,714	33	2	70	4	655	12	2666	2	1323	0	0	0	0	10	2	14	3
SERVICE CENTER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
ABRAM	15	3,912	104	1	17	1	50	12	3120	1	725	0	0	0	0	2	2	13	8
SERVICE CENTER	6	996	7	1	17	0	0	5	979	0	0	0	0	0	0				
FORTUNA	12	23,873	19	0	0	1	88	5	945	1	532	4	9,429	1	12,879	1	1	11	6
SERVICE CENTER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
CARPENTER	3	2,810	2	1	0	0	0	1	310	0	0	1	2,500	0	0	1	1	2	11
SERVICE CENTER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
ROBINSON	1	95	1	0	0	1	95	0	0	0	0	0	0	0	0	1	240	0	0
SERVICE CENTER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
HAINES	10	2,346	32	0	0	0	0	10	2346	0	0	0	0	0	0	0	0	10	4
SERVICE CENTER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
JONES	28	16,569	72	9	55	5	354	10	2746	2	1593	1	1,971	1	9,850	14	4	14	5
SERVICE CENTER	2	224	3	0	0	1	53	1	171	0	0	0	0	0	0				
MONTELONGO	2	388	5	0	0	0	0	2	388	0	0	0	0	0	0	0	0	2	1
SERVICE CENTER	2	388	5	0	0	0	0	2	388	0	0	0	0	0	0				
NEAGLE	23	10,462	79	1	23	3	223	20	4371	2	1262	2	4,598	0	0	4	8	24	5
SERVICE CENTER	10	3,371	17	0	0	2	129	6	1143	1	517	1	1,577	0	0				

BUYERS TOTAL 126 ORDERS 80,274 DOLLAR VALUE 33 10 93 5
SERVICE CENTER 20 4,979

MEDIAN DAY COUNT

1	2	3	4	5	6	7	8	9	10	11	OVER 11
37	14	6	8	18	13	7	4	5	2	1	11

(E)

U. C. L. A. PURCHASING DEPT.
RECEIVING STATISTICAL SUMMARY

RUN DATE: OCT 22,'75 PAGE 1

P.O.'S RECEIVED	2-6
SHIPMENTS RECEIVED	300
PACKAGES HANDLED	662
WEIGHT HANDLED	15,947LBS.
BLANKET COUNT	0
BLANKET WEIGHT .	0LBS.
BLANKET PKGS.	0
MISC. COUNT	0
MISC. WEIGHT	0LBS.
MISC. PKGS.	0

DEVELOPMENT AND USE OF MANAGEMENT INFORMATION AND PLANNING SYSTEMS IN HIGHER EDUCATION

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New Jersey

A number of pivotal issues are identifiable with respect to the adaptation of management information systems to institutions of higher learning. This paper deals with some of these issues, with reference to actual experiences at Rider College. Issues discussed include: the integration of hardware-software specialists with administrators in effective working teams, the integration of operating systems with planning and analysis systems, the integration and aggregation of data, the credibility of information, the effective use of models, and the training of management and personnel in the development and use of management information systems. The paper is illustrated with examples drawn from operating and planning systems. Rider College is an active participant in NCHEMS programs and the paper refers extensively to NCHEMS products and procedures.

Technical capability for developing management information systems within higher education has existed for some years. Software and hardware adequate to the task have been available. Appropriate general theories of management have been articulated. And yet, among more than 2500 institutions of higher education relatively few have developed, or are in process of developing, comprehensive management information systems. This slow growth perplexes and frustrates many persons competent in software, hardware, systems theory, and management theory.

This presentation attempts, succinctly, to establish the thesis that development of comprehensive management information systems within institutions of higher learning depends upon a commitment to manage these institutions and to develop strong implementation teams that include line management personnel as well as the software, hardware, and systems specialists. Extension of management information systems in higher education will procede no more rapidly than the will to manage develops within these institutions. The availability of software, hardware, and a well-trained supporting staff represent a much less significant impediment, but these human and technical resources must become integrated with line management.

The phrasemaker who coined the phrase "Management Information Systems" had access to a good mint. Of these three words, the most important and the most neglected is the word "management." Research literature and other available resources have focused much more attention on data and information and on information systems and data organization than on management theory and practice in higher education. Of what possible utility is a management information system without a management--a designated and organized group of people who are willing and able to manage? Yet, and this is not based on any survey, management information systems have encountered an institutional climate on campuses unsympathetic to the practice of management. This seems particularly true at the upper tier of operating line officers such as presidents, vice-presidents, deans, and the like.

Obvious and relatively simple reasons for such inhospitality can be defined. Because the interface between technically competent information-systems staff personnel and managerially inclined line personnel seems so critical, and because little recent comment has been directed toward the practice of management in higher education, some of these obvious and simple reasons deserve brief discussion.

The very word "manager" seems strange in the academic world. "Administrator" has become the generic term for categorizing those who make decisions within academe. Behind this nomenclature lies an authentic tradition of amateurism, a tradition which hallows a dean, a president, or a provost who arises from faculty ranks, whose expertise lies in an academic discipline, and who is expected to return to faculty ranks after some period of administrative service. For example, in the sixties the average tenure of college presidents declined to less than five years, a period so short as to deny learning the complexities of the office or of the institution. The possibility of a professional career directed toward the mastery of rational decision making techniques within higher educational institutions may become a growing possibility, but probably not rapidly. Many or most administrators, particularly those in academic administration, will continue to regard administrative service as a term of duty within a teaching-research career and those who select administrators will continue to favor disciplinary doctorates along with teaching and publication as important qualifications for administrative office.

The logical extensions of this kind of amateurism may be found in the processes and relationships characterized (and generally revered) under the rubrics of "collegiality" and "academic governance." Both of these terms connote more than they denote and the connotations corrode the possibilities of management-like activity. The connotation of collegiality usually separates the profession of teaching and research from other professions on campus and places it in higher esteem. Simultaneously, the connotation of collegiality assumes that professional expertise in teaching and research in an academic discipline automatically extends to the profession of decision making on the campus. This assumption of automatic extension enriches the connotation of "academic governance." In connotation, academic governance indicates a process by which decisions arise from a state of consensus informed by extended expertise derived from disciplinary training. If this picture seems caricatured, consider the persuasiveness of charges against campus decision makers based upon "non-collegial" activity or based upon charges of violations of the due processes of academic governance. Such charges seem to be effective. Consider further the unlikelihood of finding a biology steering committee composed of a controller, an admissions director, and a registrar, contrasted with the almost certainty of finding an admissions committee composed of a biologist, a physicist, and an historian.

The preceding examples of inhibitors of management-like activity among institutions of higher learning might be designated as contextual. Many will continue to admire a contextual model defined by some degree of administrative amateurism, as well as the full connotations of collegiality and academic governance. This presentation does not intend to assign values to these contextual elements, but rather to note that such contextual models will not lead to management-like behavior for decision makers, and in turn, will logically render complex information systems less desirable or undesirable for such persons.

A further observable consideration within the context of higher education deals less with such value orientations than those discussed above. This consideration deals with the judgment that institutions of higher learning are comparatively simple institutions. "Colleges are places where teachers teach, students study, and administrators balance the books." That quotation typifies the comments of many business managers representing firms mentioned in various Fortune lists or political types among various governments. Probably these judgments external to the campus have been based on cash flow, and on the basis of cash flow, institutions of higher learning may appear relatively simple compared to the banking enterprise, the automobile manufacturing enterprise, the aero-space enterprise, or the health and welfare enterprise. But cash flow represents only one measure of complexity. If one were to compare the alternative ways among institutions of higher learning of delivering a baccalaureate degree in history along with the myriad of services supporting that delivery to the alternative ways of delivering a new automobile, one might well conclude that institutions of higher learning comprehend a higher degree of complexity in terms of audience, "options", and other features. But an external definition of comparative simplicity seems to have penetrated the campus. Obviously, organizations require information systems suitable to their needs whether simple or complex.

Factors other than the contextual factors peculiar to higher education lower the perceived value of information systems among decision makers. These factors probably apply to decision makers outside the field of higher education, although they may have special significance within that context.

One indicia of managerial activity involves the exploration and definition of alternative courses of action within a spectrum as broad as possible. Further managerial activity would include some modeled iteration of various alternatives in order to explore the possible results and consequences of various alternatives. Complex management information systems show promise of becoming valuable tools in supporting this managerial activity, particularly when the MIS includes modeling and forecasting capabilities. But managers are people and many people do not want to undertake the risks of making decisions among multiple alternatives. Limits of one or two alternatives simplify decision making. Thus, when questioned, a manager may defend a decision by saying: "I had no other choice;" or, "The other choice would have been so bad that it couldn't have been selected." In short, the exploration of alternatives may be desirable, but may not be desired. Organizations in which people do not desire to explore alternatives will probably not welcome management information systems.

Another indicia of management activity involves definition of constraints as well as the effort to discover ways in which constraints may be relieved or removed. This activity serves to define which alternatives may or may not be implemented and why. However, multiple alternatives may not be desired. Many people prefer to behave as if they are absolutely constrained or absolutely unconstrained. Persons desiring rigid constraints prefer authoritarian direction and make comments like: "Just tell me what to do, don't bludgeon me with information about why it must be done." Those desiring to behave as though absolutely unconstrained make comments like: "Don't tell me resources are inadequate, it's your job to find the resources." Again, the desirable is not always desired.

Complex organizations have complex goals and objectives, and these goals and objectives become divergent rather than convergent. Consequently, the process of priority setting among competing goals and objectives nearly always results in robbing Peter to pay Paul. When Peter is destitute, the manager must attempt to find equitable ways to distribute the shortage. Management information systems illumine undesirable as well as desirable consequences among alternative courses of action--some alternatives may have positive effects in terms of one organizational goal, but negative effects in terms of others. Rarely, if ever, does a course of action have positive benefits for all goals. Consequently, managers informed by good systems make decisions within ambiguity, and attempt to find the best fit. In effect, they seek to implement a decision which is "less wrong" rather than one which is "right." Tolerance of ambiguity has become a rare element in our society, and one may suppose that many persons will resist tools and techniques which apparently deprive them of the privilege of defending decisions because those decisions are "right."

The very collection of data into systematic information for the use of management becomes a powerful tool in holding managers accountable for their decisions and the consequences of those decisions. But all people do not desire to be or to become accountable. Some people have determined to be a countable to themselves and commit themselves to compiling systematic information to support this self-accountability, but many of those same people resist the sharing of systematic information with others. Some institutions will refuse to become involved in systematic information collection because they, like individuals, do not wish to be held accountable in terms of the information they systematically collect and manipulate.

Management information systems have been presented to complex institutions as tools of benefit. While this generality may be true, no way of calculating in advance the particular benefits seems to exist. Costs can be anticipated much more readily. Deciding to undertake costs to realize future unspecified benefits involves risk. Not all managers or people possess propensity for risk and may well choose, wisely or unwisely, to forego uncalculable benefits.

Finally, a general climate of hospitality which often proves fatal to management information systems must be noted. Many organizations wish to be absolutely up to date and to possess the symbols of ultra-contemporaneity. Large, complex computers with many flashing lights and bells, have long been such a symbol. MIS may replace the number cruncher as the latest status symbol. In an apparently hospitable environment, management information systems might well have all the utility of chromed fins on an automobile. Some will go out and buy an MIS so as to be up to date without bothering to determine how to integrate the system within the institution.

Some factors within the current environment of higher education will move strongly to encourage management-like behavior. These factors are well known and can be briefly noted. They include the dawning awareness of the reality of scarce resources for higher education, the patterns of no growth, slow growth, or uneven growth in research and teaching, the growth of unionism, and the demand for accountability from students, trustees, public officials, and the public at large. These are countervailing forces, and it should not be assumed that those forces leading to management-like behavior will prevail. Mixed patterns will probably develop within and among institutions of higher learning.

Briefly, management information systems should prove of greatest effect in those institutions who with self-awareness begin to move toward a desire and will to manage and who can integrate staff functions essential to supporting a management information system with line managers who make decisions. The penetration of "management models" within and among institutions of higher education should likewise depend upon the willingness and ability of decision makers within higher education to manage those institutions. "Penetration", as used here, refers to the process by which the "management model" is adopted by and reflected in the actions of a broad range of institutional managers. It is not enough for a high ranking officer of the institution to claim the existence of a management philosophy compatible with an effective MIS or even for an institution to acquire some of the mechanical manifestations often associated with management activity. Rather, there must be a conscious recognition and commitment by those with significant decision making responsibility to the belief that a college or university can be operated more effectively and efficiently through a planning and management approach. When that occurs, penetration will have been achieved and the institution will exhibit a "management model" in its decision making processes.

When the will to manage has been established, the institution will, as Service has indicated, be involved in

> the continuous process of examining alternate courses of action in an attempt to find the most appropriate response, given the constraints and circumstances of the situation in question. Planning and management attempts to integrate informa-

> tion about resources available, their utilization, and the benefits received in order to make decisions about future courses of action.[1]

This kind of activity induces a heavy demand for the production of timely and meaningful information about all manner of institutional activities for all manner of institutional managers.

Some institutional managers are primarily responsible for decisions affecting the day to day operation of organizational units while others have primary responsibilities for the planning function and are more concerned with broad institutional issues having a future orientation. If those with planning responsibilities are to work effectively, they will need information support from those in the operating units. Information collected to meet operating needs must also be designed to meet planning needs and must do so as a normal part of the institutional information development process.

Whether because of a recognition of the need for information for planning and management purposes, a response to fadism, an instinct for survival in the jungle of demands for information by external agencies, or other real or imagined needs, some institutions have begun to develop sophisticated, computer based management information systems. These systems have the potential for providing genuine benefits to the institution but if not designed with great care, and used by informed managers, they can also create a host of unanticipated problems. What can an institution do to insure a reasonbale likelihood of achieving the potential benefits of such a system?

An important first step involves a determination of the scope and expectation for the system. About what areas of institutional operation is information

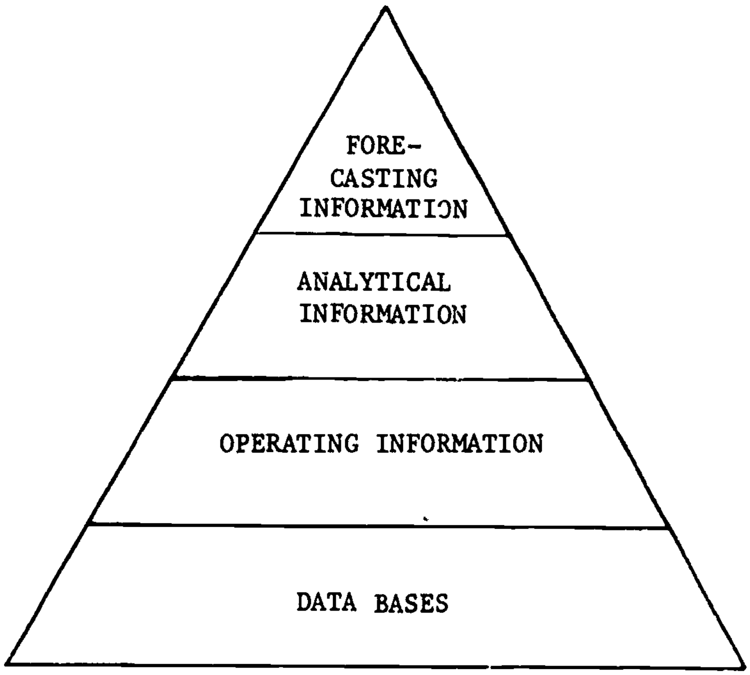
[1] Allan L. Service, Planning and Management Uses of Institutional Data: Examples, Issues, and Plans, Boulder, Colorado, NCHEMS at WICHE, 1975

needed and in what form is it desired and how will it be used by what levels of management? Normally, an institution will be ill-advised to create a series of stand-alone information units because that course will create stand-alone managers. If that approach is taken, it may well be best accomplished by allowing each operating unit to produce its own reports, in its own formats, with its own definitions of terms even though to the almost certain consternation of those who must try to make sense of the conflicting information (apparent or real) that will result. Under most circumstances, an institution will achieve much more satisfactory results by developing a carefully planned information system to provide needed information to support decision making at all levels and for diverse purposes.

If an institution is really committed to a "management model", it can be presumed that the intent is for managers to manage. To do that, they must have the information necessary better to understand and evaluate the implications of alternate courses of action. The maintenance and control of pertinent data coupled with appropriate access and manipulative capabilities for the purpose of converting data to information, constitute significant and necessary supports for the effective execution of the management function.

Just as there exists a hierarchy of managers within an institution, there also exist a hierarchy of information forms and uses. This hierarchy may be thought of as pyramidal in nature. Supporting the structure is a series of data bases. These data bases are comprised of the raw data that will, if treated successfully, drive the various operating and planning systems.

Each data base should be the responsibility of a designated manager. For instance, the Registrar would normally be responsible for the data base containing student records, the Bursar or Controller for the data base containing student accounts receivable records, the admissions director for the data base containing admissions records and so on. Although the data bases are the responsibility of an identified manager, they must be designed to meet the needs of other managers as those needs may arise.



MANAGEMENT INFORMATION HIERARCHY

The operating systems are driven by the data bases and are used to process transactions and produce reports pertaining to the management operations of the institution. Managers at the operating level are frequently interdependent and that interdependence must be reflected in the design of the information system. The Registrar will, for instance, be heavily dependent upon the Admissions Director for initial information on new students. The Admissions Director may well, in turn, be dependent upon the Registrar for measures of success for the students admitted.

Finally, both the data bases and the operating systems must be be designed to be supportive of the planning and forecasting systems. These planning and forecasting activities are likely to be most effective in those circumstances in which they are supported by the same data and procedures used at the operating level. This is not, of course, meant to suggest that additional planning and modeling devices should not be used but rather that when possible, their support should derive from other levels of the same information hierarchy. In terms of personnel, the foregoing is clearly intended to suggest that those with planning responsibilities will be heavily dependent on those with operational responsibilities such as the Registrar, the admissions director, the financial managers, and others.

By virtue of the dependence of central managers on operating managers for the information they need to discharge their responsibilities, there is a clear line of accountability from the operating managers to the central managers. They are particularly accountable for the provision of timely and accurate data for the full range of planning and management functions.

As institutions develop computer based information systems to support the management function, a carefully defined relationship between the computer operation and its technical personnel and those with managerial responsibility must be articulated and understood. If, by design or practice, the computer operation becomes a policy making unit, the focus of management responsibility will have been misplaced. Conversely, if its role is limited to the manipulation of data and the production of reports, it will have fallen well short of its potential as a management support unit. The basic problem in either case derives from the assumption that the computer operation exists as a separate functional unit rather than as an extension and support for the various managers and management functions throughout the institution.

To achieve the desired relationship requires a well-planned integration of the activities of the technical and managerial personnel. If the management information system is to realize its potential, members of both professional groups must be involved in the design, development, implementation, use, and evaluation of the various components of the information system. Managers know (or must attempt to learn) what information they will need in considering alternate course of action and technical personnel possess (or must acquire) the knowledge and skills for building the systems to provide information to satisfy management needs at both the operational and planning levels.

Technical personnel contribute significantly to the development of the information system by translating the anticipated needs of decision makers into operating systems that will produce the needed information. Of course, it will also be necessary for the technical personnel to articulate constraints and limitations and to recommend alterations to the hardware configurations. Their continued involvement from the outset should greatly improve the capability of making system modifications as they become necessary.

Members of the technical staff are accountable to both operating managers and to central managers. They support operating managers by developing and maintaining management information systems to aid managers in fulfilling their responsibilities efficiently and effectively. This responsibility makes technical personnel accountable to central managers for designing systems for collecting, maintaining, and manipulating data that will supply information to drive generalized institutional models.

If technical and management personnel have had a joint role in the planning and development of the information system, additional benefits can be realized as the institution begins to use and evaluate its system. By applying the respective understandings of the information and how it is being produced, an assessment can be made as to the effectiveness of the system in supplying information and to the accuracy of the information being produced. As questions and problems arise, the approaches to their resolution can be quite different than would be the case in a situation in which the integration of activities had not occurred. In the same sense, more formal evaluation of the system can benefit from the combined perspectives available.

The value in establishing this joint activity is also apparent in terms of providing managers with information in a form that will be more useable to them. It is obvious that those with decision making responsibility would normally not want data presented in "raw" form. However, the decisions will have to be made as to the forms in which it will be available. If the technical personnel are made aware of the anticipated management needs, systems can be designed to produce information formatted in ways that will be most helpful. Variable formatting determined by managers with direct terminal access represents a vast improvement over the fixed format report in which the managers receive information in a standard form whether it is of value or not.

As indicated earlier, it is important to operate from the assumption that data "belong to" and are the responsibility of the manager to whose area they primarily pertain. When that assumption is made, the computer operation is relieved of the responsibility for maintenance of data bases (other than for technical maintenance) and for decisions regarding access. Those kinds of responsibilities should properly be assigned to the managers whose data is being stored and processed.

Early and continued involvement of technical personnel will also help to insure compatibility among the various system components. It is normally not necessary to develop a fully integrated system but if the system components do not operate on compatible elements, the effect is not substantially better than a series of stand-alone systems. With technical and management personnel working together, the potential for reaching agreement on the definitions employed and on the kinds of data that will be collected and maintained is enhanced. The intent should be to collect data only once in a form that will allow it to be readily used by managers in various operating and decision making positions. The implementation of this intent will safeguard the integrity of information and lend greater credibility to planning and analytical activities.

Ultimately, members of the technical staff must be formally accountable to high ranking central managers such as presidents or academic vice presidents. Only in this way can the inevitable conflicts arising from the competing interests of the various operating managers be satisfactorily resolved and the needs of institutional planners met. Priority judgments must be made by central management personnel if the information system is to be developed and used successfully.

The foregoing comments have focused on the slow growth of the management philosophy in institutions of higher education and on some of the factors that have inhibited such growth. The word "manager" is at best foreign and at worst offensive to many in higher education where a tradition of amateurism has prevailed in institutional decision making. The connotations associated with "collegiality" and "academic governance" have inhibited the development of true management activity and that is particularly unfortunate at a time when decision making in institutions of higher education must become more sophisticated in response to the many demands confronting institutions. Institutions of higher education are themselves complex organizations existing in an ever more demanding socio-economic milieu. If they are not managed effectively and efficiently, the prognosis for their health and well-being is not good.

As institutions begin to assume the commitment to a "management model", they should quickly recognize the need for a system by which needed information can be supplied to institutional managers. If the development of a management information system is to be undertaken for some purpose other than the acquisition of a status symbol, it will have to be planned with great care. A major ingredient in the successful creation of the information system is the integration of the roles of technical and managerial personnel. Through their joint efforts, successful planning can be greatly facilitated and many problems avoided. If an institution has the will to manage and affords its managers the support needed, institutional planning and decision making can be greatly enhanced.

ACHIEVING CONSENSUS ON SYSTEM REQUIREMENTS

Charles P. Hurd
Registrar

Jon A. Turner
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Columbia University

The development of information systems can be viewed as effecting planned change within the enterprise. Critical to the success of this process is the system requirement definition activity. Both the literature on requirements definition and the usual practice assume a rational decision-making model. The characteristics and implications of this model are discussed, using a current information system project at Columbia University as an example.

An alternate model of this activity, based on bargining between power groups, is then introduced. The conceptual basis for the use of this model is established and its dynamics explained. Then it is shown how the bargining model was used to structure another information system project at Columbia, this time in the students records area. The results of using these two approaches to requirement definition are compared and some general conclusions drawn.

In a field so laced with techniques and procedures, it seems incongruous that such rudimentary methods are used for determining system requirements. The process of information system analysis is, as practiced for the most part, neither analytic nor systematic.

Looking inward at our machines, we find progressively more formal system descriptions in program specifications, formal languages, logic, and state diagrams. However, when we look in the reverse direction---to the user(s) operational area---we see much less formality and few descriptive procedures. There are some design aids such as information flow charts, HIPO, BSP, and a number of ad hoc procedures, but these aids are not nearly so well developed as our internal procedures.

The reason for this apparent dichotomy is that we are dealing with two different classes of systems. Our computer systems are mechanical and deterministic. The output is defined by the inputs, the transformations, and the prior internal state of the system. Even the most complex machines are completely defined by their state diagrams. Properly functioning, these systems are predictable.

However, when we build information systems, we model a phenomenon which is basically social and political, comprised of individuals, each differently motivated, who are organized into groups which in turn interact. Concepts such as "consensus," "bargaining," "negotiation," and "conflict" seem far more descriptive of these social organizations than do the rigid systems we produce with our application code. Thus, the crucial problem facing the system designer is how to perform the transformation from the complex, intuitive, relatively fuzzy world of the organization in action to the precise, deterministic, relatively static world of our information systems.

Every information system implementation involves change. At one extreme, even if the system is a replica of an existing manual system, it alters the tasks of the people who operate it. New control procedures have to be introduced and new activities created---for example, those associated with the running of computer programs. Certainly the new system is perceived by those involved as a change.

At the other extreme, an information system may provide an opportunity to rethink the way a given function is performed, thus allowing a complete restructuring of activities and removal of some constraints. Under these conditions, there may be major changes in individual tasks, organizational structure, departmental responsibilities, distribution of authority, and staffing. New interdependencies may be formed and the power structure of the enterprise permanently altered. Thus, information system development can also be viewed as effecting planned change within the enterprise.

Our focus is on the boundary between the organization and the information system and particularly with how we do and should go about deciding on system requirements. It is this process which forms the context of detailed design: relatively minor omissions or misunderstandings can easily compromise the best implemented systems.

What are the common methods of requirements definition today? What are the assumptions behind and the implications of these practices? What are the alternatives, and do they give promise of improved performance?

Environment

The environment in which we function is an important variable in understanding our approach. Columbia University was founded as Kings College in 1754 under a royal charter given by George II. As with most older universities, tradition runs deep, and this is evidenced even by the persons who occupy key positions. Statistically, Columbia has about 13,000 full time equivalent students in some twenty-one schools or divisions, including Columbia College, the Graduate School of Arts and Sciences, the Graduate School of Business, the School of General Studies, and the College of Physicians and Surgeons. The faculty, researchers, administrators, and supporting staff comprise another 11,000. There are two main campuses in New York City---Morningside Heights, which includes most of the schools and about three quarters of the population, and---two and a half miles away---the medical center in Washington Heights.

The University is heavily research oriented, with about one-third of the annual expense budget coming from government contracts and grants. The Lamont Geophysical Laboratory and the Nevis Physics Laboratory, in Rockland and Westchester counties, New York, run world-wide operations that range from oceanographic research vessels to remote research stations. The University also operates a number of hospitals in New York under a contract with the City.

But these facts do not convey the complexity of the institution. Teachers College and Barnard College have their own presidents and trustees; yet, for many administrative purposes, they are considered to be part of Columbia University. There are also constructs called bureaus, institutes, centers, programs, and faculties, which often do not appear on the organizational charts (which have not been drawn for many years) but are essential to an understanding of the University's functioning.

The dynamics of the University are probably best described by Jacques Barzun, the historian and past provost of Columbia, in his book entitled <u>The American University</u>:

> What is known on campuses as "central administration" is but one part; and its ostensible power, derived from the trustees and based on a few statutes, is little more than a concentration of influence. Technically, the president can do whatever he wishes, and his aides---the academic vice-president or dean of faculties and provost, the head of business and finance, the director of projects and grants (or scientific research)---are responsible only to him. Actually, their authority is hedged on all sides by the strength of the school deans, department chairmen, directors of institutes, senior faculty members, standing committees, and campus opinion.[1]

As an example of our complexity, consider the organizational structure of student records. The admissions function is decentralized; each school has its own admissions office, establishes its own procedures, and sets its own standards. Student financial aid is also decentralized; however, allocations are coordinated by a group in the central administration. The Registrar's activities of registration and grade recordkeeping, on the other hand, are centralized in one unit which reports to the academic executive vice-president and provost.

The other environmental component is computing, which goes back to Professor Ben Wood's use of punch card equipment for test scoring in the late thirties. Professor Wallace Eckert's Astronomical Computing Bureau produced many of the nautical almanacs used during World War II, and the joint IBM/Columbia Watson Scientific Computation Center, started in 1956, was one of the first programming schools in the country. This group became the Columbia University Computer Center in 1962. In 1968, all computing was centralized when the Administrative Data Processing Center merged with the Computer Center.

Columbia always has had a large computational resource and, coupled with a strong Electrical Engineering/Computer Science Department, a competent technical staff. However, it has been far less successful in the development of administrative systems, despite the fact that it has trained many practitioners of administrative data processing.

System Requirements Determination: The Rational Decision Model

Gordon Davis classifies the two most frequently used information system requirements definition approaches as the evolutionary or "bottom up" approach and the "top down" approach.[2] He then identifies two alternative approaches---"decision analysis," which seeks to derive the information requirements for an application system from the decisions made within the organization, and "data analysis," which derives the information requirements by analysis of the data currently in use.

Another writer identifies some of the common pitfalls to be avoided in developing information systems as lack of top management support, failure to specify objectives, the "crash program pitfall," and the "inadequate staffing pitfall." He recommends a systems study approach which includes identification of system objectives, gathering of data on current operations, analysis of data, determination of alternatives, and evaluation.

Although each of the approaches and the identification of pitfalls is useful, they do not provide us with an understanding of the dynamics of the requirements definition process, nor do they tell us specifically how to execute the study in a manner which avoids those pitfalls.

Let us characterize the systems requirements definition process in its most obvious form. When we are requested to design an information system, we dispatch a bright, young, aggressive, analytical systems analyst to meet with the older, traditional, politically oriented head of the user department. The systems analyst asks the department head what he does, what problems his office has now, how he would like to restructure the department, and what his requirements are for the new system. The ensuing dialogue supposedly produces a detailed description of the needed system.

This approach involves the assumption that the user department head makes rational decisions with regard to the development of the new information system. More precisely, it assumes that the goals and objectives of both the user and the information systems department are known, non conflicting, and capable of being translated into a "payoff" or "preference" function which represents the "value" of alternate sets of consequences. It requires that all of the alternatives be identified and that all of the consequences of these alternative actions be anticipated. Finally, it assumes that a decision rule exists for chosing between the alternatives.

Many of you will recognize this formulation as that of "economic man," who makes optimal choices in narrowly constrained, neatly defined situations.[4] Allison expresses this perspective well when he says:

> ... The concept of rational action...underpins economics, decision, and game theory, as well as the less structured notion that underlies our everyday assumption of human purposiveness both in individual behavior and in national foreign policy. Rationality refers to consistent, value-maximizing choice within specified constraints.[5]

The rational model is an extension of the pervasive assumption that what human beings do is rational---at least, in intent. This assumption of human purposiveness and goal directed activity is a major line that can be traced through economics, political science, and management science. But there is also a line that concentrates on the reactive aspects of human behavior.

We argue that the model of rational man is appropriate in certain situations---when the systems are relatively simple, when objectives are clearly defined, when little change is involved, and when the participants in the development process share the same norms, cultural background, and goals ---in short, those situations in which the amount of differentiation is relatively small and the work to be accomplished is fairly well defined. However, most of the large information system development projects do not fall into this category. The goals are usually poorly defined and often conflicting. Rather than one user, there are many with different organizational objectives. The participants have different cultural backgrounds, different norms, different priorities, and even different vocabularies. Under these conditions, the model of rationality seems inappropriate. Instead, we suggest a model which focuses on integration mechanisms and methods of attitude change.

System Requirements Determination: The Bargaining Model

The bargaining model of bureaucratic decision making considers leaders who sit on top of organizational subunits as being players in a central, competitive game. The game is called politics---bargaining along established circuits among players positioned hierarchically within the organization. The participants act according to some combination of professional, organizational, and personal goals rather than in response to a single, rational choice.[6] As Allison describes the process:

> Men share power. Men differ about what must be done. The differences matter. This milieu necessitates that ...decisions and actions result from a political process. In this process sometimes one group committed to a course of action triumphs over other groups fighting for other alternatives. Equally often, however, different groups pulling in different directions produce a result, or a better resultant---a mixture of the conflicting preferences and unequal power of the various individuals---distinct from what any person or group intended. In both cases, what moves the chess pieces is not simply the reasons that support the course of action, or the routines of the organizations that enact an alternative, but the power and skill of the proponents and opponents of the action in question.[7]

The distinction between the rational decision making model and the bargaining model is similar to the difference between a closed and an open system. A closed system is viewed as consisting of relatively self-contained structures which can successfully be regarded as independent of external forces. In contrast, an open system, whether a biological organism or a social organization, does depend on its external environment. As Katz and Kahn phrase it:

> The major misconception [in considering a social system as a closed system] is the failure to recognize fully that the organization is continually dependent upon inputs from the environment and that the inflow of materials and human energy is not constant. The fact that organizations have built in protective devices to maintain stability and that they are notoriously difficult to change in the direction of some reformer's desires should not obscure the realities of the dynamic interrelationships of any social structure with its

social and natural environment.[8]

The bargaining model is best understood in terms of small group dynamics. The writings on the behavior and interactions of small groups is lengthy; therefore, we will try to give only a flavor of this work.

Persons who interact frequently with one another tend to like one another.[9] Increased frequency of interaction will lead to greater sentiments of liking, and these sentiments will, in turn, further interactions.[10] Members of a group are highly motivated to behave in ways consistent with the goals and values of that group in order to obtain recognition, support, security, and favorable reactions from it.[11] The greater the attraction and loyalty to the group, the more the individual is motivated to accept its goals and decisions, to seek to influence them so that they become consistent with his own experience and goals, to communicate fully with the members of the group, to welcome communication and influence from other members of the group, and to behave so as to help implement the goals and decisions which are seen as most important to the group.[12] Individuals whose interests are not represented in the decision-making process are not likely to accept a decision wholeheartedly nor to strive to implement it. More often, they begin to plan how they can get the decision reversed and replaced with one which is more beneficial to them.[13]

The importance of individual goals in group functioning is discussed by March and Simon:

> Humans, in contrast to machines, evaluate their own positions in relation to the values of others and come to accept others' goals as their own. In addition, individual members of an organization come to it with a prior structure of preference---a personality, if you like---on the basis of which they make decisions while in the organization. Thus, individual goals are not "given" for the organization, but can be varied both through recruitment procedures and through organizational practice.[14]

The process of achieving a consensus implies some form of conflict resolution. Organizations react to conflict by means of four major processes---problem solving, persuasion, bargaining, and politics.[15] In problem solving, it is assumed that objectives are shared and that the decision problem is to identify the best alternative. Persuasion assumes that at some level, objectives are shared, and that disagreement over subgoals can be mediated by reference to common goals. In bargaining, the disagreement over goals is taken as fixed, and agreement without persuasion is sought. Politics differs from bargaining in that the arena of bargaining is not taken as fixed by the participants. The more the organizational conflict represents individual rather than group conflict, the greater the use of problem solving and persuasion. Conversely, the more the organizational conflict represents intergroup differences, the greater the use of bargaining.[16]

Finally, Lawrence and Lorsch studied integrating mechanisms within industry. They make the following observation:

> [The view of the early theorists] was that integration is accomplished through an entirely rational and mechanical process. If the total task of the organization was divided up according to certain principles, the integration would be taken care of simply by issuing

> orders through the management hierarchy, "the chain of command." Our view, on the other hand, is that integration is not achieved by such an automatic process. In fact the different points of view held by various functional specialists are frequently going to lead to conflicts about what direction to take. To achieve effective integration these conflicts must be resolved. ...In many organizations integrating committees and teams are established or individual integrators are designated to facilitate collaboration between functional departments at all levels of management.[17]

Thus it can be seen that the dynamics of small groups provide strong forces which can be used to achieve system requirements consensus and attitude change with regard to the way tasks are structured. In our opinion, this mechanism provides an attractive alternative to the approach of direct interviews between systems analysts and users. We do not mean to imply that there no longer is a need for information gathering, analysis, or user interviews; it is just that these activities are performed in a more participatory atmosphere by a number of different people, with little role differentiation.

A Practical Application of the Bargaining Model

Early in 1974, we first discussed the need for a new student records system at Columbia. The existing one was a rather makeshift affair which had evolved from punch card procedures over the past fifteen years. Although the system had a number of functional innovations, the difficulty of maintenance and operation coupled with its inflexibility made a complete rethinking of the student records function highly desirable. Much had been learned by both the Registrar and the Computer Center over this period, and we were both motivated to capitalize on this knowledge.

We were faced with an exceedingly intricate student records structure at Columbia. Besides the complexities of organization which we mentioned earlier, there were significant variations in the operational procedures followed by the twenty-one schools or divisions. Almost every previous attempt to reach a consensus had met with failure. The Registrar was only one of a number of power centers involved in the student records community and certainly could not operate independently of the school deans and the central administration.

On the implementation side, we were faced with the problems of obtaining development resources from an administration operating in deficit. Strong forces existed to reduce that deficit. Implementation priority had been allocated to the personnel information system, which was in the throes of its own system requirements definition. Direct support from central administration simply could not be expected.

Under these circumstances, we decided to use the integrating mechanisms of small groups to achieve requirements consensus and perform the system study. The work would be funded out of existing budgets, since we could not expect a direct appropriation until after completion of the study phase.

A parent committee would be formed, composed of the task group leaders, several other key individuals, and both of us (a total of nine). Its purpose would be to provide direction to the working task groups, to coordinate activities between the task groups, and to resolve conflicts. The official name of this committee would be the Student Records System Study Group (SRSSG) (but it quickly got the nickname of Sausage).

We established a number of operating principles:

1. Mr. Hurd would be chairman of the committee and would lead the activity. All written correspondence would be issued under his signature.

2. Mr. Turner would function as an advisor to Mr. Hurd and would concentrate on the study mechanics and methodology.

3. We would coordinate our activities closely, meeting for working lunches every several weeks. It was understood that communication problems had caused many difficulties in past system studies, and we resolved not to let that happen in this instance.

4. We would carefully select the task group leaders and staff the committees.

5. Leaders would be academic administrators rather than information systems specialists.

6. The information systems specialists would play an advisory role (to the task group leaders). They would maintain a low profile and strive to be accepted in the group on the basis of working contribution rather than on the basis of position.

7. Operating procedures would be established, including meeting minutes, task descriptions, and schedules.

To give you some idea of the magnitude of the undertaking, consider the following: Many of the proposed task group members had never met each other, none of them had ever been through a systems study, and the participation of every individual would have to be negotiated without the benefit of additional compensation.

In July, 1974, we approached the Computing Policy Committee with a proposal to perform the study. The proposal was approved, and Mr. Hurd wrote to the appropriate deans and department heads requesting that particular individuals be appointed to serve on the parent committee---SRSSG. The composition of SRSSG is shown in Figure 1.

In order to convey the extent of the study group's responsibility, we will quote important parts of the initiating memorandum:

> Prior to our first meeting I thought it might be helpful if I put into writing some of the general goals on which I believe we must concur in order that our efforts to develop a modern student records system will have some clear direction...
>
> The business of the University is to educate its students and a student records system must be designed to serve that end. It should provide timely services and data needed by the schools and faculties so that they will be better able to perform their essential function. In addition, the system must be designed to provide the University, on a timely basis, the data it requires to analyze, order, and plan its activities and priorities.
>
> ...At our first meeting, I would hope at the very least that we could complete and refine what I have set down here. It is my hope, too, that we could discuss the shape and structure of the project so work can begin as quickly as possible. I believe we have been given an important assignment and that if we produce the results I believe we are capable of producing, our proposal will be implemented by the administration to its significant benefit.[18]

With the aid of SRSSG, the task groups were structured. All totalled, they involve some forty-five academic administrators.

We used a modified matrix approach to subdivide the system. Initial division was according to the natural student life cycle components---admission, financial aid, registration, current records, and inactive records. This had the advantage of bringing together power groups with similar needs. Furthermore, we staffed the groups with individuals of roughly the same level within the University, because we felt that their common functional interest would prove stronger than a parochial view or one formed out of habit. If attitude change was going to take place---if we were going to achieve some commonality of requirements---then it would take place within these groupings.

In order to provide parallelism among the task groups, each was asked to consider its area from the perspective of operations, financial accounting, analysis and statistics, academic administration, and data management. These considerations could be thought of as being orthoganal to the student life cycle subdivision; they represented interest areas which appeared to be important to the project and as such we wanted them specifically addressed.

Within this framework, the task groups were all to describe and document the existing system; evaluate that system; identify the requirements of the new system, drawing information from whatever sources were necessary and substantiating their requirements in each case; and define the data elements of the new system. Ad hoc integrating subcommittees were established jointly by task group leaders when the need arose. Problems or concerns were brought to us and we, in turn, usually presented them to SRSSG with a recommended solution.

This approach focused, at the working task group level, on the decisions and activities which had to be performed and the data which was necessary to perform them. Data was viewed as being separate from procedure and as cascading through the components of the system. The output of each task group would be a detailed report (in a standardized format to facilitate integration by SRSSG). At the SRSSG level, the process could be viewed as top down design, but since the task group leaders (who functioned in their task groups in a bottom up manner) were also members of SRSSG, both design approaches were represented.

What have been the results? Four out of the five task groups have performed extremely well. A cursory review of their draft reports indicates that the studies are thorough and of high quality. The data gathered by the groups has been excellent and they have uncovered dependencies of which we were previously unaware. They have been objectively critical of the existing system and, in almost every instance, have made constructive suggestions for remedying these conditions. Considering the differences in perspective which existed prior to the formation of the project, the amount of consensus achieved has been extraordinary. The groups have evidenced a high degree of methodological skill---one distributed a large questionnaire, and all have used the text editor system to store data definitions.

There have been some difficulties. The process has consumed a large amount of time on the part of important people within the University community. Expectations have been raised, and failure to meet these expectations can cause frustration. The coordination requirements are high. The process is a complex one and requires constant attention. We can say, however, that if we had to perform a requirements definition study of this complexity in an environment similar to Columbia's again, we would use the same approach.

We can summarize our results as follows:

1. In an environment such as Columbia's, thoughtfully structured groups do form an effective means of achieving consensus on system requirements.

2. All participants appear to have profited from the experience: The users now have a better appreciation of the totality of their functional areas, and the systems staff has a much better knowledge of the users' activities and constraints.

3. Important relationships have been established between the participants.

4. There is evidence of an attitude change on the part of the participants in the direction of agreeing on a common system and in the willingness to support the development of that system.

5. Changes have been made in the existing system which have resulted in significant performance improvements and cost savings.

Conclusion

We have described the process of system requirements definition as it is normally practiced. The success of this process implies a user functioning as a "rational" decision maker. An alternate model of the decision making process based on bargaining was introduced, and it was suggested that this model is more appropriate for complex organizations.

A method of achieving consensus using small groups was discussed. This method was illustrated by means of the Student Records Study Group project at Columbia. Although this project represents only one attempt to use this methodology, the results to date are extremely encouraging.

FIGURE 1

Columbia University

Student Records System Study Group

NAME	TITLE
Raymond B. Anderson	Associate Dean, Graduate School of Arts & Sciences
Patricia H. Calvelli	Assistant Controller
Henry S. Coleman	Dean of Students, Columbia College
Robert J. Cooper	Assistant Vice President & University Financial Aid Officer
Charles P. Hurd (Chairman)	Registrar of the University
Virginia T. Lief	Director of Institutional Research & Budget Planning
Karin Paulson	Assistant Dean of Admissions & Student Affairs, School of Business
Frederick B. Putney	Assistant Vice President for Medical Affairs, Health Sciences
Jon A. Turner	Director, Advanced Systems, Computer Center

NOTES

1. Jacques Barzun, The American University, Harper Colophon, New York, 1968, p. 96.

2. Gordon B. Davis, Management Information Systems, McGraw Hill, New York, 1974.

3. Donald H. Sanders, Computers in Management, McGraw Hill, New York, 1974.

4. Herbert A. Simon, Administrative Behavior, The Free Press, New York, 1957.

   Graham T. Allison, Essence of Decision, Little, Brown, & Co., Boston, 1971.

5. Allison, Op. Cit., p. 30.

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HOW DATA BASE MANAGEMENT

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The transition period between the use of multiple files and an integrated data base information system can be quite painful for both users and data processing personnel. Because the two groups have different perspectives on the change, careful planning is required to encourage cooperation. Management and Technicians need accurate and honest information about the implications of a data base system, but strategies for conveying this will be different for each group. Some possible approaches and their success or failure are presented in this paper.

The discussion during this period will deal with our experience at The University of Alabama affecting the decision to establish a data management system and the selection and testing of the system which we chose. We would like to consider this a case report.

The report is presented in two parts. First, I will talk about the policy and organizational implications which influenced our decisions regarding Data Base Management. I will also discuss the role of the Data Base Administrator in our set-up. I will be followed by Dewana Green, who will discuss the important features of our Data Management System; some experiences and results of our test of the system, and our plans as far as we can forecast them at this time.

I would suggest that our policy considerations were about the same as those experienced by you who have already decided on your Data Base Management approach. Those which I wish to discuss are: The Management Role, Selection of the Software Package, Training Needs, and the Development Schedule.

In order for us to decide on Data Base Administration we had to consider the levels of management involved and the relationships in existence. Since we would be involved in a number of data bases and systems whose performance, use, and protection was of prime interest to different Vice Presidents we had to examine the effect of data and file integration on their singular interests as opposed to the overall interest of the University. Fortunately, we have had full cooperation from top management up to this point.

We also had to look at the levels of management where relationships are focused sharply. We had to see if policies and supporting procedures need to be changed drastically and to examine the impact of these changes as they affect management. So far management at the operating level has shown a real willingness to get along.

When we began the selection process for the Data Management System, we were forced to consider the cost of a package. Although we had no promise of money for purchasing a package we felt that, with adequate justification, we could influence management to come across with funds. The underlying policy, however, was to acquire a suitable package as cheaply as possible. We were fortunate to have UNIVAC offer DMS-1100 at no cost. This influenced us to consider that system over others, at least through a testing phase.

We realized that we were at a real disadvantage in that we had no one who was trained to any significant extent in any Data Management System. So, we had to decide the extent which we would bear the cost of formal training in vendor courses and the methods for extending training to our technical staff. We decided after discussing the matter with UNIVAC and receving their cooperation, to send the Data Base Administrator (DBA) to UNIVAC courses, then utilize the DBA and a UNIVAC representative to train our applications programmers and Systems Analysts. At the present time we are training the programmers selectively - that is - we train those programmers who have developed or are developing an applications system which we are converting to DMS-1100. Although this may seem like a lost of repetitive teaching by the DBA, we find that we:

1. do not interfere in the development progress of a system not yet scheduled for conversion.
2. would not need to retrain programmers because they had forgotten the subject matter from the time training occurred to time of applying the skill.

We looked at two aspects of the development schedule. Because we were already into our fifth year in the development of our Management Information System (MIS), we couldn't undertake a conversion to DMS that would disrupt our schedule and its priorities. This fact, along with technical characteristics, of the applications involved, influenced our selection of the first system to be converted.

Our organizational considerations were fairly easy to deal with. At the time the decision was made to go with a Data Management System, we had already placed all the responsibilities and functions for developing an MIS package in one department and those having to do with Computer Center Operations in another. We weighed the pros-cons for placing the office of DBA under one or the other. We have seen instances where each approach has been undertaken. However, we decided to make the office separate from either and placed directly under the supervision of the Executive Director for Computing Services. The decision was based on:

1. The matter of standardization of data elements and codes bridged the MIS Dept., the Computer Center and the application users; therefore, jurisdictional disputes relating to this matter could be resolved more readily at a management level above them organizationally.
2. The difference in views pertaining to DMS-1100 system characteristics which conflict with application Systems characteristics and which should be over-riding could be ironed out quickly.
3. The development of feasibility studies relating to the utilization of DMS and its development would not carry the possible bias represented by the views of either the Computer Center or the MIS Dept. The studies would most likely be more objective because the interests of MIS, Computer Center, and the user would be dealt with without organizational constraints.

The issue of how much Technical Support was needed to provide good progress in DBM was considered. We realized that the first order of business was to establish the office of Data Base Administrator (DBA). But then - what else? We decided that, for the first year, we would be fortunate to advance through the steps of hiring the DBA, getting the DBA trained, evaluate data management systems, and select one, then complete conclusive tests. We felt that we could do this without hiring programmers for the DBA. Instead we would use UNIVAC technicians and applications programmers for the DBA as needed. Our first year is up and we plan to acquire a programmer permanently for the Office of DBA.

When we established the Office of Data Base Administrator we announced the responsibilities of the Office to be as follows:

1. To standardize the definition of data elements and related orders.
2. To record and publish these standard items in a Data Element Dictionary.
3. To participate in the development of the Information System structure to fit the DMS.
4. To assist in defining the policies and procedures for securing and making private the data base(s) and insuring that the procedures and policies are followed.
5. Act as staff coordinator among the users and data processing specialists on all matters relating to above four items.

At this time I am pleased to introduce Dewana Green, who is our very able Data Base Administrator. She will tell you the "sweat and tears" stories of her experiences for the past year.

Since this system was already available to us through our contract with UNIVAC, we were able to use one of the University's established computer files and programs for testing. (I will use the word "system" for the rest of the paper to indicate a particular grouping of computerized files, procedures, etc. to serve an administrative need). A portion of the Financial Aids system was chosen for the test of DMS 1100 for several reasons. First, the system had just undergone major revisions and therefore would be relatively stable for a year. Also, we wanted to begin in the student area, and while Financial Aids did use data from other student systems, it was one of the few systems that could function more or less independently of the others. In addition to these reasons, there were also political considerations that encouraged us to begin in this area.

After several weeks of training from UNIVAC, I hired a part-time programmer and we both started writing programs. I was programming because I felt I needed personal knowledge of the learning curve, and I can testify that I now have empathy for programmers who are accustomed to dealing with traditional file structures! While it is true that data base administrator should not be the programmer, a "hands-on" knowledge of the data management language and system will make your expectations and demands more realistic.

Following this initial testing phase, the programmers and systems analysts who would be implementing the next phase were chosen and sent to DMS 1100 class. This can be a difficult time, since you want to avoid making the excluded programmers angry, but because our organizational structure requires a pool of DP personnel who are assigned to certain areas, it was logical to train only those people already assigned to the Financial Aids systems. Nonetheless, we still had to deal with some personality conflicts.

Common sense dictates that your transition to a data base system will be on a modular basis, but you must always deal with those interfaces to other areas. Which did we include in our design now and which did we leave until later? We based our answers on the results of two other questions: first, how much more complex would this interface make the proposed module; and second, what would it cost us in terms of programming time and procedural changes to postpone the inclusion. Sometimes the answers to these questions indicate which area or system should be the next module to include in your data base.

As you begin listing the data elements necessary for the first data base system, the question of standardization arises immediately. If an element, such as a student's name, is to occur only once; then its form and definition must be agreeable to all potential users. The data base administrator has a major task in locating all external requirements, such as federal government reporting forms, and then soliciting accord among internal users. Not only must the users and reporting requirements be satisfied, but the administrator must also deal with the computer system's requirements and limitations, and all three seldom agree.

We are now running the data base Financial Aids system in parallel with the multiple file "old" system. It has obviously been a learning experience for us, but one that has paid dividends, and will continue to be beneficial. With the hope that it will be helpful to you, we'd like to list our evaluation of the past year:

Negative aspects.

1. We did not choose the apparent logical starting point, which was the Admissions system. But we did choose the most feasible system at that time.

2. The programmers and system analysts did not feel involved in the decision to convert to a data base system and resented it to a certain extent. Some in-house, short seminars might have helped ease the transition prior to the actual training.

3. Top management was not really aware of the manpower requirements to achieve their expectations. The personalities and ambitions of the people you actually have available will have an impact on the timing of the project.

Positive aspects

1. Because almost a year elapsed from the time I was hired until we actually put a system under the data base, no one felt threatened by a "take-over". Of course, making the initial move this slowly required an understanding management.

2. Scheduled meetings and informal talks were held with users to educate them to the advantages a data base system held for them. If a user is convinced of the advantages to his department, he will be a more enthusiastic supporter.

3. The analysts became convinced, through experience, of the reduction in file maintenance time after converting to a data base. This time can then be channeled into synthesizing better information for management.

SUMMARY

The transition between an application-oriented, multi-file system and a data base system needs to be carefully planned, since the change requires the understanding that computerized data will now serve a community of users. We offer the following suggestions as reminders of some of the problem areas.

1. It is easy to recognize the need to work with department heads and others who are accustomed to thinking of "their" files, but the technical DP personnel must also be sold on the advantages. Programmers especially need to feel the system will benefit them.
2. Any software package that is chosen must be tuned to meet your particular requirements, not only in terms of mass storage allocation, but also buffer size, etc. The design of the data base will reflect the decisions and compromises in turnaround time, physical placement of data, and logical links.
3. The change to a data base system will be faster if your present computer systems already adhere to certain data standards, e.g., name prefix codes, abbreviations for states, field lengths for an address. Otherwise it is imperative to elicit agreement among the users on such standard items before you can load the first data base.
4. If your vendor offers technical training for DP personnel, then take full advantage of it. However, do not hesitate to supplement that training with in-house sessions devoted to your particular problem. The answer as to which programmers to train and when depends on your situation.
5. Do not overlook the value of contracts with other schools using data base systems and even industry contacts using your vendor. Vendor user groups and conferences like CAUSE can contribute fresh ideas and sometimes provide you with a solution to your problem. At least they give you some comfort in realizing that no one has made the changeover to a data base system without many problems.

A GENERALIZED MIS: HOPE OR DESPAIR

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This paper considers the impact the computer technology has had on administrative computing services in colleges and universities. With the steady state era in education and stabilizing or declining data processing budgets, the computer center manager is beginning to consider the purchase of generalized information systems as an alternative to in-house developments. This paper outlines a few of the perceptions and caveats from the point of view of a developer of such systems and an institutional user. The authors address characteristics of successful and unsuccessful attempts to use generalized systems.

It is the purpose of this paper to survey the impact that computing support has had on campus administrative services, to consider the alternatives in developing computer-based information systems, and to synthesize the experiences of a developer and a user of generalized information systems. The authors will use the term 'generalized management information system' to represent a computer-based system developed external to a campus. This system is used by the campus to support the administrative and managerial activities of decision makers.

Evolution of Computer Systems

In the past decade we have witnessed an explosive growth both with the rate of invention and the acceptance of computer technology on college and university campuses. Innovation on the hardware side of the computer environment has only been limited by marketing impact, and even within this limitation cost performance for key parameters such as core memory size, cycle time, and random access capacity are increasing generally by an order of magnitude every five years (Benjamin, 1971). There has, as well, been a dramatic increase in the need for hardware on campuses in recent years related to the increased demand for computational support from students in instructional programs and faculty with research grants. The acquisition of computer hardware has been promoted by subsidies from the National Science Foundation and sizeable discounts from equipment manufacturers. In this growth era of the late 1960's and early 1970's, many college campuses obtained third-generation computer technology (or access to the same through remote job entry stations) and a large number of the available options including: sophisticated operating systems, improved data access methods, higher level software languages, time sharing through remote terminals, and data base management systems.

Recent studies documented the increasing applications of this hardware and software technology to campus administrative functions. In the early 1960's, computers began to replace the campus 'tab shop' (mechanical equipment for card punching, reproducing, collating and tabulating) in performing manual and clerical administrative operations (Mann, 1975). These early applications gained the acceptance and confidence of management because of their impact in cost reduction, clerical displacement (or stabilization with increased volumes of workload), and control of administrative expense. Perhaps it would be more accurate to point out that these early efforts served more to polarize management acceptance of computer support for it was the success or failure of the first few computer-based systems that gained or irreparably damaged their confidence.

Until recently, most of the administrative uses of computer technology in academic institutions have been directed toward applications at the operations or transactions level (e.g., payroll, fund accounting, student records, etc.). These have been oriented toward increasing the speed, accuracy, and general effectiveness of the day-to-day operations of the institution. Recent estimates indicate that it is not unusual for an institution to support from 15 to 30 different operational systems (Brady, 1975). As such systems have been developed by administrative computer systems departments (who themselves have rapidly grown in responsibility, expertise, and sophistication), it is understandable that each system is frequently designed to meet the needs of one using department with relationships among various systems less rigidly defined. Today, operational systems comprise the great majority of administrative computer uses in colleges and universities, though they provide only minimal support for the kinds of management information needed by top level administrators for institutional control, policy making, and planning (Mann, 1975). As the operational activities on campus are automated, it becomes possible that the data from these many systems be integrated to provide past, present, and projected information to management to assist in institutional decision making. The systems that provide this information are frequently referred to as management information systems. The motivations and priorities on campus for development of operational systems and management systems are varied.

Colleges and universities have demonstrated an increasing need for computer-based information systems that support both operational and management administrative service functions on campus. This need is precipitated in part by societal and economic pressures that are demanding increased accountability from institutional administrators. Declining or stabilizing institutional budgets, fewer funds for research grants (that often indirectly support computing), declining government subsidies to the institution (e.g., G.I. Bill of Rights) or directly to computer support (e.g., NSF) and practically non-existant manufacture discounts have, however, had the effect of severely constraining the development of computer-based systems on campus. These events, then contribute to an interesting paradox. That is, many of the events that create the need for innovative planning and management techniques are serving also to limit the institution's ability to acquire the people and materials necessary to develop computer-based systems to support such innovations.

Managers of computing and information systems departments have devised a number of alternatives for dealing with these budgetary problems. Some, for example, have elected to reduce supplies and services expenses and to cut back on certain computer options in order to keep together the qualified staff which has built up over the years. This practice is not only humanitarian, but reflects a belief that the financial stringencies are temporary (Farmer, 1972). In addition, managers are considering alternatives to the in-house development of systems. For example, there are now a large number of generalized information systems (supporting operational or management activities) that provide a substitute to development of systems in lean budget years. These, then, are systems purchased from an off-campus agent that directly support administrative operations (e.g., payroll, personnel, student records systems) or support the management functions of control, policy making, and planning (e.g., cost analysis, cost simulation, workload analysis, budgeting systems). Generalized information systems offer the advantage of: 1) sizeable savings in the time necessary for development and installation of systems, 2) having a contractual agreement for a system at a fixed cost, and 3) purchasing considerable experience and speciality through the developing agent. There are, however, certain disadvantages to this approach that include: 1) having a system developed that doesn't exactly satisify the institution's needs, 2) the general propensity of external agents to promise the world and provide a small portion thereof, and 3) the problems with integrating such a system with other existing systems on campus.

In recent years there has been a proliferation of agencies that provide administrative information systems. These agencies include: 1) those that encourage the exchange of existing administrative systems among institutions (e.g., College and University Systems Exchange), 2) those that develop generalized approaches to planning and management systems (e.g., National Center for Higher Education Management Systems and most computer hardware vendors), and 3) private consulting firms or individuals who provide information systems and varying levels of support in training campus managers to effectively use the information in decision making (e.g., orientation workshops on strategic planning, budgeting, program planning and review, etc.). Such systems are all considered to be 'generalized information systems' as they each are developed to support a specific administrative function (operational or management) but typically reflect the generalities and assumptions of the external developer rather than of the institution.

It is the opinion of the authors that each of the three alternatives for the acquisition of generalized information systems can and does provide a workable solution to the development of computer-based information systems. There are, however, numerous cases of unsuccessful attempts to effectively use each alternative. The remainder of this paper will provide a few thoughts and opinions from the perspective of a developer and a successful user of such systems. Each will outline the caveats for successful use of generalized information systems. The authors first agreed on a graphical construct for systems design that will be a helpful framework for further discussions.

Developing an Information System

The development of a system to produce information, whether for operational or management purposes, implies an important cooperative effort between the technician/developer (either within or external to the institution) and the system user. These relationships might be explained using the construct shown in Figure 1.

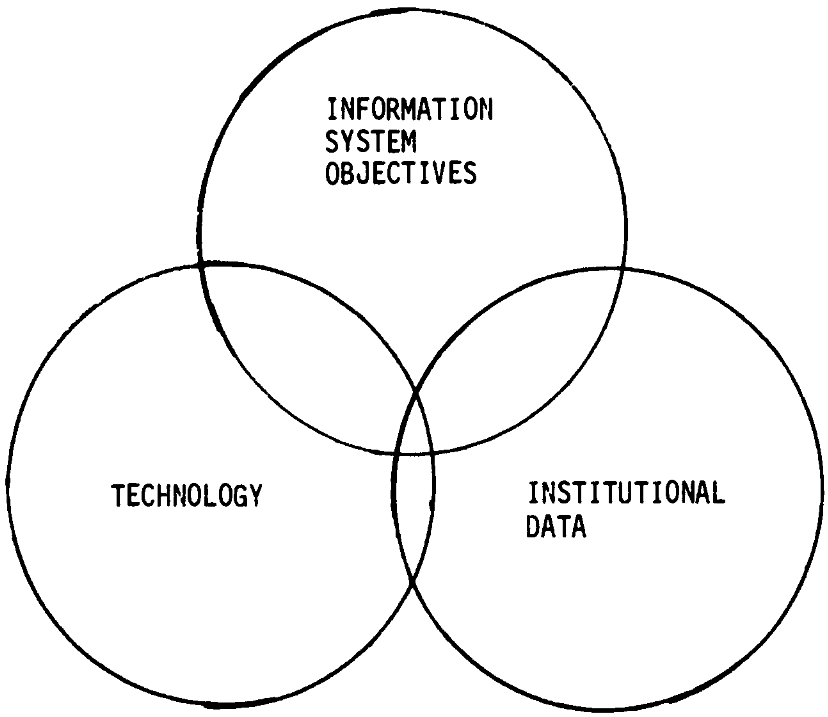

Figure 1
Systems Design Construct

The diagram points out the key components in developing an information system and implies there are relationships between each. Any system must have objectives that include a statement of the functions the system is expected to perform. Generally, a problem that arises is that: the user cannot state his requirements in the language of the computer specialist, and the computer specialist does not generally restate the user's requirements as he understands them in the language and terminology of the user. This inability to communicate at the technical or more general levels frequently results in one or both parties abdicating their responsibility to operationally define the systems purpose. An apparent lack of agreement in the purpose of the system can result in a final product that isn't what the user needs and expects. A statement of system objectives includes, as well, the criteria for evaluating the success of a system. That is, some measure of how well the system satisfies user requirements and, as important, economic measures used to monitor the systems efficiency such as cost per transaction, cost per month (fixed and variable), manpower requirements, etc.

The technology component of systems design includes the computer-based hardware, software, and technical personnel that will support the system. The technician/developer has the responsibility of understanding the capabilities of the institution's technological assets. While this is a technical training requirement of significant (and proper) importance to systems managers, there is a more critical need for the developer to use these assets to meet the information systems objectives in a cost-effective environment. The user of information systems must, as well, have some understanding of the technology in order to understand and consider her/his alternatives in system designs.

The third component in our design framework includes the vast amount of data available throughout the institution describing its many operations and activities. The union of each set then includes the data that can be collected, stored, and manipulated by the current technology to accomplish the information system functions (objectives).

It is recognized that there are a number of potential problem areas that appear when an institution attempts to apply such a conceptual framework to a specific system development task. Guidelines for development of systems, while often theoretical, do provide a basis for communications and coordination between user and developer.

Observations of a Systems Developer

All institutions, large and small, public and private, already have some form of a management system. That is, a systematic technique for collecting information (or data) and using it judicially in the formulation of alternatives that lead to a decision. This existing system must obviously work to some degree or the campus would not continue to operate. A study of the existing management system on any campus would show that while being systematic and rational, it also reflects the personality and management style of the executives who use it to direct the campus. No standardized information system superimposed over the existing management structure of the campus can be expected to work adequately. In fact, under some conditions, the arbitrary application of standardized information systems can be destructive to the organization. It is imperative, then, that campus executives insure that any information system, whether purchased or developed in-house, recognize the uniqueness of the organization and accommodate different styles of leadership and operation. This, then, requires a significant involvement of management including: 1) selection and definition of the explicit role of the computing services department, 2) setting priorities for information systems development consistant with plans for future management innovations, and 3) active participation in the statement of objectives for an information system and the identification of measures of its effectiveness. This participation by all levels of management avoids the unfortunate circumstance where the technical developer dictates what information is to be provided or judges what information is necessary, thus influencing management style. Where generalized information systems are acquired, campus personnel must insure that the information that results complements their decision-making structure.

When a campus obtains a generalized information system from an outside source, the campus must recognize its responsibilities in the design, refinement, and/or installation of such systems. A generalized system is occasionally confused as a gift wrapped package that is purchased, unwrapped, and 'plugged-in' on campus to immediately begin assisting in the provision of administrative services. Any system produced by a set of developers who are external to the organization must be tailored to fit the enviornment in which it will be used. Such tailoring allows for organizational uniqueness and constructs the necessary linkages to other information systems on campus. So the acquisition of generalized information systems doesn't preclude the need for technical computer trained personnel, but redefines their role as that of design, refinement, installation, and interfacing of systems. The final caveat suggests that occasionally both the external developer of systems and the campus user of such systems are at fault in failing to understand and articulate their relationship. First, each party should recognize that the developer (consultant) who sells or exchanges information systems has expertise in limited areas (e.g., systems development, data processing, management, organizational behavior, etc.) and that advice or counsel in unrelated areas (e.g., decision making) is not unlike asking a heart specialist to tune your car engine. The developer should be prepared and willing to identify the areas of his speciality. The user, then, should understand the credentials of the developer and make an effort to use the expertise to his best advantage. Secondly, both parties should consider whether or not there is a need for computer support in the particular application being proposed. Finally, the developer and institutional user should both be willing to consider the possibility of unsophisticated systems when necessary.

Observations of an Information System User

Successful installation of a large generalized information system relies importantly on communications between the user and developer of such systems. The user must understand what a system will provide, at what cost, and the part it will play in an overall plan to set policy, plan future activities, and control the institution's operations. The developer, on the other hand, serves as an asset to the user by assisting this understanding, assessing the institution's need where necessary, and providing systems as designed.

We must recognize that success of a system to the user is broadly described and measured in terms of its utility in supporting decision making on campus; while to the developer, success is often construed as maximizing profit, minimizing user dissatisfaction, and providing future product marketability. Communication is an important part, then, in first recognizing the objectives of both user and developer, then promoting an environment where the objectives of both can be achieved. Inexperience with computer-based information systems on the part of the institutional manager often causes a dependancy on the expertise of a vendor. While such a situation can be quite effective, it more frequently creates high expectations on campus and sets a climate for future unhappiness and failure.

The following planning and management framework includes suggestions for enhancing communication and understanding between user and developer and thereby improving the relationships outlined in Figure 1.

Institutional Master Plan

The basis for all information system planning should be rooted within the institutional master plan. However, the master plan, regardless of its depth and comprehensiveness, is but a temporary guide, not a final solution (Halstead, 1974). As the master plan changes from its original objectives, so must the information system respond, if necessary, to these changes, and therefore, the relationships shown in Figure 1 are altered. The master plan, then, should provide a guide in establishing information systems objectives. A resulting information system must be 'open-ended' to accommodate deviations, where they occur, from a master plan and continue to provide timely, accurate information.

Information System Definition and Goal

A broadly stated goal for an information system is to support orderly decision making related to the organizations planning and management objectives. The user must develop a system definition consistant with the broadly stated institutional goals, satisfying some problem definition (e.g., we need a better payroll system), and providing management with measures of organizational effeciency and effectiveness. The management user of systems should be acquainted with the organization's hierachy of information systems.

Efficiency is a measure of an organizational unit's ability to use a set of resources in the production of output (a good or service) for the institution. Efficiency, then, is a measure of output per unit of input (e.g., resources). If the available resources are to be used efficiently, institutional planners and managers must maximize 'outputs' for a given amount of resources (Hitch, 1970) or minimize 'inputs' for a given amount of outputs (Chirstenson, 1968).

For effective planning and management, efficiency cannot be an end in itself. Effectiveness is concerned with operationalizing the institution's goals and periodically measuring the degree to which the institution achieves these goals. The prudent use of efficiency and effectiveness measures tempered by sound judgement are the crux of institutional decisions.

An organizational hierarchy of information systems, as mentioned above, categorizes systems into three levels:

1) Those known as operational systems which support the administrative functions necessary to operate an institution (e.g., payroll, accounting, student records).

2) Those known as management information systems (MIS) that are built upon the first operational level and provide information necessary for management to monitor and control those operations.

3) Those known as planning systems that occupy a third hierarchical tier, use aggregate data from the MIS level, and support the formulation of policy and institutional plans (Sheehan, 1972).

A system definition, then, must recognize this tiered relationship and allow the provision of data in appropriate aggregations to support each management function. A generalized information system is either operational, management, or planning in nature and consistant with this hierarchy.

Acquisition of a System

Once the general goals of the system are known, the campus administrator must select from alternative means for development of the system including: 1) design and development by his institution's computing services staff, 2) considering the adaptation of an existing system, or 3) negotiation of a contract for development of the system. Each alternative must be evaluated in a cost-effectiveness environment. Two important considerations in such a decision are negotiation where it is necessary and the final evaluation of the system's impact. Both of these issues should be considered before a system is acquired.

When an institution elects to have a vendor contractually develop a system there are a host of issues that surface immediately. To insure user success the following points are important:

1) Agree upon the performance criteria to be used to evaluate the system's effectiveness in meeting design specifications and efficiency in the use of available computer resources.

2) If possible, negotiate a lease agreement with an option to buy if the system performs as expected.

3) Negotiate a sound legal contract from the institutional point of view. A study of government contracting is helpful.

4) Consider competative bidding among vendors who have otherwise equal qualifications.

5) Define the role and involvement of the vendor, user, and technical in-house staff.

These are but a few of the many considerations in producing a contract for systems that allow some flexibility to the developer for innovations, while assuring that the institution's expectations are met. A point of view by many is that a contract can be as important as the system. Laxity in contract negotiations can lead to differing expectations and potential failure.

System installation, like system definition, should involve a task force of institutional representatives who share the responsibilities of training other personnel and evaluating the system. Training should be provided, where possible, by the developer and carried on by the task force.

Evaluation of a system must consider the extent to which it meets its contractual obligations and its ability to run in an operational environment following installation. McKinsey (1968) summarized this in an international survey of industrial corporations, by noting three dimensions of management system performance: technical feasibility, economic feasibility and operational feasibility. The third dimension, conspicuously absent in system failures, roughly translates into the requirement that the developed system be understood and used by managers.

Finally, we must recognize that the present criteria for evaluating systems (clerical displacement, cost reduction, and control of administrative expense) might be appropriate for those systems that support the day-to-day operation of the institution, but are much less useful in evaluating management information and planning systems. Kriebel (1970) and Diebold (1969) suggest that evaluation criteria for such systems might include: reduction in inventories or cash balance; personnel stability; improved customer (student) relations; cost control; improved negotiating position; improved vendor relations and performance; optimum use of plant; more realistic forecasting; improved program planning; and improved resource planning. Clearly, the future holds improvements to the state-of-the-art in evaluating generalized (and other) information systems.

Conclusions

The topic and much of the focus of this paper was generalized information systems that support administrative operations, management, and planning. The material, however, is appropriate in considering the design, development, and use of any information system. Whatever the purpose, it is important that management (users) and technicians (developers) create a climate that includes involvement and a full understanding of the purpose of a system. Both parties must recognize the expertise that each brings into a systems development effort and strive to use these talents effectively.

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INFORMATION UTILIZATION AND MANAGEMENT DECISION-MAKING

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This paper examines how typical organizations actually obtain and utilize information in daily operations. Better understanding of the quasi-rational processes of data collection and use by managers can be useful in the development of information systems. The author examines some of the organizational constraints and influences of qualitative information on decision-making, as well as explores implications for adapting information systems and strengthening management effectiveness.

Organizations which provide services to people face increasing demands from consumer groups and funding sources for greater accountability, including the demonstration and evaluation of program performance by explicit criteria. In both public and private institutions, acceptance of traditional operating procedures is declining, and organizations are confronted by the difficult challenge of re-examing practices against some specific performance measures. Often there are differences of opinion over exactly what results a program is intended to produce, as well as the choice of relevant indicators of outcomes. At the same time, there are conflicting pressures to modify existing procedures and to implement alternative methods, on the belief that these will lead to greater achievement of the organization's goals.

In order to foster more responsive and effective systems for delivering health, educational, or welfare services, planners are developing extensive procedures for obtaining and utilizing information about targeted human needs and preferences, and are monitoring and assessing the impacts of alternative approaches to such objectives. Program-relevant findings must then be transmitted to the decision makers and administrators of programs for use in modifying and reshaping programs. The processes of collecting, assessing, and utilizing such information are crucial to the design and management of more effective services. In actual practice, however, decisions often seem to be made upon the basis of quite limited information. New information and knowledge can often go unrecognized, and technically magnificent systems for information retrieval go unused.

The field of information systems has extensively addressed the issues of data collection, processing, and presentation. Actual utilization, however, has not been so successfully demonstrated.

Originally developed to perform repetitive tasks on large batches of simple figures, data processing systems have been greatly expanded to deal with much more complex types of information. Their potential for contributing to macro-level planning and management decisions was soon recognized and addressed. An elaborate processing technology has developed, with numerous components for measuring, storing, and printing out data on vast ranges of variables. However, our technology in this area seems to have advanced far more rapidly than has our ability to use its potential effectively and efficiently. It is not secret that widespread public disillusionment from the actual experiences of trying to use automated systems of data collection have resulted in far more critical views of them. Hopefully, such experiences will lead to more balanced and realistic expectations of what we can expect them to contribute to the planning, management, and evaluation of programs.

The author's experiences in developing and trying to sustain computer-based information systems led to an interest in this all-too-frequent problem of breakdown after the system had been so carefully designed and installed. Reams of print-out filled shelves, with little impact on staff, except perhaps to aggravate their burdens of collecting and processing the volumes of data into the system. Why is there so consistently this "slip between the cup and the lip?" What can be done to make the technology more useful?

Such questions as these prompted an interest in exploring the utilization problem. Setting aside the technology of information systems for the moment, the author became interested in examining the factors which influence how typical organizations actually obtain and use information in their daily operations. If such an exercise could be fruitful and we could better understand the usual processes of information utilization, perhaps systems designers and users could join forces, taking this information as input into systems development and modify our approach to automated systems to make them more responsive to their intended users.

A quick review of the literature on information systems and decision making reveals numerous rational and normative models of such systems. Many of these models rest upon such questionable assumptions as: (1) an organization has a single objective toward which all activities are oriented; and (2) decisions are made with perfect or near perfect knowledge of options and consequences (Edward & Tversky, 1967; Papandreau, 1952:183-219). Neither assumption adequately describes the actual circumstances of organizational activity. At a less abstract level, others approach this area by assuming the constraints of automated data-processing systems and then considering how managers should adapt themselves to efficient use of the technology (Brady et al., 1975).

The influences and constraints upon managers seem to be far more complex than generally recognized in such literature. Hence, it seemed necessary to explore alternative frameworks for describing how organizations actually utilize information and arrive at decisions. Let us examine the functioning of organizations which provide education, health care, or other human services. We will pay particular attention to how managers and staff utilize information to make decisions in their daily operations, as well as to some of the implications of such factors for the design of information systems.

A Descriptive Framework of Organizational Decision Making

Goals and Decisions

The basic conception of an organization underlying our perspective is that of coalitions of individuals, grouped into subcoalitions, and manged by a dominant coalition. The participants are likely to have quite divergent individual motivations and goals. The organization arrives at some overall goals through bargaining and compromise among the coalitions. The derived goals are subsequently stabilized and elaborated through internal organizational processes of social control. Coalition agreements are adjusted and modified over time in response to environmental changes (Dahrendorf, 1958:174-179; Cyert & March, 1974:127-136).

Thus, rather than having a single, well specified objective, most organizations can be characterized as having several objectives somewhat imperfectly rationalized in terms of broader, vague, general goals. Certain groups in the coalition have a dominant influence over resources. This control is accomplished by a definition of the nature of the tasks of the organization, which rationalizes the division and allocation of component assignments to divisions or groups within the organization, as well as the rewards they receive.

Among the essential requirements for goal attainment in organizations is a system which will take in information about their activities and the environment; filter, process, and communicate such information; and render decisions which guide the behavior of participants. This system follows more or less regular patterns or sequences. These organizational processes are shaped by such factors as the distribution of influence among participants, the negotiated objectives, commonly accepted operating procedures for work, and general guidelines for responding to novel situations (Katz & Kahn, 1966:235-247).

Management of Uncertainty

The admininistrative center of an organization seeks to cope with and control the diversity of interests of participants as well as the numerous uncertain environmental influences upon the organization. Routines and procedures are thus set up which categorize and regulate the activities of participants.

The system of organizational control includes such components as: patterns for performing tasks; channels for handling information; and procedures for handling novel situations. These components may be more or less standardized into rules or standard operating procedures. Standardization of work tasks is a major method of coping with program uncertainty, and of increasing predictability and control in any organization (Etzioni, 1964: 58-74; Perrow, 1970:51-57).

The extent to which activities may be routinized is related to a number of factors. Perrow (1970:75-91) suggests two crucial considerations: (1) the degree of specificity of the technology utilized, and (2) the extent of uniformity and stability of the objects or material with which the organization deals. Where techniques are well specified and materials are uniform (such as a basic industry) the decisions are few and mainly involve selection among known alternative responses to recurring tasks upon the materials. Conversely, when either the technology is not well developed or the objects are not uniform or well understood, the necessity for frequent search for alternative response is increased. This latter case is more typical of educational or health care organizations, which have to deal with individualized services to diverse people.

A crucial consequence of whatever standardization and division of tasks that exists in an organization is that each unit in it deal with only a limited set of problems and a limited set of objectives. Thus, the organization can avoid having to rationalize every activity in terms of a single goal or to solve every problem at once. A basic task of management is to oversee the decisions and activities of all the various divisions and to maintain some acceptable degree of overall productivity and coordination among them.

Decision Making and Planning

A cross-sectional examination of the decisions in any organization may reveal an apparently illogical and inconsistent order. Each organizational unit is likely to respond to problems or conflicting pressures by acting sequentially toward its goals, solving one problem at a time. The emphasis is upon short-run reaction to immediate feedback, rather than the development of long-run strategies or plans in anticipation of uncertain future events (Lindblom, 1965:3-24; Cyert & March, 1964:117-118).

The major preparation for possible future events for the total organization is made through a number of control devices for stabilizing the environment as much as possible. Contracts with external agencies represent one such means of coping with uncertainty in the external environment, while internal planning processes, such as budgeting, provide a negotiated internal stability. In sum, organizations:

> . . .achieve a reasonably manageable decision situation by avoiding planning where plans depend upon prediction of uncertain future events and by emphasizing planning where plans can be made self-confirming through some control device (Cyert & March, 1963:119).

Information Search

The search for information in an organization is stimulated when it encounters a specific problem which requires a solution. Such solutions involve incremental adaptations to problems, rather than optimal changes. Discovery and selection of optimum alternative solutions require procedures much more complex than the mere finding of an option satisfactory enough to do the job (Taylor, 1965:48-86; Charnes & Cooper, 1958:450-458). Thus, organizational problem-solving must be distinguished from the more abstract search for knowledge that characterizes academic research or the more rational sequences underlying management information systems. (Guetzkow, 1959; Havelock, 1970).

An organization or an individual participant recognizes a problem when a block to the satisfaction of some objective is encountered or anticipated. Sequential review and selection among familiar concepts or skills, on the basis of their direct contribution to solving or controlling the problem, will be stressed. The problem situation may be resolved either by discovering an acceptable alternative that satisfies the goal, or by revising the goal to a level that makes an available alternative acceptable. As soon as a satisfactory solution is found, search will cease (March & Simon, 1967:179-180; Cyert & March, 1964:120-122) and with it will go the interest in the system which provided information for that search.

Besides requiring the existence of a problem, organizational search is likely to be restricted and parsimonious; that is, it will be confined to straightforward and familiar explanations of the situation until these are seen as not resolving the problem. Further search will then emphasize finding explanations closely associated with the problem symptom and as close as possible to current organizational responses. Only when familiar causal assumptions are seen as unsuccessful will the organization consider more distant or novel activities (Perrow, 1970:75-79).

The screen through which organizational participants view and assess alternatives is biased by their own training, values, interests, and goals. Proposed solutions are filtered on the basis of their <u>proximity to existing goals</u> and their potential for <u>minimum disturbance to existing assumptions and distributions of influence</u>. Such screens serve both to ward off new explanations and to maintain the existing structure and repertoires of behavior (Mannheim, 1952:33-54).

As problems central to the organization's attainment of basic goals go unresolved, rival explanations and proposals begin to compete for dominance. The biases and interests of the various subcoalitions influence the ensuing search and negotiations. As Berger and Luckmann suggest (1967:109-118), the usefulness of any proposal is demonstrated not so much by its virtue as by the political interests of the group that has become its carrier.

Innovation

Departures from traditional practices in an organization are closely related to changes in its environment, technology, or materials, which make the existing assumptions and standard operating procedures unsatisfactory. Hence, one would expect greater efforts toward innovation in an organization, school, or department whose funds, staff, clientele, or community support were declining. The relative extent of attention paid by management to information from such sources, as well as the extent of dissatisfaction registered, may vary. Nevertheless, it may be anticipated that innovation will take place following recognition of diminishing social acceptability of the organization's programs or other basic threats to its continued operation (March & Simon, 1967:172-188; Glazer, 5-8).

The organization's search for adaptive responses to such threats will be heavily influenced by the nature and accessibility of new ideas and information; by the communication structure through which information and proposals are presented to decision makers; and by the timing and sequence in which such data are presented. The types of ideas considered will be influenced by differential exposures and interests of participants who encounter new information, as well as by the selective filtering of data during its transmission through the organization.

As previously described, it may be expected that as awareness of a problem grows, solutions will first be sought from among the familiar repertories of participants. The greater the problem, the wider the participation in searching for alternatives and in the diversity and innovativeness of solutions considered (March & Simon, 1967:189-210). Alternative proposals will be examined sequentially and filtered on the basis of their proximity to previous assumptions, operating procedures, and allocations of resources, as well as by their familiarity and acceptability as a solution to the problem (Katz & Kahn, 1966:253-257).

Over periods of time, organizations may be seen as adapting to changes in their environment and arriving at acceptable levels of goal attainment. Such negotiated stability or equilibrium is temporary and continually changes as a result of their experiences. Changes may occur over time in the goals an organization seeks, in its attention and responses to environmental changes, and in the processes by which it searches out solutions to problems. An organization may learn to pay attention to certain indicators of performance and ignore others, or to observe closely some parts of its environment and avoid others (Cyert & March, 1964:123-125). Likewise, the organization may develop more effective procedures for communicating such information internally, classifying it, and utilizing it in decision-making.

Some Implications for Development of Organizational Information Systems

A basic stimulus underlying the descriptive examination of organizational systems for information gathering and utilization is the apparent need for some concepts and strategies to guide our attempts at purposive intervention into such systems. The design and management of more effective human service programs depends highly upon understanding the methods of active intervention in ongoing organizational processes. This is necessary to develop more adaptive and responsive systems for (1) goal formulation, (2) environmental scanning for goal-relevant information, (3) searching among new knowledge sources for alternative responses to problem solution, and (4) decision making to maximize desired outcomes.

Recognition of Problem

From this and other inquiries into such change processes, a number of implications are suggested for helping organizations strengthen their capacities to obtain, assess, and utilize relevant information for decision making. Recognition by the organization's participants, particularly top administration and management, of the crucial influence of information upon decisions, and ultimately upon the achievement of goals, is a basic and essential component for organizational development in this area. Without such support, any efforts at formalizing, routinizing, and accelerating the organization's system for obtaining and handling information is doomed.

Educational and service organizations do not often extend their search activities to the point of actually examining their own decision-making processes or the nature and sources of information utilized therein. However, the current mounting public pressures for accountability and demonstration of results, as well as declining resources, are likely to increase the frequency and extent of such self-examination.

Building Upon Existing Systems

Rather than assuming at the outset that a totally new information system should or could be implemented in an existing organization, it seems more feasible to emphasize building upon the existing informal information handling procedures and strengthening the organization's processes and structures for decision making. Thus the initial focus of organizational development would identify the problems which make the existing system of information collection and communication unsatisfactory.

While the systems designer may have some grand and ideal plan in mind, few organizations will sustain the necessarily costly investment of time and money to operate such a system. Hence, the designer must move at the organization's pace and develop <u>incremental</u> adjustments in the existing informal system. While the "grand design" of the developer may provide a framework for his operations and guide his recommendations to management, the other interests of organizational participants will constrain his contributions to that level of development which is acceptable to participants, supportive of their interests, and feasible within the limited organizational resources they will allocate to such an effort.

Thus we would propose approaching systems development and implementation in an organization from the perspective of making gradual, incremental adjustments in its existing and familiar procedures, rather than directly adopting or implanting some new pre-packaged, automated information system. Such an approach reduces the extent of organizational change necessary, and can fortify the efforts of the organization to implement the adjusted program. The frequency with which the extensive, automated systems fall into disuse further underscores the necessity of backing up and giving careful thought to the actual needs of the users. Incremental extensions of existing information-handling procedures appear much more likely to survive and be actually utilized, despite their technical inelegance (Dearden, 1965:65-73).

The frustration of the designer over the incompatibilities between such highly idiosyncratic systems must be acknowledged. Exchange of data and comparisons of variables across organizations are important objectives to the designer and perhaps also to some state and federal planners. But to the administrator of a specific organization, other objectives are comparatively higher in the set of priorities, and hence the resources necessary to implement the designer's objectives will only be available if more immediate organizational priorities are satisfied. Even the public planners are also likely to find themselves extensively constrained by political factors, regardless of what the "facts" seem to show. Probably the best we can hope for is the slow improvement of political, and administrative decisions through gradual extension of the use of systematic information on the issues at hand.

Another source of disillusionment with some of the formal information systems is their tendency to provide managers with large volumes of data on everything easily quantifiable, while omitting the more qualitative information which may be highly relevant to decision-making. The latter includes such critical information as priority and value factors in the external environment, internal capacity and performance indicators, as well as the more familiar service inputs and process factors (O'Brien & Service, 1973:35-38; Spencer, 1962:4-12). Such factors may be only partially quantifiable. Most administrators intuitively distrust systems output which purport to reduce decisions to single indicators and make their familiar protests regarding the uniqueness of their situation from all others. It may be a better approach to systems design to frankly acknowledge that there are some things that a formal system cannot do, some factors on demand, but when and how attention will be paid to such information will probably always be an administrative decision. A good system will provide what is needed when it is needed, with the recognition that its users will filter the output through numerous qualitative screens.

Specifying Information Needs

The developmental process would begin in the particular problematic area of the organization and would involve front-line staff in the detailed examination and analysis of decisions actually being made, as well as the nature, types, and sources of information currently utilized in handling that problematic area. This would be followed by the staff's specification of the information needed and desired to facilitate finding more satisfactory solutions.

The analysis would locate potential sources of such needed information, either internal or external to the organization, as well as specify how, in what form, and to whom such information would be maximally useful. This would include not only consideration of internal monitoring of current operations, but also the collection of new information and ideas for extending the range of alternative responses available to participants (Daniel, 1961:111-121). The system so developed may include only limited use of automated processes, in combination with manual and individualized procedures.

Developing Collection and Processing Capacities

Having determined the nature and sources of needed and useful information, the developmental process would next examine the organization's procedures for scanning, collecting, filtering, and routing information. Such analysis would locate the most appropriate points at which information might be gathered, and determine the most efficient and effective methods for condensing and distributing it (Dearden, 1965:67-69). Wherever possible, such procedures should attempt to build up existing methods of handling information before trying to introduce new demands upon personnel.

Important to the development of an organization's information-processing capacity is that information be summarized and presented to users in forms that are readily understandable, relevant to their needs, and available on time in answer to their questions (O'Brien & Service, 1973:39-40). Large amounts of quantifiable data may be handled by computerization, while more qualitative information, less amenable to such procedures, requires more imaginative and individualized communication structures.

Following the design and initial implementation of new or revised information-handling procedures. the development task is not complete without extensive testing and close monitoring of its operation and results. It seems likely that breakdowns will occur in the early stages, particularly as the revised procedures involve more extensive departures from previous operation. If the system is actually serving its purposes, the payoffs to its users should constitute a strong motivation for their active investment in its maintenance (Spencer, 1962:4-12).

Supporting Innovation

In order to support the responsiveness of an organization to new information which may be useful in its goal attainment, it is necessary to allocate specific resources for continuous scanning of the environment and drawing new knowledge and innovative ideas into the organization. Informal reliance upon staff initiatives, or even upon the organization's own research department, does not seem to be sufficient for bringing innovative ideas into most organizations (Glaser:8-17).

As Larsen and Nichols report (1972:39-44), the utilization of new information in human service organizations is strongly related to the presence of specific administrative policies which encourage and support innovation. Their studies indicate that person exposure to new information through such methods as attending conferences and workshops is a major source of innovative ideas for organizational participants. New concepts lead to interest and attention to new information. The purposeful collection and communication of new information throughout an organization can serve to bring about change, not only by suggesting solutions to immediate problems, but also by raising aspiration levels of paticipants, which can lead to consideration of more effective and efficient methods for attaining the goals of the organization.

Conclusions

The development of more effective human service programs requires close attention to the systems of information gathering and decision making. These organizational components are extensively shaped by the goals and values of its participants, as well as by the need to cope with problems and uncertainties in mangement and service delivery. When problems are encountered, review of information and search for new solutions are undertaken. Available alternatives are sequentially considered and filtered through the communications network of the organization and through the value structures of participants.

In most organizations, the collection and use of information is basically an informal process and decision-making is far from routine or "rational" in the usual sense of that term. The kinds of information most often used in planning and management decisions are not collected in any systematic manner and are only partially quantifiable. Examples include individual values, benefits, priorities, previous experience with an activity, perceived capacity and readiness of staff to move, consumer preferences, and other very elusive areas. Most decision-making is heavily influenced, if not determined, by filters composed of political and value factors and are oriented toward several objectives simultaneously, only some of which are overt, explicit, and consistent with other organizational goals.

Automated information systems usually involve the superimposition of a rational process upon these basically quasi-rational procedures. Breakdowns occur where the quantitative and routinized aspects of the technical system do not fit with the qualitative needs of decision makers. In order to be more effective, systems designers must take into account such reality factors regarding users. This implies a more wholistic view of organizational functioning and a more limited and realistic expectation of where and to what extent decision-making can be enhanced by automated data systems. It also underscores the crucial need for more sensitive attention to the analysis of information needs of organizational users prior to introducing any new procedures.

Strengthening information handling procedures and extending them to include new and more useful information for effective planning and programming require detailed examination of decision making points in organizational functioning and specification of the nature and types of information needed at each point. Such systems will include a range of kind of information, objective and subjective, quantitative and qualitative. Likewise, the procedures for collecting and processing information will include combinations of formal, routinized sequences and informal, individualized processes. This approach to systems development requires a wide range of both technical, administrative, and social science skills. While the admonitions are often given to administrators regarding their need for technical experts, the reverse is equally true if we are to avoid situations where the "operations" were successful but the "patient" died. The development of such multifaceted systems for scanning, collecting, transmitting, and using a variety of information will make possible the consideration of a more extensive range of information for decision-making. Management effectiveness can be strengthened through the availability of new options for choice. The systematic utilization of new program-relevant knowledge can thus serve to enhance and guide organizational change and innovation.

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MANAGEMENT/VENDOR SYSTEM DEVELOPMENT INTERACTION

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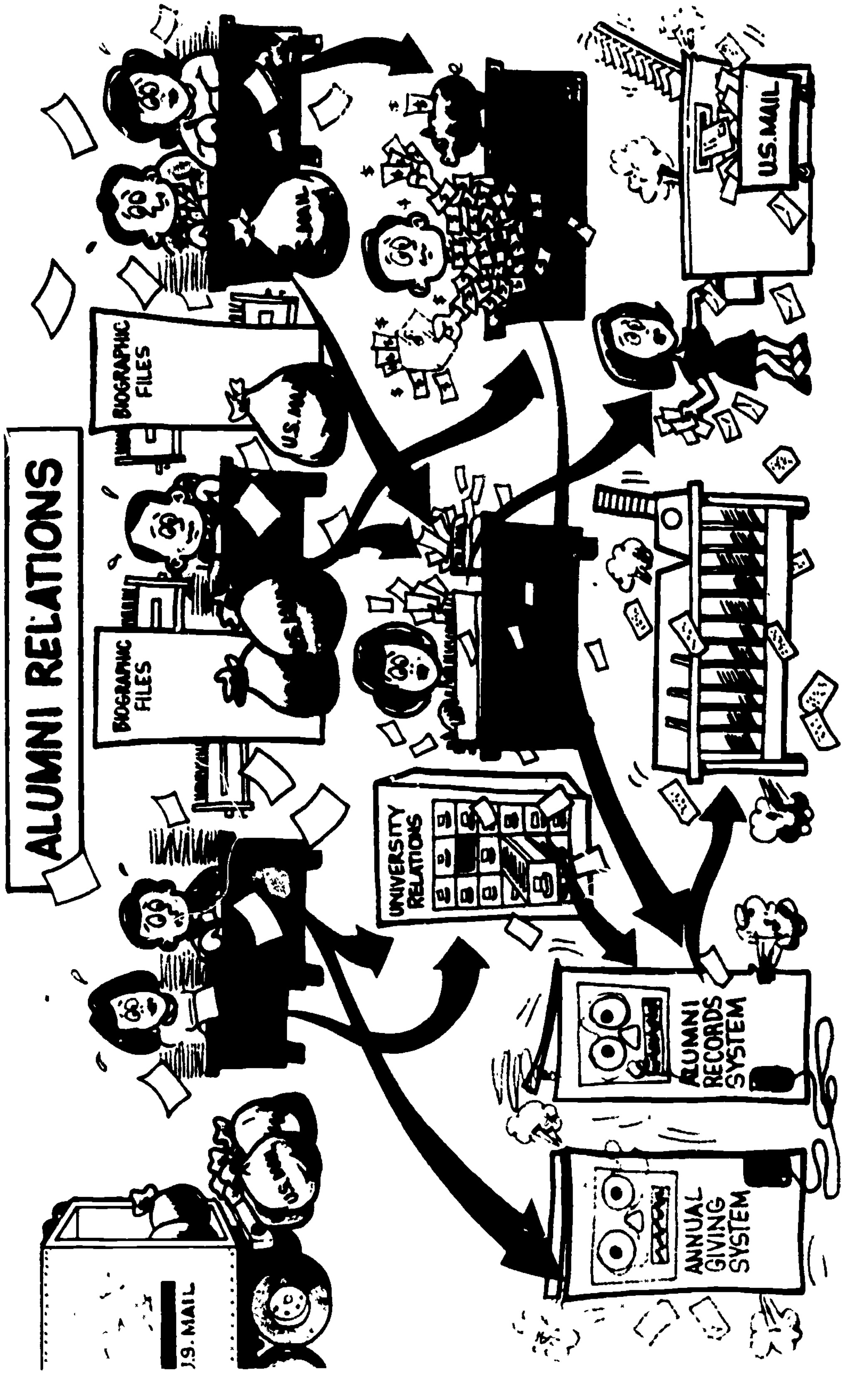
This paper describes the mutually supportive relationship which must exist among management, administration, and technical functions in a university for a major development effort to succeed and serve. The case under consideration is the Rutgers University project to replace and improve support to its alumni offices and to the foundation which directs its fund raising activities. In order to effectuate a useful system, the interest, cooperation, and support of the Board of Trustees, the Office of the President, the Rutgers' Foundation management, and the various school and campus alumni offices were essential, as were the establishment of and adherence to a detailed plan for implementation. The trials and tribulations of responding to the complex demands of this environment, while assuring the delivery of an effective system, are discussed, along with the current status of the project and its impact on the institution. The cooperative efforts of the University systems function and the vendor to satisfy the diverse and changing requirements of the University community are covered, as well as some insights on how to maintain an effective relationship among the managerial, technical, and administrative segments of universities.

Rutgers, The State University of New Jersey was founded in 1766 as a private college; since that time it has grown and matured into a major public institution serving over 40,000 students, largely from the Middle Atlantic region of New Jersey, New Yor and Pennsylvania. The University has three major campuses - New Brunswick, Newark and Camden - as well as an active extension division and is made up of more than thirty schools at both the graduate and undergraduate levels. Rutgers is largely State-supported having acquired public status shortly after World War II. Many of the schools in the University maintain active relations with their alumni and a University-level alumni relations function is also maintained.

Until this year Rutgers utilized a variety of disparate systems to support its alumni and fund-raising activities; these systems were spread about the University and were designed to serve only the special purposes of each maintainer. No unified information system was available to serve the University for its overall development effort.

On a number of occasions in the past ten years the difficulties of utilizing the varied mailing and record-keeping systems had caused system improvement programs to be begun; these efforts had all been dropped due to funding problems. However, in late 1971 the Board of Trustees of Rutgers authorized the expenditure of funds to analyze the University's requirements for a more effective approach to the management of their development efforts - especially important were the elimination of duplicate systems, the replacement of outmoded procedures, and the heightening of



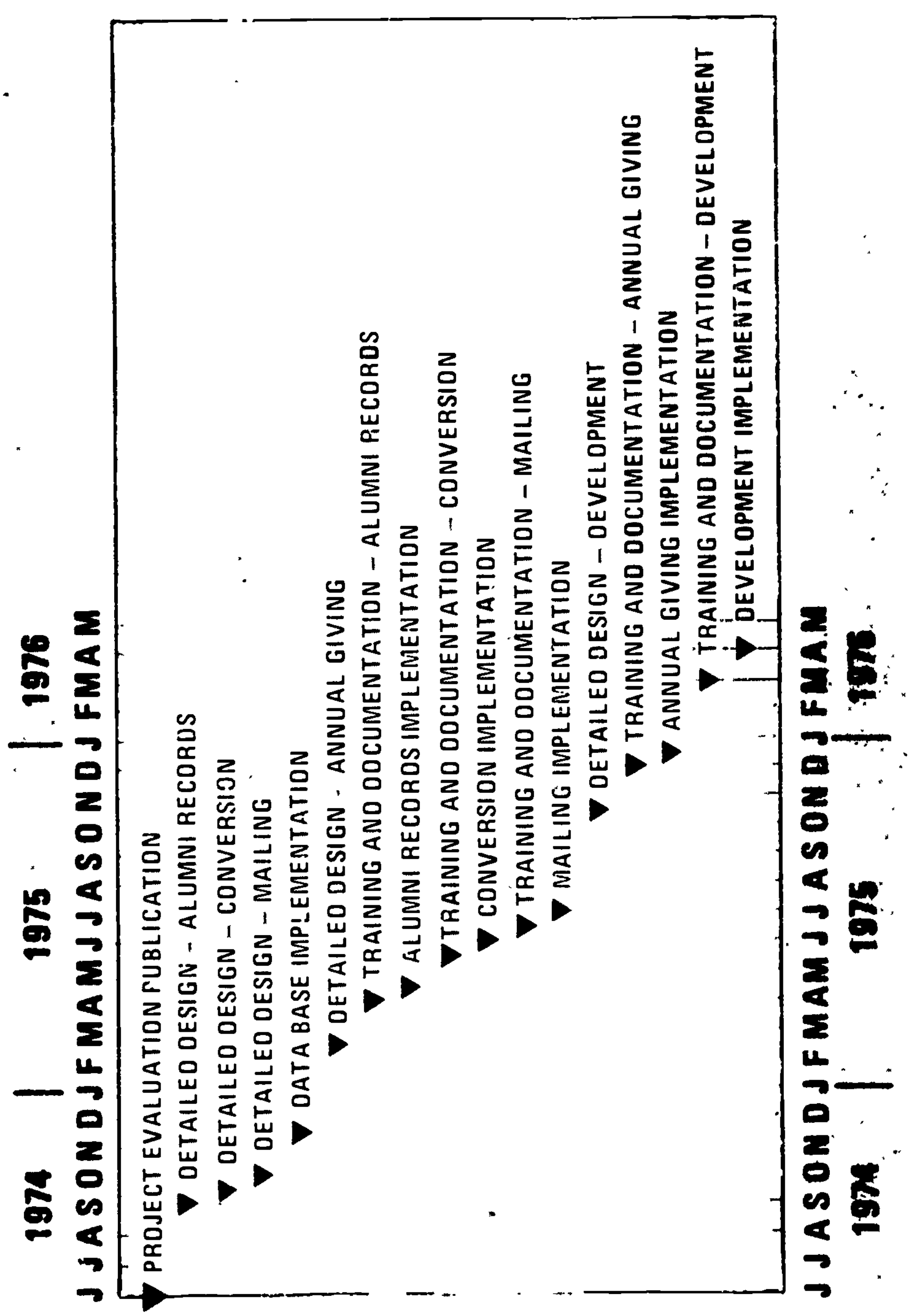
ALUMNI RELATIONS
BIOGRAPHIC FILES
BIOGRAPHIC FILES
U.S. MAIL
U.S. MAIL
UNIVERSITY RELATIONS
ALUMNI RECORDS SYSTEM
ANNUAL GIVING SYSTEM

information integrity for fund drives and alumni communications. The Center for Computer and Management Services (CCMS) was given the responsibility for initiating the analysis and subsequent steps. As the first step towards producing a new development system, a study of the detailed operation and function of the existing systems was undertaken. Following this study, the projected requirements of the alumni offices were studied. From these two studies a set of objectives for the system was established; the primary objectives identified were the following:

- accuracy and timeliness
- sophisticated selection capabilities
- simplicity and ease of use
- elimination of duplicate effort, information and responsibilities
- rigid controls of validity, integrity and security
- full financial controls and reporting
- interface with other University systems
- operational efficiency.

In order to identify the best possible overall approach the objectives were expanded into system functional specifications which, in August of 1972, were provided to eleven firms specializing in system development and CCMS. Of these, six firms and CCMS evinced interest in bidding; a request for proposal and bid was issued to the interested parties in late November of 1972 for response by December 26, 1972. Three outside firms and CCMS responded with a proposal and bid. Upon receipt of the four proposals, an evaluation team analyzed and scored them according to an exhaustive set of selection criteria. The evaluation procedure resulted in two measurements; a "score" derived from weighted evaluation of each proposal on the following points:

- system facilities
- ease of use
- implementation methodology
- vendor support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PROJECT EVALUATION PUBLICATION
DETAILED DESIGN – ALUMNI RECORDS
DETAILED DESIGN – CONVERSION
DETAILED DESIGN – MAILING
DATA BASE IMPLEMENTATION
DETAILED DESIGN – ANNUAL GIVING
TRAINING AND DOCUMENTATION – ALUMNI RECORDS
ALUMNI RECORDS IMPLEMENTATION
TRAINING AND DOCUMENTATION – CONVERSION
CONVERSION IMPLEMENTATION
TRAINING AND DOCUMENTATION – MAILING
MAILING IMPLEMENTATION
DETAILED DESIGN – DEVELOPMENT
TRAINING AND DOCUMENTATION – ANNUAL GIVING
ANNUAL GIVING IMPLEMENTATION
TRAINING AND DOCUMENTATION – DEVELOPMENT
DEVELOPMENT IMPLEMENTATION

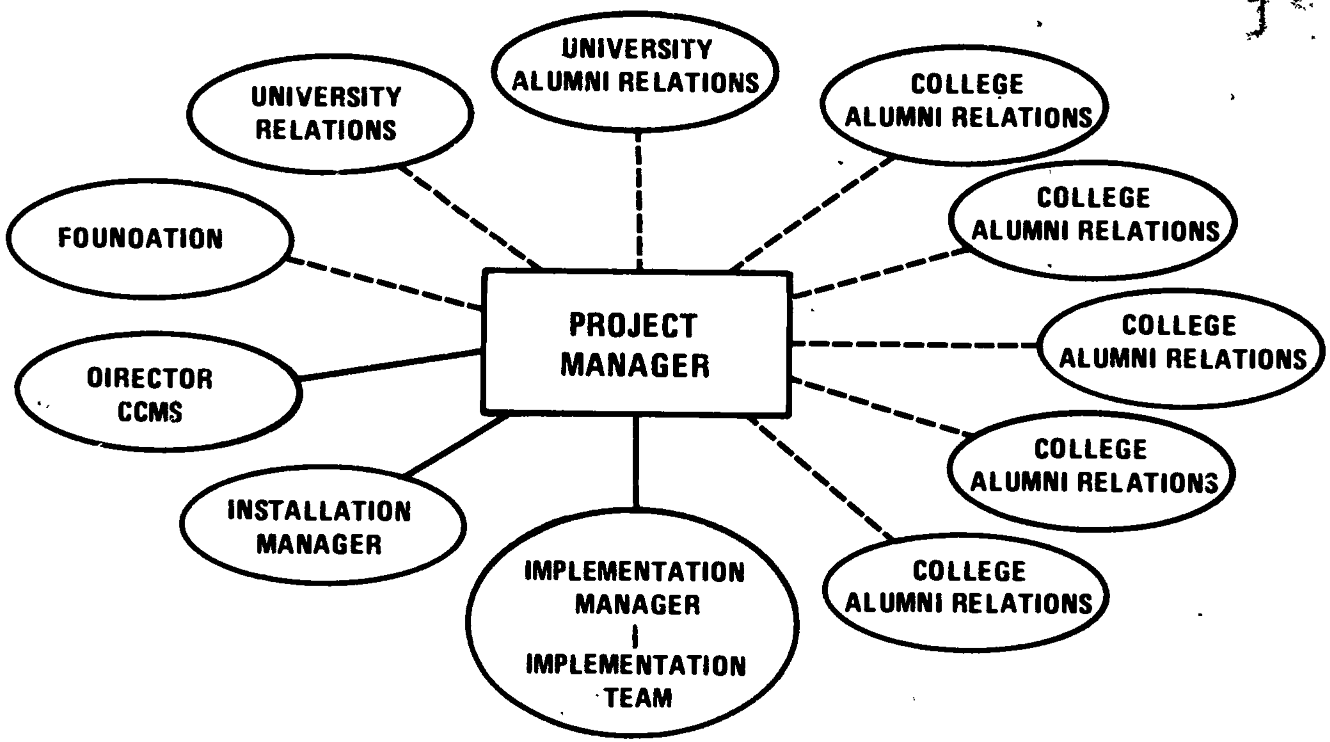
- system ownership
- schedule
- hardware requirements
- forms design
- conversion
- security
- vendor reliability.

A Price Effectiveness Ratio was determined by dividing the "monthly price" (amortized development over 36 months plus operational cost) by the "score" derived above. One of the proposals was dropped from further consideration because it received a weighted score of less than 50%. The three remaining proposals were evaluated subjectively to assess the "reputation and record" of the potential suppliers; this evaluation resulted in a third measure, which, when applied to the other measures, led to the selection of a supplier of the Rutgers' Alumni Development System: the supplier selected was Integral Systems, Incorporated (ISI). The selection recommendations were made in late February of 1973, formal notice of selection to the vendor did not occur until October of 1973. Concurrent with formal approval of the recommended approach, the Board of Trustees officially established the Rutgers Foundation, which had been under consideration for a number of years; the requirements of the Foundation were also to be served by the new system. Contract negotiations and approvals weren't completed until July 31, 1974.

While contract approvals were being sought, a combined University/ISI project evaluation was undertaken. This effort produced a project evaluation document containing general designs for the major system processes, a description of the conversion procedures to be employed and a detailed project plan. The project plan defined by task a multipart, phased development and installation. Four major parts were identified - Alumni Records, Mailing, Annual Giving, and Development; each of these was to be developed through the phases of detailed design, implementation, documentation, training and conversion. The system processes according to the project evaluation were to be developed and installed in sequence. The sequence of installation was designed to allow a gradual release of the system to the users and to involve them in key decision points along the way. The prime publications in the project were the project evaluation and detailed design documents for alumni records, conversion, mailing, annual giving and development; each of these was used as a basis for evaluation and for deciding to proceed to the next phase. The operational aspects of the system were fully tested by both implementors and the installers prior to release. Concurrent with release of a system module training of user personnel was initiated and system documentation was issued. The project has been maintained essentially on or ahead of schedule to date in spite of design revisions necessitated by changes in user requirements and is within the original cost estimates.

During the project evaluation phase, the project organization and "report to" relationship were also defined. This organization, shown on the following page, is the key to success of the project to date.

PROJECT ORGANIZATION



"COORDINATIVE MANAGEMENT"

The Alumni Development System Project Manager was established as the focus for all contact with the University community; supporting the Project Manager are two technically-oriented groups - one of which supplies day to day support and guidance to the user community for planning, training, and conversion while the other is involved in implementing the system and is responsible for specification, programming, testing, documentation and user training for the Alumni Development System. The breadth of the user community precludes identification of a single "prime-user," a fairly common situation when developing large-scale systems and one which necessitates far more management attention than is required for single user systems.

The Project Manager's responsibility is to assure participation in the project by the various users and to obtain their views and concurrence on the key documents published and on issues arising during implementation. The most critical role played by the Project Manager is in the coordination of activities both within the project and in the University community to assure an effective synthesis; by monitoring the ongoing changes in the University's needs and modulating the project installation and implementation efforts accordingly, the Project Manager assures the continuous fitness of the Alumni Development System. The presence of specialists in installation and implementation enables the Project Manager to concentrate on the coordinative role.

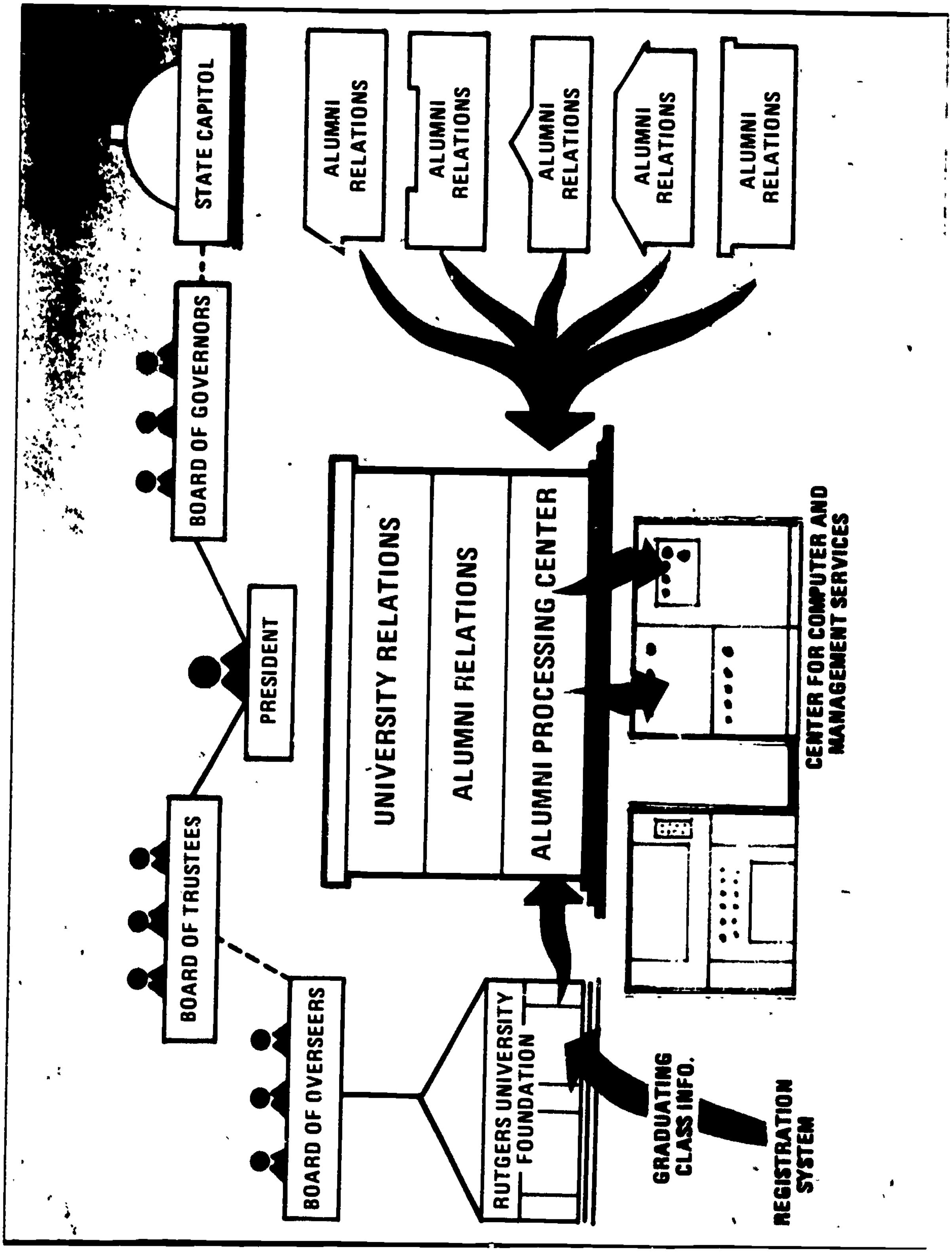
Several reorganizations and personnel changes occurred in the user functions while the system was being developed; the Project Manager acted as liaison for the project to secure involvement and assistance from individuals newly arrived in key alumni and development positions. Since the system was thoroughly defined during the project evaluation phase, there has been little need to significantly alter the design during implementation. Naturally, minor changes and improvements were made at the users request, but only two major changes in design arose during the eighteen months since the general design was released. Both of these changes were accommodated without noticeable impact to the overall schedule.

The Installation Manager supervises the conversion effort, coordinates system operation and works with various user and systems personnel to assure ongoing conformance to the project schedule. During the past year the Installation Manager has overseen the conversion of University's manual alumni records, the class cards; this conversion began in November of 1974 and was concluded in July, 1975. The class cards served as the prime source document for the establishment of the Alumni/Contributor Data Base. The conversion of the class cards resulted in the replacement of the existing automated mailing file and the Alumni Development System was used for some mailing purposes this summer.

While these conversions were progressing, the existing Scriptomatic file and the automated Annual Giving file were included in dual maintenance with the Alumni/Contributor Data Base. Graduated phase out of these two files will be accomplished under the user's control, the dual maintenance procedures are such that the decision to begin using the Alumni Development

System can be made at any time. The Alumni/Contributor Data Base is being analyzed and edited under the guidance of the Installation Manager to reduce the defects and omissions carried over from the prior records. Upon completion of this effort the Installation Manager will coordinate the mailing of a questionnaire to a sample alumni group and then, depending on the results from the sample, the questionnaire will be mailed to all alumni under the Installation Manager's supervision. The questionnaire is intended to verify existing information on an individual and to obtain more detailed demographic information. The Installation Manager will also coordinate the use of the system for the Annual Giving Drive in the beginning of 1976.

Complementing the Installation Manager on the Alumni Development System Project is an Implementation Manager who is charged with the actual development of the system. The Implementation Manager and his staff produced the project evaluation, detailed design, training and system documents for use in communicating with the user community and for use in precisely defining the Alumni Development System. All programming, system testing and the like are the Implementation Manager's responsibility. The Implementation Manager provides direct support to the Project Manager in evaluating specific users requests and in supplying information to the users. Similarly, the Implementation Manager or members of the Implementation Team provide support in installation tasks such as conversion, trial runs, follow-on training and the like. The Implementation Manager, who represents ISI, is responsible for the overall design and operability of the system and for keeping the system in tune with University requirements as specified by the Project Manager.

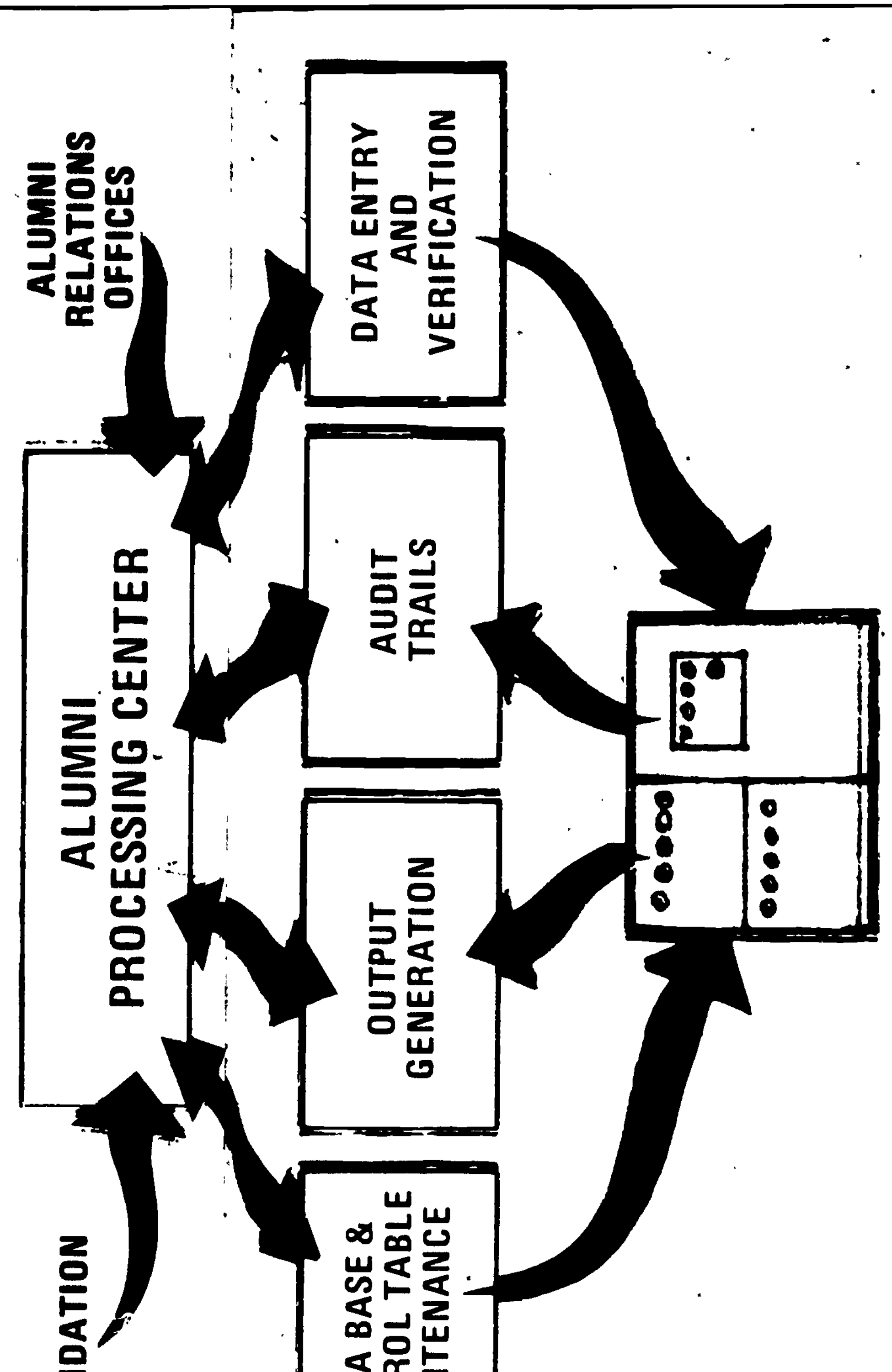

STATE CAPITOL
BOARD OF GOVERNORS
PRESIDENT
BOARD OF TRUSTEES
BOARD OF OVERSEERS
RUTGERS UNIVERSITY FOUNDATION
GRADUATING CLASS INFO.
REGISTRATION SYSTEM
ALUMNI RELATIONS
ALUMNI RELATIONS
ALUMNI RELATIONS
ALUMNI RELATIONS
ALUMNI RELATIONS
UNIVERSITY RELATIONS
ALUMNI RELATIONS
ALUMNI PROCESSING CENTER
CENTER FOR COMPUTER AND MANAGEMENT SERVICES

In recognition of the capabilities provided in the Alumni Development System, the University community developed a new, unified approach to aspects of their procedures; this approach took advantage of system features which allowed dispersed activities to fulfill their unique requirements while assuring effective use of personnel and system resources. A revised plan for maintenance of alumni records and donor information was developed which established an Alumni Processing Center (APC); this center performs all system-related maintenance and reporting activities as a service to the University Foundation and the various alumni relations offices. The APC is responsible for coordination of requests for information, information dissemination, and the operation of the Alumni Development System. The specific functions performed by the Alumni Processing Center include the following:

1. data entry and verification
2. output generation
3. maintenance of the data base and control tables
4. audit trail analysis and controls
5. coordination of other services, e.g., mailing.

The APC is the focus for the operational activities of University-wide alumni and development; it is enabled to perform its functions because the Alumni Development System automatically supplies much of the information needed by the colleges and the Foundation; thereby, allowing each unit to operate independently even though they all utilize the same system.

A disparate group of users share a common need for the Alumni Development System; the system's design is such that it satisfies these diverse users


ALUMNI RELATIONS OFFICES
DATA ENTRY AND VERIFICATION
ALUMNI PROCESSING CENTER
AUDIT TRAILS
OUTPUT GENERATION
FOUNDATION
DATA BASE & CONTROL TABLE MAINTENANCE

without sacrificing efficiency or coherence. A few of the key features of the Alumni Development System are described below to exemplify the methods used to fulfill the user's requirements.

- Discrete (but interrelative) maintenance procedures:

  Two principle segments can be identified in the user community - the alumni segment and the fund raising segment. Each of these segments utilizes the Alumni/Contributor Data Base and the Alumni Development System for different purposes; the alumni segment requires accurate alumni records for its purposes and the fund raising segment requires tracking and controls on its various campaign drives. Two discrete maintenance procedures are employed to serve these separate purposes. The procedures are distinct because there is no synchronous relationship between the two. Alumni records maintenance does not require financial controls, is low frequency and often entails extremely high volumes, e.g., entry of a graduating class. The monetary and drive information is high frequency, low volume and requires continuous tracking to assure financial control and timely posting of receipts.

- Common reference documents and access procedures:

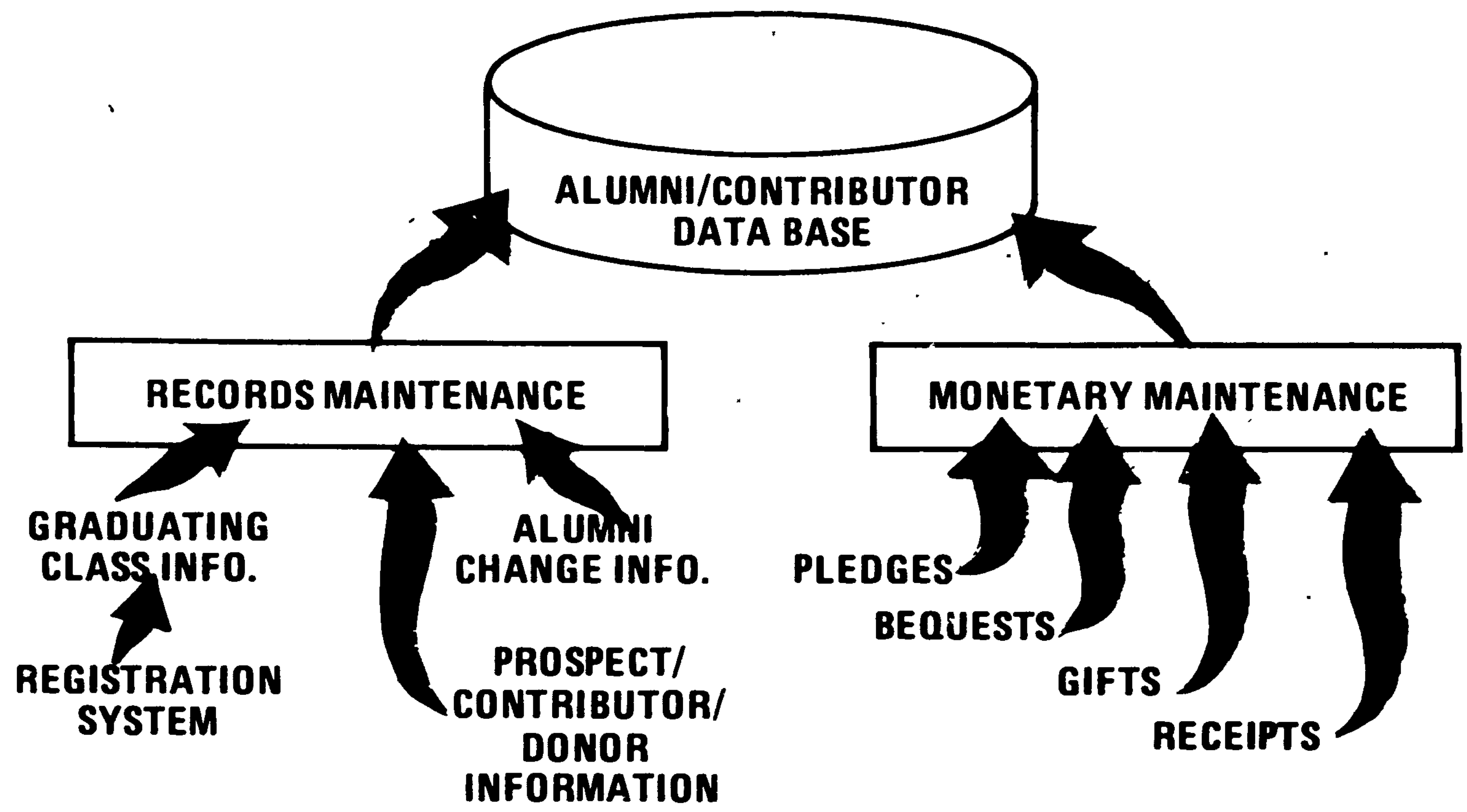
  All information from the Alumni/Contributor Data Base is presented in uniform format to the various users. A microfiche reference document for use in alumni and development activities is maintained by the system. All information requests flow through a single, coordinative function and yet each separate unit has complete records on its alumni or donors.

- System notices of important events to all concerned activities:

  The Alumni Development System provides notices to the alumni offices and development office of any significant events occurring with an individual on record. These notices include notices of receipt of gifts and pledges, notices of death, notices of change for alumni or contributors. These notices are prepared for every unit interested in a given individual.

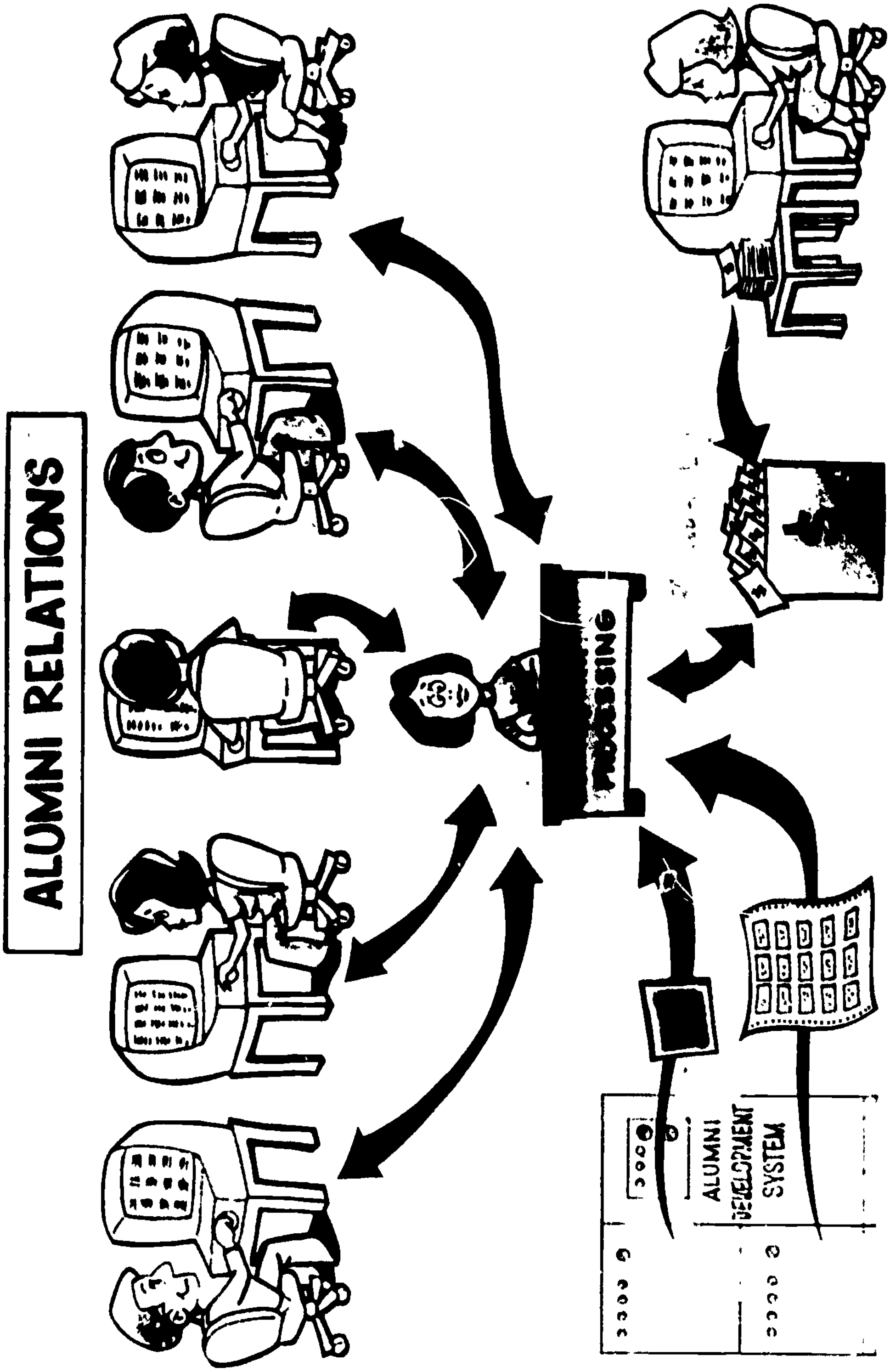
The Alumni Development System represents an important step forward for Rutgers; it has the potential of heightening the effectiveness of development

PARALLEL FUNCTIONAL MAINTENANCE



drives, it reduces the cost of alumni record keeping, and it eliminates redundant systems and procedures throughout the institution. Other tangible benefits derived from the Alumni Development System include the ability to run multiple, concurrent, targeted campaigns; the ability to respond quickly to special information requirements -- e.g., supplying the President with backup information on alumni and donors to allow personal contact; the ability to support regional or special alumni associations - Illinois, Greater Chicago, Football, Medical, etc.; the unexpected benefit of having "discovered" many good prospective donors as part of the research connected with conversion; and significantly lower operating costs than before.

Moreover, it has made an important contribution to the reputation and creditability of CCMS by serving as an example of how a well-run project works. Not only is the project still on the original schedule, it is also well within the original budget. Credit for this accomplishment belongs to the functional specifications and the project evaluation which detailed every aspect of the system and the requisite steps to install it. Equally important was the ongoing good relationship with each member of the user community which precluded unnecessary changes to the design. The resilience of the design and of its implementors helped greatly by allowing adaptation to changes with no noticeable schedule slips or cost increments. Major events which were safely accommodated included the formation of the Rutgers University Foundation simultaneous with the

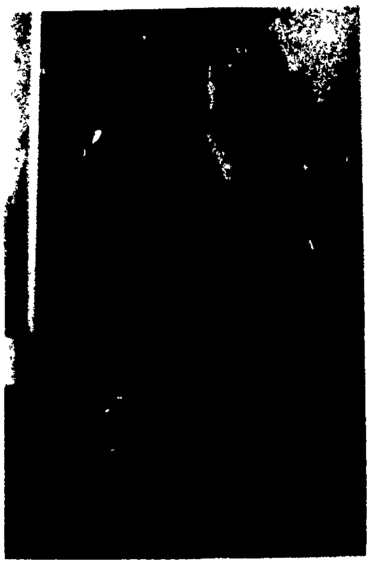

ALUMNI RELATIONS
PROCESSING
ALUMNI DEVELOPMENT SYSTEM

selection of ISI to develop the system and numerous personnel changes related to the Foundation's establishment. All in all (and to date) this is probably one of the best run and most successful projects ever undertaken by Rutgers.

TRACK IV
CONTRIBUTED PAPERS

Through the Contributed Papers Track of the National Conference, an opportunity for professional growth is provided. Abstracts of all contributed papers appear in the Proceedings, and the complete papers are available upon request at the cost of reproduction through the CAUSE Exchange Library.

A. Wayne Donald



George Sargent

Coordinator: Wayne Donald
Virginia Tech

THE PATH TO EFFECTIVE DATA ADMINISTRATION

Hazel Adamick
Shirley Roddenberry
Data Base Coordinators
State University System of Florida

This paper describes the path chosen by the State University System of Florida in their effort to move towards truly effective data base administration. It relates the beginning definitional and educational processes, and the procedure and organizational structures that resulted from these processes. It further describes the standardization that is taking place in documentation and systems for use in all nine state universities; and the tools, such as the data dictionary, that are being used to accomplish standardization. The SUS data base, how it is defined, and how it serves management at university and state levels, is also discussed.

INSTRUCTIONAL CAPACITY UTILIZATION SYSTEM

Lawrence J. Andria
Assistant to the Director

Roger Taylor
Director

Space Management
University of Pittsburgh

This paper describes a computerized system of measuring the effectiveness of room scheduling of classrooms and teaching laboratories. The system includes the effectiveness of both room-hour utilization and student-station utilization. These are displayed room by room, building by building, and by campus-wide summary. The output reports also include utilization rates for ten different room-size ranges so that the sizes of rooms versus the size of classes can be compared. The efficiencies, cost savings and other benefits which can be obtained from this system are also discussed.

THE CHALLENGE OF BETTER INFORMATION FOR ENROLLMENT PROJECTIONS

William R. Lucas
Senior Staff Associate
University Office of Long Range Planning & Analysis
University of Illinois

In this paper four basic deficiencies of traditional enrollment projections are explored:

1. The projections make limited use of demographic structure.
2. The projected levels of attendance are not adequate for many important planning purposes.
3. The projections represent a single scenario about the future.
4. The projections give no detailed insight into the impact of future enrollment in terms of cost, staff and facilities.

Each of these problems is analyzed in terms of the preliminary results of an enrollment scenario system under development at the University of Illinois. The early results are impressive, but future development of the system is seen to be dependent on new data sources. The implications for higher education information systems are discussed.

CROSSWALKING AT THE CROSSROADS

David R. Hornfischer
Computer Systems Coordinator
Treasurer's Office
Amherst College
Amherst, Massachusetts

This paper reviews the capabilities of the Three College Financial Accounting Systems developed by Amherst, Hampshire and Mount Holyoke Colleges. Primary emphasis is given to the use of the system in crosswalking traditional accounting data to a program budget format. The paper also reviews the Three College Course Registration System and indicates its use in providing data for cost distribution.

OASIS: TOMORROW STARTS NOW

A. R. Diet
Manager
Data Base
University of Windsor

Even with full support of top management and the necessary resources of funds, time and manpower, the implementation and productive use of applications systems using a data base management system becomes a challenge to the Data Base Administrator. The current challenge at the University of Windsor is to prove the new worth of the data base management system, specifically designed for university environments, by effectively managing and controlling new applications.

Certain key aspects of a data base, data management system, unless carefully controlled, spell success or failure for the system. Yesterday's dream world and promises of a data base system, once thought of as incapable of being implemented, are today's operational problems. The blending together of new designs, effective training, and dynamic user liaison are but a part of the challenge of change that must be considered. This paper concentrates on the use of OASIS at the University of Windsor.

DATA SYSTEM FROM ADMISSIONS TO GRADUATION FOR A TWO OR FOUR YEAR INSTITUTION

John R. Moore
Director
Data Processing
Allegany Community College
Cumberland, Maryland

This paper describes five modules of a system that is currently in operation at Allegany Community College. The Admission and Grade Report Systems are only mentioned briefly because they are similar to those found at many other colleges. The major emphasis of the paper is the advantages of a comprehensive History System. The paper also provides some explanation of what a continuous on-line registration system can provide for a community college.

MANAGERIAL FEEDBACK REGARDING INFORMATION SYSTEMS

J. B. Mathews
Division Director
Systems and Computer Services
Medical College of Georgia

Interestingly enough, there often appears to be little systematic feedback to management on the performance of information systems, which themselves are usually designed to give feedback on other functions. With the growing dependence on, and expenditures for, automated information systems, it is imperative that the performance of the information systems itself be systematically monitored. This can be accomplished in a combination of ways. This paper proposes and discusses two specific methods for the data processing organization to obtain for itself and to provide for users feedback on the performance or automated information systems: (1) by establishing an explicit "systems review" function within the organization; and (2) by designing into systems specific mechanisms for automatically measuring and reporting aspects of systems performance relative to initial design assumptions, constraints, and objectives.

A SALARY SOLVENCY MODEL

H. Phillip Nicely, Jr.
Dean of Systems, Planning & Research
Miami-Dade Community College
Miami, Florida

This paper discusses the Salary Solvency Model, a newly developed sophisticated gaming model which can be used for long-range planning purposes. Although specifically designed to meet the needs of Miami-Dade Community College, the model is appropriate for use for many institutions, agencies, or companies having incremental salary schedules.

The model permits the close examination of the future consequences of proposed salaries and policies prior to their implementation. Additionally, the model provides valuable insight into employee flow. An interesting by-product is the mean age of the employees on a year-by-year basis. The model is a Monte Carlo simulation and it utilizes a modified Markov chain process.

LIBRARY AUTOMATION IN THE SMALL COLLEGE ENVIRONMENT

James H. Nye
Readers' Service Librarian

Peter B. Worland
Director
Computer Center

Gustavus Adolphus College
St. Peter, Minnesota

This paper discusses three readily implementable applications of the computer to the small college library, an area almost totally ignored in the literature. Applications are in the areas of library management, technical processing, and reference service. The programs, written in Extended BASIC, are of a generic nature allowing for their use in numerous similar bibliographic and managerial tasks.

MANAGEMENT/TECHNICAL INTERACTION IN INTEGRATED INFORMATION SYSTEM DEVELOPMENT

Clarence H. Bagley
Assistant Director
Institutional Studies

Don E. Gardner
Coordinator
Information Systems

Arizona State University
Tempe, Arizona

This paper is divided into three main sections, Part 1 briefly outlines the basic elements and advantages of the emerging "true" integrated approach to data processing; i.e., resulting in a comprehensive integrated data base residing in mass storage and supported by data base management software such as is available in commerical packages like TOTAL, IMS2, DMS-1100,etc.

Part 2 explores the potential impact of the integrated data base approach on the management structure and philosophy of a college or university, pointing out the necessity of continuous management involvement and extensive interdepartmental cooperation. While some writers have espoused the need for extensive "top management" involvement, this paper proposes that such expectations are unrealistic; effective management involvement and interaction with data processing technicians will occur primarily at the "middle management" level.

Part 3 outlines the structure, functions and experiences of a Data Base Review Committee (involving "middle managers" and data processing personnel) recently formed at Arizona State University in an attempt to obtain more effective management involvement in the University's integrated information system effort.

APL ON-LINE FILE MANAGEMENT

K. C. Hill
Clark Foundation Student

D. D. McElroy
Office of Institutional Research

The University of Texas at Dallas
Richardson, Texas

An APL user who uses files extensively is often faced with rapidly changing information. They may require frequent data storage and retrieval for the purposes of keeping management informed of the most current data. The system discussed in this paper describes a cohesive system that can do much of the routine work in APL file management, and is both flexible and simple to use. The major characteristics of this system are: (1) it eliminates the intricasies of tieing files, and keeps track of where each is tied; (2) in non-homogeneous files (i.e. components of varying information), it makes the task of storing and retrieving information simple, and (3) it is able to route information output to either the high-speed printer or the terminal with no program modification.

DATA BASE ADMINISTRATION AFTER ONE YEAR

Dorothy J. Hopkin
Assistant Director
University Office of Management Information Systems
University of Illinois
Champaign, Illinois

This paper discusses the plans, successes, and pitfalls one year into the data base environment encompassing the technical, administrative, and managerial rolls. It will include the impact of outside forces, technical and political; staffing and training; the role of DBA consulting to varying types of users; the setting of standards through the use of a Data Base Handbook; the use of a data base dictionary to enforce standards and lend control; usurping DBA responsibilities; organizational placement of the DBA; and the emerging role of data communications administration. Some do's and don'ts from the standpoint of the University of Illinois which will apply to single or multi-campus units will also be discussed.

A MARKETING APPROACH TO SYSTEMS IMPLEMENTATION

Terry K. Hammack
Systems Analyst
Computer Services
University of Texas of the Permian Basin
Odessa, Texas

An area which has received little attention by computer specialists is systems implementation. Once a system has been debugged and released to the user, the involvement of the computer specialists is terminated. Any major change in the established work procedures created by the new system is ignored; and yet for a system to work effectively, it must have the total support of all "production" personnel. Through techniques developed by consumer marketing for new product adoption, implementation problems can be minimized.

This paper presents a model for system implementation based on the "new product adoption" concepts for marketing. Included in the model is a definition of the stages of the adoption process, methods for increasing the adoption rate and minimizing late adoptor resistance, effective utilization of opinion leaders and change agents, and necessary communication procedures.

IMPLEMENTATION OF PROGRAM BUDGETING IN MINNESOTA PUBLIC POST-SECONDARY EDUCATION

Robert J. Rustad
Director of Budget Review
Minnesota Higher Education Coordinating Commission
St. Paul, Minnesota

The Minnesota Higher Education Coordinating Commission has implemented a compatible program budget system for all public PSE systems in Minnesota. Budget data for each instructional, research and support program has been collected from 63 institutions for five years covering a variety of financial and non-financial measures. The data is stored using System 2000, a data base management system, which permits on-line access to the data, updating of the data base and has the capacity to produce complex analytical reports geared to the user's needs. This paper describes the development and operation of this system.

CONTROLLING DATA PROCESSING EXPENDITURES AT THE UNIVERSITY OF CINCINNATI

George D. Wolterman
Assistant Director
Management Services and Analytical Studies
University of Cincinnati

This paper describes how the University of Cincinnati controls expenditures of data processing resources for new computer systems. The four phases involved in the control process are discussed, as well as the advantages and dis-advantages of the process.

STATEWIDE EXPENDITURE ANALYSIS USING STANDARD DATA SYSTEMS

Jerry L. Bigham
Systems Coordinator

J. Kent Caruthers
Director
Planning and Analysis

Management Information Systems
State University System of Florida

The State University System of Florida is developing new funding formulae for statewide university budgeting. To determine direct and support costs of instructional programs, an expenditure analysis was performed based on NCHEMS Information Exchange Procedures and computer software.

This paper discusses the interaction between a budget planner and an information specialist in tailoring the NCHEMS procedures to meet SUS objectives using the IEP software in conjunction with central and institutional data systems. Institutional task force members recast university accounting records into standard form and conducted the local analysis. The central office promulgated, maintained common software and data in regional data centers, conducted field reviews, and produced the systemwide analysis.

USER INVOLVEMENT IN ESTABLISHING A COLLEGE INFORMATION SYSTEM

Barbara F. Medina
Director
Computer Educational Center
Mansfield State College
Mansfield, Pennsylvania

Reductions in costs and improvements in computer and communication equipment, and a better understanding of software design structure have made it feasible to implement information systems at many colleges. The potential value of these systems for planning and budgeting is understood. Yet the problems associated with design, implementation and maintenance still exist.

Committees to resolve problems have been a long standing tradition at colleges. Unfortunately, committees can be used to avoid problems as well as to resolve problems.

This paper reviews four case histories of committees that were used to design, implement and maintain modules of an information system. The structure, the goals and the achievements of each are reviewed. An evaluation of the factors that made one of the committees more successful than the others is presented. Finally, the conclusions are reported.

UNIVERSITY INFORMATION SYSTEMS

Frances B. Craig
Director
Information Systems

Richard Van Horn
Vice President for Academic Affairs

Presented by

Fred Rogers
Acting Director
Information Systems

Carnegie-Mellon University
Pittsburgh, Pennsylvania

Faced by a series of crises, universities have embraced both management and management information systems. Most have achieved only limited progress. The best publicized efforts on university MIS are too expensive for the large number of medium-sized schools. In addition, existing systems focus largely on daily operations and provide little support to key planning and control decisions. This paper discusses the design of a cost-effective information system for a medium-sized university and the extension of the system to highlight planning and control activities. Examples from Carnegie-Mellon University are used to illustrate the various issues.

DATA AND ITS USE: A PROCESS SYSTEM FOR PLANNING

William A. Shoemaker
Vice President
Research
Council for the Advancement of Small Colleges

This paper presents an outline of 17 conceptual elements that have been identified as important influences on the use of data for analytic management and planning. A conceptual and practical framework for combining these elements (a planning process) is suggested. This "process" system encourages the use of data at all levels (chief exectives to departmental) and attempts to make use of the psycho-socio-political realities of a college campus. The system is in use on most of the 15 campuses participating in the recently completed $1,000,000 three-year pilot test of data display and use directed by the author.

COMMUNITY COLLEGE PLANNING AND ACCOUNTABILITY

Gary A. Rice
Institutional Planning & Management Systems
Yakima Valley College
Yakima, Washington

This paper briefly presents the structure and interlock of eight MIS data base master computer files. Two interfaced cost accountability computer models, NCHEMS, and a locally designed model are driven off identical input formats, linked to the data base, and their outputs compared. A new component which allows for model use in a predictive mode rather than description post hoc. picture will be introduced. A brief discussion on tactics and strategies to acquaint various levels of users with the structure, process, meaning and implications of long-range planning via computer simulation is presented. Finally, an experimental accountability matrix that is tied to the college MIS and arrays expenditures in relation to institutional mission, goals and objectives is presented.

PERSONNEL MANAGEMENT:
THE KEY TO SECURE INFORMATION SYSTEMS
IN HIGHER EDUCATION

Margaret Drake
Systems Analyst
University of Texas System
Austin, Texas

Effective management in the changing higher education environment of 1975 presents a real challenge to college and university administrators. Because effective management necessitates the processing of information, higher education is increasingly dependent upon computers for the timely handling of large amounts of data for instruction, research and administration. A number of factors, including Federal and state privacy legislation, student concerns and faculty pressures, demand that information processing operations be secure. The most effective means of securing information processing is sound personnel management. Several procedures are offered to higher management that could result in secure higher education information systems.

TRANSITION TO INFORMATION SYSTEMS AT A LIBERAL ARTS COLLEGE

Jerry Van Voorhis
Assistant to the President
College of William and Mary
Williamsburg, Virginia

The College of William and Mary has just completed an extensive information study in cooperation with the IBM Corporation. The study was undertaken by the College for the purpose of defining its institutional data needs at the management and technical levels, and recommending a course of action in information systems from the "top down." We believe the College's study can act as a model for other institutions, especially the small college, seeking to survive the steady state.

This paper centers on how William and Mary, as a prototype of a small liberal arts university, becomes information conscious. It includes discussion of how a consensus for an information systems approach gradually emerges within an institution whose educational mission, stated goals, and governing norms continue to be traditional and well-defined; how the College administration, in the course of a study that stresses the need of administrators and technicians to work more closely together, evolves a clearer sense of identity about its own information needs; and to what extent the role of the President appears to be instrumental to both these developments.

RRPM ON-LINE VIA A MICRO-COMPUTER

Norman Bell
George Sargent
Michigan State University

Richard Brandt
Dominguez Hills State College
Los Angeles, California

Since RRPM (Resource Requirements Prediction Model) has proven to be an important management and planning tool for instructional cost simulation, it is important that it be made as widely available as possible. In addition, if RRPM were available in an interactive form, users would receive immediate feedback of simulations and be able then to enter additional changes and immediately be informed of the results. Consequently, a version of RRPM has been programmed in APL (A Programming Language) to operate on a micro-computer, the MCM-70. This paper features an explanation of RRPM in operation on the MCM-70.

TRACK V
VENDOR PRESENTATIONS AND USERS GROUPS

The Vendor Track of the CAUSE National Conference offers an opportunity for participants to review products of interest to the higher education data processing community. These sessions feature professional presentations rather than exhibits or displays, and the use of products in colleges and universities is emphasized. An abstract of each presentation is included, and additional information may be obtained by contacting representatives of the vendor.

Louis R. Leurig

Bob Flynn

Dan Ackley

Steve Rothschild

Coordinator: Dick Leurig
University of New Mexico

COFFEE SPONSORSHIPS

Each of the five Conference Coffees was sponsored by a Vendor organization. This contribution to the Conference from the following Vendors is appreciated.

INFORMATICS, INC.
Canoga Park, California

INFORMATION ASSOCIATES, INC.
Rochester, New York

SYSTEMS & COMPUTER TECHNOLOGY
Westchester, Pennsylvania

UNIVAC COMPUTER SYSTEMS
Blue Bell, Pennsylvania

WACHOVIA SERVICES, INC.
Winston-Salem, North Carolina

DATA BASE/DATA COMMUNICATIONS: THE FUTURE IS NOW

Bob Flynn
CINCOM Systems, Inc.
San Francisco, California

Mr. Flynn discussed the data base management and telecommunications/task monitoring approaches in the market place today.

Emphasis was on historical failures, contemporary approaches, and future directions in these two most vital and symbiotic components of the information system.

The student records data base was used as the focal point of the presentation.

For further information on Data Base/Data Communications contact Mr. Bob Flynn, CINCOM Systems, Inc., 50 California Street, San Francisco, California 94111 (415) 362-2316.

informatics inc
Western Systems Company
222 South Riverside Plaza
Chicago, Illinois 60606
(312) 648-0280

Abstract, CAUSE Presentation -- December 4, 1975

by: Joe Reed, Informatics Inc., Western Systems Company

Informatics Inc. is one of the largest independent software companies in the world. A subsidiary of The Equitable Life Assurance Society of the United States since early 1974, Informatics is committed to "fulfilling the computer's promise" through an unmatched offering of software products and services. The MARK IV System, first and most successful general purpose software product for implementing data processing applications, is in more than 950 installations in 40 countries and has 35,000 trained users with 4,000 user years of operation. Other MARK IV product offerings include Accounts Payable, MARK IV General Ledger, and CL*IV, a COBOL generator. Communications Systems and Network Data Services provide message switching and applications development tools nationwide on a computer network. The Insurance industry is served with four financial products providing administrative and management systems, policy application and issue, portfolio processing, and mortgage loan accounting. Accounting needs are satisfied with General Ledger, Accounts Payable, and Accounts Receivable packages written in COBOL. Major undertakings in the past on a custom basis have satisfied needs in law enforcement telecommunication, major banking switching systems, brokerage accounting, military command and control futures, election forecasting, automated material and order control, and worldwide agricultural and trade data collection and dissemination. Manufacturing needs are answered with PRODUCTION IV, a complete manufacturing management system. Users of System/3, and System/32 -- and other small business computers are served through a mail order service and a monthly magazine, System/3 World. Government, commercial, and higher education contract design and programming services are available from offices in New York, Chicago, Los Angeles and San Francisco. For further information regarding products or services, contact Joseph H. Reed, Manager/Chicago Office, Informatics Inc., 120 South Riverside Plaza, Room 866, Chicago, Illinois (312) 648-0280; or -- John F. Bentivegna, Product Manager, Informatics MARK IV Systems Company, 21050 Vanowen, Canoga Park, California (213) 887-9121.

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DAVID E. MCKELVEY
President

IAI FINANCIAL ACCOUNTING SYSTEM

INFORMATION ASSOCIATES, INC. specializes in the design and implementation of modern computer-based administrative systems for higher educat on. The IAI Financial Accounting System is the most widely used integrated General Ledger-Management Reporting Fund Accounting System for colleges and universities today.

EXTENSIVE EXPERTISE

IAI has delivered this system to 24 institutional corporate entities. Some of these customers are state institutions with multiple college operations geographically disbursed. In some cases, these campuses are included in one common data base; in others, they are separate data bases. In total, there are at least 47 geographically separate colleges using this system. As you can see from the following reference list, IAI has probably worked with an institution or two very similar to yours. Over the year prior to committing yourselves, you can observe FAS in operation. Our users have been extremely generous with their time and facility to host visits from potential customers. Generally, a visit can be arranged for you to see the system in a live environment and converse with your counterpart on any aspect of the system. It is presently operating on the following computing equipment: IBM 360/370 - All Models; UNIVAC 1106/1108; NCR 200; DEC PDP-10; Burroughs 3500.

MAJOR DATA BASE COMPONENT

Most institutions consider their data base in three major components: Financial Accounting, Payroll/Personnel, Student Records. Of course, there are appendages, but these are the key ones. The IAI FAS is very comprehensive and well-defined. The inherent flexibility has been proven many times by the diverse institutions in which it has been installed. It blends well, and provides the customer with a major module that is very easy to work with.

ATTRIBUTES

Attributes is a term used as a synonym for descriptive data elements such as: Name, Geographic Location, School, WICHE Code, Department, etc. These attributes provide the ability to store relations and characteristics that permit the user to categorize and assimilate data in a myriad of ways for extensive reporting flexibility. Since characteristics are not reflected in the account number, the account number required on each transaction can be small (9, 10, or 11 digits). This reduced size simplifies the data entry function, reduces the chance for error, and eliminates the need to revise account numbers because of changes in function and organization.

DICTIONARY FOR DATA ELEMENT CONTROL

The dictionary provides the accounting area with greater control over the system and requires significantly less programming support. The dictionary is a facility in which the user can maintain information that tells where, within the system, data elements are stored, on which transactions they will be entered and what edits should be performed in order to accept the data. The user can change the dictionary and effectively change the file maintenance program without actually changing the code of the program. Thus, the user is far less dependent upon the availability of the programmer.

DICTIONARY FOR REPORTING -- FLEXIBILITY

The dictionary provides the means for extensive, flexible reporting. Many of the reports provided as part of the system have a very powerful feature built into them. The user can enter a parameter card at execution time specifying element numbers and data values. These reports will reorganize themselves by element (for example, in departmental sequence). Also, if a value is specified (Dept. No. 12004), only those entitities with the department attribute having a value of 12004 will be selected. The dictionary provides the mechanism to makes this possible. The user can conceive a new data element, describe it to the dictionary, enter this new data element, and then selectively report upon it, all without a program change -- VERY POWERFUL. This is truly report flexibility.

LABOR COST SAVINGS

There are several well-documented examples of dramatic labor savings that various institutions have experienced. In some cases, this has been an actual reduction in staff. In others, it has been the elimination of overtime, particularly at year-end. In still others, the same staff is handling significantly increased volumes that have occurred along with the growth of the institution.

INSTALLATION TIME FRAMES

IAI is very proud of the fact that the implementation of this system has always been accomplished on time. In some cases, this implementation has taken as little as 3 months and in others, as long as 18 months. Typically, the time frame is 5-9 months. The customer can truly count on meeting his target date for live operations. Thus, his costs in terms of elapsed time are generally fixed.

REPRESENTATIVE CUSTOMERS

BOSTON COLLEGE
BROWN UNIVERSITY
CITY UNIVERSITY OF NEW YORK
COLLEGE OF WILLIAM & MARY
COLORADO STATE COLLEGE SYSTEM
CORNELL UNIVERSITY MEDICAL COLLEGE
MEHARRY MEDICAL COLLEGE
MINNESOTA STATE COLLEGE SYSTEM
MONROE COMMUNITY HOSPITAL
NEW YORK UNIVERSITY
ROCKEFELLER UNIVERSITY
SCRIPPS CLINIC & RESEARCH FOUNDATION
TUFTS UNIVERSITY
UNIVERSITY OF BRIDGEPORT
UNIVERSITY OF LOUISVILLE
UNIVERSITY OF MAINE
UNIVERSITY OF MASSACHUSETTS
UNIVERSITY OF NEW HAMPSHIRE
UNIVERSITY OF PENNSYLVANIA
UNIVERSITY OF PITTSBURGH
UNIVERSITY OF ROCHESTER
UNIVERSITY OF SOUTH ALABAMA
UNIVERSITY OF VERMONT
UNIVERSITY OF VIRGINIA

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ALUMNI/DEVELOPMENT SYSTEMS: RESPONDING TO INCREASED DEMANDS

Michael P. Aherne
Steven D. Rothschild
Integral Systems, Inc.
Flemington, New Jersey

The higher education enviroment today is increasingly pressed for new and innovative approaches to improve fund raising campaigns and to more effectively utilize alumni information. This presentation describes an approach to Alumni/Development Systems which is responsive to the increased and often countervailing demands of fund-raising and alumni activities. The System discussed was recently installed in production after more than nine man-years of development effort. Specific topics covered include the establishment of coherent alumni and contributor records, the provision of special handling for preferred alumni/givers, the institution of selective fund-drive approaches to allow more effective use of development resources, the operation of multiple, simultaneous campaigns, the maintenance of comprehensive pledge, receipt, gift and bequest controls, and the techniques to be used in smoothing and simplifying operations for both alumni and development functions. The system which is the basis for the presentation is currently operational. Actual results and outputs are described.

For further information on the ISI Alumni/Development System contact Michael P. Aherne at (201) 782-3600 or write to the address above.

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HUMAN RESOURCE SYSTEMS: GETTING PAST PAYROLL/PERSONNEL

Michael P. Aherne
Robert L. Bartman
Integral Systems, Inc.
Flemington, New Jersey

Human Resource Systems include not only payroll and personnel, but also biographic information benefits management, applicant flow control, position control and the like. Too often the means used to meet pressing needs in payroll and personnel precludes or hampers efforts to satisfy requirements in related areas. The pivotal importance of flexible, user-oriented, human resource systems to a well rounded systems support function in higher education is discussed in this presentation. The areas covered include the design of a human resource data base, accommodation of the requirements of personnel administration, wage and salary controls, adherence to affirmative action requirements, reduction of effort to meet grant and contract accounting demands, and the establishment of an effective information supply for the satisfaction of "ad hoc" requirments from both internal and external agencies. Application of the human resource data is described in relation to supplying employee information, supporting the payroll function, interfacing with the financial system, and in the production of the reports required to satisfy EEO, AAUP, and others. The importance of a flexible, "user-controlled" approach to human resource systems is discussed; especially as it relates to providing the keystone for ongoing development in related application areas.

For further information on the ISI Human Resource Systems contact Michael P. Aherne at (201) 782-3600 or write the address above.

INTERACTIVE PRODUCT ANNOUNCEMENT

Today we are announcing significant additions to IBM's interactive computing offerings.

These additions include:

. Virtual Storage Personal Computing (VSPC), interactive computing program products designed primarily for the problem solver and interactive application user under DOS/VS, OS/VS1, and OS/VS2 (MVS).

. VS APL - A new APL program product for both VSPC and VM/370 CMS.

. VSPC FORTRAN - A new interactive FORTRAN program product for VSPC.

. Enhanced support for VS BASIC.

. Three new hardware features -- the 3270 Data Analysis - APL Feature, APL Assist for System/370 Models 135 and 145, and the 3767 APL Feature (SDLC).

Highlights ... VS Personal Computing (VSPC) offers an interactive environment for personal computing and includes the following features:

. Command language facilities provide for:

- A responsive, interactive, flexible editor for program and data manipulation.
- Conversational remote job entry functions (submit job to the background and retrieve or reroute job output).
- Control of the user's terminal session and management of his/her library.
- Command list processing
- Interactive administration and control of VSPC.

. A foreground processor interface is provided to support installation written programs executing interactively under VSPC control.

. A Shared Storage Manager for the sharing of data between VSPC foreground programs and/or batch programs is provided.

. The installation can control the number of users and their use of system resources at initialization or dynamically by operator command.

. A VSPC library may have three kinds of user libraries: private, project and public, allowing the installation to make different data and applications available to different users.

. VSAM is used exclusively as the device independent access method for VSPC library support.

. VTAM is used exclusively as the terminal access method.

. Use of VTAM and its associated network independence allows the same terminals, and/or communication lines, to be used for VSPC and other VTAM applications such as CICS, IMS, etc.

VS APL Features and Applications ... VS APL provides an interactive way to use computers which can help enhance productivity in application development and personal computing. VS APL incorporates facilities for writing, debugging, storing and executing programs in many user application areas. It can be used in a convenient desk-calculator mode of operation in which large or small jobs can be executed as soon as entered. VS APL permits free-form input, and can automatically format output: it requires no declarations of either type or extent, and can automatically extend statements valid for a single element to handle data arrays without iteration. Programmers and non-programmers can learn the language and how to use it at the terminal.

VS APL supports the APL system commands through which the terminal users manage their APL environment. It is in this environment that the APL user can create and/or execute APL programs.

VS APL also provides a shared variable facility that allows APL users to communicate with other APL users (VSPC only) and with non-APL programs (called auxiliary processors) operating outside the APL environment. This auxiliary processor concept provides a method of extending the capability of the APL environment. VS APL includes auxiliary processors that provide the APL user selected data management services, including VSAM file access under VSPC, and, additionally, for the VM/370 CMS environment, selected CP and CMS command services. Installation supplied auxiliary processors can provide customer specific capabilities.

VS APL contains major extensions to APL\360, and has functions provided for in APLSV and APL/CMS.

The VS APL language is compatible with APL\360, APLSV and APL/CMS with minor differences.

mri SYSTEMS CORPORATION

THE DATA BASE MANAGEMENT COMPANY

REFERENCE:

This presentation gives a broad overview of SYSTEM 2000®, MRI's generalized data base management system which is operational on IBM, UNIVAC and CDC hardware and has over 300 users. Details are given on each of the user facilities: data definition language, self-contained languages, report writer, procedural language interfaces, data base administration controls, and executive code.

For further information about SYSTEM 2000, contact:

Mr. Donald A. Flanagan, MRI Systems Corporation, P.O. Box 9968, Austin, Texas 78766, (512) 258-5171.

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(512) 258-5171/TWX: 910-874-1316/CABLE: MRI

PANSOPHIC

"PANVALET AND EASYTRIEVE IN THE UNIVERSITY ENVIRONMENT"

by Robert S. Briggs, Pansophic Systems

In CAUSE Conference presentations this year, Pansophic Vice President Bob Briggs explained how the utility software systems PANVALET and EASYTRIEVE directly apply to the total college and university environment.

EASYTRIEVE has recently been enhanced to where today, the system can fulfill any report request quickly and correctly, often in the first run of a program. Briggs pre-announced Version Six of the system, a release that encompasses a CALL capability, an ELSE command for alternative processing, and many other features. EASYTRIEVE reference guide has been completely rewritten for this release of the system, now including a written EASYTRIEVE class for non-technical personnel, detailed examples with every system aspect, and an 11-page index with over 1,000 cross-referenced entries that makes problem solving simple.

Briggs distributed a publication called "EASYTRIEVE, The Information Retrieval and Data Management System for Student Data Bases," which described in detail the coding necessary for doing file updates, mailing labels, class roster reports, drop/add reports, fee statements and registration reports. Briggs stressed that these are only a few examples of the capabilities of EASYTRIEVE, and mentioned that in many dozen higher education institutions, EASYTRIEVE is being used for retrieving cost center information, file repairs, developing test data, SEMIS reporting to the federal government, audit confirmations, affirmative action reporting, conversions and much more.

PANVALET is especially useful for college and university data centers, Briggs said, because of the unique use environment that exists: administrative data processing alongside student processing. All the reasons that PANVALET is in widespread industry use apply equally well to higher education ADP: for storage of source programs, protection of program materials, complete programming audit trails, and programmer tools. When applied to student data bases, PANVALET can be of immeasurable assistance in teaching program principles. When discussing structured programming, what better way to illustrate the point than with the PANVALET Include Facility and the ability to nest includes up to six levels? When striving for the ability to work with many types of program languages, what better way to accomplish that than with a library system that can handle all program languages? When trying to teach the excitement of programming, PANVALET eliminates the drudgery of the job and gets the project completed faster... and with faster results comes a natural sense of satisfaction.

Indeed, Briggs explained, PANVALET and EASYTRIEVE are proven, rapidly-implemented ways to automate a data center, whether for student use or administrative work.

For further information, contact Bob Briggs at 312/986-6040, or Lee Mulder at 312/986-6055; they are both at Pansophic world headquarters at Oak Brook IL.

WACHOVIA SERVICES, INC.

STUDENT LOAN SOFTWARE

Wachovia Services, Inc. is now offering an automated student loan software package for lenders who desire to maintain its own billing and bookkeeping system in-house. This system is the product of ten year's involvement in student loan processing.

In 1964 Wachovia Services began work on its first NDSL System; in 1968 the system was modified to accommodate the latest changes in loan legislation. In 1973 the system was redesigned from the ground up and is now the most complete and sophisticated National Defense/Direct Education Act Loan processing system available. This System is now used to process more than 400,000 NDSL, NTA, HPA, and Institutional programs for over 450 lenders.

The System is written in ANS/COBOL and is available for either OS or DOS environments. One master file is used and the files are arranged sequentially. There are five programs including monthly updates, reports, (both weekly and monthly) weekly post, weekly input edit and the header update.

The System as presently used by Wachovia Services, Inc., is oriented to a weekly editing and posting cycle with monthly, quarterly, and annually billings plus aging of past due accounts. Activity received daily is processed and controlled for a weekly balancing cycle. The System, when purchased by an institution of higher education may be run as frequent as necessary.

Realizing that different institutions have different needs, Wachovia is not only offering the outright purchase of this software package, but at the institution's option, Wachovia Services will service a portfolio for a period of one, two, or three years with eventual institutional purchase of the software package at a reduced rate. This gradual approach to outright purchase appears to be an attractive alternative to most institutions as it allows WSI to take a major portion of the conversion responsibilities. Also this allows the institution's borrowers to become familiar with this new and improved approach to handling their student loan accounts.

Pricing Schedule, Maintenance Agreements, and further information regarding this System are available from:

Wachovia Services, Inc.
Institutional Marketing Department
Post Office Box 3176
Winston-Salem, North Carolina 27102
Telephone: 919/748-5608

USER GROUPS

Tuesday afternoon before the Conference the following meetings were held for users of specific products. These meetings provided an opportunity for college and university users of these products to share experiences. Each User's Group was convened by the person(s) listed below.

CICS	Joseph Cermak Daryl Sawin University of Iowa
EPIC/SOCRATES	Don Perrin Michigan State University
IMS	William McKelvey Ohio State University
MARK IV	Dorothy Hopkin Richard Mann University of Illinois
PANSOPHIC SYSTEMS	Eugene Hilton Mercer County Community College New Jersey
SYSTEM 2000	Ernest Jones Indiana University
TOTAL/ENVIRON 1	David T. Clements Coast Community College California Robert Ogilvie American University Washington, D. C.