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ABSTRACT

Fifteen papers on computer centers and data processing management presented at the Association for Educational Data Systems (AEDS) 1976 convention are included in this document. The first two papers review the recent controversy for proposed licensing of data processors, and they are followed by a description of the Institute for Certification of Computer Professionals. Also included is an article about the changing education of data processing managers. Two articles deal with the use of computing services for library circulation and assignment of students to schools. Five articles deal with the use of information systems and computer facilities by schools and organizations. Billing rates for computing services, computer security in a university administrative computer system, and the use of transaction processing for university registration are discussed. An article which describes ways in which potential computer users can prepare to utilize computer services concludes the document. (CH)

COMPUTER CENTER/DP MANAGEMENT. Papers presented at the Association for Educational Data Systems Annual Convention.

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ASSOCIATION FOR EDUCATIONAL DATA SYSTEMS

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THE LICENCING CONTROVERSY AND IT'S MEANING TO PROFESSIONALISM

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ABSTRACT: This paper reviews the recent licencing controversy instigated by the Society of Certified Data Processors (SCDP). The rationale for proposing licencing legislation is evaluated as an intent to facilitate the creation of a legitimate computing profession and as to the reaction received. The resultant discourse has focused attention upon the development of Codes of Good Practice which will define the professional and his conduct as well as provide the basis for obtaining public acceptance as a legitimate profession. The challenge is made for participation in this development effort.

The past year has seen considerable discussion relative to the questions of professionalization, certification, and licencing. The controversy has been heated, emotional, demanding, and for the most part non-productive.

How could so much discourse and attention have produced so little substantive effort and persuaded so few? There is a temptation to answer that the licencing controversy initiated by the Society of Certified Data Processors (SCDP) was ill-advised, self-serving, or a "hoax". (19)(22)

If such arguments were to prevail, then why has the controversy persisted for well over a year, and why have some of the most responsible personalities in the computer industry been moved to make public statements concerning matters alleged to be so trivial? Why has virtually every major computer society made a public statement on this matter? (9) (10) (14) (15) (18) (21) (22)

Although one could offer many explanations for these statements, it would appear to me that one of them could not be that the topic was trivial. A responsive chord has been touched and it has set off serious introspection, doubt, fear, and concern among many. Any serious student of history could well reflect that the sheer volume of discourse and the level and quality of the participants, to say nothing of the legislative bodies involved, is clearly diagnostic of a major historical event in the industry. Why, then, haven't sweeping proposals and activities been made apparent?

May I suggest that the answer lies in the fact that licencing was merely symptomatic of the real malady, and while capable of evoking uneasiness in the industry, represents a mis-diagnosis of the problem. Of course, such a statement begs the question, what is the proper problem definition?

I suspect that the answer to that question is to be found in the teeming value conflicts associated with our concepts of freedom from regulation, of protecting individual rights, of free enterprise, of competency, and of protecting the public, to mention but a few. This I hope will at least prove true of serious members of the industry. Other negative reactions come in part from those who are threatened by the possibility of having their ignorance and lack of skill and knowledge exposed. The attendant loss of job potential due to constraints resulting from standards must certainly threaten some. I also suspect that until we have resolved such conflicts, little real progress can be achieved.

For example, as long as we hold that the individual has the right, without regulation, to perform any service for which he can find a buyer, it will remain difficult to protect the buyer. Certainly most data processors realize that a person may be extremely competent in selling a system yet prove wholly inadequate in attempting its implementation. I suspect that most of the members of the industry active in the societies have come to grips with such issues. But I also suspect from reading the licencing controversy letters and articles, that many of our colleagues in the field haven't. (12) (13)

Considerable reference is made among our peers in the computing industry of a data processing or computing professional. The term itself is elusive, for most who use it are extremely hard pressed to provide distinguishing characteristic's although they feel they are professional and many others are not, an interesting egotist reaction.

At the outset let it be perfectly clear that the use of the term professional in our industry is merely a dream or hope for the future. In fact, currently no such creature exists. True, many are working for the reality but the vast majority are either apathetic or actively opposed to the concept. It is this apathy and opposition which must command our interest, for a lack of understanding of the motives of such opposition may well spell out doom to the efforts to legitimatize a computing profession. Since the Association for Educational Data Systems is already actively involved in the efforts to create a profession, let's reflect upon what is necessary to create a legitimate professional in our society.

Before gaining such status, it is clear that the profession must exercise discipline such that its members perform in acceptable and ethical ways which protect the public interest and command its respect. Further, those who do not perform in such a manner must be disciplined or the profession faces the loss of public respect and support. Therefore, an element of regulation is required.

The very concepts of professionalism, certification, and licencing involve an element of regulation. I believe it to be quite clear that most computer societies and leaders favor some sort of regulation. It already exists in that college degrees, on the job training, and experience evaluations are being increasingly utilized in hiring and promotion procedures. I'm confident that few, if any, of this audience would argue against some such regulatory influence although great divergence might exist concerning its form. Therefore, no further argument will be made in defense of the concept of regulation. Rather, attention to the form of such regulation is appropriate.

The simplest form of regulation would be voluntarily imposed by the individual upon himself. He would exercise care to upgrade his skills, not present himself beyond the capability of his skills, exercise ethical conduct, and give his employer full value for dollars received. While such a position is ideal, it is also dangerously naive. Yet, many of the criticisms made in the recent licencing controversy tend to promote such naivete. Far too many responses from the field argued that such voluntarism is possible. As a matter of fact, the best arguments in support of the need for standards and regulation come from reading the ignorant, mis-informed, naive, emotional, and flagrantly erroneous statements made by many respondents to the licencing controversy. (13)

The next level of regulation involves peer and employer pressure by providing educational opportunities and self-improvement procedures such as the often mentioned self-assessment programs proposed by the Association of Computing Machinery (ACM). Other examples can be seen in the management training programs of Data Processing Management Association (DPMA). Another proposed program, the ombudsman, would give some coercive power in that an individual could be subjected to review of his peers in the presence of a complaint. Historically, however, such programs have accomplished little in establishing regulatory controls and promoting the concept of a profession.

A more formal effort to achieve such peer and employer pressure to encourage voluntary participation and adherence to standards is the certification movement. Here is attempted a clear and comprehensive articulation of peer evaluation and approval with attendant subscription to a continuing practice of ethical behavior. At this level one finds most of the generally mentioned and accepted attributes of the definition of a profession except enforceability. This of course is the realm of the Institute for Certification of Computer Professionals (ICCP). This effort is essential to the development of a professional group of people and represents the most significant industry effort to improve and regulate itself.

However, with an estimated half million practioners of data processing, and fourteen years since the inception of the Certificate in Data Processing (CDP) program, only 30,000 plus people have taken advantage of the program while only 15,000 plus have achieved CDP status. (17) This would appear to be hardly a booming recommendation for voluntary certification and regulation.

It should be no surprise that the competent feel no necessity to prove their abilities beyond their every-day performance; and even more so, the incompetent certainly aren't going to flock to demonstrate their status to the world. Only when certification becomes legitimate and the competent understand its role, will they make the effort to comply. Then the incompetent will be identified and will find it necessary to improve or accept roles in keeping with their skill levels. Thus the public interest will be protected.

But the question now becomes, how long

will this process take? A corollary is how much time is available for completion? If one decides that the time required exceeds the time available, then the voluntary certification approach becomes untenable. Why then might one come to this conclusion.

The answer depends upon projections of current and future events now evident and believed to be inevitable. In November 1974, this author presented what I believed to be compelling arguments that privacy legislation was necessary and imminent. Less than a month later the Congress passed the first public privacy bill into law. (16) Projections of private domain laws are readily available and indicate need for immediate concern, since privacy laws are passing state legislatures with increasing regularity and implications for the data processor. (1) (8)

If the computer industry is to participate in this regulation of computer related areas rather than perform as technicians under the guidance of other professions then we must establish ourselves as acceptable professionals and in short order. Notice the movements of other professions such as law and particularly accounting to fill the void here. Already CPA firms are hiring DP personnel as technicians to deal with systems and procedural audits. Furthermore, accounting education is changing to adapt to computer technology. Besides not being comprehensive enough to cover all computer applications, are we going to accept technician roles to other professionals? Or worse yet, unionization as a technical function only?

An additional concern that the public interest must be protected is causing legislatures to become increasingly sensitive to the impact of computer technology. How long are they going to tolerate the technology without regulation? Do we have time for voluntary approaches?

If one accepts the inevitability of such regulation within limited time frames, the argument becomes compelling for accelerating formation of the profession and the regulation within it. In fact, the passage of regulatory legislation could make all the prior concerns empty rhetoric.

It is in the belief that such would happen, and especially that it would come in a relatively short time frame, that prompted many in the licencing movement. Licencing legislation would provide immediate legitimacy for the profession and prompt accelerated development of standards within it. Contrary to the emotional attacks on the movement, it certainly provides an alternative for those who believe in and desire to establish a data processing profession. And as such it is worthy of consideration. Again, I suspect the cooler thinkers realize this and recognize the need to address the controversy. Further, it should be noted that many public statements of the leaders of the industry indicate their belief in the future inevitability of licencing. (4) (6) (10) (14) (18)

It should also be noted that licencing bills are still on the docket in at least two states (New Hampshire and Florida), and that other states are considering such. Further, new activity in this area can be expected. Passage of such a bill will make all arguments moot and place the industry in the position of having to react rather than having the opportunity to prepare in advance. This may well happen, however, since few people seem inclined to seriously prepare for such eventualities. Rather many seem to want to deny the possibility. Such seems naive and out of touch, especially since legislatures sought the SCDP licencing proposal with amazing speed and persistence.

Therefore, far from being trivial, SCDP's licencing effort (22) was an attempt to achieve accelerated development of the profession. The success of this effort has been significant in at least causing awareness and, in view of perceived time constraints, a valuable contribution to the industry. However, such legislation is not without peril and inadequte preparation must be avoided if possible.

Such has been my appeal in the past. (3) (4) I have been concerned that the industry is faced with potential for the establishment of the profession, and think it would seem prudent to prepare for it. I have argued that certain things must be done to prepare. In particular, that identification must be made of who would be a professional, what he would do that would differ from non-professionals, and how he would perform those activities. Subsequently ACPA, ICCP, ACM, DPMA and others have accepted such a possibility and the need for the same types of definitions in their public statements on licencing.

The "who" question is being addressed, in my opinion, by such efforts as the certification program of ICCP, which has seen advances in its association with the Psychological Corporation, the announced long range planning project and the beginning of a Codes of Practice Project. Also efforts such as DPMA's new Education Foundation, ACM's self-assessment program, and AFIPS' job analysis for programmers and analysts are valuable in this area.

Therefore, the licencing controversy has focused attention upon what a professional will do and how he will do it. It is in this domain in which all interested societies might participate to define projects, identify funding sources, and assign task forces to accomplish the necessary work. While it is proposed that each society be free to pursue its own interests, it is hoped all will cooperate with one another for the common good. The outcome hoped for is the establishment of a Code of Good Data Processing Practices.

Such a code will then form the basis for processional activities. Without such a code, professional status will remain meaningless, certification will continue to struggle, and licencing will remain premature.

Therefore, the real issue is the formation of a legitimate profession, regulated to protect the public interest, to insure the quality of the professional, and to provide him with the working tools with which he will perform. Time and human nature argue against pruely voluntary standards, yet the more powerful, and in my opinion inevitable, effects of licencing appear premature until a Code of Good Practices is developed. Further, when it does happen, I hope for an industry licence not federal control. (9)

Therefore, I see the licencing controversy instigated by SCDP as a valuable contribution to the industry. It has created interest, discussion, and focus upon our needs. It has enhanced the possibilities for creating a profession by focusing attention upon the real problem of developing a Code of Good Practice. This is the major challenge now facing the industry and the societies. Now is the time for enlightened commitment of personal effort and resources to meet the challenge. I sincerely hope we are up to it and solicit your personal involvement and support.

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8

AEDS, CERTIFICATION, AND THE ICCP - A PARTNERSHIP FOR THE FUTURE

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ABSTRACT: The Association for Educational Data Systems, in its attempt to serve the educational community, has adopted as one of its objectives a high level of expertise on the part of practitioners in the field of educational data systems. An important element of such a level of expertise is some method of certifying qualifications. This paper will attempt to show how membership in the ICCP and support of the CDP examination will aid the Association in its pursuit of this objective.

Since AEDS' membership consists of professional educators as well as computer technicians, many of you may be wondering why this organization is a member of the ICCP and is so supportive of the CDP examination program. Some questions that you may be asking are: How do these activities affect you as an individual member of AEDS? How do they affect you as a technician, an educator, or an administrator? Why does AEDS support the Institute, certification, and the CDP program? During the next few minutes, I hope to answer these questions for you. Or at least, furnish you with enough information to figure out the answers yourselves.

Certification is nothing new to the education field; we all realize its purpose and its importance. It has essentially the same purpose and importance in teaching as it does in educational data systems. According to the dictionary, to certify is to endorse authoritatively as being of a standard quality, preparation, etc. Certification is not to be confused with licensing, as licensing is defined as formal permission by a government body to practice in a particular area. Certification, on the other hand, is the endorsement by a peer group of an individual's having met pre-determined standards of quality in a particular area of expertise. You will hear more about this from some of our other speakers today. As important as certification is to AEDS as an organization, it is even more so to you as an individual. With all of our glamorous and sophisticated computer systems and the related programming packages, we sometimes forget the importance of the individual data processor. The competence of that person is often taken for granted, and therefore we often do not recognize those who have become obsolete. Unfortunately, we sometimes do not even recognize it in ourselves.

Because of rapidly changing technical methods and techniques, the data processor must continually seek to maintain and improve his or her expertise. George Glaser, past president of AFIPS, has said, "Those who are now competent are becoming less so every day as technological developments continue at an overwhelming rate." In other words, they are becoming obsolete. The danger of obsolescence faces all of us in the field of data processing - from the beginning programmer to the head of the department. It should concern not only the technician but also the educational administrator who relies so heavily on the information generated by the computer.

How can we protect ourselves and our educational institutions against this danger? One way is by taking it upon ourselves to maintain our personal expertise at an up-to-date level. This can be accomplished in several ways, most of which are already familiar to us. Attending this AEDS convention is a good example of how we can keep ourselves abreast of latest developments. For in depth training in new methods, we should attend specialized workshops and seminars. Another way, sometimes ignored, is reviewing technical publications, most of which are obtainable at no cost.

Yes, we can do these things - if we recognize our deficiencies! But what happens to those of us who are busy in our own little worlds, feeling that our present methods and techniques are the ultimate? There's an old saying down south that goes, "It ain't the things you don't know that get you in trouble; it's the things you know for sure that ain't so!" At one time or another, we have all been guilty of falling into this trap. Certification and an examination program, like the CDP, could prevent such things from happening.

What better way is there to recognize our deficiencies than to take an examination on what we <u>think</u> we know? A wise man once said, "It's strange how much you've got to know before you know how little you know." Testing to determine knowledge is one of the mainstays of our educational system. Isn't this, then, what the CDP examination is all about? It offers us an opportunity to discover what we actually know <u>and</u> what we do not know. Passing the examination is a great achievement indeed, but we can gain many benefits even if we are not successful. The preparation to take the examination, by itself, forces the applicant to acquire useful information about a wide range of technical areas that he or she may not have come in direct contact with in his or her day-to-day work environment. The applicant who is sincere cannot help but improve his or her expertise by experiencing this preparation.

Most of us like to think of ourselves as professionals, irregardless of recent court decisions. If this is the case, then we should be willing to assume the responsibility of being a professional. We have a responsibility to our employers, to our students, to our public, and to ourselves to perform our services in the most efficient and intelligent way possible. Before this can be done, we must satisfy ourselves that we have the personal ability to perform in such a manner. With more and more emphasis being placed on privacy of data, security of equipment and data files, and accountability, the data processor is faced with greater demands for a high level of competency and expertise than ever before. It is up to us to equip ourselves to meet these demands!

Let's look at the importance of certification from the administrator's point of view. To the administrator, the certification program (and in particular the CDP examination) is important in that he or she now has a "yardstick" with which to measure the level of competency of personnel or of applicants for data processing positions. He or she no longer has to take a shot in the dark when hiring these people. Certification sets a standard by which the administrator can make vital personnel decisions with some degree of certainty that they are the right decisions. The importance of certification standards and the usefulness of the examination will increase as the program is perfected and expanded to include a wider range of test areas, aspects of which are currently under development by the ICCP. As a member society, AEDS is making a direct contribution to this development.

Included in the expansion of the examination program are the eventual development of a series of examinations testing skill levels and a standardized set of job requirements upon which such examinations can be based. Here again, AEDS will have the opportunity to make an important contribution to an activity that will effect all of us in one way or another.

There is still another benefit derived from our membership in the ICCP. With our membership in the ICCP, and in AFIPS, we have the opportunity to speak out on behalf of our members and the educational community on issues of deep concern. You may be saying to yourself that AEDS could always speak out, whether or not it was a member of the ICCP. That's true, but now this association, through such affiliations, has assurance that it's words will be heard! AEDS is now able to participate in activities far beyond our capabilities if attempted alone, and the certification program is only one example. Through our officers and representatives and their meetings with the representatives of other member societies, AEDS has been able to make a significant impact on the data processing community. I sincerely believe that this is only the beginning, for we are fast becoming accepted as the "spokesman" for all of educational computer technology. I foresee the time, in the not too distant future, when there will exist a specialized examination for practitioners in educational data systems, both technicians and instructors. AEDS will be able to use its influence as the representative society of the educational data systems field to make a large contribution toward the development of such an examination.

There is another aspect of the ICCP's activities for us to bear in mind, and that concerns the influence and status of the ICCP itself. The status of the Institute has been continually on the rise since its inception, but it received its greatest boost when it was publicly recognized by AFIPS as <u>the</u> certification group. I am proud to say that AEDS, being a member society of both groups, played a big part in bringing this public recognition about. With its elevated status and its increased influence in the field, the ICCP will eventually become an authoritative source of information and expertise for employers, educators, practitioners, and public officials.

Many words have been used to point out the importance of the ICCP and the certification program to this association. If I had to condense these words into only a few, I think I could say that realizing the need for qualified personnel and the importance of a certification program with which to meet those needs, AEDS is able to reap more benefits for its members and contribute more assistance to the educational community by taking an <u>active</u> part in the development and maintenance of such activities. Or as the worm said as he bored into the apple- you can accomplish much more on the inside!

In conclusion, I would like to remind you of the principal purpose of this organization - to provide a forum for the exchange of ideas and techniques in the field of educational data systems. This purpose is also applicable to the relationship between professional organizations in that groups like the ICCP and AFIPS provide their member societies with a forum for the exchange of ideas. In turn, you as members of AEDS have a much greater forum available to you.

The officers and members of AEDS realized this serious need when we adopted our present set of long-range goals and objectives two years ago. Specifically, this organization has committed itself to the pursuit of the following objectives relevant to certification and the ICCP: to develop and install an organizational mechanism which will permit AEDS to certify individuals in the field of educational data systems, to promote the sharing of ideas with other organizations, to work with related organizations in order to better monitor and coordinate those activities which affect educational data processing, and to promote recognition of the reliable professional role of the educational data processing specialist and high level of competence required for this role.

Here we have our own goals and objectives, and

As I mentioned before, we are committed to pursue these goals and objectives. Our membership in the ICCP and our support of the certification activities are significant milestones in their eventual achievement!

Before I sit down, I'd like to pass along a bit of philosophy that I ran across recently and thought very appropriate. The author is unknown, but it sounds like something anyone of us might be thinking.

"He who knows not and knows not he knows not, he is a fool - shun him; he who knows not and knows he knows not, he is simple - teach him; he who knows and knows not he knows, he is asleep - wake him; he who knows and knows he knows, he is wise - follow him!" My wish for each of you is that you know - and know you know!

Thank you.

INSTITUTE FOR CERTIFICATION OF COMPUTER PROFESSIONALS

Paul M. Pair, Secretary
Institute for Certification of Computer Professionals

The Institute for Certification of Computer Professionals was incorporated in August 1973 as a non-profit, professional organization by eight societies in the field of data processing and information management. At that time the Institute assumed all responsibility for the Certification Program initiated by the Data Processing Management Association in 1962. Hence, the Institute "inherited" the more than 14,000 persons who had earned the CDP (Certified Data Processor) Certificate.

CHARTER MEMBER SOCIETIES

ACM	Association for Computing Machinery
ACPA	Association of Computer Programmers and Analysts
AEDS	Association for Educational Data Systems
A1A	Automation One Association
CIPS	Canadian Information Processing Society
DPMA	Data Processing Management Association
IEEE	Computer Society of the Institute of Electrical and Electronics Engineers
SCDP	Society of Certified Data Processors

The membership of the eight charter societies represents more than 65,000 professionals in this field. Each society selects its two representatives to serve on the ICCP board. The two AEDS Directors are:

Dr. Philip J. Gensler
Department Head, School of Business
West Texas State University
Canyon, Texas

Paul M. Pair
Senior Education Consultant
Control Data Institute
430 North Michigan Avenue
Chicago, Illinois

Following the incorporation of the Institute, the sixteen Directors elected officers and established working committees. Their first responsibility was to issue a brochure describing the Institute's purpose, programs and structure, as follows:

PURPOSE

ICCP is a non-profit organization established for the purpose of testing and certifying knowledge and skills of computing personnel. It is a coordinated, cooperative, industry-wide effort.

A primary objective is the pooling of resources of constituent societies so that the full attention of the information processing industry will be focused on the vital tasks of development and recognition of qualified personnel.

The Institute will foster, promote and encourage development and improvement of standards of performance and of good practice. It will become an authoritative source of information for employers, educators, practitioners and public officials.

PROGRAMS

ICCP serves as the focal point for its constituent societies which sponsor related programs so that the results of their activities may be incorporated into that of the Institute. In addition to testing and certification, ICCP planned programs include job definitions, curricula, continuing education, self-assessment, and codes of ethics.

During its initial stages, the Institute's highest priority is the improvement of existing programs and the establishment of new examinations for various specialties. A framework for a broad spectrum of tests, and the relationship of these tests to job functions and curricula is under development.

In parallel with the creation of new examinations the Institute is also concentrating on self-assessment programs.

The Institute acquired in early 1974 the testing and certification programs of the Data Processing Management Association (DPMA), including the Registered Business Programmer (RBP) and the Certificate in Data Processing (CDP). The latter is offered annually in test centers in colleges and universities in the U.S.A. and Canada.

STRUCTURE

The Institute is governed by a Board of Directors to which each constituent society designates two directors. The Board of Directors elect officers who serve as an Executive Committee to act for the Board between meetings.

Standing Committees that provide advice to the Board and assist in the management of the Institute are: (1) Program, (2) Public Information, and (3) Budget and Finance. As programs are initiated by the Institute, Councils will be established to oversee them and to provide the necessary guidelines to assure the highest standards. Initially, there is one Council--the Certification Council--which has jurisdiction over the CDP examination program.

CODE OF ETHICS FOR HOLDERS OF THE CERTIFICATE IN DATA PROCESSING

"The holder of the Certificate in Data Processing, consistent with his obligation to the public at large, should promote the understanding of data processing methods and procedures using every resource at his command.

"The holder of the Certificate in Data Processing has an obligation to his profession to uphold the high ideals and the level of personal knowledge certified by the Certificate. He should also encourage the dissemination of knowledge pertaining to the development of data processing.

"The holder of the Certificate in Data Processing has an obligation to serve the interests of his employer and clients loyally, diligently, and honestly."

THE CERTIFICATION COUNCIL

Responsibility for policy-making, planning and directing the CDP Program is vested in the "Certification Council" which was created in 1963. To insure that the CDP program is representative of the entire data processing profession, the members of the Council have continuously been selected for diversity, as well as depth, in their knowledge of data processing. Five members, elected by the Council from acknowledged leaders in the field, serve overlapping terms. The Chairman is appointed by the ICCP Directors. The current Chairman is Professor William Horne, Boston College.

The responsibilities of the Certification Council include: establishing the rules governing academic, experience, and character requirements for candidates; determining the scope of the CDP examination; and, annually, approving the contents of the examination. They are responsible for continuously updating the content and subject matter of the examination.

THE C D P EXAMINATION

The CDP Examination is offered once a year (currently the third Saturday in February) in over 90 locations in the U.S. and Canada. It consists of five major sections as follows:

- Data Processing Equipment
- Computer Programming and Software
- Principals of Management
- Quantitative Methods
- Systems Analysis and Design

Each section consists of 60 questions.

I C C P: CREATING A NEW IMAGE

As Corporate Secretary I included in my annual report, January, 1974: "The incorporation of ICCP as a non-profit, professional organization appears to have created a broad appeal to new segments of our data processing professionals. The response has indicated that MANY persons and organizations are in agreement with our objectives and programs. It is especially gratifying to note the response from the academic community as we answer our telephone calls and read our correspondence. Inquiries from business and industry also tell us there is a search for a professional association which will aid "Mr. Employer" in determining who is qualified for employment in his computing organization. Comments and inquiries are literally coming from "all over the free world."

ICCP SIGNS AGREEMENT WITH THE PSYCHOLOGICAL CORPORATION

Following are excerpts from the Newsrelease announcing this important decision: "ICCP and The Psychological Corporation have signed a long-term agreement for the conduct of testing and related programs for personnel in the industry. Under the agreement The Corporation will provide ICCP with psychometric consultation and services and administrative support for ICCP's testing programs, particularly the CDP Program. Equally important, the agreement provides for cooperative efforts in the expansion of ICCP's programs to provide broader, more effective certification test coverage for personnel in the computing industry.

"The Professional Examinations Division of The Psychological Corporation designs, develops, and administers tests and testing programs for professional groups and organizations, for business and industry, for educational institutions, and for private and public agencies. It provides complete services for entrance and admissions examination programs, as well as licensure, qualifying and certifying examinations. It also offers test scoring, processing, data analysis, and related services, in relation to its own or others' tests, questionnaires, surveys, and other measurement instruments."

CHARTER MEMBER SOCIETIES COOPERATIVE EFFORTS

One of the major programs of the ICCP Directors is PROJECT ICCP in which it prepares ample and pertinent information for the use of each of the eight charter member societies. It has been most gratifying to note that each society, in its own management of promotion activities with its own members, has been highly cooperative. Each is to be highly commended.

Pertinent to the above, it is pointed out that the number of applicants for the 1975 CDP examination increased from the previous year by 12% or 2363 applicants. In a recent Newsrelease it was announced that the number of applicants for the 1976 examination increased about 17% to 2876 applicants.

AWARDS FOR EXCELLENCE

The ICCP Directors announced after the 1975 examination that an AWARD FOR EXCELLENCE would be made to: (1) The person making the highest score on the entire examination of five parts, and (2) to the person who made the highest score on EACH of the five parts of the examination. This recognition resulted in the creation of great interest on the part of employers as well as all those who sat for the examination.

AMERICAN FEDERATION OF INFORMATION PROCESSING SOCIETIES

Four of the eight charter member societies are also members of AFIPS (ACM, AEDS, DPMA and IEEE). This is significant because it provides ICCP with another opportunity to cooperate with the 16 constituent societies of AFIPS whose membership represents more than 200,000 professionals in our field of data processing and information management.

CONCLUSION

It is becoming increasingly evident that the original concept of establishing a non-profit professional organization was sound. The breadth and depth of ICCP programs and policies appear to have produced high credibility. The positive response from both the academic community AND from career-minded young men and women in the field indicates they are, indeed, interested in professional advancement.

CERTIFICATION has become a synonym for many persons interested in achievement recognition in many occupational classifications. Just a few examples indicate the trend and the urgency of action:

CPA Certified Public Accountant
CDP Certified Data Processor
CLU Certified Life Underwriter
CPCU Certified Property Casualty Underwriter
CAM Certified Administrative Manager
CPS Certified Professional Secretary
CPM Certified Property Manager

The increasing demand for well-trained professionals in our field is evidenced by the survey produced by the U. S. Department of Labor:

ESTIMATED DEMAND FOR COMPUTER-RELATED EMPLOYEES

	In 1968	In 1980
Programmers	175K	400K
Systems Analysts	150K	425K
Computer Operations	175K	400K

An editorial in the March 1976 INFOSYSTEMS magazine entitled, INFOWORKERS OUTNUMBER ALL OTHERS, Robert Diamond states, "The importance of effective, economical information handling, storage and processing systems, cannot be overemphasized if you are to believe the findings of a Stanford University researcher whose report, 'The Information Sector of the Economy' was presented at the Paris Conference on Computer/Telecommunications Policies last year."

"According to Edwin Parker of Stanford's Center for Interdisciplinary Research, information workers, as a group, now outnumber all other workers."

The above illustrate the timeliness and, hopefully, the effectiveness, of the Institute's on-going programs to provide "Mr. Employer" with a uniform yardstick (the CDP examination) as he/she requires more well-trained personnel in this ever-expanding field of data processing and information management.

THE EDUCATION OF TOMORROW'S DP MANAGER

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U. S. Department of Agriculture

ABSTRACT The dynamic nature of the computer industry is more than apparent when the evolving functions of data processing management are examined. The need of management to keep in touch with changes in computer technology is an accepted truism within most management circles. However, the changing nature of the DP manager's role is largely dependent upon forces other than those within the technology itself. Social forces in the form of legislative fiats and forces of consumerism are typical past events that have been able to draw the attention of data processing managers at all levels. Some of these subjects are being avoided in planning the curricula in our colleges and universities. It is now time for academicians to look at the needs and functions of tomorrow's data processing managers to see if planned educational programs are responsive to these evolving needs. This paper is based on a 1975 research project conducted by the authors. Some 1,000 DP managers at many management levels were queried to determine how they perceived their roles and functions in the years ahead.

The dynamic nature of the evolving computer industry is well known to all of us associated with computer systems. In rapid succession the trade and professional journals report to the world the latest technological advances in hardware. This is followed by announcements of bold new techniques in software. Yet educational offerings frequently lag behind these technological developments.

Professionals in the computer industry are hard pressed to keep up with all these new developments. They are desirous of maintaining their technological currency and are even hopeful of applying some of these advances to their day-to-day tasks. One has only to read the announcements of courses offered by proprietary firms to see the broad spectrum of interests. A prodigious number of books is being produced on every aspect of computer use and technology. Despite the evident exchange of ideas and the educational opportunities for practitioners, many of our colleges and universities are still offering the same courses they offered in the past.

The computer science programs of many universities and colleges are based on two reports of the Association for Computing Machinery (ACM) Curriculum Committee on Computer Education for Management. This committee produced these reports, one on "Curriculum Recommendations for Graduate Professional Programs in Information Systems," in May 1972 [Ashenhurst], and the other, "Curriculum Recommendations for Undergraduate Programs in Information Systems," in December 1973 [Couger]. Both proposals represent the views of distinguished panelists. Some of the recommendations have been adopted by a number of schools, and programs based on these suggestions about the curricula are in effect today. However, many of the recommended goals have been unattainable in the struggle to develop programs responsive to students and to employers seeking qualified graduates. The broad spectrum of recommended and required material just cannot fit into a normal graduate or undergraduate program.

The thrust of these recommendations was directed toward a discipline called [illegible] areas, with courses as part of programs offered by mathematics or computer science departments in some schools. In keeping with current trends, a distinct shift away from the computer science flavor of programs was announced by Harvard and the University of Pennsylvania in early 1975. These two schools have developed informations systems programs in an attempt to close the gap between the needs of business data processing and the courses offered in traditional computer science programs [Holmes].

Other schools have been working in this direction for some time. In 1958 The American University's Center for Technology and Administration began with course offerings leading to graduate degrees that followed traditional computer science paths. These programs have evolved into very sophisticated and carefully balanced curricula leading to the Bachelor of Science and to the Master of Science in Technology of Management. These programs are more pragmatic than they were at the outset. Changes have been directed by the forces of the marketplace, the needs of the students themselves, and the needs of the potential employers of the graduates [Bassler & Kennevan]. But these changes have generally been academically oriented for the rank-and-file employee. Equally important considerations should be the educational needs of the DP manager and an examination of how educational institutions can respond to these needs.

WHAT SYSTEMS MANAGERS SEE AS THE DIRECTION OF THE PROFESSION

The authors of this paper examined the marketplace by sending out questionnaires to 1,000 information processing managers and asking them to respond to a structured set of questions and to comment on their management functions [Joslin & Bassler]. Over thirty percent responded with usable material.

In the structured portion of the questionnaire (Figure 1), respondents identified the relative importance of the work they are doing *today*, and predicted the importance of these activities five to ten years into the *future*. The tabulated responses are shown in Figure 2.

PURPOSES OF THE SURVEY

One purpose of the survey was to determine what subject matter should be included in the authors' new book, *Managing Data Processing**, published in early 1976. Another purpose was to look for disparities

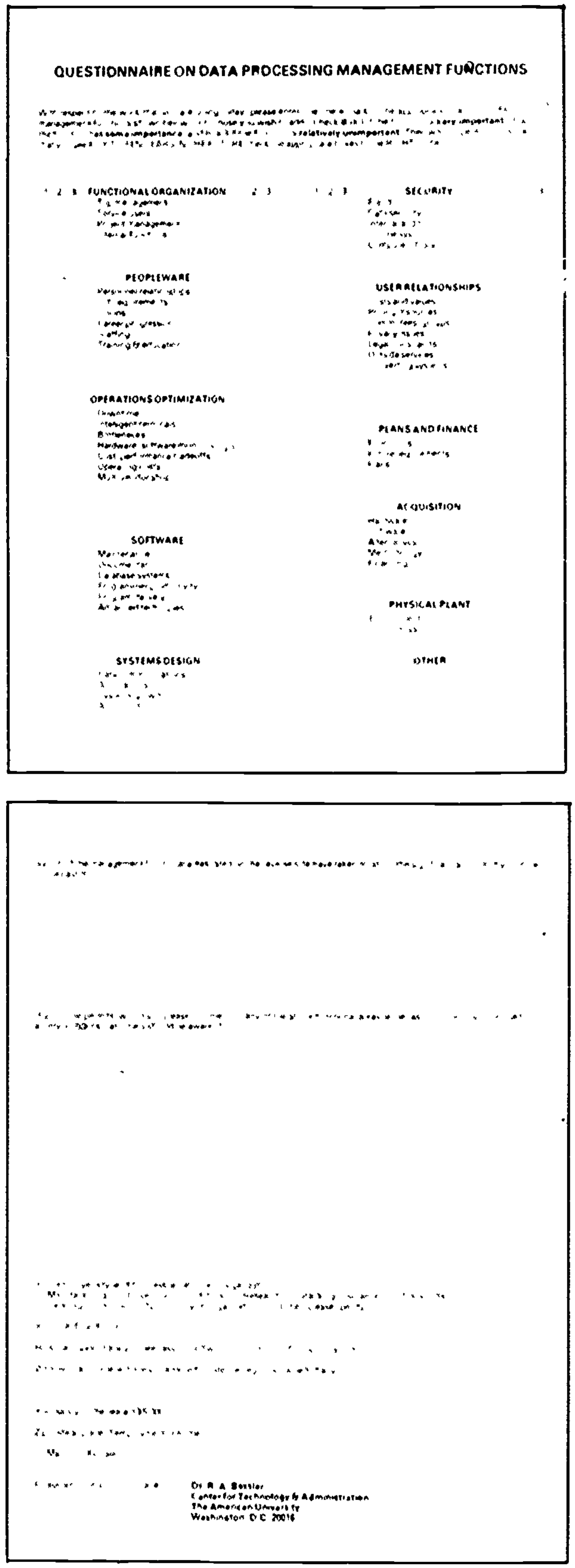

FIGURE 1

* Published by College Readings, Inc.
P.O. Box 11244
Alexandria, Virginia 22312

Trends in Information Processing Functions

Functional Organization	Present very	Present some	Present not	Future very	Future some	Future not
Top management	44	41	12	71	18	3
Serve users	63	28	8	67	24	7
Project management	43	39	16	51	37	10
Internal functions	26	50	20	30	52	13
User Relationships						
Costs and values	37	43	17	63	28	5
Project procedures	18	48	30	42	41	14
Committees groups	16	42	38	33	38	26
Privacy issues	8	35	53	33	39	24
Legal constraint	8	36	52	31	39	27
[illegible]	9	39	49	18	49	30
Converting systems	23	48	27	20	53	25
Plans and Finance						
[illegible]	36	42	20	56	31	10
Financial statements	38	51	12	69	26	4
Plans	44	38	16	73	21	3
Peopleware						
[illegible]	50	37	10	67	27	4
[illegible] requirements	32	58	8	46	45	7
[illegible]	3	16	76	13	35	47
Career [illegible]	30	50	19	49	40	9
Staffing	32	53	13	42	49	7
Training & education	34	50	14	58	33	7
Systems Design						
Data communications	32	45	21	74	20	4
Applications	51	43	6	61	33	5
Systems [illegible]	36	49	14	55	36	8
Audit controls	33	44	22	65	29	5

Acquisition	Present very	Present some	Present not	Future very	Future some	Future not
Hardware	29	44	24	31	49	17
Software	27	53	17	46	43	8
Alternatives	23	52	21	43	41	12
Methodology	16	53	28	33	49	14
Financing	21	38	37	31	41	[illegible]
Operations Optimization						
Downtime	33	38	25	47	26	22
Intelligent terminals	18	42	37	60	28	9
Bottlenecks	32	46	18	35	45	16
Hardware software monitors	12	37	46	33	38	23
Cost performance tradeoffs	30	50	17	59	31	6
Operating costs	47	[illegible]	8	64	29	4
Multi-vendor shop	8	34	51	31	35	26
Physical Plant						
Environment	20	49	28	32	49	16
Support systems	20	52	25	38	47	12
Software						
Maintenance	38	44	16	41	41	17
Documentation	41	43	16	63	29	8
Database systems	30	44	24	71	20	7
Programmer productivity	33	44	20	54	30	13
Program delivery	30	42	23	45	37	13
Advanced techniques	20	47	30	52	31	13
Security						
Fraud	13	33	50	37	35	24
Data security	29	47	24	64	29	7
Internal audit	23	42	33	53	35	10
On-line systems	26	42	29	66	26	7
Computer library	18	43	36	40	40	16

(Percentages do not add to 100% because some of the respondents did not answer all questions.)

FIGURE 2

between the managers' perception of their future role and the schools' offerings in data processing courses. A third reason was to evaluate not only the progress of in-house course offerings under employer-sponsored educational programs, but the relevance of courses taken by employees in external professional enhancement programs. The fourth reason was to determine what the practitioners of the art are concerned with today and to evaluate how these concerns might change in the future. Such indicated changes could conceivably be reflected in curricula to meet the needs of the individuals and their employers.

RESPONSES TO STRUCTURED PORTION OF SURVEY

According to the responses, several items stand out as areas of special concern, particularly for the years ahead. Of those, this paper will address: Security, Software, and Operations Optimization.

Security

Every subcategory under Security shows a significant increase in the number of respondents who thought these topics would become "very important" parts of their management functions in the future (see Security tabulation in Figure 2). Only a few colleges and universities are currently offering specific courses about fraud, internal audit, on-line systems security, and computer library protection (four of the subtopics). Numerous institutes on these subjects have been offered mostly by proprietary firms catering to the education of computer professionals. Local chapters of national professional societies have also been offering intensive short courses on some of these subjects. Certainly the trade and professional literature has been featuring these topics in their recent articles. There are indications that data security is receiving some attention too, but usually as part of some other course.

It seems that course offerings should include these subjects, at least to the extent that they are adequately covered in existing courses, if not in dedicated courses. On the other hand, short courses of the seminar type might provide the needed coverage of the subject matter, whether for credit or not.

Although there is a clear distinction between privacy and security, these two subjects are often mentioned together. With all the attention given to privacy these days, this might well be selected for a course to be repeated every two years or so because the subject matter is so dynamic. The relationship of security to privacy, as a method of guaranteeing the right of the individual, evokes all sorts of ideas related to hardware, software, and policy topics. All of these are interrelated, and cannot be separated from each other in the overall subject of Security.

Software

Programming, a basic subject, is covered adequately in most academic curricula. The more advanced and complex areas of Software, due for greater future attention, consist of database systems, programmer productivity, program delivery, and advanced proggamming techniques. There is evidence that some of these subjects are receiving the attention they deserve at the university and college level. Some of them are offered at community colleges. A number of these subjects can be adequately covered by greater emphasis in existing courses. Others, such as database systems and advanced software techniques, are certainly worthy of independent courses and, in some cases, of several courses at different levels of complexity. Seminars and institutes offered by proprietary groups are providing thorough coverage of these subjects. A look at Figure 2 will show that there is considerable concern on the part of management about all the topics under Software.

Operations Optimization

Significant shifts in management's concerns appear in this category. Again, most of the subjects are covered to some extent in existing courses. But it appears that the emphasis is going to be such that some of these subtopics can no longer be relegated to a minor role within a course. Take the subject of intelligent terminals. This appears to be a minor item, but in the context of the future use of computers, it can become a major one. Widespread use of intelligent terminals is suggested in [illegible] by Rein Turn. He also discusses many technological advances and related concerns of management that parallel this study [Turn].

Multi-vendor shops and cost/performance trade-offs appear to be items of increasing interest. This suggests a course combining the selection of computer systems from a standpoint of technical characteristics and of related financial and managerial factors. Practices that consider only technological capabilities are no longer suitable. Since few DP students are cognizant of the various financial factors of the computer marketplace, a course covering the business aspects of this would be suitable for computer people as well as for business students.

OTHER OBSERVATIONS

As interesting as they may seem, those findings already discussed are [illegible] what management is most concerned with. The real area in which DP managers need education did not come through in the structured portion of the questionnaire, but was made very clear in comments about the importance of their daily functions in managing.

Many respondents did express their opinions. Some did so in great detail, providing greater insight into their concerns than could be obtained from only a tabulation of the items in the structured portion of the questionnaire.

The following are some of the comments received. See if you get the same message as we got:

> The most important lesson I've learned in my twenty years in data processing is to take the time to make sure I understand what my customers and managers want and need, and to make sure they understand what I can deliver.

> One of the problem areas is in the understanding of the purposes of information for management, particularly top management. This is a problem not only with computer people, but with top management itself. There seems to be some blind acceptance by the computer people that management knows what it wants and needs. There has to be more dialogue concerning the kinds of decisions that management has to make, how often, and the impact of these decisions, rather than the almost automatic supplying of any data requested.

> In my company, we spend too much time preparing for and presenting proposals to top management. Too often, follow-up presentations are required. Too much emphasis is placed on where we are in the project and reporting it. Project management is required, but the main objective should completing the project, not reporting its status.

Far too many applications, techniques, etc., fail simply because top management failed to adequately involve themselves in operations. I do not suggest that the President of Westinghouse involve himself with every application, but if the application being considered is an MIS application, and he is going to be a principal user of the system, then his involvement is mandatory.

The most important and continually pressing problem I experience is the lack of understanding of the data processing environment and the need for training (of users) and understanding on their part of the expense involved in changing current systems to meet their intermediate needs.

A full chargeback of costs to the ultimate user of computer processing provides the control at the right level. The user determines his needs and justifies his costs. This tends to inhibit such advancements as data base concepts, etc., but does control what was an ever-increasing computer processing budget.

To us, these six quotations, and one hundred others like them, pointed to one principal problem — human communications. And human communications is a problem to be met at the university level. But can you think of a single computer-oriented course that is really directed toward this challenging communications problem? Before we can educate DP managers, we must educate ourselves about their needs.

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NEW TECHNIQUES IN ESTABLISHING BILLING RATES FOR COMPUTING SERVICES

By
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and
George E. May

ABSTRACT: During the development of a new computer center billing system at Clemson University, the authors found that procedures generally employed for rate calculations did not provide the degree of equitable cost allocation or repeatability of charges desired. The design criteria, costing philosophy, and selected rate calculations of the new system are discussed to illustrate the more interesting and unusual of the techniques employed.

I. INTRODUCTION

Among the many problems of the seventies with which College and University Business Officers have had to cope, perhaps the most frustrating have accompanied the growth of campus computing facilities. Next to the library, the computer center has become the major central academic support facility at many institutions. One of the problems, which of course is not unique to computers, is finding the funds to pay for what seems to be never ending requests for newer, faster, larger, and hopefully better, equipment. Unlike the library's new books, which augment rather than displace existing stocks, computers appear to become obsolete in frightening short periods. One recent study concluded that the expected life of the typical college computing system was three years! When this is compared with typical rental or lease-purchase contracts of five or six years, one appreciates the on-going nature of the problem. While such financing problems resulting from technological obsolescence and escalating demand will probably continue, there are other areas of growing importance of which improved computer costing and billing systems is one.

Whether the approval body for computer funding be University Administration, Trustees or Regents, all will want some assurance that the appropriation is justified in the first place, and with increasing frequency, that a mechanism exists for equitable allocation of the resources and their costs on an on-going basis. If computing facilities are utilized in sponsored research projects, whether in federal government contracts or by other third parties, a comprehensive and auditable computer billing system becomes a necessity rather than a nicety. In fact, full and timely reimbursement for services may soon depend upon it.

While the Federal government does not yet prescribe the precise method to be employed in the direct costing of computer facilities usage, one requirement is that any method used provides for full cost recovery and be non-discriminatory, that is, the government pay no more than other users. There are strong indications that in the not too distant future, government auditors will be giving computer rates an even closer scrutiny and review, once government expertise in this area becomes established.

II. DESIGN CRITERIA

We mentioned above that a computer billing system should be equitable to all users, comprehensive in scope, and auditable. In addition, it should not be so complex or esoteric that it requires special training in mathematics to comprehend; in other words, it must be understandable to the users and to the accounting staff and not just to specialists in the computer center. Finally, the system must retain sufficient flexibility to permit subsequent adjustments as changes in resources or utilization may dictate. On multiprogrammed and multiprocessing systems, where resource utilization such as the CPU time to execute a program varies with the job mix, the additional requirement of repeatability must be included.

To summarize, the ideal computer usage costing system should satisfy six design criteria:

A. Comprehensive

The cost system, to be comprehensive, should consider all Computer Center resources which a user may require, whether owned or leased by the center. Computer resources not owned or leased by the center, such as RJE equipment or terminals owned or leased by Administrative or Academic departments, should not be included in center resources.

B. Repeatable

Users should not be liable to significant shifts in charges unrelated to the nature of the user's job. In a multiprogramming, virtual storage environment, it is difficult to obtain perfect repeatability. However, the user who reruns an identical job should be assessed essentially the same charge, irrespective of the job stream mix.

C. Equitable

Charges to users should reasonably reflect the costs of resources employed. Charging users for the consumption of Computer Center resources actually required encourages users to manage their demands and to design applications for efficient operation.

Ideally, the usage of every resource is measured, and a cost is assigned. This, however, could be very expensive and accordingly usage is generally measured for the more significant resources only.

D. Understandable

The method of costing services rendered should be simple and straightforward to encourage user acceptance and comprehension. Although the center may use complex formulae to compute charging units, the user should be presented with the number of units of resource used, the cost per unit, and the total charge.

It is essential that users receive sufficient information to satisfy them as to the justification for their charges and to permit them to make modifications which could reduce their charges in the future.

E. Flexible

The system should be flexible enough to permit the center to change rates and to establish special rates, if required, without extensive reprogramming.

F. Auditable

Sufficient data must be available to allow a user or others to investigate the validity of charges.

Before describing how the new system was developed at Clemson University, it might be useful to point out that these criteria are to some degree interdependent, that is, there are trade-offs among them, so that emphasizing one factor will tend to diminish the impact of one or more of the others.

For example, greater equitability can only be gained at the expense of understandability, since greater equitability requires that a greater number of rates be employed and understood. The most flexible system is at the same time one which has been generalized to the degree where the history of past usage and rates can become quite difficult to audit. Thus, flexibility and auditability are conflicting criteria as well. A few examples should make this clearer.

The oldest and most commonly utilized computer costing system employs CPU time as the sole unit of measure. It is easily understood and highly auditable. A more recent and somewhat more sophisticated approach employs five or six computer usage or resource units, which equate costs to additional measurable units of resource consumption such as memory occupancy time, tape and disk use, and punched card and printing volumes. It is certainly more equitable than the "CPU time only" method, but sacrifices simplicity and understandability in the process. The design goal then becomes some ideal trade-offs between pairs of compensating factors. We have yet to find anyone clever enough, however, to determine in advance just where the optimum point lies.

III. OBJECTIVES AND METHODS OF THE STUDY

At Clemson, it was agreed at a project kick-off meeting that all six of these design criteria would be considered. A task force comprising members of the University's Business Administration staff, Computer Center Management and management consultants from Alexander Grant & Company specializing in University computing and cost studies, was formed. At this point the Center had been using a CPU time only approach, but had been investigating a five-resource usage method, but on an experimental basis only and with no bills sent to users. Some questions, however, had been raised by Center personnel, Business Office personnel and by the cost specialists in Alexander Grant & Company as to the completeness and validity of this method as compared with alternatives. For example, Center personnel doubted if the five-resource method would provide that much greater repeatability and equitability than the CPU only method. The University's contract accounting staff expressed reservations with respect to auditability and Alexander Grant personnel were concerned with both the flexibility and auditability of the contemplated system.

It was agreed therefore that the task force should adopt a study plan which would identify all possible resource cost centers and prepare "tentative" billing rates for each, recognizing at the same time that some combining of these "lowest level" rates into a smaller number of "composite" rates would most likely be necessary in the interest of understandability. In addition, the cost of measuring and billing a resource should not exceed the costs recovered.

Cost data for all equipment, personnel, supplies and allocated University expenses was collected and analyzed. Estimates of utilization for approximately thirty separate facilities/resources were developed. Subsequent analysis and feedback eventually reduced the list to seventeen rates, which were consolidated into four groups.

In the remainder of this article we shall discuss some of the more interesting conclusions reached during the study and which we believe would be of interest to other institutions.

The Clemson Computer Center uses an IBM 370/158 with 3330 and 3333 disk storage and 3 megabytes of core, and is running under the OS/VS 2 operating system. HASP and the TSO option are also employed.

IV. COSTING PHILOSOPHY

A. Time-Sharing Versus Batch Users

For many classes of problems, the academic community may access the computer via either time-shared terminals or batched input at the Center or remotely. To maximize system utilization, the University encourages the use of time-sharing and therefore a costing system which would discriminate against time-sharing users was deemed undesirable.

We considered two alternatives: (1) charging both groups for Center resources used for input and output and (2) not charging either group. We concluded that both groups should be charged.

B. Rate Setting

Rates may be applied either on a fluctuating basis to recover all costs actually incurred (generally monthly) or at a predetermined levels based on budgeted levels of cost and utilization.

1. Fluctuating Rate

This method uses a rate which is calculated relatively often to ensure that the total costs for the period are recovered. Unfortunately, such rates will change frequently reflecting fluctuations in demand. Rates during a period of lower demand, such as the summer, could be much higher than rates during periods of high demand.

2. Predetermined Rates

This method charges users a rate which does not fluctuate over an established period, usually one year. The rate would be established at the beginning of a budget year using total Center costs and forecasted demand.

This method has the advantage of not having rates fluctuate because of demand fluctuations.

It, however, also has disadvantages:

- rates will not change to reflect changes during the budget year unless the changes are allowed for when the rate is established;

- it is often difficult to forecast demand for a twelve month period; and

- at the end of the year, there will be variances reflecting changes in resource costs or demand variances.

3. Conclusions

We concluded that the use of predetermined rates which would be reevaluated once per quarter was preferable. A quarterly reevaluation has been recommended by HEW for costs of similar facilities. At the end of each quarter, the actual volumes and costs would be computed on an annualized basis and actual rates calculated. If the rates vary significantly (in excess of 10%) from the rates in effect, the rates would be changed to recover (by the end of the fiscal year) the total costs of the center.

V. COSTING METHODS AND RATE CALCULATIONS

A. Use Charge

A use charge for fixed assets was employed and was calculated at 6-2/3% per year of the acquisition cost of usable equipment. This is allowed by Federal Management Circular (FMC) 73-8 -- "Cost Principles for Educational Institutions." A use charge, unlike depreciation, does not expire after a period of years, but continues as long as the fixed assets are usable.

Although the use charge method has been adopted for the purpose of preparing rates, the University could apply in the future to use the depreciation method. The depreciation method generally allows a write-off of the cost of fixed assets, net of salvage value, over their useful life; resulting in higher rates than the use charge method. However, the use of the depreciation method would require that the University significantly modify its fixed asset recordkeeping system.

B. General Procedures

Development of all rates entailed the following procedural sequence:

- The determination of the total costs to be allocated.

- The allocation of fixed asset costs to each resource, and the assignment of all other costs either directly to a resource or, if not assignable to a resource, to an overhead cost pool.

- The calculation of an overhead rate and its application to all rates.

- The estimation of utilization volumes for each resource.

- The computation of rates.

- The development of composite rates by combining costs for card reading, card punching, and printing.

All costs and utilization figures were monthly. All rate calculations, of course, follow the general calculation of Cost ÷ Volume = Rate.

VI. SELECTED RATE CALCULATIONS

A. Introduction

We have selected from the rate calculations, those where the approach and methodology should be of special interest to Centers with IBM 370/145 through 370/168 systems running under virtual storage operating systems, although many of the techniques employed would be applicable to the systems of other vendors as well. The selected utilization methods, to the authors' knowledge, have not previously been employed. They were designed to achieve a degree of equitability and repeatability previous approaches did not provide.

It was important that the chosen billing units also be a good yardstick for measuring the availability of the commodity which the resource is intended to provide. For example, it would be improper to recover the cost of resources made available for time-sharing through real time, since real time has no relationship to the physical limits of the resources to provide time-sharing. For each rate, the single best indicator of the physical limits of the resource was used as the billing unit.

It should be noted that the system employs direct machine measurement of utilization wherever possible and does not rely upon manual recordkeeping or calculation.

The remainder of this article will describe some of the more interesting and unusual rate calculations.

The complete rate schedule precedes the discussion of the selected rates.

B. Rate Schedule

The following table reflects the Computer Center rates by resource/service, billing unit, and unit rate.

RATE SCHEDULE

	RESOURCE/SERVICE	BILLING UNIT	RATE
1.	Processor		
	CPU	One CPU Hour	$94.00
	I/O	1,000 I/O's	.13
	Core Storage	100K Hour	24.00
2.	Peripherals		
	Tape	1 Allocation Hour	7.46
	Card Reading	1,000 Cards	1.94
	Card Punching	1,000 Cards	4.24
	Printing	1,000 Lines	.75
	Special Forms	Per Job	1.92
	Supplies	Per Unit	At Cost
	Digital Plotter	One Real Time Hour	24.79
3.	Time-Sharing		
	TCAM Subsystem		
	Messages	1,000 Messages	2.72
	Dedicated Polling	One CPU Hour	94.00
	Public Dial Lines	One Connect Hour	1.05
	TSO Subsystem	100 Carriage Returns	1.69
4.	Fixed		
	3705 Front End Dedicated Ports	One Port Per Month	
	9600 BAUD		41.11
	4800 BAUD		36.39
	2400 BAUD		34.03
	1200 BAUD		21.74
	Dedicated Disk	1 Track/Month	.07
	Date Base Management System	Per User per Month	57.00

C. CPU Time and General I/O Rates

1. Costs

CPU use charge, maintenance charge, and applied overhead cost.

Since IBM did not break out costs for the CPU between the CPU itself, core, the 3 block multiplexor channels or the 4650 ISC (Integrated Storage Control) unit, we calculated these costs as proportional to the purchase price of the components. This seems appropriate since these units are all electronic and contain no mechanical components. Only CPU cost was used for this rate.

2. Utilization

- CPU hours were projected from historical data, excluding that consumed by the center for internal use.
- CPU hours for TCAM and dedicated polling were extracted from SMF or GTF data.
- An I/O constant of 5 milliseconds was used as best representing the impact which an I/O operation was felt to have on the system.
- I/O time was then estimated at 83 hours (60 million I/O's at 5 milliseconds each) per month.
- The 5 millisecond constant used for I/O was also intuitively "right" and supported by historical data which indicated that CPU processor costs had accounted for about 2/3 and I/O processor costs about 1/3 of the total.

3. Rate Calculation

- CPU hourly rate was calculated by dividing the total cost by the sum of CPU and I/O hours.
- The rate per 1,000 I/O's was determined by multiplying the CPU hourly rate by the estimated I/O hours and dividing this by the estimated number of I/O's.

4. Comments/Rationale

It was concluded that this approach, which employs separate CPU time rates and one for I/O operations generally, is more reflective of actual resource utilization than a composite or general CPU time rate alone.

D. Core Storage Rate

1. Costs

Core use charge, maintenance charge, and applied overhead cost allocation.

Clemson purchased their CPU with 1.5 MB of core from IBM. The cost of the core, however, is not broken out by IBM. In addition, Clemson purchased an additional 1.5 MB from another supplier. It was necessary, therefore, to calculate the cost of the IBM core and subtract it from the IBM CPU cost. This was done by looking up the costs of 370/158's with various core capacities from IBM price lists, determining the incremental cost for 0.5 MB, and multiplying by 3 to get the cost for 1.5 MB. This was added to the cost of the 1.5 MB obtained from the other supplier to get the cost of 3 MB. Of this total, .375 MB is dedicated to TSO and .125 MB to TCAM. The remaining 2.5 MB cost was allocated to the core storage resource.

It is not critical that the precise amount of storage used by TSO and by TCAM be recovered through each subsystem. Rather, because of the changing nature of those systems, it is more important that a good estimate be used in combination with intent. For example, at Clemson, an additional 0.5 MB of storage was acquired to implement time-sharing. Since the storage was acquired to implement time-sharing, its cost was most appropriately charged to time-sharing users.

2. Utilization

Metered CPU use in hours times the number of 100K virtual storage regions requested by the user was determined to be the most appropriate figure to employ. Metered use is the CPU time plus I/O time as estimated in the CPU time and I/O rate calculations (c above).

3. Rate Calculation

The cost of 2.5 MB of core was divided by the estimated product of metered use in CPU hours times the estimated number of 100K regions which will be requested.

4. Comments/Rationale

The employment of the metered use hours as well as using a net storage figure for core available to users seems preferable to the simplistic but commonly employed gross CPU time/gross core usage methods usually employed.

E. Dedicated Disk Rate

1. Costs

Equipment use charge, maintenance charge, and applied overhead cost allocation.

IBM's prices do not break out the cost of the 3333 disk control unit from the disk drives as they do with the 3330 units. It was necessary, therefore, to calculate this cost.

It was also necessary to separate the disk storage and costs dedicated to system overhead and which is not available to users from that which is. Of the 14 drives, 4 are dedicated to system overhead and utility work space, leaving 10 for users.

In addition, it was necessary to calculate the cost of the block multiplexor channels assigned to disks, since this was not supplied by IBM. This was done by averaging the costs of the priced third and fourth channels to get the cost of the unpriced first and second channels.

2. Utilization

It was estimated that users would occupy 76,000 tracks for one month in a dedicated fashion (as contrasted with temporary use). The track/month was deemed the most appropriate billing unit.

3. Rate Calculation

The monthly cost was divided by the estimated utilization to derive the rate for a track/month.

4. Comments/Rationale

The rate utilized for dedicated disk storage is preferable to that employed elsewhere where no distinction is made between dedicated and transient storage or where no calculation of systems overhead occupancy is included.

F. Card Reading, Punching and Printing Rates

1. Costs

There are three card readers, two printers, and one card punch in Clemson's configuration. One card reader is part of an RJE terminal as is one of the printers. The punch is part of a 2540 read/punch unit in the center which also has a 2501 card reader and two 1403 printers. The costs utilized in developing these rates included not only the equipment use charges, maintenance charges, rentals and applied overhead cost allocations, but also handling charges which are the costs of the personnel assigned to operate these devices.

Several allocations were required. First, an allocation of the cost of the 2821 control unit between printing and card operations was made based upon the relative rentals of the controlled units. Second, an allocation of the processor, storage, and communications costs of the RJE terminal was made to reading and printing based upon the cost of the respective read and print components. Third, the cost of keypunches exclusively associated with card readers was included in the cost of those reader functions.

Finally, a weight was assigned to the personnel time (and cost) associated with the functions at each location.

2. Utilization

Utilization volumes (in 1,000 cards or 1,000 lines) were developed from historical data for each function at each location.

3. Rate Calculations

Seven rates were developed for each of the seven function/locations by dividing the associated costs by the estimated utilization.

4. Comments/Rationale

It was necessary to determine individual rates for all locations initially to ascertain the reasonability and tradeoffs possible in combinations. Three composite rates were then calculated as illustrated on the following page.

COMPOSITE RATE SCHEDULE

FOR CARD READING, PUNCHING AND PRINTING

Resource/Service	Volume	Unit Cost	Total Cost
CARD READING			
2540 Computer Center	850M	$ .38	$ 327
2501 Front Office	1,504M	.13	198
Martin Hall	832M	.27	225
Composite Rate	3,186M	.24	750
Handling			
Operations			1,632
Front Office			
Personnel 2540 Reader (2000 Jobs)			1,140
Equipment			291
Martin Hall			
Personnel			1,103
Equipment			1,260
Total Handling			5,426
Total Composite Card Reading	3,186M	$ 1.94	$ 6,176
CARD PUNCHING			
2540 Computer Center	331M	$ 2.32	$ 768
Handling			636
Total Composite Card Punching	331M	$ 4.24	$ 1,404
PRINTING			
Computer Center	13,500M	$ .16	$ 2,192
Martin Hall	2,153M	.40	861
Composite Rate	15,653M	.20	3,053
Handling			
1403 Personnel (12,759 Jobs)			7,273
Martin Hall			1,365
Total Handling			8,638
Total Composite Printing	15,653M	$ .75	$11,691

G. TSO (Time-Sharing) Rates

1. Costs

Equipment use charges, maintenance, and applied overhead for the following were determined to be dedicated to interactive computing:

- one ISC path
- one Block Multiplexor Channel
- one 3333 Disk Control Unit
- .375 MB of core

In addition, the cost of one systems programmer, whose time is dedicated to this area, was assigned.

2. Utilization

To avoid penalizing the faster device users and the "thinkers," it was concluded that the number of carriage returns, or their equivalent on a CRT terminal, was the fairest unit of measure to employ here for the consumption of the resource. The billing unit was equated to 100 carriage returns.

3. Rate Calculation

The costs were divided by the estimated utilization to develop a rate per 100 carriage returns.

4. Comments/Rationale

The commonly employed billing units of characters or connect time, or some combination of these, could penalize or reward users to a greater extent than the method employed here.

H. 3705 Front End Rates

The calculation of rates for the 3705 front end consists of two rates: (1) the monthly use of a port for a given line speed and (2) a rate per public dial line connect hour.

1. Costs

The costs of the dedicated ports are the equipment cost and overhead. The costs of public dial lines are the modems, phone, overhead, and the cost of 10 ASYNC lines.

For dedicated ports, the cost of the 3705 and overhead is allocated between its components: processor and storage, scanners, and ports, based on IBM price lists. The cost of each of these three components for each type of line was calculated based upon rated capacities. A composite cost of each type line was determined by adding the processor, scanner, and port costs.

2. Utilization

The number of ports used and the number of hours of use of dial-up lines was based upon historical usage.

3. Rate Calculation

The costs divided by utilization determined the rates for the four dedicated port line speeds. The dial-up hourly rate was developed by dividing the costs by an estimated 1,000 total hours of monthly use.

4. Comments/Rationale

The dedicated port rates used take into account the allocation of 3705 component costs according to the line speed required. The dial-up rates include modem, phone, and overhead as well as the cost of the lines themselves. A maximum degree of equitability has been obtained.

I. Tape Rates

1. Costs

The costs are equipment, maintenance, and overhead. If an entire drive is dedicated to a user, its cost would be deducted. The costing unit is the number of drives used, multiplied by a calculated allocation time per drive. The calculated allocation time per drive is an estimate of the time the drive would be on-line if there were no other jobs in the job stream. This is estimated as the sum of the job's SMF-measured CPU time, plus the number of EXCP's for all devices times 50 milliseconds.

2. Utilization

The total number of hours per month of tape usage for all drives was based upon SMF data.

3. Rate Calculation

Total tape costs were divided by the utilization hours to determine an hourly rate.

4. Comments/Rationale

The use of a calculated allocation time per drive based upon CPU time, all I/O time and assuming a 50 millisecond per I/O execution gives an excellent measure of the actual tape utilization.

VII. CONCLUSION

By employing a multi-disciplinary approach in developing rates for computer center services, the rate structure will reflect the needs and desires of both the users and suppliers to a much greater extent than less cooperative efforts. At

Clemson University, the joint efforts of computer center, business office, and outside consultant personnel resulted in a system which has proven to be equitable, comprehensive, and auditable. The special expertise contributed by each group are essential ingredients for proper design.

USER INVOLVEMENT IN THE INFORMATION SYSTEMS EFFORT

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ABSTRACT: User involvement is a critical factor in the development of information systems. This paper discusses factors that determine the degree of user involvement in the systems effort. The findings are based upon data collected through interviews with systems personnel and with users in six major organizations that are heavily involved in systems development.

INTRODUCTION

A widely accepted principle in effective information systems development is the need for user involvement. Systems practitioners recognize user involvement as a necessity. John Wagner (1), a manager for Peat, Marwick, Mitchell & Co., stated in 1972 that, "Considering the many ingredients which comprise a management information system, and being asked to quantify and list those ingredients in order of importance," he would place user involvement at or near the top of that list. Formal research findings point to the need for user involvement. Dickson and Powers (2) concluded from their study, "User participation is crucial to the success of the MIS project.... Successful systems are developed whenever users and systems personnel work meaningfully as a unit."

In a study recently completed of critical factors in information systems development, the author and two of his colleagues (3) determined user involvement to be a critical factor in systems work, one of several study outcomes. Other critical factors cited in that research effort were planning and control, systems expertise, and attitudes.

Even on a broader front, research studies in varions areas of decisions for change indicate the importance of employee participation in creating acceptance of change. (4, 5) Thus, involvement is not peculiar to information systems development only.

Various project management schemes have been designed to more effectively bring about user involvement; for example, utilization of a steering committee, involvement of the user or user representative as an intimate, working member of the project team, establishment of a user liaison, etc. These techniques have been successful in several cases. Lucas (6) found that involvement ratings were higher in those companies utilizing steering committees. However, even with the use of various management techniques, user involvement in some systems efforts has not been at a desired level for maximum effectiveness.

The question addressed by this paper is: What factors determine the degree of user involvement in the systems effort? If managerial structures do not insure user participation, what factors do determine the level of involvement?

PROCEDURES

Data to assist in answering these questions were collected from systems analysts and user personnel at six organizations that are heavily involved in systems developmental efforts at various levels of systems sophistication.

Participants were interviewed to obtain their definition and perception of involvement and to collect data for analysis of factors contributing to effective user involvement. The factors indicated by the interviewees are listed in Table I and are discussed in the following paragraphs. No ranking of the factors was determined. The inherit danger in ranking would have been that the lower ranked factors might appear to be of much less or negligible value. The absence in a particular system effort of even a very low ranked factor may have a detrimental effect upon accomplishing a satisfactory level of user involvement.

TABLE I

FACTORS AFFECTING USER INVOLVEMENT

Communication Effectiveness between User and Systems Personnel

Extent of User Involvement Desired

Functional Expertise of User

How the Analyst and User Define User Involvement

Impact of System upon User Activities

Management Support for the System Effort

Managerial Philosophy within User Department

Persistence of Involved Personnel

Physical Proximity of User to System-Effort Activities

Prior Involvement of User in Computer-Related Efforts

Rapport Established between User and Systems Personnel

User's Perceived Benefit from System Effort

USER INVOLVEMENT FACTORS

Factor 1. Communication Effectiveness between User and Systems Personnel.

Overcoming the technical jargon barrier is a problem faced by any discipline in attempting to communicate with personnel outside that discipline. In information systems efforts, the communication barrier is one of double jeopardy. Not only must the analyst translate computer utilization into a language understandable to the user, but also, the analyst must understand the functional language of the user.

The systems manager for a major oil company stated recently in an interview, "Our problem is a user problem--a communication problem. We have to say it in basic English. If it isn't said in plain English, we need to try again; make another attempt at communicating."

Factor 2. Extent of User Involvement Desired.

In the study, some analysts indicated they did not want as much user involvement in their systems work as that desired by other analysts. Variations in the amount of involvement desired seemed to be determined by (1) type of system being developed, (2) personalities of the involved individuals, (3) training and experience of the analyst, and (4) background of the user. User satisfaction with the system effort appeared to be closely related to the degree of user involvement desired by the analyst. As R. N. Kashyap (7), a principal in R. N. Kashyap & Associates, indicated, ". . . managers (need to) have a major say in the development of information systems and . . . the technical interests of the systems specialist (should not be) allowed to dictate the type of systems to be developed. . . ."

Factor 3. Managerial Philosophy within the User Department.

User involvement, particularly at the operational level, is partially determined by the managerial philosophy in the user department. The philosophy may be one of open access to departmental personnel and information, or it may be one that erects protective barriers so that involvement of the operational user is difficult to obtain. Some analysts indicated in the study that operational user involvement was almost impossible to obtain in some departments because of the attitude of management toward involving his/her people in the system effort. In the study, management practice varied from departments that were totally open (the analyst was free to talk to anyone within the department and was not required to have specific management approval) to those in which all interviews, documentation, and recommendations had to be cleared by the departmental manager. One departmental manager did all of the communicating with the analyst in a particular system effort; the analyst was not allowed to talk with any other departmental personnel.

Factor 4. Persistence of Involved Personnel.

Persistence of the systems personnel in soliciting and obtaining user involvement and persistence of user personnel in being involved are two additional aspects of user involvement. Generally, the impetus for user involvement comes from the analyst; however, instances were noted in the study where the user was involved due mainly to his own insistence and his desire to contribute to the system effort.

Factor 5. Physical Proximity of the User to System-Effort Activities.

Physical distance is frequently a barrier to user involvement. Communications, rapport, data collection, training, etc., are more difficult to bring about if distance between user personnel and systems staff must be overcome. One systems department resolved the distance problem in one system effort by physically moving the analyst to the user location. When physical distance becomes a problem, user participation may be based upon a sampling process and be effective.

Factor 6. Prior Involvement of User in Computer-Related Efforts.

Prior experiences of the user in computer-related activities has a major effect upon his attitude toward involvement in a given system effort. If past experiences have benefited the user, he will be more receptive to involvement in present or later systems activities. Too often analyst assume, and frequently an improper assumption, that the user will look favorably upon new systems efforts, or at least he will not be antagonistic toward those efforts. In the critical factors study conducted by the author and his colleagues, one analyst indicated that if the systems department in that firm had known the type of experiences had in previous systems efforts, the approach to a particular system in which they were currently engaged would have been quite different. In particular, he stated that the time frame would have been lengthened to allow for overcoming problems created by the users' experiences with other systems.

Factor 7. Rapport Established between User and Systems Personnel.

One successful analyst spent several hours with the user to achieve this one objective--establishing a desirable rapport with users. He stated that his purpose was to develop within the user the feeling that this was his system, that he would be the major benefactor of it (directly or indirectly), that the analyst was there to help him achieve his aspirations, and that the analyst should not be considered a threat to those aspirations. This factor has been well set forth in professional literature; yet, in practice, too many analysts assume an effective rapport without devoting sufficient effort to its establishment.

Factor 8. User's Perceived Benefit from the System Effort.

The question is not one of whether or not the user will receive any benefit from the new system, but rather is one of whether or not the user thinks he will benefit from the new system.

Factor 9. Functional Expertise of the User.

If the user knew his/her job well, his involvement was solicited more heavily than if the user was inexperienced or, for various reasons, did not function well at his tasks.

Factor 10. How the Analyst and User Define "User Involvement."

The definition of user involvement varied among analysts and among users. For example, one analyst believed he had accomplished user involvement upon completion of a one-month observation period in the user's department. However, the manager in that user department did not consider such activity at all as involvement. To be effective, user involvement should be at the decision-making level. One manager stated, "I should be able to specify my inputs and desired outputs; he (the analysts can figure out the processing." Observation of user activities does not constitute involvement.

Factor 11. Management Support for the System Effort.

Management support is critical to effective user involvement. Management must provide financial resources and display its enthusiasm for the system effort if the potential for involvement is to be fully realized. Not only is financial and moral support of management a determinant of user involvement, but physical support must be included also. Management's participation in system decision-making activities, in particular in planning for the system effort and later in arbitrating user differences and conflicting user needs, is a requisite for involvement.

Factor 12. Impact of the System upon User Activities.

Users generally were more eager for involvement in those systems impacting their activities; that is, the greater the impact, the greater the user's desire to become involved. However, the impact must not only be a possibility, it also must be perceived by the user. A problem arises in attempting to define the degree of impact. A partial solution is found in the proper definition of prime users.

MEASUREMENT OF USER INVOLVEMENT

The measurement of user involvement is difficult to achieve for several reasons:

(1) What criteria should be used to reflect effective user involvement?

(2) Can quantitative measures be used; if they can, which measures and what instruments would be the most desirable?

(3) Are qualitative measures more important than quantitative; that is, can one be concerned with only numbers of meetings--conferences, interviews, etc.--for the quality of input that occurs in those communications is of prime consideration.

CHECKLIST OF FACTORS

A checklist of the twelve subfactors is shown at the right and could be used to elicit the perceptions of users and analysts as to the level at which the factors appear to be operating in a given system effort. Other checklists could be developed, using Lickert and Thurstone formats, for example. The illustrated checklist has not been tested.

SUMMARY

Many factors contribute to the level of user involvement: the organizational structure of the project, the twelve factors discussed in this paper, and other factors not previously mentioned in this paper, such as the effect of the system upon the power structure, recognition given to users' suggestions, user understanding of system definition and objectives, etc. (The "etc." is necessary, for no list of factors can be 100 per cent complete.) Further research is needed particularly in the measurement of involvement and in determining desirable levels of involvement.

CHECKLIST
USER INVOLVEMENT

Directions: Indicate on a 1-10 scale the level at which you perceive the following subfactors exist in the ______ system effort. A "1" indicates no or minimal existence of the factor; a "10" rating indicates that the factor is being met with a high degree of satisfaction.

		1	5	10
1.	Management support for this system is			
2.	The rapport established between user and systems personnel is			
3.	Impact of the system upon user activities is			
4.	Benefit of system to its major users is			
5.	Analysts may pursue the systems study with minimal interference			
6.	Communication channels between systems personnel and users are			
7.	Users and analysts agree as to what constitutes user involvement			
8.	Desirable level of user involvement is			
9.	Satisfying experiences of user in prior systems effort is			
10.	Analysts' and users' persistence in becoming and remaining involved is			
11.	Level at which users know their jobs is			
12.	The detrimental effect of physical distance is			

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COST ANALYSIS FOR SYSTEMS DEVELOPMENT

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ABSTRACT. Cost analysis for systems development seems to have gained more attention recently, probably due to tighter budgets as imposed by Boards of Education and related governmental agencies. In the past, many data processing functions could command a substantial increase in resources simply because of the computer "halo" effect or with a state-of-the-art justification of what would be available in the near future. Unfortunately, the near future for many users was in reality the distant future or never. Negative user reaction plus the financial pinch has forced many educational agencies to reevaluate the data processing function in terms of its overall worth or impact on the agency versus its cost. This paper deals with analytical techniques used to determine the cost of the present system as well as the new system. The derivation of these costs is essential for cost benefit analysis and for budget justification for development effort.

I. INTRODUCTION

Cost analysis also enables the assignment of equitable priorities as user competition for limited data processing services increases. It is paradoxical that even the harshest critics of data processing agencies seek expanded services. This seemingly unlimited demand must be confronted with the knowledge that resources are limited. This limitation raises the question of which application is most cost beneficial to the organization in comparison to other requests.

II. PRESENT SYSTEM COSTS VERSUS NEW SYSTEM COSTS

In order to arrive at an equitable distribution of system development resources, the proposed system implementation and operation cost must be developed and compared to manual or present methods. However, a strict comparison of system costs may not provide a cost factor for any additional benefits of a new system over the present system. In reality the impetus for a new system is frequently based on the need for expanded or improved services that the present system lacks. This problem can be solved by presenting the benefits along with the cost analysis as simply the payoff for the systems investment or by computing the cost savings of the new benefits. Frequently, such a cost savings can be readily computed but in many cases, particularly in educational agencies, the cost savings of improved systems are difficult to define. For example, if a new registration system reduces the student time spent in lines; what are the savings? The total student hours saved at x dollars per hours or perhaps the new process will encourage more students to register for more courses. In either case, the computation is complicated and may be difficult to determine in specific dollar savings. That does not mean that improving registration is not a worthwhile project, but in a tight fiscal situation student time savings may not be a reasonable objective for the dollars expended.

A clear statement of benefits may be more reasonable for management decision making than a complex dollar computation for benefits. A sample request form with the cost benefit analysis is included in Appendix A.

An additional pitfall for cost analysis is the problem of cost savings versus cost avoidance. A cost savings is an out-of-pocket savings that can be spent on something else. The savings must be in terms of money that has been budgeted, preferably in the present fiscal year. A cost avoidance is the elimination of cost factors that will not be incurred if the recommended system is implemented. Both are legitimate factors in a cost analysis, but cost savings are much more easily presented and appreciated. Cost avoidance, on the other hand, depends on the analyst's ability to define and predict a logical pattern of cost factors and then determine the rationale for the new system avoidance of such costs. The distinction between cost savings and cost avoidance is not always clear but don't try to spend that cost avoidance money.

The final product of a system cost analysis will be a cost comparison between what is currently being done and what must be done versus alternate ways of satisfying the system objectives. It's important that the systems objectives are considered in terms of the overall organizational objectives. It's possible that the system you're studying was intended to do something that no longer needs to be done either in whole or in part. If the system is to be redesigned or the objectives and hence the processing system redefined or eliminated, there still remains the knotty question of how much does "what we're doing" cost. Also don't be shy about recommending that the system objectives can be satisfied better manually if indeed that is the case.

Basically the cost of a system can be divided into three major categories; people or labor-related costs, supply and equipment cost and facilities cost. Each of these major cost elements can be further divided into a myriad of elements. Labor, for example, can be divided into full time, part time, overtime, or training. Equipment and supplies can be divided into capital outlay, maintenance, forms, paper, etc. Facilities will include capital construction, heat, light, utilities and so forth.

Fortunately, most cost elements are related to the operating unit in even the most rudimentary accounting and budgeting systems. An exception to this is facilities, but more about that problem later. The labor, equipment and supplies, although usually related to an operating unit, must be further broken down into system-related functions.

III. ANALYSIS OF LABOR COSTS

The most expensive cost element in nearly all administrative type systems will be the labor or people cost. Unfortunately, for cost analysis, employee time is rarely completely devoted to a single process or system. Therefore it is necessary to analyze the duties of each employee directly associated with the system to determine how much of his time is spent on the system under study. In large systems an even more basic consideration may be to determine what organizational units are involved in the process. Consequently, the first step is to determine what employee or groups of employees should be surveyed with regard to task analysis.

This is not usually a major problem since organization charts, procedure manuals, and custom give you a pretty good clue as to who does what to whom. At any rate, once you begin the study you can track down any loose ends you have missed.

Once the group is identified, their potential should be surveyed via a Task Dedescription Sheet (Appendix B). The Task Description Sheet simply asks the employee to list his duties and an estimated percentage of time for each duty. A word of caution is in order. You must be certain to notify the top administrators in each survey area of your intentions and approach. In fact, the requests as well as the employee completed task lists should be relayed through the supervisor/administrator. An alternative to the task lists may be the personnel files if the personnel office maintains up-to-date job description that includes duties and time percentages. If you gain access to this material and it is up-to-date, the task lists may be dispensed with.

Once the task lists have been completed and reviewed by the supervisor, the systems development staff can begin interviewing. Each employee should be interviewed and particular attention paid to those duties that are directly related to the system. The interviewing will provide an important source of information for the final system design. Important products of the interviewing process may include flow charts, procedures, organization charts, data element notices and a work distribution chart. The work distribution chart (Appendix C) is especially important for the cost analysis. This chart is a summary of the task lists after the duties and percentages have been verified in the interview. This chart will enable the analyst to determine employee time devoted to specific system tasks. The isolation of specific tasks with employee time makes it possible to determine the approximate cost of each major system function currently being performed.

The cost computation will require the translating of the work distribution chart percentage into hours and then into dollars. For conversion to hours, multiply the percentage from the work distribution chart times the hours in a work year which for eight-hour days will be 2080. The 2080 hours constitutes a full work year and does not make any direct allowances for sick leave, vacations, holidays, etc. The 'absent' hours are simply viewed as overhead to the work year. Thus when you compute a function at x hours that x total includes a factor for the missing or lost hours since the total work year is accounted for in the percentage totals. Similarly, I never received a task list that indicated time spent on coffee breaks, late starts or early quits, etc. These items are simply overhead costs to the employee work year.

After the hours are determined it is necessary to arrive at an hourly rate for the employee time. It is possible to compute the costs for each employee but such a computation is time consuming and may breach confidentiality requirements. An alternative is to determine an average dollar rate for the organization as a whole. This factor can be determined by dividing the total salaries for clerical or selected employees by the number of clerical employees, then by 2080 for hours in the workweek. An administrative rate as well as the clerical rate should be determined. The administrative rate is determined in the same manner as the clerical rate except for a different group of employees. An hourly factor for fringe benefits can also be added into the rate. Keep in mind that the hourly rate is for a base year and that projections of system costs of a multi year period will require the addition of cost of living and merit increases to the salary structure. A flat percentage applied to the total cost figure should be sufficient. This will, however, be a compound computation for the years to be projected.

Since labor is usually the most expensive cost item, it is broken down into the following subelements:

A. Systems analysis and design
B. Programming
C. Clerical and administrative
D. Orientation and training

This breakdown favors the data systems function but is useful as a planning guide since it forces the development of time estimates that are necessary for proper scheduling of development work within the data center.

I wish I could provide you with a nice, neat equation for predicting how long each of these items should take. Generally, the projects are reviewed and the more complex ones discussed with the programmers and an estimate is made. By and large this technique has proved reasonably accurate with a slight time overrun of approximately 10% on most projects. One or two projects took slightly less time and at least one project took twice as long as estimated. The areas that caused difficulty and took more time than estimated were in securing user approval particularly when policy questions were involved and in the preparation of systems and programming documentation process. It is imperative that documentation be completed as a byproduct of the steps in the process and not as the last step.

Good estimates require that individuals familiar with systems and programming are preparing or reviewing the estimates. A knowledge of the work patterns at the center and even the individual capabilities of the analysts and programmers is essential. To view manweeks and manhours as completely interchangeable is spurious logic that can cause serious problems.

The clerical and administrative element is the result of the employee study mentioned earlier at least for the present system costs. The proposed systems costs for this item are arrived at by reviewing the work distribution chart and determining those functions that would be supplanted by the automated or revised system. It is important that the cognizant administrator for the study area be consulted in this determination.

This type of analysis of labor costs is intended for a large system development effort involving a major system design and implementation. For small or one-time type requests an estimate of employee time savings from the requester may be sufficient for employee time savings. The amount of analytical time spent must be weighted against the size of the request itself.

IV. EQUIPMENT, SUPPLIES COSTS, CONSULTANT SERVICES

The major equipment costs will normally be for Data Processing at the computer center. To arrive at a rate for this element, the total yearly hardware costs plus the salary cost of the operation staff were divided by the hours of utilization per year. The rate utilized thus included the staff overhead as part of the hardware hourly cost figure.

Present utilization records are retained so that the present system costs were not too difficult to determine. The projected costs are much more difficult and are arrived at by reviewing the system design and making certain preliminary decisions regarding frequency of run, size of reports, potential special runs and so forth.

Data preparation includes keypunching, verification and any special equipment such as optical scanning devices. For the keypunch rate the rate used by local keypunching contract firms is reasonable and easily obtained. The input volume was estimated and then the rate was applied. Similarly if the input data was entered via a terminal device, the labor costs of the using agency would be included in this element. This element could be a labor element cost if the punching and verifying will be done in house.

Data terminals, modems and transmission costs would also be included for on-line systems.

V. FACILITIES COST

The facilities cost is the most difficult to define. The most reasonable approach may be to include any major modifications to buildings or fixed equipment necessitated by the proposed system. This is not a usual consideration for a new system; however, the implementation of on-line terminal access systems may make modifications to existing building structures desirable - soundproofing, additional service bays, underground cable installation, etc.

A more frequent consideration may be in the cost avoidance of new facilities by eliminating new positions. If the system eliminates positions or defers new positions, the facilities cost may be a legitimate cost saving/avoidance. The use of cost saving for facilities will depend to a large degree on the particular situation at your institution. Occasionally the costs may be readily apparent especially if the system is for a new project that requires new staff and facilities. Obviously the elimination of a position provides a direct and legitimate facilities cost savings. The savings can be computed on a square foot basis since most institutions have some guidelines for the square feet allocated to each position. Facilities cost per square foot should also be available from the facilities or finance departments.

At any rate the cooperation of the organization unit responsible for facilities planning should be secured before a facilities savings is applied. This is essential to preserve the integrity of the cost analysis.

Depending on your particular environment, the cost analysis could be omitted for overhead facility costs without seriously distorting the cost picture.

VI. COST ANALYSIS AND THE DECISION PROCESS

After the requested data processing services have been analyzed some means must be provided to assign priorities to the requests. In many organizations this task is assigned to a steering committee usually made up of representative computer services users. Ideally this group should review the computer services requests with the cost benefit analysis in concert with the budgeting process so that any budget requests for additional development staff can be tied directly to the services. If the positions are not funded the services will not be provided.

Appendix A

INTERAGENCY DATA PROCESSING AUTHORITY **Request For Data Processing Services**	INSTRUCTIONS: 1 Complete top portion 2 Forward White and Yellow copy to Director, IDPA 3. Retain Pink copy for file 4 Yellow copy will be returned after cost analysis

REQUESTED BY	EXT.	AGENCY/DEPT.	PRIORITY OF	TODAYS DATE	DATE REQUIRED
R. Jones		Registrar	1 1		9-5-76

DESCRIPTION OF REQUEST (Attach Additional Sheets as required)

Provide an early registration capability that can be accomplished by mailing registration forms to students. The forms can be mailed back to the registrar so that a "bull pen" type of registration is not required for early registration. The student schedule and an invoice would be prepared based on the student's requested sections.

BENEFITS (Attach Additional Sheets as required) 1. Reduce peak work loads. Early registration can be spread over a much longer time span.
2. Consolidate student records. The same registration record will be used by all college organizations. No college office will maintain separate registration records.
3. Improve service to the student. The mailing feature will eliminate the need to stand in line for section selection.
4. Consolidate student billing. A single billing record will be created for each student regardless of campus. A student will be charged for total hours and all deliquency will be shown on the invoice.

EMPLOYEE HOURS SAVED PER YEAR	NON-EMPLOYEE SAVINGS (DOLLARS PER YEAR)	ADDITIONAL EMPLOYEE HOURS REQUIRED IF REQUEST IS NOT APPROVED (PER YEAR)

THE SECTION BELOW WILL BE COMPLETED BY IDPA STAFF

COST ELEMENTS		ESTIMATED COSTS: DEVELOPMENT		ANNUAL		5 YEAR LIFE CYCLE	
		PRESENT	PROPOSED	PRESENT	PROPOSED	PRESENT	PROPOSED
SYSTEMS ANALYSIS	DOLLARS / MAN WEEKS		6,480 / 18	540	1,080	2,700	11,800
PROGRAMMING	DOLLARS / MAN WEEKS		7,280 / 26		560		10,080
SUPPLIES and EQUIPMENT							
DATA PROCESSING			480	3,000	3,600	15,000	18,480
CLERICAL and ADMINISTRATIVE			320	28,740	22,110	143,700	110,870
INPUT PREPARATION			110	1,650	4,800	8,250	24,110
POSTAGE				-	1,200	-	6,000
TOTALS			14,670	33,930	33,350	169,650	181,420

APPROVALS

REQUESTER	DATE	DIRECTOR OF DATA PROCESSING	DATE

IDPA 1 8/75

[illegible]

APPENDIX B
2300 [illegible]

TASK LIST

[illegible] Registrar

[illegible]	[illegible]	SUPERVISOR	DATE
J. Crater	Clerk	Registrar	

DESCRIPTION OF WORK PERFORMED	VOLUME OF RECORDS	% TIME
Original Check-out of Graduates	600	32
Final Check-out of Candidates for Graduation	500	10
Determine Eligibility for Student Benefits from Social Security, Civil Service Retirement and Railroad Retirement, Assist Students.	250	10
Certify Athletic Eligibility	210	2
Determine Selective Service Eligibility and Student Conferences	4000	20
Employment References and Confidential Reports for Transfer Students	600	3
Preparation of Two Final Examination Schedules and Summer Exam	3020	5
Prepare Budget for Registrar's Office	75	3
Research Prospective Candidates for Honors at Graduation for Depts.	600	1
Confer with Systems Analyst on New Program Needs	-	1
Prepare Two Mid-Semester Exam Schedules a Year	150	1
Routines and Academic Regulations	-	1
Registration and Setting Fees	unlimited	3
Advising Students of Rights by Telephone and Letter. Certify Attendance of Foreign Students with Letters to Embassy.		3
Supervise Processing of Transcripts and Telephone Connected with Same	4500	2
Assist in Clarifying Situations That Come to Office with Newer Staff	-	2

IDPA-6(11-75)

[illegible] AUTHORITY
[illegible], MARYLAND

APPENDIX C

WORK DISTRIBUTION CHART

[illegible] Registrar's Office PREPARED BY R. Baumbach DATE 12-9-70

	E M P L O Y E E S												
Range	Clerk TypII	Secretary	Adm Clk	Clerk TypII	Clk TypII	Adm Aide	Clk TypI	Clk TypII	Registr				TOTAL
Process Advance Standings	4	10							17				31
Add/Drop Procedure	1			30	30			2					63
Recomputation of Grades	19												19
Registration General	3			26	26	20		6	7				88
Supv Checkers & Special Reg Headstrt	9												9
Room Scheduling		15											15
Update Schedule		5											5
Setting Fees			3										3
Gen'l Filing, Mail, Typing, Appointments	4	25		9	9		11	6					64
Change of Address	1						1						2
Counter Work	6			15	15		70						106
Ans Telephone	2	10				15	1						28
PR Card File Maintenance	9	5				2							16
Process - Grade Labels to PR Card	8												8
Correct PR Card	9												9
Process Graduations		30	12			5			5				82
Student Benefits			10										10
Athletic Eligibility			5										5
Selective Service			20										20
Exam Schedules (All)			6						2				8
Research Cand. for Honors Grad.			1										1
Prepare Budget			3						5				8
Foreign Students			3										3
Grade Processing				10	10	10							30
Assist Faculty				10	10	8		4					32
Supervision			2			25							27
Adm. Student Help						5							5
Transcripts							15	4					19
General			3			10	2	3	64				84
	75	100	100	100	100	100	100	25	100				800

AN ALTERNATE APPROACH

TO THE DEVELOPMENT OF AN

INTEGRATED, UNIVERSITY INFORMATION SYSTEM

Lynn Bellamy

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for Computer Services

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Tempe, Arizona 85281

ABSTRACT: An integrated, university information system may be viewed as three separate, functional components:

1) transaction or operating systems,
2) statistical reporting systems and
3) planning and budgeting systems.

Traditionally the transaction systems have been designed and implemented without focusing on the ancillary statistical and planning systems. An alternate approach, which does focus on the remaining components, consists of a survey of projected user needs for statistical and planning information (i.e. the "wish list"). Another alternative is to conceptually incorporate the entire WICHE data element dictionary into the overall design. A fourth alternative is recommended which involves the use of existing, packaged systems for statistical reporting (e.g. HEPS) and planning (e.g. CAMPUS VIII). The packaged systems can be used to develop the specifications required for adequate statistical reporting and planning information (e.g. data elements, report content and operating procedures, etc.). The transaction systems can then be designed with due regard for future components (i.e. statistical reporting and planning). In fact, the packaged systems can be modified and used as the statistical and planning components during some specified interim period. The use of previously installed, tested systems for developing specifications should be more cost effective than the other alternatives.

* * * * * *

INTRODUCTION

Over the past decade a great deal of attention has been focused upon the development of management information systems (MIS) for universities (Ref. 1, 3, 6, 9, 10, 11). The advantages and disadvantages as well as the uses and misuses of an MIS at universities was reviewed recently by Driscoll (Ref. 3, 4). The review, however, was from the vantage point of a major state university president.

In a recent article Mowbray and Levine (Ref. 9), indicated that the MIS is alive, well and ready for academia. They also state that the problems associated with developing and installing an MIS in a university are "social" rather than "technical". They continue with the statement that the MIS "begins in the hearts and minds of educational managers."

Driscoll states that an MIS exists at a number of institutions and is being developed or implemented at many more as a result of the recent demands for "accountability" in public institutions. As an aside he also states that private institutions will feel the same pressure if they require public funds for survival (i.e., yardsticks which serve as operational common denominators for all institutions are an integral part of an MIS development effort). Several other cognent issues are also addressed from the viewpoint of the president. In particular, the need for internal information as opposed to the demand by external agencies for information, the fear that the computer will make the decision as opposed to the computer providing information upon which to base the decision and finally contribution of an MIS to the historical conflict between the "bean counters" and the "academicians." The administrative data processing (ADP) department at most universities has and will continue to be impacted by developments in this area.

All of the issues above should concern the manager or director of ADP at any institution of higher education. Unfortunately, the recent literature has not addressed the development of an MIS from the vantage point of the director or manager of ADP. It is almost impossible to refute the statement that, for whatever reason, MIS is either "here" or "coming soon". The relevant question, from the vantage point of the manager or director of ADP, is "What impact will this have on me and my organization?"

Recently, several technical approaches to the problem have been reported in the literature (Ref. 8, 9). The author reports progress in explaining data base to university administrators, developing the conceptual design for a university data base and proposing a structure for dealing with the policy questions which naturally arise from such an effort. Even in this case, it is highly probably that the university administration is more aware of the "technical" aspects of the problem (i.e. the data base management system) than they are of the "social" aspects of the problem (i.e. the fears and historical conflicts). One must also ask the obvious question, "Did the MIS concept originate with the author and the ADP group, or did it begin in the hearts and minds of the educational managers?"

Given that MIS is inevitable, the real problem is how does the ADP manager or director plan to respond to the need in a reasonable time frame and at a reasonable cost. A pragmatic approach to the problem will be addressed in this paper. First, however, it is appropriate to define MIS in the context of an institution of higher education.

* * * * * *

THE INTEGRATED, UNIVERSITY INFORMATION SYSTEM (IUIS)

Traditionally, the manager or director of ADP has viewed systems as shown on the lower part of Figure 1. With few exceptions, each system was characterized as a financial system, a student system or a planning system. Recently, Mowbray and Levine (9) have developed a scheme for classifying administrative systems which is more consistent with the MIS or IUIS. They propose that all administrative systems be separated into three functional areas:

* transaction or operating systems,
* statistical reporting systems and
* planning and budgeting systems.

An inventory of current systems published in the original paper is reproduced in Figures 2, 3 & 4. Certainly, there is no disagreement among managers or directors of ADP that transactional systems are essential to the daily operation of the University. With few exceptions, most major universities are in the process of developing or have all of the transaction systems listed in Figure 2. The statistical reporting systems in Figure 3 as well as the planning and budgeting systems in Figure 4, however, are another matter entirely. Statistical reporting systems can definitely be found in public universities where state reporting is required by the legislature or the Board of Regents. There are few universities, however, which have a comprehensive planning and budgeting system.

The proposed scheme for classifying administrative systems has obvious value for the manager or director of ADP. More important, however, is the structure which was proposed by Mowbray and Levine. The structure is reproduced in Figure 5. Note that a fourth functional component of the MIS or IUIS is proposed which is the output evaluation and goals review. Also note the information system master plan at the base of the structure. Recently a large scale, multi university effort on output evaluation and goals review has been initiated by the Educational Testing Service and Education & Economic Systems (i.e. project HEIEX).

SDL in Toronto has developed a comprehensive planning and budgeting system called CAMPUS VIII. Education & Economic Systems has developed a comprehensive statistical reporting system called HEPS, SCI, INFORMATICS and a number of other firms have developed basic transactional systems in the student and finance areas. Thus, both Driscoll and Levine are correct in stating that MIS is alive, well and ready for academia. At the heart of the proposed structure, however, is the information system master plan which must be developed by the institution. Note that in Figure 5 data flows and/or is aggregated from the bottom to the top (i.e. data is collected by the transaction systems, aggregated to prepare statistical reports, the statistical reports then provide basic data for the planning and budgeting systems, etc.). It is also important to note that external data is added to prepare both the statistical reports and the planning and budgeting reports. Thus it is essential that the design of the basic transactional systems focus on future components (i.e. the statistical reporting system as well as the planning and budget system). The relative cost of the development and implementation of the various components versus the benefits derived from their implementation has also been addressed by Mowbray and Levine. Their comments are reproduced below.

> "One of the ironies of MIS planning and development in higher education has been the inverse relationship between costs incurred and benefits derived. Large sums have been spent on computerized transactional systems where the educational pay off is least. Moderate sums have gone into statistical reporting where the benefits are modest. Little has been spent on integrated planning, budgeting and futuristics where the payoff is very great. Almost no systematic effort has been devoted to conscientious evaluation and goals review where the costs are relative small and the potential benefits astronomical."

Given that all major public institutions will soon be faced with the implementation of at least the three basic components of the IUIS, the manager or director of ADP must ask himself, "How can I best prepare for the onslaught?" Mowbray and Levine deal with the philosophical issue of developing the information system master plan which has been referred to in the present work as a "wish list". They also note that the "social" problem results from the difficulty that most people have in trying to explain in detail their information requirements. Furthermore, MIS or IUIS may not have "begun in the hearts and minds of the educational managers" at the institution. In other words, from the vantage point of the director or manager of ADP, the traditional "wish list" and its use as a development and implementation tool represents an idealistic rather than a pragmatic approach to the problem. The next section deals with a more pragmatic approach to the development and implementation of the IUIS components.

* * * * * *

A PRAGMATIC APPROACH TO THE DEVELOPMENT OF THE IUIS

Before discussing the recommended approach to IUIS development, a word of warning is in order.

Under no circumstances should the manager or director of ADP become involved in the nontechnical aspects of the decision to implement (or not to implement) the remaining components of the IUIS.

The recommended approach is based upon the premises listed below:

1. All four of the components of the IUIS will be recommended for installation at the institution within three to five years.

2. Transaction systems are more unique to a given institution than statistical reporting systems and statistical reporting systems are more unique to an institution than planning and budgeting systems, etc.

3. The design of the IUIS should be from the "top down" while the construction must be from the "bottom up" (see Figure 6).

4. Substantial savings can be realized if the data elements, report content, operating procedures, etc. for the statistical reporting component as well as for the planning and budgeting component are specified and considered in the design and construction of the transaction or operating systems.

5. ADP must be able to respond within a reasonable time frame and at a reasonable cost to an administrative decision to implement the remaining components of the IUIS.

Given the above, the recommended approach is rather simple (acquire the statistical reporting component as well as the planning and budgeting component from institutions where these components have been developed in a evolutionary process). The components can also be acquired from vendors (e.g. HEPS from Education & Economic Systems and CAMPUS VIII from Systems Dimensions Ltd.).

Electing to acquire the "package" components from a sister institution or from a commercial vendor depends upon the available funding and/or the institutional structure. Individual modules of the "package" components can then be implemented as resources and basic data become available. More important, however, is the fact that the data elements, report content and operating procedures (which are an integral part of these components) can be used to replace the user survey or "wish list" recommended in the traditional approach. Rather than depend upon a single user at the institution, one can benefit from the experience of many users at other institutions and the evolutionary process which led to the development of the "package" components.

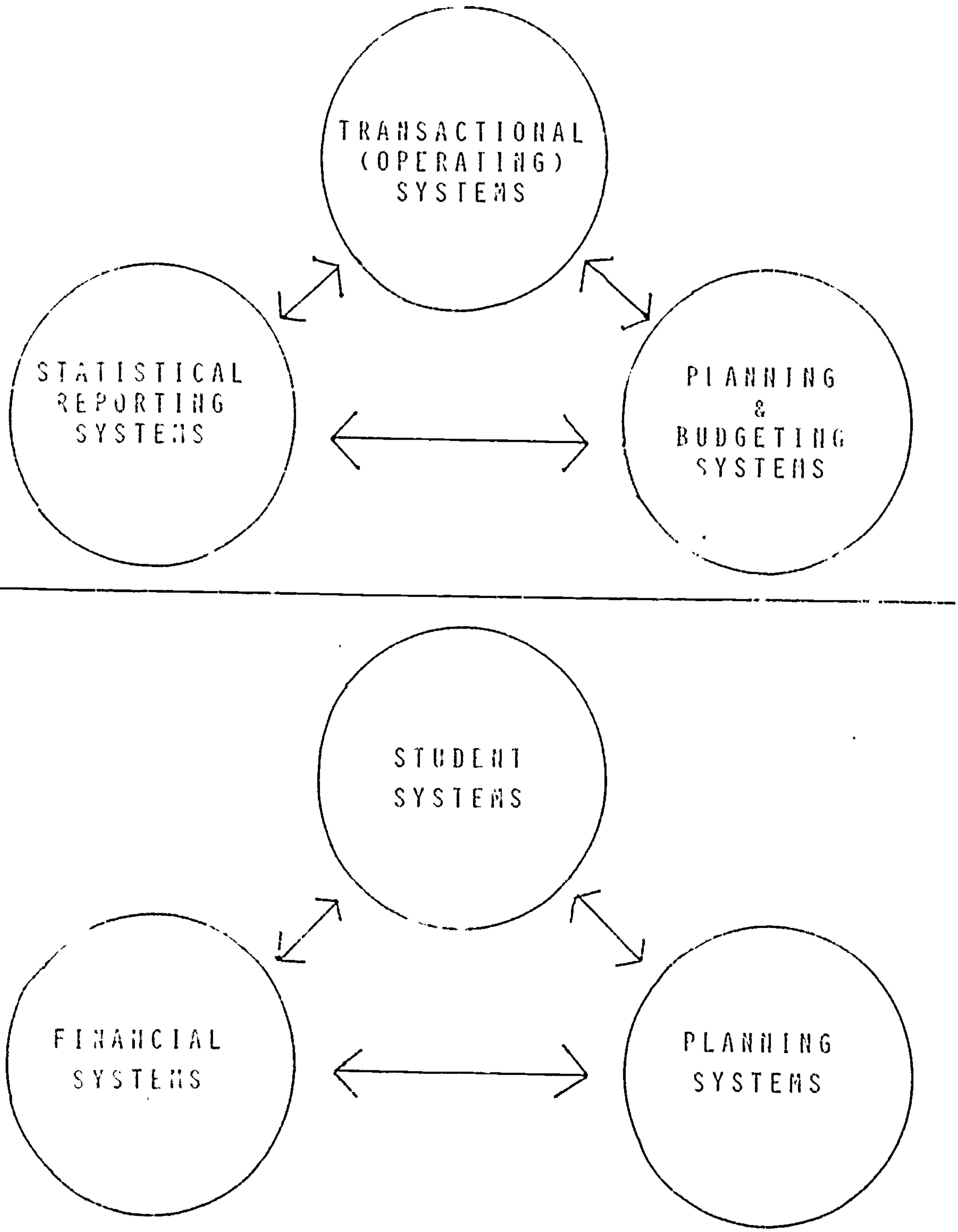
Once the transactional systems have been constructed (including the data elements, report content and operating procedures for the statistical and planning components), the institution can elect to utilize the "package" components, to modify the "package" components or to proceed with the evolutionary development of unique components. From a review of the statistical and planning "package" components, the administration will also gain an awareness of the policy questions which arise as a result of the IUIS (e.g. the use of contact versus credit hours, calculating faculty loads, evaluating and measuring public service and research activities, etc.). In fact, the implementation and/or review of the "package" components can be an educational experience in itself.

The marginal cost to the institution for this approach will range from $50,000 to $150,000 depending upon the selection of "packaged" components. The costs associated with the evolutionary development of comparable systems is one or more order of magnitude greater than this marginal cost. Furthermore, if the "off the shelf", modular implementation approach is taken, the response time on the part of ADP will be minimized. Obviously, the reports will not precisely satisfy the need of the users at every institution. One should expect, however, a high degree of commonality in the statistical and planning reporting areas. Thus even with additional modification costs, the approach should be cost effective.

In closing, another statement of Mowbray and Levine should be reiterated. They indicate that people must understand that every college and univeristy has the kind of information system it deserves. In a later article, Bride (Ref.2) indicates that the computer system is only a "mirror" of the institution and that it reflects our ability to think. He further states that people often blame the "mirror" (i.e. the computer) when in fact it is the reflected entity (i.e. the institution) that is at fault.

* * * * * *

FIGURE 1
STRUCTURES



41

FIGURE 2

TRANSACTIONAL (OPERATING) SYSTEMS

ADMISSION
- APPLICATION
- EVALUATION
- CONFIRMATION

FINANCIAL AID
- APPLICATION
- EVALUATION
- CONFIRMATION

RESIDENCE
- PREPARATION
- APPLICATION
- CONFIRMATION
- REGISTRATION

REGISTRATION
- MASTER SCHEDULE
- PREPARATION
- PREREGISTRATION
- REGISTRATION (in person)
- REGISTRATION CHANGE

HEALTH SERVICE

STUDENT RECORD
- PREPARATION
- GRADE PROCESSING
- EVALUATION
- TRANSCRIPTS

DEVELOPMENT
- GRADUATE FOLLOW-UP
- FUND RAISING - FILE PREPARATION
- FUND RAISING - SOLICITATION
- FUND RAISING - DONATIONS
- PORTFOLIO - TRANSACTIONS
- PORTFOLIO - VALUATION

STAFF
- POSITION FILE
- HIRING
- ASSIGNMENT
- TERMINATION
- UPDATE
- PAYROLL

PURCHASING
- PURCHASE ORDER PREPARATION
- PURCHASE ORDER
- UPDATE
- QUALITY CONTROL

ACCOUNTING
- TYPES OF ACCOUNTS
- IDENTIFICATION
- AGGREGATION
- ACCOUNT FORMAT
- CHART OF ACCOUNTS - PRINTOUT
- CHART OF ACCOUNTS
- AGENCY FILE
- ACCOUNT MASTER FILE
- ENCUMBRANCE
- ADVANCES
- INVOICES LIQUIDATION
- PAYROLL
- FINANCIAL AID
- BILLING
- BUDGETARY CONTROL
- RECEIPTS
- TRIAL BALANCE
- PERSONAL ACCOUNTS
- CLOSING THE BOOKS

FACILITIES MANAGEMENT
- INVENTORY
- UTILIZATION
- CAPITAL PROJECTS

TAKEN FROM. LEVINE, JACK B. and GEORGE MOWBRAY. "Specifications for a Management Information System", EDUCATIONAL COMMENT/1974, The University as a System (R. T. Sandin, Editor/College of Education, University of Toledo, Publisher).

FIGURE 3

STATISTICAL REPORTING SYSTEMS

STUDENTS

- BACKGROUND (admissions fil)
- EDUCATIONAL ACTIVITIES
- ATTRITION
- GRADUATION
- POSTGRADUATE ACHIEVEMENTS (alumni file)
- CURRICULAR FEEDBACK

STAFF

- ORIGINS
- EDUCATIONAL and OTHER EXPERIENCE
- INSTRUCTIONAL LOADS
- OTHER ACTIVITIES
- TITLES PUBLISHED, HONORS, etc.
- RANK DISTRIBUTION
- COSTS

SPACE

- INSTITUTIONAL
- CAMPUS
- BUILDING
- CATEGORY
- SUBCATEGORY
- SIZE
- UTILIZATION

FINANCE

- COURSE COSTS
- PROGRAM COSTS
- DEPARTMENTAL COSTS
- INSTITUTIONAL SUMMARIES
- ENDOWMENT PORTFOLIO
- INVESTMENT YIELDS
- OPERATING STATEMENT
- BALANCE SHEET

TAKEN FROM: LEVINE, JACK B. and GEORGE MOWBRAY, "Specifications for a Management Information System", EDUCATIONAL COMMENT/1974, The University as a System (R. T. Sandin, Editor/College of Education, University of Toledo, Publisher).

FIGURE 4

PLANNING AND BUDGETING

HISTORICAL

- LAST YEAR'S ACTUAL OPERATING EXPERIENCE
- THIS YEAR'S BUDGET
- THIS YEAR'S ACTUAL OPERATING EXPERIENCE
- PROGRAM ANALYSIS
- DEPARTMENTAL (COLLEGE AGGREGATE REPORTS ON RESOURCE USE)
- COST DETAILS (ACADEMIC AND SUPPORT DEPARTMENTS, PROGRAMS, COURSES, CREDIT/CONTACT HOURS)
- REVENUES

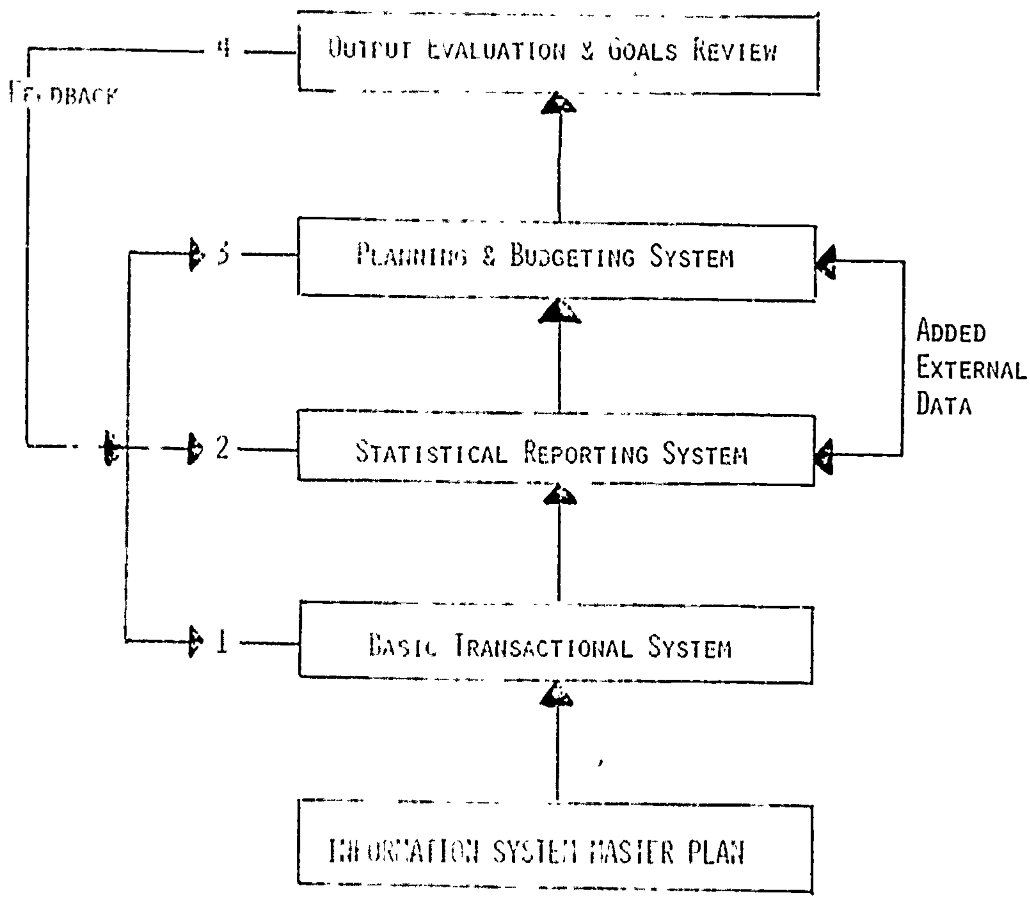
FUTURE

- ARRAYED COST/REVENUE ALTERNATIVES FOR CHOICE IN ACADEMIC PLANNING
- NEXT YEAR'S BUDGET
- NEXT 2-5 YEARS' BUDGETS
- DEPARTMENTAL COMMENTARY
- FINAL DECISION FOR NEXT YEAR'S BUDGET (COST CENTER ALLOCATIONS)
- FINANCING POLICIES (LONG AND SHORT-TERM)

TAKEN FROM. LEVINE, JACK B. and GEORGE MOWBRAY. "Specifications for a Management Information System", EDUCATIONAL COMMENT/1974, The University as a System (R. T. Sandin, Editor/College of Education, University of Toledo, Publisher).

FIGURE 5

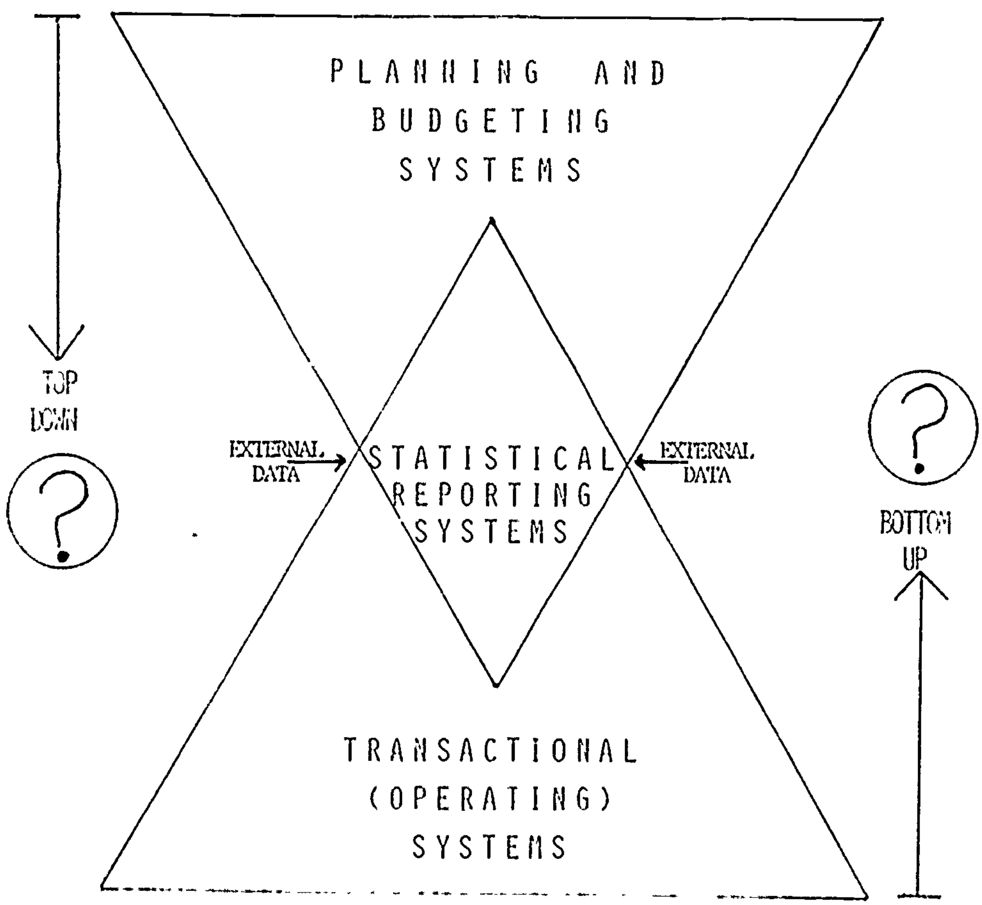
MANAGEMENT INFORMATION SYSTEM



ADAPTED FROM: LEVINE, JACK B. and GEORGE MOWBRAY: "Specifications for a Management Information System", EDUCATIONAL COMMENT/1974, The University as a System (R. T. Sandin, Editor/College of Education, University of Toledo, Publisher).

Figure 6

DESIGN
AND
CONSTRUCTION



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A PUBLIC SCHOOL CONVERTS FROM BATCH TO AN ON-LINE ENVIRONMENT IMPACT ON VARIOUS USERS

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ABSTRACT

In a School District comprised of 61,000 students in grades KG - 12, the decision to convert from a batch-oriented system to an on-line environment carried with it fundamental implications for all types of long-standing users. The Purchasing Department now uses CRTs to capture P.O. transactions while checking computations and providing accurate vendor information. A Business Education data processing configuration was converted from a small stand-alone computer system to an RJE station connected to the large central computer. All nine high school Mathematics Departments are using NDEA grant money to acquire equipment to provide extensive and varied on-line services within their schools. Their Registrar's Offices are planning to be on-line this Fall to the central Student Data Base of 120,000 records and to their own course registration and mini-Data Base files.

Tucson Public Schools had offered 12 years of basic data processing services to its schools in a straight batch environment. Each new computer system installed afforded slightly more speed and capacity for slightly more money. Gradually, tighter school budgets, more variety in curriculums and individualized approaches to teaching made the standard batch approach appear both cumbersome and outmoded. An analysis of existing applications indicated that many were batch not by nature, but by necessity.

Pressures on management demanded quicker response to special information requests. At the same time inflation gave computer purchase a new air of respectability.

Responding to those factors, the District let a bid for a responsive, growth-oriented computer system. After extensive evaluation of proposals, a time-sharing system was chosen. Since the existing data processing staff was batch oriented, design for on-line systems prior to installation was inadvisable, and a period of orientation to the new environment was necessary to assure a non-trivial approach to systems design.

However, two large questions remained to be tested: 1) Could the new computer with its totally new approach to work really accomplish the existing load with time to spare, and 2) was conversion of programs and data as easy as advertised? The 128K word DEC System-10 arrived early in January. We planned that the old machine would remain six months until we could be assured the transition would be smooth. It was accomplished ahead of schedule and the next phase started which was to prepare the Business Education remote job entry station for the opening of school.

Here we learned our first hard lesson in coordinating efforts of the computer vendor, the phone company and an independent modem manufacturer. Mr. Bill Drum and his first period class took the brunt of the problem.

I. <u>Business Education</u>, W. O. Drum, Rincon High School

The Business Education program must respond to the changes taking place in the business world where more and more companies are becoming increasingly involved with a variety of computers in all phases of operation. First, secondary school educators must be aware of those changes taking place and relate them effectively to the curriculum working to find better ways to teach the common vocational skills of communication and computation. Second, central school management must respond by attempting to provide the necessary tools for instruction.

The pilot configuration for Business Education classes consists of a 300 lpm printer, a 300 cpm card reader, and a teletype console. In addition there is a cathode ray tube multiplexed through the PDP-8 computer at the remote site. This system allows for simulation of stand-alone computer operation and both batch and interactive programming in COBOL, FORTRAN or BASIC.

In addition, the school's registrar is served by the ability to obtain several basic reports and labels from their small private student data bases, which can be refreshed from the central site as needed.

This system is also being used to teach Junior College courses in the evening and for our own District mathematics inservice courses in the late afternoon.

II. Administrative Business Applications, D. H. Miller, Data Processing

The first on-line application was access to the budget by many combinations of the basic elements of the budget key, that is district, fund, function, account code, department, course.

Requisition information is entered via cathode ray tubes, using a conversational method where the computer does the extensions, taxes, looks up the vendor's address, and captures the order transaction. In the afternoon the purchase orders are printed out on a hard-copy terminal. As a result, purchasing can process 25 to 50 per cent more orders than before. The next budget phase will include a method whereby payments can be posted to an on-line pending file.

Work is currently proceeding on a new property control system to replace the large card file system now employed. The main inventory file will reside on tape and be updated once a week with transactions captured at the cathode ray tube. A totally new classification system employing major and minor category codes is being developed by our property control people for use in this system. File maintenance and new item information will be captured from the purchase order system with additional coding being added by the property control personnel.

III. Mathematics Education, E. M. Roselle, Sabino High School

Several math teachers had been involved with using and teaching about computers for several years. When the new central system arrived, enormous possibilities presented themselves, so planning began. Built around the central concept of "computer literacy" a proposal took shape. It was presented first to District central personnel and finally to the Federal government under NDEA Title III. The grant awarded was of sufficient size to place at least two terminals at each of nine high schools. In addition to obtaining a cathode ray tube and a hard-copy terminal, four high schools are going to use a 120 cps card reader which will make more computer power available to more students each class period.

Interactive COBOL, FORTRAN and BASIC are available at all nine sites, each with file spaces large enough to save significant amounts of data. The registrar's mini-data bases can be accessed here also, so that the school administrative office can use the hard-copy terminal for a printer after school.

This year, several sections of math inservice course teaching the use of the new computer have been offered so that teachers can prepare for the installations at their schools.

IV. School Administrative Applications, L. S. Hargis, Data Processing

Plans for the next fiscal year include the possibility of c.r.t. terminals in the registrars' offices at ten high schools.

The terminals will help considerably in determining at the point of enrollment into school whether or not a student has been in the District before by means of an efficient search of an alphabetic cross reference to our 120,000 student records. Registrars can then determine for a returning student when and where he dropped from school and whether or not he was a dropout.

A new application which has course changes as its first phase is currently being developed for implementation this fall. Drops, adds, and changes to course sections and individual student schedules will provide up-to-the-minute course totals, and ethnic balances for each section. Scheduling of courses for the next quarter can begin the second day of the prior quarter to the extent that school administration can start to supply some master schedule information. Placement of students into the master schedule and development of the schedule itself can proceed simultaneously for the coming quarter.

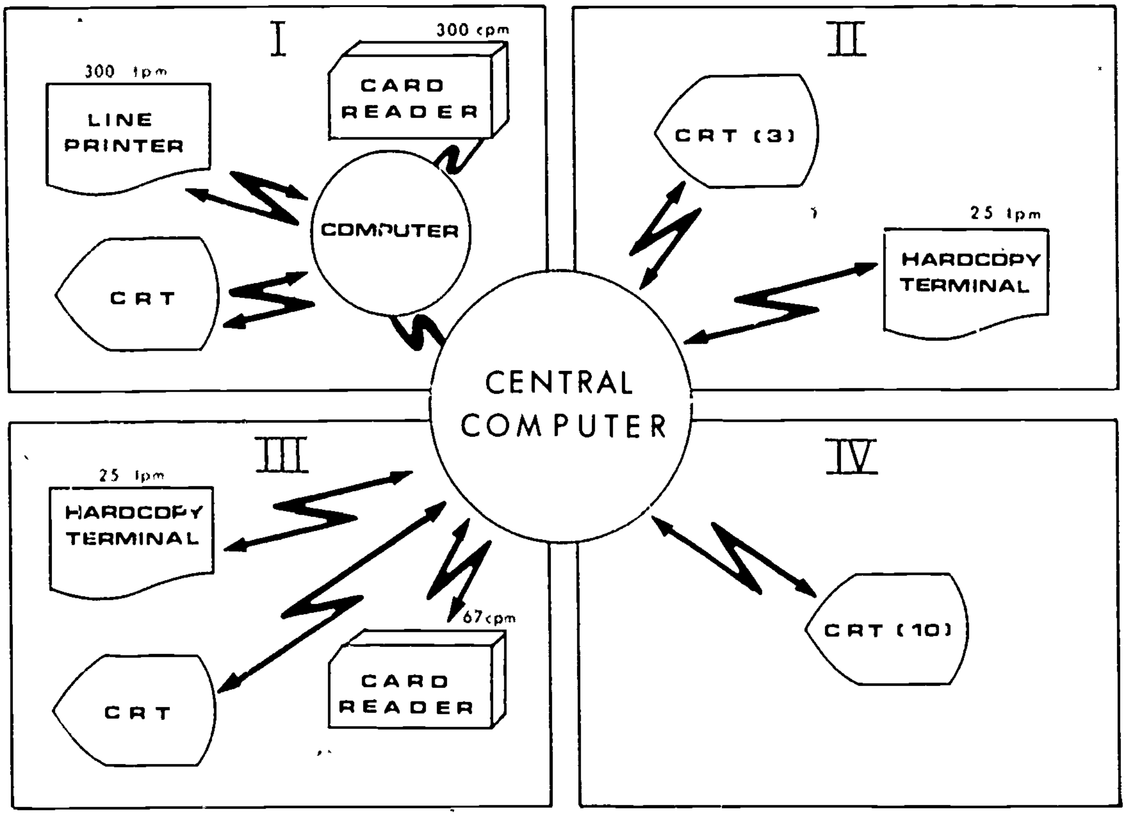
V. Conclusion

The first year of change has given those who are working closely with the new system the ability to control the application with which they are involved.

The central Data Processing staff is no exception. Programmers each work interactively to program, test, and debug their programs. No keypunching of programs is necessary. A program can be written, compiled and tested in a few days' time where previously it took a few weeks. Programmers are able to produce at least twice or more than previously.

User and programmer satisfaction are both up this first year. We expect even better things next year.

PUBLIC SCHOOL DATA PROCESSING



EXAMPLES OF USER SERVICES

SECURITY AND RISK ASSESSMENT IN THE UNIVERSITY'S ADMINISTRATIVE COMPUTER SYSTEM

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ABSTRACT. As privacy legislation is passed, as more administrative applications are computerized, and as more people develop computer expertise, the security problems of a university's administrative computer center change. Fire bombing has become less of a problem relative to the modification or disclosure of student and financial records. This paper presents a discussion of those changing problems and how best to cope with them. Included are risk assessment procedures used to develop a viable security plan, a discussion of the responsibilities of the university community to make the security plan work, and a presentation of the costs of an inadequate security plan to the university.

I. INTRODUCTION: Computers are assuming an increasing level of responsbility in colleges and universities. As a varied university populus has gained access and knowledge of computing system characteristics, the opportunity to interrogate, disseminate or destroy confidential and public information must raise concern in the minds of those charged with the responsbility of managing the information processing facility(s). We have now developed the capability to create and maintain concentrated information systems. This expertise presents a new and broad spectrum of dilemmas to those conversant with the computer system and information intimacies.

Single facility environments (such as that at Arizona State University), present particularly perplexing problems as both administrative and academic computing are supported by the same computer system. Physical damage to the facility impairs all phases of campus administration, instruction, and research. Information misuse is viable as academic users and administrative technicians both have knowledge of system specifics and, therefore, the opportunity to cross discipline boundaries in their interrogation or manipulation of information. Multiple facility systems that effectively separate administrative and academic computing chores (such as that at the University of Massachusetts), still pose security breach and information misuse dilemmas for the users and staff of each facility.

Academic computing environments typically contain both public and proprietary software packages, data sets and research results. Administrative processing tasks require the maintenance of student, personnel, finance, and facilities' records. The unauthorized or negligent misuse of any of these elements represents the potential for significant losses of time, money, credibility and could, conceivably, violate federal laws.

II. SECURITY AND PRIVACY: Security and privacy problems have evolved through advances in information processing technology. The ability to concentrate, access, and process large amounts of information has created the opportunity for knowledgable persons to misuse the power of the information system; the ability to uncover fraud or the illegal dissemination of computer resident information has not grown commensurately. Donn Parker of the Stanford Research Institute indicates that no technological solutions to these problems are at hand and that none are expected for several years.[1] Information residence and processing concentrations have also increased the potential damage from Acts of God, such as fire and flood, and other unintentional acts, such as operator error.

Several security and privacy breaches have already occurred in universities. Examples include:

1. a university parking slot allocation program was sabotaged by a programmer;
2. grades were altered by an employee of the registrar's office to maintain the eligibility of her football player boyfriend;
3. wirecutting and acid were used to destroy an IBM computer;
4. students took over a university computer; and
5. a university computer center was bombed.[2]

Computer security, employed to prevent these events from occurring, is best defined as the protection of the computer, the data it contains, and the programs that direct its actions from accidental or deliberate destruction, modification or disclosure.[3] To implement an effective security plan, various techniques must be applied which range from installing locks on the data center door to the installation of sophisticated software encipherment techniques for the protection of data transmission.

Coupled with the installation of security procedures, universities must also be concerned with the issue of privacy. Although privacy is not guaranteed by our constitution, or mentioned in the Bill of Rights, the civil liberties tradition has been that sensitive personal information collected by government agencies for a specific purpose mandated by law should not be given to other agencies or individuals.[6] This tradition has been incorporated into the Privacy Act of 1974, the Family Education Rights and Privacy Act (the so-called "Buckley Amendment"), pending legislation, and state and local privacy laws which require that universities include privacy considerations into security plans.

As an example, in January, Massachusetts enacted the Fair Information Act. This law requires that state agencies, including universities, that maintain personnel information about individuals report to the individuals involved what information is maintained and the reasons for maintaining the file. In addition, they must maintain a record of who accessed the information and file certain reports with the Secretary of State each year. This law applies to manual systems as well as automated systems.

Laws similar to the one in Massachusetts have been enacted in three other states. It is only a matter of time before a majority of other states enact privacy laws which, according to Capt. Grace Hopper, head of the Navy's Programming Languages Section, could triple the cost of maintaining personal data files.[7] As 1984 approaches and the government grows in power, it can be expected that individuals will demand more privacy protection.

It is these problems of security and privacy that an adequate security plan will attempt to attack. In this paper we will discuss why security problems differ in various environments, the criterion necessary to develop a viable security plan, and how a university might plan and implement security proposals.

III. SECURITY IN DIFFERING ENVIRONMENTS: As each computer installation is different, it is not possible to develop one security plan for all computer environments. These differences are a result of various types of processing applications and levels of equipment sophistication.

Quite clearly, businesses have a wide variety of security needs. Banks have security needs that differ from manufacturers. Large companies have security needs that differ from small companies. These differences can be enumerated along organizational lines or processing lines.

Even within universities, great differences are present. As previously mentioned, the most common difference is the use of a single facility or a multi-facility for administration, research, and teaching needs. When a university elects to employ a single facility, physical damage will impair its use by all users. In addition, the possibility of information misuse is greatly increased as large numbers of faculty, staff, and students acquire the ability to access information not intended for their use.

In a multi-facility environment, security problems are different. In fact, separate security plans must be developed for each facility. Each of these plans will have different objectives depending on the facility's use.

In either type of installation it is quite likely that operating personnel are former students who have extensive computer programming training. This practice of employing operators with programming abilities creates a substantial potential for information misuse.

Unlike many businesses, users of the computer systems in a university, such as financial aid, housing, and others, have been found to be unaware of the value of the information within their control.[7] This lack of awareness can lead to significant security problems.

Universities are also more likely to experience firebombings, take-overs, and other violent acts than other types of computer installations. However, in recent years, very few violent acts have occurred and universities must look at security problems that are more likely to occur.

These differences are clear. Unfortunately, adequate research has, as yet, not been performed to identify all of the significant differences that should be known if we are to develop sufficient security plans for universities.

IV. DESIGN CRITERIA: When a security plan is established, whether it be for a single facility environment or for a multi-facility environment, four design criteria must be met. They are: 1) effectiveness, 2) economy, 3) simplicity, and 4) reliability.[8]

To be effective, the plan must not allow data to be modified, destroyed, or disclosed either intentionally or accidently as it goes into the computer, while stored in the computer, or as data results come from the computer.[9] An effective system will monitor the operation of the computer system to determine when, and if, any of these unfortunate events occur. Simply stated, the computer output should be what was expected from the computer input and the program that processed the data.

Given that it is never possible to develop a security plan that offers 100 percent protection, it is necessary to include economy as one of the criterion. Security needs must be balanced with the funds available. As funds are always a scarce resource that must be shared with other demands of the computer system, economy becomes a very important criterion.

When speaking of simplicity we mean operating simplicity. For example, if a user at a remote terminal must input his social security number, his mother's birthdate, today's date multiplied by three plus two, and a user code, he is apt not to use the system because of all the security barriers that have been created. It must be remembered that the computer is designed to provide a service to the user and if we make that service difficult to obtain, then users will be less likely to fully utilize the computer.

Simplicity must also extend to the operation of control procedures within the computer center, the tape library, the backup storage facility, and other operational centers. In the event that the control procedures are not simple to operate, employees can be expected to bypass control procedures. Without adequate control, security becomes a myth.

As for reliability, it is quite evident that the security plan must work continually to be acceptable. The computer system will be of little value if the security plan is unreliable. Catching some of the intruders some of the time should be unacceptable to security plan developers.

Each of these criterion must be considered in the development of a viable security plan. They should be considered throughout the design and implementation phase.

V. DESIGNING AND IMPLEMENTING SECURITY: The first step to be performed in the development of a security plan is to select a security team. A team is necessary, rather than an individual, because of the amount of work required and the wide variety of skills necessary.

Team membership would be different when developing a security plan in a multi-facility environment as opposed to a single-facility environment. Here our assumption is that we are discussing a single facility environment and are concerned with the administrative computer facility. Included should be representatives from the computer facility management, large academic users, the internal auditors, the legal staff and from each of the functional areas (such as the bursar, admissions office, scheduling, financial aid, etc.) that currently use the computer or intend to use it in the future. Each of these representatives should have a clear understanding of the information needs and responsibilities of the group that they represent. The auditors should be available to recommend proper control procedures while the legal representative should be responsible for insuring that privacy laws are complied with.

Once that the team has been assembled, it will be necessary to assess the risk environment that the facility and its users are operating in, as well as an estimate made of probabilities that these risks will occur. This is a laborious and difficult task, but a very necessary function.

Each team member must attempt to enumerate all possible risks that might occur in their departments and assess a probability rating to that occurrence. To develop this list and its associated probability ratings, many different types of questions might be asked. Some examples are: 1) How many people have access to the data files?; 2) Do these files contain monetary or personal information?; 3) Of what value are these data files and programs to others?; and 4) Are computer-resident data files and programs adequately backed-up? Guidelines for developing appropriate questions can be found in Van Tassel's Computer Security Management and Krauss' SAFE: Security Audit and Field Evaluation.

The risk analysis is also difficult because there is no defined stopping point. Clearly, new risks will always be turning up. It is necessary, then, to uncover as many risks as possible and to allow for future admendments when new risks appear.

The estimation of occurrence probabilities is very difficult. However, it has been said that extremely rough subjective estimates are adequate when objective estimates are unavailable.[11] A method for expressing these probabilities is to determine how frequently the risk might occur. Martin suggests a scale ranging from "virtually impossible" to "might happen ten times a day."[11]

After the team has uncovered all possible risks and the occurrence probability associated with each risk, it is necessary to determine exposure costs. Each risk has a cost associated with it should the event occur; the university will suffer some monetary damage and/or some other loss in terms of time or other inconvience that should be converted into a dollar amount.

These costs are then multiplied by the occurrence probability to determine an exposure cost for each risk. Therefore, what has been developed is a weighted cost for each possible risk. The exposure costs will clarify which risks should be most important to protect against and will often surprise you. For example, a fire that might cause $250,000 damage could have a lower exposure cost than a data error that occurs ten times a day and costs five dollars to correct.

These exposure costs should be rank ordered with the highest exposure cost first. From this list the security team can determine which security measures to institute. However, each security measure must be proven to be cost effective before it is installed. In other words, the cost of installing the measure must be less than the exposure costs. In addition, a number of other considerations must be included rather than just the security measure's cost-effectiveness.

First, most security measures do not reduce the occurrence probability to zero. Therefore, it is necessary to compare the reduction in exposure cost, rather than the exposure cost, against the installation costs of the security measure.

Secondly, many security measures will reduce the occurrence probabilities of more than one risk. While a particular measure might not be cost-effective for one risk, when the reductions in exposure costs of all risks that this security measure affects are summed, it could become cost-effective.

Thirdly, some security measures will have to be installed regardless of cost considerations. For example, privacy legislation, at both the state and federal level as well as institutional policies might require that certain security measures be installed. Failure to do so could result in a violation of a law and, quite likely, significant embarrassment to the institution.

Given the exposure costs and these considerations, the security measures to be installed should be selected. As a limited budget is likely to be allocated to security, not all of the security measures will be installed. The team should select those security measures to be installed and proceed with their installation.

Periodically, the plan should be reviewed. The review should include surprise audits to determine if the security measures are working. In addition, each risk originally uncovered, but not protected against, should be re-analyzed to determine if its appropriate security measure is now cost-effective or if additional funds have been provided to increase the security level. Final. due to changes in laws, applications, or equipment, new risks might be uncovered which must be analyzed to determine if security measures should be installed.

VI. CONCLUSIONS: This paper has presented a very general overview of problems of security and privacy in universities and colleges. Volumes could be written about security and privacy in educational environments. It has been the intention of this paper, however, to identify the problem and offer general guidelines to aid in developing a solution to security and privacy problems.

The situation is intensifying. More people who do not have computer backgrounds fear that the computer is a tool for an invasion of their privacy and this fear appears to be increasing as we approach 1984.

Universities and colleges must not look lightly at these problems. They must be willing to commit significant resources to solving these problems or they could find themselves in an embarrassing situation.

FOOTNOTES

[1]Donn B. Parker, Susan Nycum, and Stephen Oura, Computer Abuse (Menlo Park, Ca.: Stanford Research Institute, 1973), p. 7.

[2]Items 1 and 2 are from: Parker, Nycum, and Oura, Ibid. pp. 91-112, and items 3, 4, and 5 from: Leslie D. Ball, "Defining Security Needs in a University Data Base Environment" (unpublished Ph.D. Dissertation, University of Massachusetts, 1975), pp. 146-148.

[3]Robert H. Courtney, "A Systematic Approach to Data Security" (paper presented to U.S. Bureau of Standards Symposium on Privacy and Security in Computer Systems, Washington, D.C., March 4-5, 1974), p. 2.

[4]Alan F. Westin and Michael A. Baker, Databanks in a Free Society: Computers, Record-Keeping and Privacy (New York: Quadrangle, 1972), p. 19.

[5]Nancy French, "Massachusetts Governor Becomes Fourth to Sign Privacy Protection Act," Computerworld, Vol. 10, No. 4 (January 26, 1976), p. 9.

[6]Ester Surden, "Privacy Laws May Usher In 'Defensive DP': Hopper," Computerworld, Vol. 10, No. 4 (January 26, 1976), p. 9.

[7]Ball, Ibid., p. 154.

[8]Rein Turn and Norman Z. Shapiro, "Privacy and Security in Databank Systems - Man-Measures of Effectiveness, Costs, and Protector - Intruder Interaction," Fall Joint Computer Conference, Vol. 41 (Fall, 1972), p. 437.

[9]Courtney, Ibid., p. 2.

[10]Courtney, Private Interview at IBM, Poughkepsie, N.Y., July 22, 1974.

[11]James Martin, Security, Accuracy, and Privacy in Computer Systems (Englewood Cliffs, N.J.: Prentice-Hall, 1973), p. 14.

INTEGRATED INFORMATION SYSTEMS IN EDUCATION:

STATE OF THE ART

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ABSTRACT: This paper explores the concept of integration in Administrative Data Processing in Education. The various options currently available for achieving integration are discussed, and a "DBMS-based" approach is proposed as the only method of attaining "true" integration. Both advantages and disadvantages of the DBMS approach are presented.

The "accountability movement" in education has resulted in ever-increasing demands for better "management information" pertaining to the operation of almost all types of educational institutions. Most of these demands have come from outside the institutions themselves; from local governing boards, state coordinating agencies, and, of course, the federal government. At the same time, educational administrators have been faced with increasingly difficult internal resource allocation questions and, in many cases, have turned to "modern management techniques" for their solution. As a result, there is a manifest need for more and better evaluative data to improve both the internal operation of the institution and its capability to respond to information requests from external agencies.

To a large extent, these pressures have been "aided and abetted" by the availability of ever-more sophisticated computerized tools for management. "MIS," "on-line systems" and "data base" are all familiar phrases to the educational administrator of today. In many cases, it seems as though the mere existence of the capability to produce large quantities of computerized reports has been a more relevant factor in the decision to implement a computerized system, than the actual need for the information to be produced. Whether this is true or not, almost all educational administrators today have had some experience with electronic data processing (if only as a frustrated user) and computerized administrative information systems.

The Concept of Integration

Where does the concept of "integration" enter into the management information picture? From a theoretical standpoint, the concept is a central issue in the application of management theory to the problems of management in the educational setting. A recent article in the Chronicle of Higher Education highlighted the emergence of such applications in post-secondary institutions, beginning with the statement that "sophisticated corporate style management systems," using electronic computers and "space age" data processing techniques "are rapidly becoming standard equipment on the American campus."[1] The "systems approach" to management alluded to here is based on a concept of the organization as a "whole," with the relative importance of the various sub-units being determined on the basis of the functional relationships of each system component to each other and to the whole. Obviously, in a management approach based on this type of theory integration is an essential concept, as educational sub-systems are viewed not as separate and distinct from one another but more in terms of their contribution to the total well-being of the institution.

From a practical standpoint, whether or not the educational administrator is versed in management theory, he is definitely aware of the pressures that exist for data which cross sub-system boundaries. Federal reports, program evaluation data and information to support internal cost-allocation decisions, all require integrated data at one level or another. For example, analysis of instructional costs is possible only if you can effectively relate information on students, faculty, programs and monetary and physical resources.

Integration: The Alternatives

What are the alternatives for achieving integration in administrative data systems? At a broad, conceptual level, there appears to be four basic options (these will almost certainly overlap in actual practice): (1) a default option, (2) the "coordinated file" option, (3) the "distributed processing" option, and (4) the "data base" option.

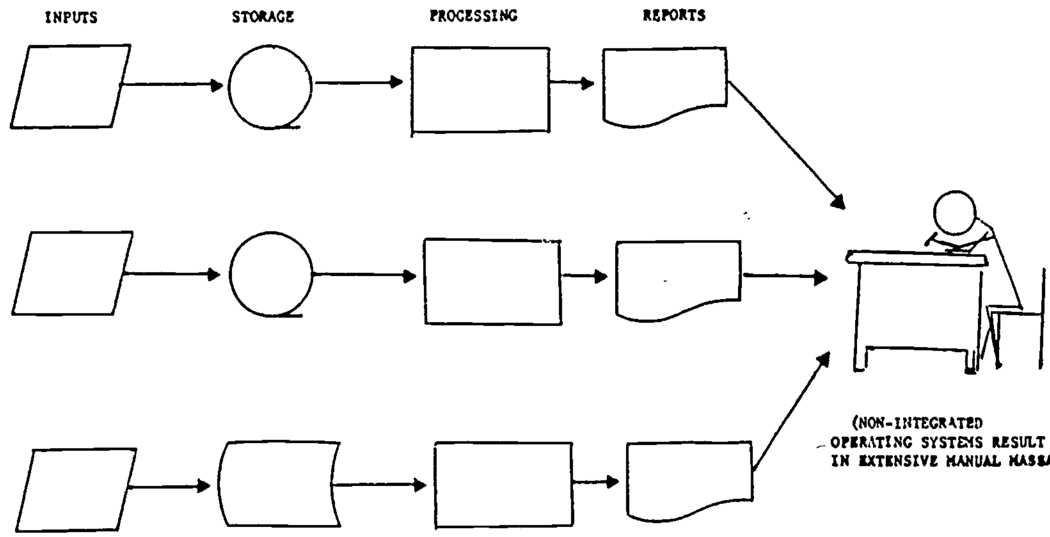

FIGURE 1.
THE "DEFAULT OPTION" FOR ACHIEVING INTEGRATION

The obvious "default" option is depicted in Figure 1. This is the situation where little or no integration exists between the "operational," or "transaction oriented," data systems in the institution. Separate processing and file systems have evolved for students, finances, personnel and physical plant, each one in virtual isolation from the others. This means that the only alternative that exists for correlating data from the different sub-systems is "manual massage." Practical experience from an administrative point of view affirms that manual massage is "alive and well" and, to some degree, will undoubtedly live on forever. For example, the Office of Institutional Studies at Arizona State University (ASU) is currently faced with the prospect of considerable manual effort in bringing together (for cost analysis purposes) faculty data that are presently scattered among four basic systems: "position control," the academic vice presidents' faculty file, the payroll master file, and the master course file. It is almost impossible to describe the amount of manual effort that is sometimes required to pull together accurate, timely data from four separate systems which were each designed with a distinct purpose in mind.

The basic option for achieving integration in the data processing shop is the technique of "coordinated file processing" (see Figure 2). Here, integration is accomplished through "cross-walk programming," the creation of "extract files" of selected data elements from operational systems, and other similar techniques. For example, as a possible interim solution to the ASU faculty data problem mentioned above, Administrative Systems and Programming personnel may develop -- without changing the basic operational systems in any way -- the necessary software to create and maintain a new "personnel history file" which extracts data from all four operational systems. Unfortunately, data processing technicians are well aware of the complexities and problems associated with this type of procedure, especially where standardized assumptions and data element definitions are lacking. Data/File Management System software (not to be confused with Data Base Management Systems, to be discussed later) such as Informatics' MARK IV, can go a long way toward facilitating correlation of data in a basically non-integrated environment; however, standard "keys" for cross-referencing data must be present in the existing files, or added later -- perhaps at considerable expense. Because this method of achieving system integration is necessarily "after the fact," there will almost always be deficiencies of one type or another in the results.

A new bandwagon which offers an option for integrating with a different twist is "distributed processing." The development of economical intelligent terminals, compatible mini-computer systems, key-to-disc hardware, and specialized "turn-key" systems have already had substantial impact on traditional systems design concepts. For

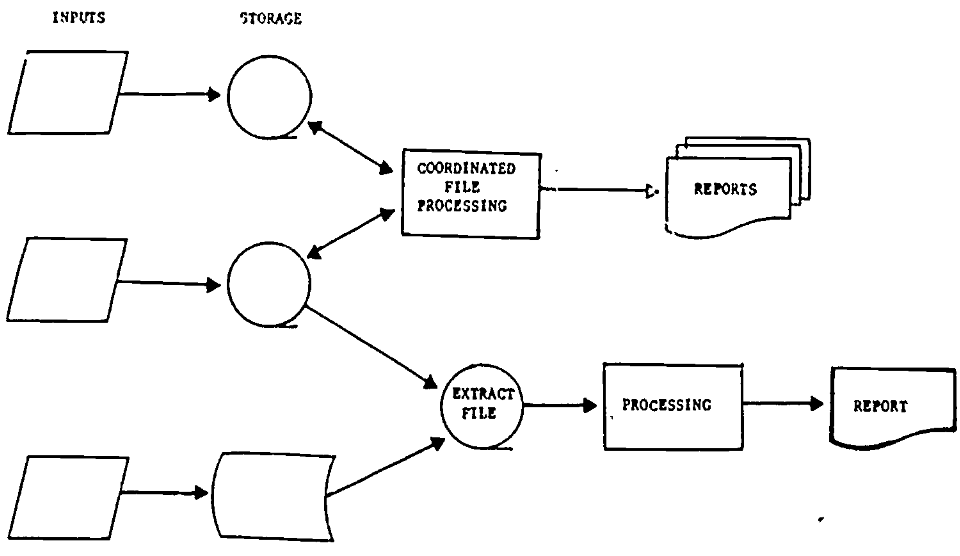

FIGURE 2.
ACHIEVING INTEGRATION THROUGH "COORDINATED FILE" TECHNIQUES

example, a centralized keypunch operation was once the "rule" for data entry at ASU. Today, keypunch machines have been replaced with UNIVAC key-to-disc equipment, including "distributed" key stations for direct input of transactions in the university purchasing department. Also, new equipment has been purchased for university cashiers which includes a built-in mini-computer (and random access storage) that will interface with the main financial system at the central site. The implication is clear that, as distributed processing concepts become widespread, a new level of "hardware dependent" integration will be designed into specialized subsystems that "talk to" or "feed" one another at different levels of interaction (see Figure 3).

The final option is the development of an "integrated data base" through the use of data base management system (DBMS) software. Commercially available DBMS packages include TOTAL, IDMS, SYSTEM 2000, DMS 1100, ADABAS, and IMS. Persons interested in comparative evaluations of these packages should refer to Datapro's "Buyer's Guide to Data Base Management Systems," and a recent article by Ross.[2] Essentially, a DBMS package facilitates non-redundant "application-independent" data storage with data elements linked together in a variety of hierarchical or network (chained) relationships. To over-simplify, instead of data inputs from different functional areas within the institution being fed into physically separate tape and disc files, selected inputs from the various departments are funneled through carefully controlled maintenance procedures into a single mass storage "file" (see Figure 4). Theoretically, the data elements stored in the resulting centralized data base may be linked in an infinite variety of ways to produce required reports.

It is the opinion of the author that the DBMS approach to information systems development, represents the only "true" integrated approach to administrative data processing. Integrated systems based on the coordinated file or distributed processing approaches are much more likely to result in systems that are too "application oriented" (i.e., developed without regard to an overall design for the organization as a whole) and integrated after the fact, if at all.

The centralized data base approach has been considered by many in the past to be too expensive and complicated to be able to implement effectively. However, software sales statistics indicate that more and more organizations are turning to DBMS for the solution to their management information problems and Datapro reports a generally high degree of user satisfaction with the various "major" packages. Software with DBMS capabilities is already available for some of the medium size hardware systems, and the trade journals report that work is progrssing on packages that will make this capability available to mini-computer based configurations. In the words of one writer, the current interest in the DBMS approach represents "perhaps the groundswell of a new era in which the standard method of computation will be data based data processing."

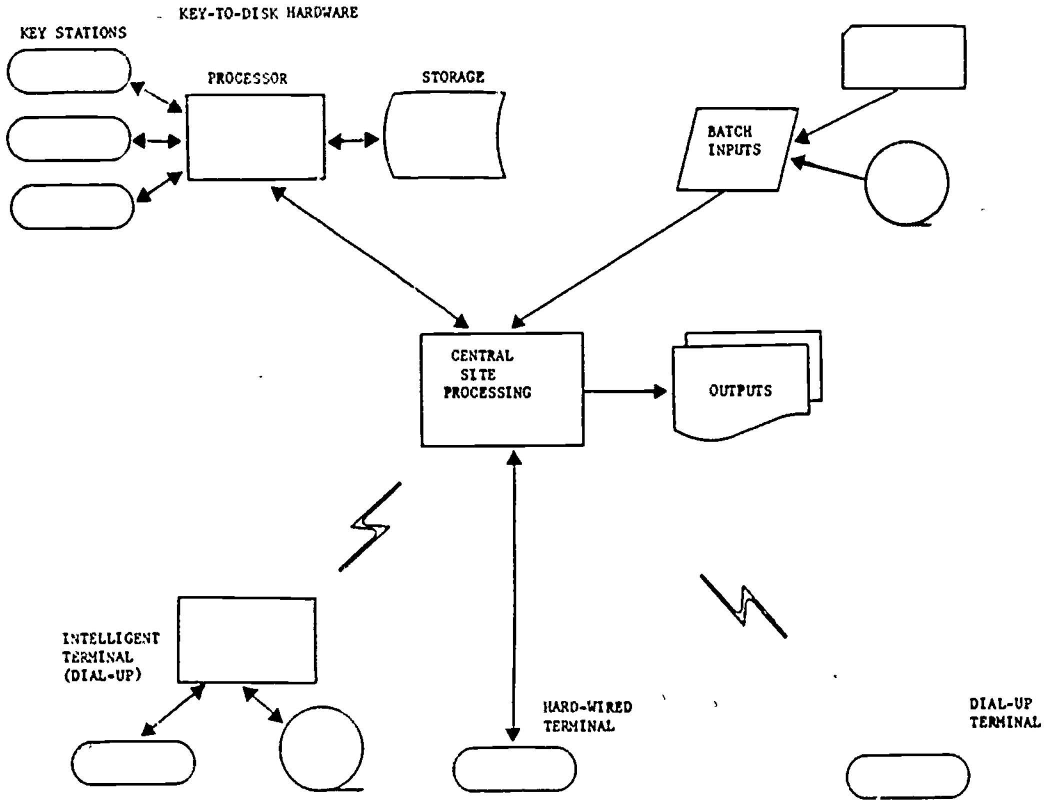

FIGURE 3
INTEGRATION WITH
DISTRIBUTED PROCESSING

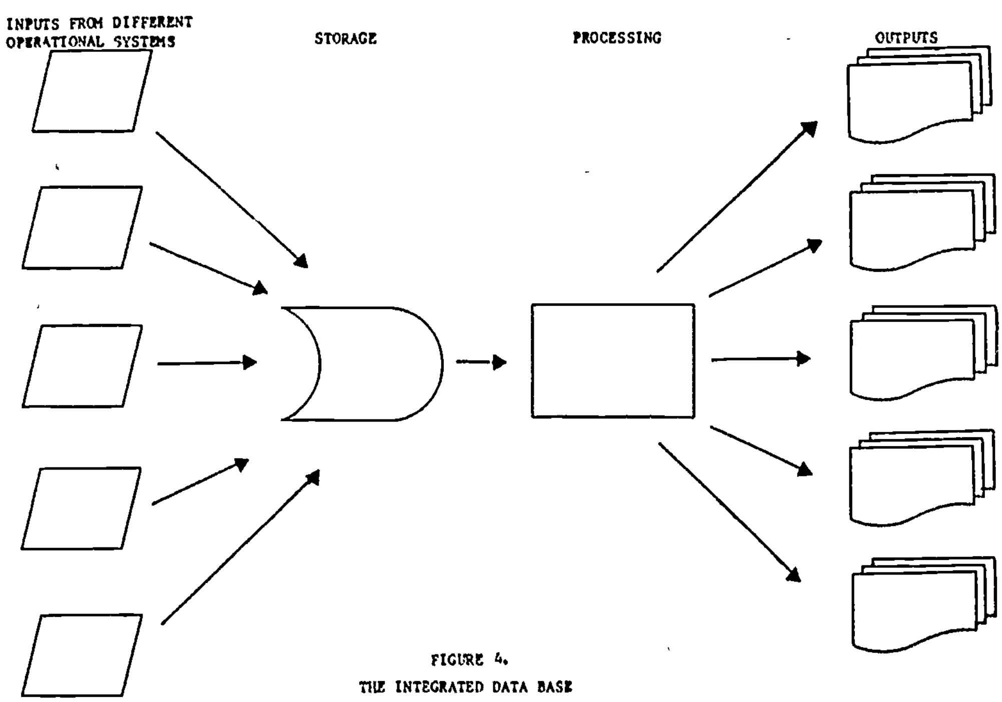

FIGURE 4.
THE INTEGRATED DATA BASE
(DBMS APPROACH)

Advantages of the DBMS Approach

What are some of the advantages of the DBMS-based integrated approach to administrative data processing? In the area of data collection, multiple data sources or "inputs" result in data entry errors proportionate to the amount of handling and number of different input source documents -- this is true of all types of administrative information systems. However, in conventional "multiple file" systems, much of the data collected is, of necessity, redundant; in a data base, much (if not most) redundancy in data entry can be eliminated. Also, multiple file systems have generally evolved in such a way that data inputs are validated through highly fragmented edit routines and procedures. In a DBMS environment, carefully defined "single entry" input points and standardized (centrally controlled) edit programs permit effective validation control and can thereby reduce error rates.

In the area of data storage and manipulation, traditional information systems are characterized by multiple definitions and storage formats for the same data elements, resulting in "non-comparability" and a variety of processing problems. While many institutions have attempted to impose standardized data definitions and formats "after the fact" on their existing systems, in practice the task has often proved unmanageable. On the other hand, in a DBMS-approach, the construction of the centralized data base becomes a major vehicle for the accomplishment of standardization because standard definitions and formats are a system constraint.

Another advantage of a DBMS-based system is that it is theoretically possible to store basic data elements (such as student name, social security number, etc.) only once for access by all report generating programs. In "multiple file" systems, the fact that the same data element can be stored in a number of different files in a number of different formats makes cross-file and multiple update routines necessary where periodic changes are required to keep data current. A major review of systems at ASU has revealed that the data element "student name," is currently maintained in 13 different computer files in five distinct formats -- all of which must be updated separately. The "single entry" update capability of a data base makes it possible to provide up-to-date information to all user areas as the result of a single updating process.

In the area of information dissemination, reports which draw on data stored in separate files (i.e., "cross-file reporting") generally require "special" programming and job stream considerations. In many cases, the complexities and delays involved in linking data element in multiple files is the primary cause of inordinate waste from production re-runs, delays in meeting report deadlines, and that familiar programmer response, "it can't be done." More than likely, this latter statement will surface where similar data elements existing in two separate files were defined somewhat differently and, therefore, require a massive "lookup" or "correspondence" table for a linkup to be possible. For example, at ASU there are currently four different sets of building and room codes in effect on campus; obviously, you are going to encounter problems if you require information keyed on building or room code from one or more files (e.g., to produce space utilization statistics) with non-compatible data element structures.

Disadvantages of the DBMS Approach

What are some of the disadvantages or limitations of the DBMS-based integrated information system concept? For one thing, the diversity of information needed to fulfill federal report requirements, internal needs, and state and local governing board requests, dictates that the data base will be continually evolving or deficient in some respect. This means that the system must be designed with extreme flexibility and responsiveness in mind. However, this is a problem that is shared to some extent by all computerized information systems, and, of the possible options, the DBMS approach appears to offer the most probability of success. This is particularly true if some type of generalized report-writing capability is developed in conjunction with the data base. Unfortunately, old habits are hard to break, and flexibility is still an elusive goal in many instances.

A basic limitation of integrated information systems that is so obvious that it is often overlooked, is that a DBMS-based system (like all computerized systems) will deal only with certain kinds of decision information. Unfortunately, the benefits of the "totally" integrated information system have often been oversold to administrators by the technicians involved; they have stated on occasion that the finished system will provide "all" of the information the administrator needs to make better decisions. They forget that there are a variety of inputs into any given decision situation -- i.e., formal vs. informal, quantitative vs. qualitative and objective vs. subjective. Computerized data tends to be formal, quantitative and objective -- which may be the least relevant type of input to an administrator in a real-life problem situation. Furthermore, everyone knows (or should know), certain types of data are much more amenable to processing via automated systems than others. In their book on "decision-information systems" in education, Andrew and Moir include the following classic "disclaimer" which should be periodically reviewed by every individual involved in administrative systems development, and particularly of the "totally integrated" variety:

> "The information systems that will be discussed in this book will pertain primarily to the quantitative

information necessary for an educational organization to pursue its purposes successfully. The total information system required for such an organization necessarily involves much more than just those few aspects that can be relegated to numbers or alphanumeric descriptors. The qualitative aspects, including the feelings, intuitions, and emotions that are quite relevant to the activity of any organization of man, are not discussed -- not because they are unnecessary, but because they are beyond the scope of this treatise. It is important for the reader to recognize, therefore, that the information system as described herein is merely a part of the total requisite information systems for an organization. . .Furthermore, the information system will use only some aspects of the recorded data base documentation commonly found in an organization. It will confine itself to the collection, manipulation, and use of information that is amenable to processing via automated systems."[4]

The main cost disadvantages of a DBMS based system are generally related to: (1) the cost of the package itself, (2) the fact that such systems are mass storage based and (3) increased processing overhead (e.g., increased CPU-time consumed and CORE storage requirements). Unfortunately, it is very difficult to derive any useful generalizations for cost-evaluation purposes because system configurations, expertise and needs vary so much from organization to organization. For example, the cost of the various DBMS packages might seem relatively simple to compare; in actuality, differences in individual capabilities and pricing options makes this a very difficult area to evaluate. On the other hand, at ASU (since the central computer is a UNIVAC 1110 and UNIVAC provides its software "free" as part of a "bundled" agreement) DMS-1100 was acquired without any direct cost for the software itself.

The fact that a DBMS system is generally mass storage-based and may make increased processing demands is also a difficult area to evaluate. For one thing, there almost certainly will be cost tradeoffs if a new system is designed to replace older, more inefficient systems. Also, it is very difficult to obtain realistic performance data for purposes of cost comparison (even if some type of benchmark testing is done) because a good approximation of the final system in operation is pragmatically impossible to achieve. Because of the difficulties enumerated here, the final decision as to whether a DBMS approach will be cost-effective in a particular situation will probably be based on a "best-guess" estimate of incremental cost (i.e., "how much more will it cost over other possible alternatives" -- including maintaining the status quo) vs. how much the expected benefits to be derived are likely to be worth to the institution.

The final disadvantage of a DBMS-based integrated information system centers around the fact that development of such a system constitutes a commitment to a radically different philosophy of data processing than the one to which people have generally become accustomed. As was noted earlier, standard data definitions are required. This means that administrators and user personnel with different expectations of how the system should ultimately serve their needs must come to agreement on mutually useful data definitions. Similarly, individual sub-systems cannot be developed in isolation of one another and still benefit from the advantages of the data base approach. Programmers must adjust to a new environment in which programs are "data independent" and must adhere to established standards which they may consider to be rigid and constricting.

Conclusion

Of course, the ultimate goal of integrated information system development regardless of the approach taken is to improve the capability of data processing to serve the information needs of administrators. As always, this requires that system development proceed in a user oriented (as opposed to "technology oriented") mode for the effort to be successful. This is especially true in the integrated system environment where programmers and analysts must be certain that data elements are defined, collected, stored, maintained and accessed in such a way that the needs of a variety of users (at a variety of levels within the organization) may be met through the use of the same basic resource. The development of a "truly integrated" administrative system will be a challenging and in many cases frustrating, experience. However, the increased responsiveness which can result if the effort is successful should be well worth the time and effort.

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A SIMPLE AND COST EFFECTIVE LIBRARY CIRCULATION SYSTEM

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ABSTRACT: A very successful library circulation system has been implemented without special equipment and with negligible conversion costs. The only machine readable data elements required are patron files and Library of Congress call numbers which are collected as circulation takes place thus spreading conversion over time and focusing on the most active part of the collection first. Patron files require only I.D. number, name and address. Even minimal batch configurations can support daily circulation rates ranging from 200 to 2,000 transactions. Measures of success include cost information, benefits from circulation statistics, and patron acceptance as suggested by a sudden circulation increase.

Automated circulation systems for college libraries do not necessarily require the expenditure of huge sums of money. The Library at California Polytechnic State University, San Luis Obispo, has implemented a powerful yet simple and very cost effective computer-based circulation system. It allows for the quick and easy checking out of books while still capturing all the information required to handle overdue processing and to generate management reports which reveal the usage patterns of library patrons and other useful data. It was implemented without purchasing special equipment and without the massive conversion effort so often required for sophisticated referencing and extensive automated circulation systems.

PROBLEM DEFINITION

When this system was conceived in late 1970, the circulation of books was a growing problem. There were about ten thousand students at the university at that time, and circulation figures were approaching fifteen thousand circulations per month. With the necessity for recording the charge out and return of each book plus the special handling associated with more than five percent requiring overdue processing, considerably in excess of thirty thousand transactions per month were required. Growth of the university was continuing (we are approaching fifteen thousand students now), and we were anxious to improve the efficiency of our circulation procedures.

At the time, our circulation procedures were entirely manual. Borrowers were asked to print their name and address. The book's Library of Congress (L.C.) number, the author, and title of the book and sign for it. All of this was recorded for each book checked out on a McBee card. The cards were accumulated and notched to indicate due date, talleyed by major classification to provide minimal circulation statistics and filed in L.C. number sequence. Book returns involved searching the card file for the charge card, removing the card, and reshelving the book.

Periodically the files of McBee cards were "needled" to locate overdue books. The shelves were searched for any suspected overdue books to avoid sending erroneous overdue notices. For those not located, the McBee cards were Xeroxed, the name and address was typed on envelopes and the Xerox copy of the McBee card mailed as an overdue notice. The original card was notched again to indicate that the notice had been sent and refiled. If it was subsequently noted during the processing that two previous notices had been sent, a bill was prepared and mailed to the user.

This was a very standard system and some varient of that system continues in use at a great many libraries. While improved efficiency was clearly one of our goals, there were others of equal importance. The amount of information the borrower was required to record was fairly extensive and quite time-consuming. Students needing several books for a short time, perhaps only over night, were frustrated with the need to record so much repetitive information and inevitably neatness and readability suffered by the time they reached the fourth or fifth card. This was, of course, the reason for typing name and address on envelopes for overdue notification. Reducing the user effort was considered an important goal for improving user relations. Another goal was to improve the circulation statistics. This was particularly important because we are a somewhat specialized polytechnic university in a large state university system. A great many plans for statewide library systems could have serious impact on the nature of our collections, and reliable circulation information in considerable detail was required to evaluate the effectiveness of these plans.

DATA BASE

At the beginning, it was clear that all of the identifying information used in the circulation of books already existed in some form. The number of data elements actually required is quite small. We needed only the users identification, the book identification and the due date. With the earlier system, the user was required to record both his own and the book's identification for each book borrowed. The library verified that information by reference to the book itself and the user's I.D. card and added the due date. In more than 90 percent of the circulations, the identifying information was never used! It was only used when overdue notices had to be sent. Ideally, then, we should have only recorded identifying information on books which would become overdue. Unfortunately, of course, we had no way to predict which books those would be. It did point out, however, that in planning a data base for implementation on limited equipment configurations, we would want to avoid recording all identifying information for each transaction and substitute keys instead. We needed only a unique code key for each book and each library patron.

The users were required to show an identification card during the checkout process. That card contained, in our case, a Social Security Number which served as a unique identification key for faculty, staff, and students. The earlier "permanent student number" was equally acceptable as long as it was unique and keyed to files providing a more complete identification of the borrower. Such files with records containing name and address were already available in machine readable form at the computer center. In order to reduce file size, an extract of the student record files and the personnel files was made containing only the necessary information for the mailing of overdue notices. This information can be compacted into 40 characters or less and even a fairly good-sized college or university should be able to fit the entire patron file into a small segment of a disk pack or tape. Available files usually contain additional information such as class level, major, age, sex, and grade point average. While we were very interested in using these data elements to gain insight into library circulation patterns, we elected not to include them in the patron file since reference for statistical study would be rather infrequent. Our intention was to search the patron file using borrower identification number as a key to obtain only the information needed to prepare an overdue notice.

The author and title and the Library of Congress number are customarily used for book identification. The L.C. number is unique and makes the author and title redundant although admittedly they are a great convenience. Although it is a very clumsy code from the standpoint of data processing, L.C. number was already available on practically every book in the collection, and of special importance was the fact that its use required no retraining of library personnel. If your library uses an ascension number (a sequential number incremented whenever a new book is purchased) it may be used in place of the L.C. number. It is easier from a computer processing point of view, but you may lose the statistical data concerning the subject areas of the circulated books. The only requirement for the book identification key is that it be unique and tie back to a card catalog or shelf list description of the book, therefore, a Dewey Decimal System number could also serve as the identifier.

Our circulation file was to consist of only three elements. (A fourth element indicating borrower status, i.e. faculty, staff, or student, via a single digit code was also included to accommodate policy differences in overdue processing.) The user I.D. number was available from the user's I.D. card at the time of circulation and when needed, the rest of the identification could be located in the machine readable files already available using this access key. The due date was determined at the time of circulation and could be added to the transaction record by any convenient means. The book identification was available on the book but no machine readable file consisting of the book identification itself or the more descriptive author and title information was available. Our next problem was to find a means for establishing such a descriptive file or alternatively to find a way to get along without it.

A BOOK IDENTIFICATION FILE

How much time and how much cost would be involved if we were to start from scratch and develop a machine readable book identification file? The circulating collection was in excess of one quarter million volumes, and we knew intuitively that capturing even a minimal amount of descriptive information on that many holdings would be a monumental task. At that point, we turned to the literature in search of library conversion cost estimates. DeGennaro (1) noted in 1970 that:

> "While experience has shown mass conversion (of shelf list) to be technically feasible at this time, it has also demonstrated that the cost is extremely high -- in a range of one to two dollars per entry."

An earlier work edited by Rather (2) in 1969 indicated more specifically that:

> "The total cost per entry of the four alternatives ranged from a high of \$1.87 to a low of \$1.51. . . with 94 percent of the cost ascribable to manpower and six percent to machine costs."

While these standards contempleted the capture of substantially more information than would be needed for circulation alone, it was very clear to us that the costs were beyond our meager means. We explored two additional ideas. The first was simply to do without author and title in machine readable form. The second and real key to rapid implementation was the notion that collection of L.C. number in machine readable form could take place as the books in the collection actually circulated. We chose as a media for collection a standard computer card to remain available with the book while on the shelf and to serve as a human readable transaction record while the book was in circulation.

The absence of the author and title information implied that a reference to the library catalog file would be required when and if this information was needed. Fortunately, this information can easily be added to the system. When a computer readable book file is available, it can be searched in the same manner as the patron file. That is, it can be searched by L.C. number for author and title which can then be printed on overdue or recall notices. If price information is on this file, then it can be used for the preparation of bills. A printed list would also be available for use at the circulation desk eliminating the need to go to the card catalog or a shelf list.

Originally we were concerned that an overdue or recall notice without authors or titles would cause difficulty, however, our experience has shown that the stimulation of memory triggered by an overdue notice usually makes further description unnecessary. The patron does have the L.C. number and can determine which book is being requested from that or from the due date stamped in the book. It is a rare exception when we have to refer to the catalog for author or title.

The idea of maintaining circulation files without author and title was a key item of contention in the decision whether or not to implement this system. After nearly five years of operation, it is still an item of contention, but, as we shall discuss further, it is an observable fact that the system has operated successfully without such information.

OPERATIONAL PROCEDURE

The mechanics of the system are extremely simple and closely parallel the manual system it replaced. Since cards containing L.C. number were prepared as the collection circulated, there were two situations depending on whether or not the book had been circulated previously under the new system. Assuming it had, a card containing the L.C. number was stored in a pocket inside the book. The borrower removes the card, writes his identification number on it, and presents the card and book to the circulation desk together with his identification card. The clerk verifies the L.C. number on the book card by reference to the book, verifies the user identification by reference to the user's I.D. card, stamps the due date in the book, and sets the card in a batch with similar due dates to be processed at the computer center.

The computer center keypunches the user identification directly into the book card. The book card was designed so that user identification would be clearly visible with the card in the punch station of the keypunch. The keypunching of nine (or ten if borrower status is recorded) numeric digits is very rapid. The cards are mechanically sorted by L.C. number in preparation for a computer run which will merge a new book card with the old and produce a circulation file containing the three required data elements for each book charged out. The pair of book cards (one with the user identification number and the due date and the other with only the L.C. number) are interpreted and returned to the library where they are filed until the book is returned, renewed, or recalled.

When the book is returned, the two cards are removed from the file. The one with the user's identification number is sent to the computer center; the other is placed in the book which is reshelved. The computer center uses the returned cards to purge records from the circulation file. In this way, the circulation file contains only records for books still in circulation. If the book is returned late, the card to be returned is batched separately with others on which a "fine due" is to be noted. Rather than retaining a cumulative file for fines due, reference is made to the user file, and a notice similar to an overdue notice is returned to the library for retention or disposition.

When a book is renewed, the two cards are removed from the file and the user's number is written on the new card. A renewal indicator is noted on the card with a rubber stamp and both cards go to the computer center. The computer center updates the due date and produces a new book card. The renewal indicator is only for the benefit of circulation statistics. A recall notice could be generated by indicating recall on both cards (again a rubber stamp) and sending the card with the user's identification number to the computer center, but using a patron file listing manually seemed more convenient for this infrequent transaction.

Periodically, the circulation file is searched by computer for overdue books. If a record is found with a past due date, the program searches the user file for the same identification number, uses the name and address associated with it, and produces an overdue notice or bill. A listing of L.C. numbers of overdue books for a shelf search is also produced. The library staff, after verifying the book's absence, mails the notice.

If a book had never circulated previously under the system, no book card would be present so an initial one is prepared. Although the user could be asked to do so, the field structure is a bit too messy with L.C. number so the library clerical staff records the L.C. number during checkout. Samples of the book cards are shown as Figure 1.

COST AND IMPLEMENTATION CONSIDERATIONS

The critical point with regard to implementation is that no conversion of the library holdings was required. To begin, we needed only three things:

1. The user file extract from existing student and faculty files,

2. The computer processing programs, and

3. The printed cards and miscellaneous supplies to be used.

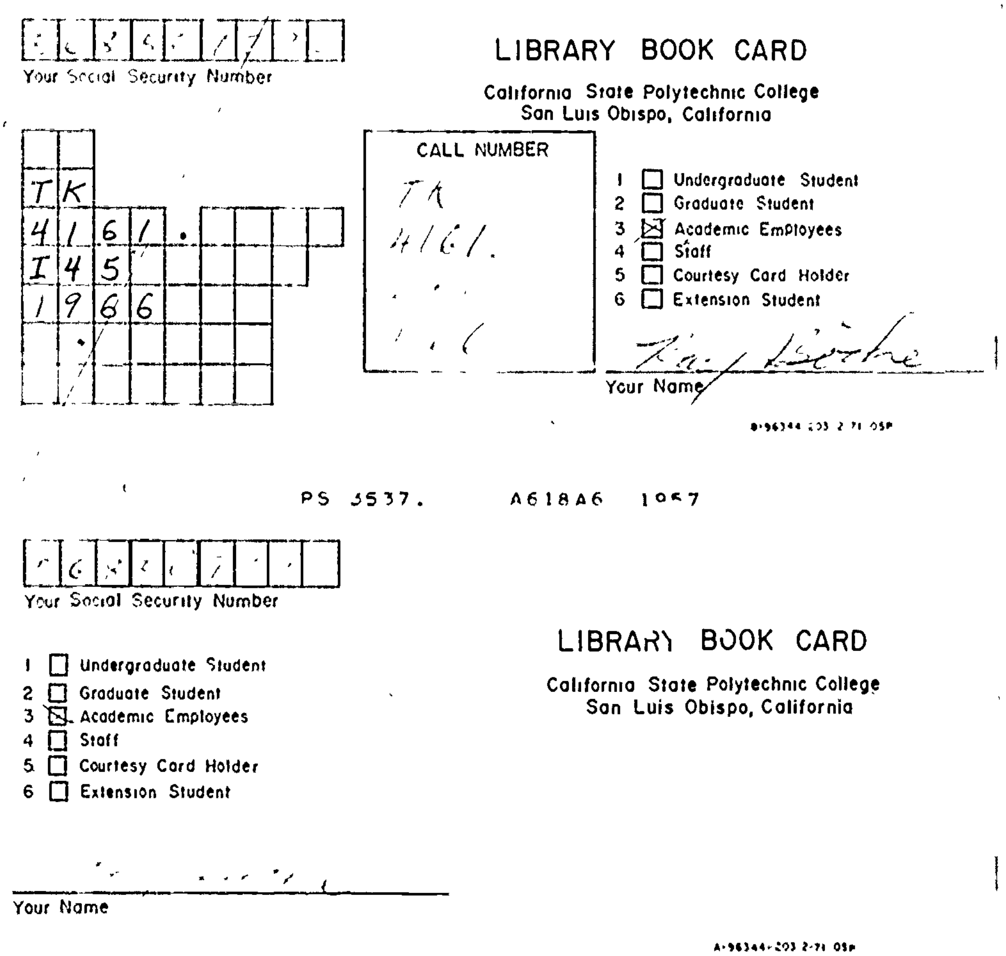
One of the authors prepared all of the necessary computer programs including those for the file extracts, prepared user documentation, and trained library, keypunch, and computer operations personnel all in less than two man-months.

Item one proved to be the most difficult. A campus conversion to Social Security number for student identification was incomplete at the time. The necessity for concatonating the several different and moderately incompatible personnel files into a single patron file was annoying rather than difficult. Additional preparation was needed to provide identifying records for courtesy card holders, arrange for interlibrary loans, and accommodate internal transactions such as temporary removal to the mendery and the bindery. The file must be restructured each quarter as students in particular come and go. It is necessary to defer preparation of the file until after any changes of address detected during the university's registration have been processed and the files updated. However, this poses no serious delays since books checked out by new students would not be due for two weeks or more anyway.

The programs in item two were very simple. They were developed in an evolutionary manner to a final state of reasonable efficiency and refinement. For implementation speed and simplicity, sequential file structures were initially used. From time to time various modifications transparent to the library have been incorporated in the interests of convenience and efficiency. Output formats of overdue notices and circulation lists printed occasionally on request were refined considerably for mailing convenience and aesthetic purposes after the system was underway. Programs to accumulate circulation statistics were added shortly after initial implementation and a large file containing only the two letter L.C. prefix was retained with user I.D. and security precautions. This was subsequently used for a preliminary circulation study by extracting major, class level, and similar information from the student file, deleting I.D. number, compressing, and cross-tabulating.

Item three encompassed the preprinting of the cards illustrated, the purchase of pockets and glue for inserting cards in the books, and the acquisition and arrangement of trays in the circulation area for the card file. In our case, no pockets were available in the book so they were added on reshelving following the first circulation thus handling this mechanical conversion in an evolutionary manner also.

None of the above items was particularly costly. The printed computer cards


LIBRARY BOOK CARD

California State Polytechnic College
San Luis Obispo, California

Your Social Security Number

CALL NUMBER

TA
4161.

1 Undergraduate Student
2 Graduate Student
3 Academic Employees
4 Staff
5 Courtesy Card Holder
6 Extension Student

Your Name

A-96344-203 2-71 OSP

PS 3537. A618A6 1957

Your Social Security Number

LIBRARY BOOK CARD

California State Polytechnic College
San Luis Obispo, California

1 Undergraduate Student
2 Graduate Student
3 Academic Employees
4 Staff
5 Courtesy Card Holder
6 Extension Student

Your Name

A-96344-203 2-71 OSP

Sample Circulation Cards (First Time at Top)

FIGURE 1

cost $3.40 per thousand less than the McBee cards previously used. Pockets and glue are a one-time cost of minor magnitude and can be spread over several years. Although the initial time expended for programming costs was very small, the evolutionary development and program maintenance has consumed approximately two weeks per year of programmer time. Keypunching of the first-time circulation cards is slow and variable since the card format with desirable L.C. number spacing is inconvenient for keypunch. For the first week or so nearly 100 percent of the circulations were "first-time." One month after start-up first-time circulations were down to percent, and with each succeeding month, it declined to roughly 65 percent, 42 percent, 34 percent, on down to under ten percent within 18 months. In operation the short numeric cards used in all circulations after the first are punched at speeds exceeding 1,000 cards per hour average even by many of our inexperienced student keypunch operators. Sorting using a mechanical card sorter is a bit tedious and the operator must follow instructions for the intermingled alphabetic fields. We must also interpret the new book cards prepared. While all of our calculations indicate that the total time for 1,000 daily circulations should be little more than one hour, in practice, we find that it consumes nearly two and one half hours per day. We hire student assistants specifically for this daily processing thus keeping our total costs well under $150 per month. At present, we are using an IBM 360/40 computer system operating under OS. For the entire fall quarter just completed, our processing time was under six hours or less than one half hour per week. This includes time necessary for patron file preparation and monthly circulation statistical reports.

Library circulation staff previously used the equivalent of two full-time people in the processing and handling of overdue transactions alone. There were modest savings as a result of the system described here, but since the personnel involved also had many other duties and total circulation increased, no major staff savings in the library were clearly discernable. There were minor savings in supplies and Xerox costs.

For a library of such size, the costs were obviously very low, but what about benefits? The system was clearly an overwhelming success from the library user's point of view. The previous frustrations of identification recording were eliminated. There was a marked increase in circulation statistics in the weeks immediately following system implementation. We hesitate to attribute the circulation increase to the system alone since many confounding factors were active simultaneously. User testimonial as noted by the library circulation staff was overwhelmingly favorable. There were modest improvements in accuracy particularly for the L.C. number recording, but there was an offsetting loss of timeliness in address changes for borrowers. Circulation statistics were greatly improved, and we have yet to use the full potential of the statistical data accumulated as a result of circulation automation.

ADVANTAGES AND DISADVANTAGES

The system offers many modest advantages in operation and enormous advantages in implementation. Some particular advantages are:

1. No library conversion of the circulating collection is required.

2. No special data collection equipment is required in the library.

3. Very minimal computing equipment including only facilities for keypunch, sorting and interpreting of cards is required together with very modest computer file handling capabilities. (The authors determined that the system could be easily implemented by a community college with 4,000 students and a small IBM 1130 configuration.)

4. There are moderate reductions in library circulation staff time particularly for overdue processing.

5. Operating expenses are extremely low.

6. Accurate statistical information can be produced in a variety of forms with very little effort.

7. There are additional opportunities for evolutionary improvement of the system by incorporating, for example, I.D. card readers and author/title book files.

The only real disadvantage noted is the important one revolving around the absence of author and title information. One previous use of the information was to correct errors in L.C. number recording and that need has been virtually eliminated. There have been a few other minor inconveniences that appear in almost any system. The only one that comes to mind is that the hand filing of the cards is still required. Recently, we acquired a surplus collator and considered merging the outstanding circulation cards using that machine, but some books had been in circulation for very long periods of time and the cards had become quite tattered. An alternative merge procedure with a less sensitive machine was subsequently implemented. Temporary removal of the circulation information from the library to the computer center was an initial minor disadvantage that was overcome with careful scheduling of student personnel.

EVOLUTIONARY DEVELOPMENT

During the years the system has been operational on our campus, we have moved various components of the processing from machine to machine as matters of internal scheduling convenience. We initially punched and merged the new cards resulting from each circulation directly on our IBM 360/40 computer. That was the only suitable machine available at the time and certainly not ideally suited to the application. We subsequently acquired a 360/20 used primarily as a remote job entry system to an off-campus computer, and transplanted the card punching and merging to that machine, retaining only the file maintenance on the 360/40. We expect to be making a total conversion of batch systems in about two years and anticipate no serious conversion difficulties for any typical batch system.

The most important area of evolutionary development relates to the patron I.D. cards. When the system was conceived, the campus was in the process of planning a plastic photo-identification card. We implemented the system using only a paper card that was in effect a registration receipt. That proved wor able, but less than ideal. In fact, we still use registration receipts for new students prior to availability of their permanent I.D. cards. We were able to contribute to the design of the I.D. card and arranged for embossed identification lettering and Hollerith punching. It was our intent to use an I.D. cardreader in conjunction with the system. Once such a reader was available, it would be possible to eliminate the second card, which would be a major system improvement. We were precluded from taking that step by massive political problems. The problems stemmed from well-intended plans to provide an elaborate circulation system for statewide use. Many years later, that system is still on the drawing boards, but its planning served to preclude our acquisition, even on a lease basis, of an I.D. cardreader. Others without that constraint should find this system even more attractive. We did, however, make use of the embossed I.D. card using an imprinter similar to that typically used with gasoline credit cards in service stations. This device has greatly speeded checkout and improved accuracy, and the cost is in the neighborhood of $100 per checkout station.

The remaining area for evolutionary development is a dream of the library staff. If an author/title file became available keyed in some way to the L.C. number, that file could be searched in order to provide the missing information for overdue processing. While we recognize the convenience of this information to the library, querying an additional file via an awkward code could add substantial computer time to the processing. If we limited the increased searching to overdue books and similar exceptions, it might not be too bad, but matching to the full circulation file when circulation lists are printed would add considerable computer processing time. In view of our current experience, such additional time warrants careful cost-effectiveness evaluation.

CONCLUSION

While this system does not solve all of the school library problems, it does provide a quick, inexpensive way to:

1. Minimize circulation difficulties for the patron,
2. Reduce the effort required in circulation accounting,
3. Minimize the manual effort for overdue processing, and
4. Produce a wide variety of circulation statistics.

Finally, it is failsafe. In the event of computer failure, the process can be done with tab equipment or, wi h some additional effort, by hand. The power simplicity and low cost of this system can allow your school library to have an operational circulation system while the rest of the world is still floundering in the struggle between total systems and economic realities. We think the world needs more simple systems that work!

(1) DeGennaro, Richard, "A National Bibliographic Data Base In Machine-Readable Form: Progress and Prospects", Library Trends, April 1970.

(2) Rather, J. C. ed., "Conversion of Retrospective Catalog Records to Machine Readable Form; A Study of the Feasibility of a National Bibliographic Service", RECON Working Task Force, Library of Congress, Washington, D.C., 1969.

METHODOLOGY FOR ASSIGNING STUDENTS TO SCHOOLS FROM RESIDENTIAL NEIGHBORHOODS

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ABSTRACT Operations research has been applied to primary and secondary educational systems on a minimal basis. At the same time many school districts in the United States are under severe stress to maximize their cost effectiveness.

To assist school districts in becoming cost effective in the major area of pupil transportation, IIT Research Institute (IITRI) has developed a methodology for assigning students to schools to minimize transportation costs while meeting a number of system constraints.

A major part of the methodology involved is a computer software package consisting of a set of computer programs. Central to this software package is an algorithm which has for its objective function transportation distance (or cost). The function minimizes transportation cost in a school system while meeting several constraints such as school building capacities, grade ranges assigned to a building, maximum student walking distance, socio-economic integration, ethnic desegregation, neighborhood groupings, etc.

This methodology is a direct "spin-off" from operations research work applied to the manufacturing-distribution environment. Neighborhood, students, and schools are analogous to factories, products, and warehouses. In the manufacturing sense, the problem involves distributing the products from a factory network to a warehouse network while minimizing costs and satisfying constraints. In the educational sense, the problem involves distributing students from a residential network to a school building network.

The methodology described here has been successfully used by more than 20 school districts in 5 states. It has also served to unmask the O.R. role in the sociological area.

Introduction

Many communities in the United States are faced with a dilemma. In these communities school children attend neighborhood schools.

Minority groups are not evenly distributed among the community's residential areas. Consequently, if children are assigned to the school located in their neighborhood the schools will tend to be segregated. The minority group children will be over represented in their neighborhood school and underrepresented in the other schools in the community.

Changes in residential living patterns may not take place at a sufficient pace to achieve the desired desegregation in a neighborhood schools system.

Therefore these communities will have to assign children to schools on a basis which differs from the traditional neighborhood school method in order to achieve desegregation of their school system. This can be a very difficult task for a school district.

To help school districts with this task IIT Research Institute has developed a system involving the use of planning techniques and computer technology which greatly simplifies the school district's job. The key features of this system are.

- Objectivity - The computer is completely objective (not prone to outside pressure) in redistributing students among schools to achieve desegregation.
- Minimum Transportation Impact - The plan developed maximizes the number of students who walk.

- Minimum transportation cost — The plan keeps the total travel distance to a minimum and consequently minimizes the transportation cost to the school district.

- Proven Application — It has been successfully used in several school districts.

- Availability — The system exists. It does not require a major development effort -- only minor modifications to adjust to a given school district.

- Responsiveness — In accomplishing its job the system produces results in a short period of time.

- Convenience - All services from organizing the program to producing results are provided while relieving the school board and administration of a large administrative task.

This paper describes in a straightforward manner how a school district may make use of this powerful tool.

Planning Overview

- An organization meeting is held with the school district and key school board members to determine the school redistricting planning process.

- The school district supplies basic information concerning
  - the location of the schools
  - the location of the students
  - the minority group to which the student belongs
  - certain policy information

- This information is put into a form which can be read by the computer.

- All information and programs are computer processed.

- Outputs are reviewed to determine compatibility with school district requirements.

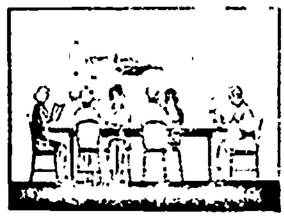
- Computer generated plans are provided to the school district. These are used to effectively assign students to schools to achieve the desired level of desegregation.

Planning Details

Policy Information

The school district meets with project staff members and provides information concerning the school district's policies on class size, transportation, grade levels in each school, and desired desegregation levels in terms of a minimum and maximum percentage of minority students which can be assigned to a given school building.

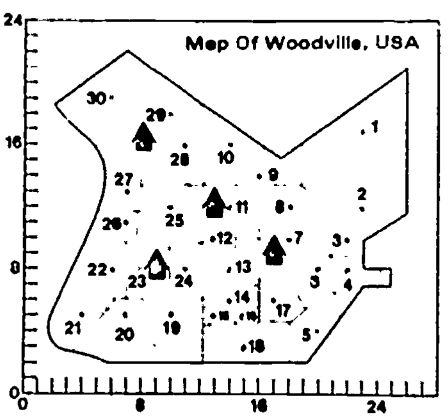
School District



Discusses Policies With IITRI

1. High Grade
2. Low Grade
3. Class Size
4. Maximum Walking Distance
5. Desegregation Specifications

Describing the School District



Locate Schools

The present school district boundaries are shown on a map of the area as shown above. A coordinate system using any convenient distance unit (usually 1/8ths of a mile) is established. The X axis is the lower horizontal line and the Y axis is the left hand vertical line.

The area on the map within the school

72

district boundaries is totally divided into residential areas.

It is important to note that each of these areas is ultimately assigned by the computer to a particular school. The students in these areas attend the school to which their residential area has been assigned.

Usually the task of establishing residential areas is accomplished with the assistance of one or two members of the school board or school administration who are knowledgeable with respect to the general distribution of the students residences within the school district. Each area should contain a reasonable number of students (usually not more than 30 or so). It is not necessary to count the number of students in each neighborhood to precisely determine their geographic distribution before the residential area boundaries are set.

The important thing is to draw the boundaries according to a school official's best judgment. If it develops that too many students have been included in a residential area, the first computer output will indicate this. Those areas with excessive numbers of students can be further subdivided and new residential areas established.

The approximate population center of each residential area is represented at the closest X and Y coordinate intersection within the residential area. Each area is labelled with a number.

A list showing the X and Y coordinates of each residential area is developed.

Residential Area List

Area No.	X	Y
1	23	17
2	23	12
3	22	10
4	22	8
30	6	19

Describing the Schools

Each school is located on the map in terms of its X and Y coordinates.

On a special coding form, the following information is listed for each school.

School Code - a number assigned by the school district. The computer will recognize this number and identify it with this school.

Low Grade - the lowest grade in this building being considered in this assignment. (The school building may house different grade groupings, i.e., a junior high school and a senior high school but only one grade grouping is considered for assignment at one time).

High Grade - the highest grade in this assignment.

No. of Rooms - the number of rooms in the building assigned to the grades between the low grade and the high grade inclusive.

Capacity - the number of students which can be accommodated in these rooms. This is usually the number of rooms multiplied by the maximum class size specified for this grade grouping.

X & Y Coordinates - the value of the X and Y coordinate on the map which represents the school.

School List

No.	Name	Grade High	Grade Low	Capacity	X	Y
1	Washington	6	4	230	8	16
2	Jefferson	6	4	184	9	8
3	Lincoln	6	4	276	13	12
4	Wilson	6	4	230	17	9

Describing the Students

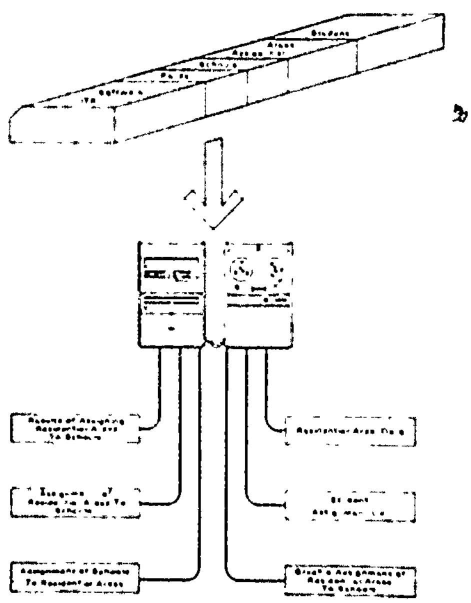
Additional special forms are provided to record each student's name together with his residential area, minority group, and school grade.

Student List

Name	Residential Area	Grade	Ethnic Group
Jones, A	5	4	1
Smith, J	16	5	0
Rogers, T	2	4	0

Processing the Information

All information is put in machine readable format The computer programs are modified and all information is computer processed to produce the system outputs.



The Computer Outputs

These can vary depending on the school district's particular requirements but the following typical outputs are usually supplied to the school district.

- RESULTS OF ASSIGNING RESIDENTIAL AREAS TO SCHOOL

For each school, this output lists the number of residential areas assigned to the school, a breakdown by grade of the students, the percentage of students who will walk to school and the number of minority group students who will attend that school.

Results Of Assigning Residential Areas To Schools

School	No. of RA's	Students by Grade			% Walk	% Minority
		4	5	6		
1. Washington	6	62	61	80	83	18
2. Jefferson	7	59	65	42	90	22
3. Lincoln	9	85	88	81	75	21
4. Wilson	8	60	66	61	72	17
Totals	30	266	280	264	81	20

- ASSIGNMENT OF RESIDENTIAL AREAS TO SCHOOLS

For each school the number of the residential areas assigned to that school is listed.

Assignment Of Residential Areas To Schools

School	Residential Areas			
1 Washington	9	10	27	28
	29	30		
2 Jefferson	20	21	22	23
	24	25	26	
3. Lincoln	1	8	11	12
	13	14	15	18
	19			
4. Wilson	2	3	4	5
	6	7	16	17

- ASSIGNMENT OF SCHOOLS TO RESIDENTIAL AREAS

Each residential area is listed in sequence together with the school to which it is assigned, the number of students in the residential area, the distance (in eighths of a mile) between the residential area and the school, and the travel mode of the students in that residential area.

Assignment Of Schools To Residential Areas

Res Area	School	No Students	Distance	Travel Mode
1	3 Lincoln	19	15	Bus
2	4 Wilson	24	9	Walk
3	4 Wilson	21	6	Walk
4	4 Wilson	23	6	Walk
5	4 Wilson	24	8	Walk
6	4 Wilson	25	4	Walk
28	1 Washington	20	3	Walk
29	1 Washington	27	4	Walk
30	1 Washington	19	5	Walk

- RESIDENTIAL AREA DATA

For each residential area this document lists the breakdown by grade and for all grades the number of students by minority group (RI and RO). The total number of students in the residential area is also listed.

Residential Area Data

Area	Grade 4		Grade 5		Grade 6		Total		Total Students
	RI	RO	RI	RO	RI	RO	RI	RO	
1	7	0	6	0	6	0	19	0	19
2	8	1	6	2	8	1	20	4	24
3	5	2	5	4	4	1	14	7	21
4	6	5	4	3	5	0	15	8	23
5	3	5	3	5	4	4	10	14	24
6	6	0	6	3	8	2	20	5	25
28	3	3	0	5	7	2	10	10	20
29	7	4	8	1	7	0	22	5	27
30	6	0	8	0	4	0	19	0	19

- THE STUDENT ASSIGNMENT LIST

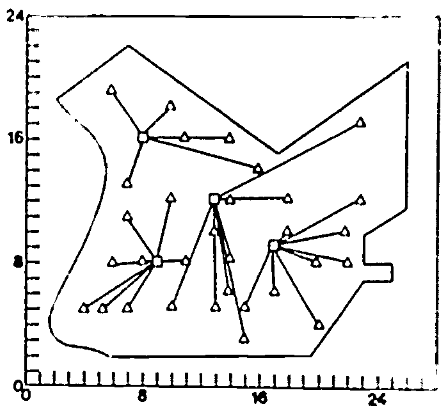
Each student in the district is alphabetically listed together with his residential area, school, grade, and ethnic group.

Student Assignment List

Name	Res Area	School	Grade	Ethnic Group
Abbot S	3	4 Wilson	4	0
Armour L	27	1 Washington	4	1
Brown J	6	4 Wilson	6	1
Byrne T	6	4 Wilson	5	0
Caine A	18	3 Lincoln	6	1
C ro R	26	2 Jefferson	4	0
Como B	22	2 Jefferson	5	0
Varenda P	14	3 Lincoln	5	1
Walsh T	9	1 Washington	6	1
Wilton J	30	1 Washington	6	1
Wyzaco F	20	2 Jefferson	6	0
Yule J	12	2 Jefferson	4	1
Zeccone T	17	4 Wilson	5	0

- GRAPHIC REPRESENTATION OF THE ASSIGNMENT OF RESIDENTIAL AREAS TO SCHOOLS

This picture is drawn by a computer. The triangles represent residential areas and the squares represent the schools. A line is drawn from each residential area to its assigned school. This picture can be superimposed on a school district map making it possible to visualize in one glance the way in which residential areas have been assigned to schools.



Graphic Representation Of Assignment Of Residential Areas To Schools

Modifying the Data

After the outputs from the computer processing have been reviewed and verified they are forwarded to the school district.

The results are discussed with the school district. Based on these discussions certain changes and modifications can be made to resolve special problems. Among the changes that can be made are.

-- Pre-assigning certain residential areas to certain schools. This may result in more than the minimum transportation possible but it may be desirable for other reasons.

-- Changing some policies and obtaining a new assignment.

-- Making a finer breakdown of residential areas.

After these changes are made the data are reprocessed to produce a new assignment.

Summary

A proven system has been described for planning school desegregation with minimum transportation. It provides for the effective application of school board policies, taking into account the detailed facts concerning the individual district. One facet of a very sensitive issue can thus be handled in a professional and objective manner at a modest cost.

This represents an application of Operations Research Technology to a sociological problem. To date the results have been most gratifying. The system has been successfully applied in over 20 school districts by IIT Research Institute.

TRANSACTION PROCESSING USING SOURCE DATA ENTRY TERMINALS

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ABSTRACT: Carleton University uses a polled network of mark-sense reader/printer terminals to collect registration and tuition data. Responsibility for transaction processing functions are shared by the operating system: polling and message assembly and the application program: transaction logic, editing, updating and journalization. The resulting system concurrently supports pre-registration, regular registration and fee payment activities. At the end of the four day fall registration session, the university's computer files accurately reflect some 68,000 new course registrations and tuition payments for 17,000 students.

Despite many technological advances in the computer industry, data entry methods still present a major problem for data processing. Three years ago, Carleton University implemented a highly successful data entry system. Our particular system is a student registration application. No other event in the academic year is as traumatic as registration. All members of the university community get involved and their perception of the registration system is very important. Nothing else will establish the image of the university administration in the eyes of faculty and students quite so firmly as the ability to handle registration transactions.

The general problem of registration is to defuse the emotional impact of the event itself, but the particular problem for data processing is to collect and process a large volume of data within a brief period of time and to do so with complete accuracy. In the data processing environment, data errors have a natural tendency to compound themselves and jeopardize an entire system. Student record systems are more dynamic than most. Student records data is fluid and generally lacks any internal structure which might be used for validity checking once the data is on the computer file. It is therefore important to develop a registration system which places most of its emphasis on handling registration transactions properly. The penalties for not doing so are most severe. If the registration system can not deliver reliable data to the student record system, the development of graduation and promotion systems is precluded since the quality of the registration data will have already negated the results. Until the registration system runs well, line managers and systems analysts will find themselves perpetually engaged in making enhancements and changes to the registration procedures and programs.

Further to compound the problem, in Ontario, all universities are publically financed according to a formula based on a count of student registration approximately six weeks after registration. The data on the university's student record file must accurately reflect the university's actual registration on the count day. It must reflect not only the registration, but all of the subsequent course changes and withdrawals and any changes in academic programs. If the data is either missing or inaccurate, the university will lose money. As well, this data will later be audited and it must be remembered that the audit will be conducted from paper systems which have the propensity to become more accurate over time. In a system where the objective might otherwise be to produce a transcript record by the end of the academic year, the financial implications of student enrollment have the effect of severely compressing the processing schedule and of re-emphasizing the need for accurate data early in the academic year.

One of the popular solutions to a university's registration problems has been the development of a pre-registration system. Pre-registration systems are normally implemented for one of the following reasons. They can be used to flatten the profile of registration by redistributing the processing load or they may be developed to provide student demand data for the university planners. When pre-registration systems are implemented for planning purposes, the data processing problem still remains to collect large volume data quickly and accurately. At Carleton we have always had difficulty scheduling holidays for the staff during the summer months because we operate a very large summer school. We did not find the addition of pre-registration processing to an already heavy summer work load to be an acceptable or attractive solution to our registration problems. Although we are not very interested in student demand data we do offer a limited counselling and pre-registration service for freshman students.

In the past, we have invested and wasted a lot of time and effort trying to develop our registration system. The results were not successful because the approach used was never the correct one. We initially used traditional keypunching methods. It took too long to prepare the data, and bolstering the keypunch staff with part-time employees only increased the error rate. The detection of errors occur far too late in the processing and the operations staff were always faced with the problem of trying to reconcile massive sequential error reports with thousands of paper documents which were in no particular order at that time in the academic year. While the registration error corrections went on and on, the course changes piled up waiting for processing. The data processing procedures create more problems than they solve in this type of operation.

Later we developed a card picking operation, in which name and course cards were prepared prior to registration. A package of cards was selected for each student in a post-office type of processing. This was a vast improvement over the keypunching method. The data could be prepared in much less time and the method enabled us to detect certain types of errors before the data was posted against the computer file. However, we found it was a severe strain on our human resources to produce and interpret the thousands of cards required. As well, this is a galley-slave type of operation, where the success is closely tied to the manager's ability to whip the workers.

Three years ago, we implemented our current registration system. It is a transaction processing system using a network of T-Scan terminals. It permits us to collect our data on a real-time basis and complete all the processing during the registration period. The data is excellent and as a result, we have been able to extensively develop our student records system. Best of all, both the faculty and staff now display a positive attitude towards student records in particular and computers in general which was not previously the case.

Two things can be identified which contribute to the system's success. The first is transaction processing which enables the staff to operate in an efficient manner and the second is the terminal hardware which enforces the transaction processing and provides an efficient manner of operation as well. It is necessary to discuss some of the characteristics of both the hardware and transaction processing before describing the application system.

T-Scan terminals are mark-sense reader/printer terminals designed to process messages consisting of a statement and a response. The statement can be up to 340 characters which are read from a card and the response consists of 17 lines of 22 characters which are printed back onto the same card. The use of the card for data entry allows the user to prepare his data off-line and to receive hard copy confirmation of the transaction. The terminals are polled devices connected in series on a communications line. Each terminal can be uniquely addressed and there can be up to 63 terminals in a network. In our installation, the communications line is a 2400 baud time-sharing line connected on a single port to our communications controller.

Each T-Scan terminal looks rather like a large toaster. Cards are dropped in for processing and 'pop' when the processing is completed. A T-Scan card is divided into three logical areas. The input area is read by a mark-sense reader capable of detecting pencil marks. There is a 24 bit T-line in the lower right corner of the card. The T-line is optically read. Immediately above the T-line is the area into which the terminal prints 16 lines. The 17th line is the T-line. Normal print characters are not used on the T-line, but the use of blanks and 1's permit the user to number each card uniquely and thus identify a card with a particular transaction should the card be re-entered into the system. The two outside bits on the T-line cannot be printed on but may be used to identify the card type if the application has more than one.

Transaction processing could roughly be defined to be the sending of a message over communications lines to a computer, the occurrence of some processing and the receipt of the results of the processing by the original user. Messages are non-physical items which appear when the thoughts or activities of some individual must be made known to the system for some purpose. Messages should be logically complete in themselves, and action oriented messages are normally called transactions. The general objective of transaction processing is to satisfy the data processing requirements of an organization by querying and modifying a central data base as transactions occur throughout the organization.

There are two important concepts in transaction processing. The first is that both successful and unsuccessful transactions elicit a reply. A transaction to modify the data base which cannot be permitted to update because an edit check has failed is nontheless completed when the original user has been informed of the detection of an error. The second concept is that all transactions must be logically complete. Therefore edit checks are always applied to the entire transaction and the implementation of this idea prevents data re-entrancy problems from occuring on the computer file.

Transaction processing must occur in an on-line environment. On-line systems immediately overcome the basic problems of batch processing systems. While batch systems are very efficient in their utilization of electronic equipment they do tend to delay transactions and thus to conceal information from the operational staff until such time as is convenient to use a central processing machine. As well computer output from batch systems tend to overwhelm the operational user. The presumption of the operating staff's ability to deal with this overload is not a realistic expectation.

Transaction processing permits the people most closely associated with the data to input it and validate the results. This is more efficient than the introduction of a highly skilled data input operator, particularly in terms of data error correction. The introduction of a skilled operator requires the re-cycle of errors to the original user. The ensuing time lost and the facilities consumed in such an error correcting operation should be charged not to the system user but to data processing which does not permit the operating staff to function in an efficient manner.

In a T-Scan application, the terminal operator is a member of the operational staff concerned with the transaction being processed. The input medium is paper, the data is entered with a pencil and corrections are made by using an eraser. These are tools with which the operational staff are very familiar. As well no special skills are required for terminal operation, anyone who can make his own toast can operate a T-Scan terminal.

Not only does the card provide a comfortable environment for the staff, but as well it must be credited with real economies in both processing and software development time. T-Scan cards are pre-printed to perform the prompting function usually associated with more conventional terminals. Data entry is performed off-line and no c.p.u. or connect time is wasted in entry-keying or printing operations. There is no one-to-one relationship of operator to terminal. The T-Scan terminal is centrally located and an entire office may share one terminal.

Use of the card reinforces the idea of logically complete transactions. The simplest clerk dealing with the most rudimentary paper system will not knowingly accept a partial transaction in the guise of an incomplete document. Yet many sophisticated data processing systems are guilty of such behaviour due to the high costs of data entry. When data items have been deleted or defaulted in a transaction, not only is the transaction itself logically incomplete but the correction process that follows is an example of re-entrant data. In a T-Scan application, errors are corrected with an eraser and the corrected card is reprocessed with no re-entry costs. To provide this facility with a key-driven system, software would have to be developed to save the invalid transactions and re-call them when the staff wish to enter error corrections.

When the computer is down, data entry operations continue in the office and the cards are set aside to be processed when the computer is operational once more. Processed cards fulfill the function of journalization normally found in on-line systems. If for some reason, the data base must be restored from a backup file, all that is required to bring the data base up to date is to re-drop those cards which have been processed since the backup was taken. When the cards are no longer required to provide journalization facilities, they can be filed in some meaningful order to provide an audit trail in which the transaction and its result are forever tied together. No software development was required to obtain the functions of both journalization and audit, both are prov'ded by the input medium itself.

We did develop three pieces of software which together manage the network of terminals and process the transactions. The software for polling the terminals and queueing and printing messages is resident in the operating system. This provides the network management and transaction queueing facilities normally provided by a transaction processing package. Logical transactions are processed by a cobol application program. The cobol program is loaded with the third piece of software, an interface through which the terminal handler and the application program communicate.

Cards in the terminals are decoded according to a scheme of user defined tables so that the cobol application programmer treats the network in exactly the same manner as he would a card reader and printer. When the application program requests a terminal read, the network handler begins polling terminals and sending print lines. As soon as a card is detected in a terminal control is returned to the application program.

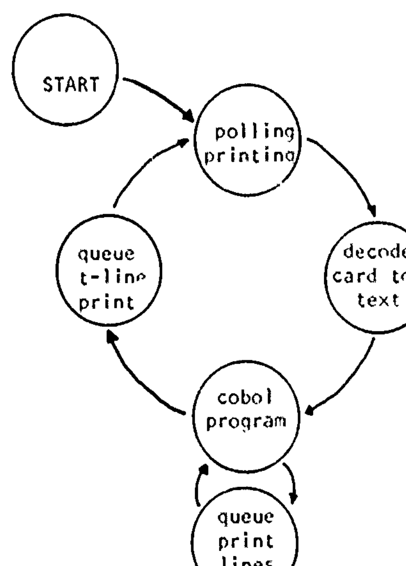

fig. 1 Terminal Handler's view of network

Registration at Carleton takes place over a four day period during the first week in September. There are two distinct phases to the registration process, the first being the selection and approval of the academic program and the second making financial arrangements with the university. The student begins by selecting a timetable and entering his selection on a Registration and Fee Contract. This is a paper document used to collect the student's year in program, expected date of graduation and current address as well as his course selections. After receiving program approval from faculty and departmental advisors, the student completes the second step, that of making tuition arrangements with the Business Office.

Capture of the registration and tuition data for the computer file follows the same two steps. For each step there is a corresponding card drop in a T-Scan terminal. The first drop posts the student's academic data and assesses his fees. The second drop transacts the financial data associated with registration. At each step the operating staff are able to check the accuracy and completeness of the transaction as it occurs. To ensure validity in the overall data, two global checks are made. All tuition transactions are entered with reference to a cash register batch number and in a batch mode. When a batch is completed, the computer batch totals for fee assessment and cash receipt must agree with the cash register tapes taken in the registration line. Student addresses which do not have a high priority for processing are sent to keypunching. When they are added to the computer file, each address must be processed against a registered student.

The concept of two transactions which approximate the two steps in registration is important. The system has only two rules. There must be two logical transactions for each student and the academic transaction must occur first. Both transactions are processed on the same card. As a result the introduction of the actual data collection system into the physical registration process is flexible and three basic configurations are possible. To derive the greatest benefit, the system should be run on-line and in-line as a part of the registration procedure for the student In this configuration, the student fills out his own card, enters the card in a terminal and checks the printed results before carrying the card with him to the Business Office. However, to process a mail-in pre-pay registration, the same system can be operated in the office by the registration staff. To satisfy the requirements of a pre-registration system, a combination configuration permits the first drop to occur in an office environment and the processed transaction is given to the student for validation prior to his completion of financial arrangements.

The best way to understand the system is to examine a sample set of transactions. The shaded area on the cards shown correspond to an 'office use only' area on more familiar paper documents. To enter data on the card, the student joins two dots summing digits if necessary to achieve the proper value in a column. This is an easy operation which we all normally employ when making change and students are able to complete their own cards using sample posters for instruction. In Fig. 2 below, the student whose number is 84032 has entered the course 49.100C on his T-Scan card. The faculty under which his fees are to be assessed has been marked in the shaded area by the staff member who gave the student his card. The same staff member entered the first initial of the student's surname in the shaded area next to the student number. The initial will be compared to the one on the computer file for the student number read. The course on the card will be validated against the file of current courses offered. If errors are detected, an error code will be printed back on the card in one of the boxes in the upper right corner. Although this is a cryptic notation, it enables the system to print error messages as often as is required while still preserving the print area for when the transaction is successfully processed.

Fig. 2

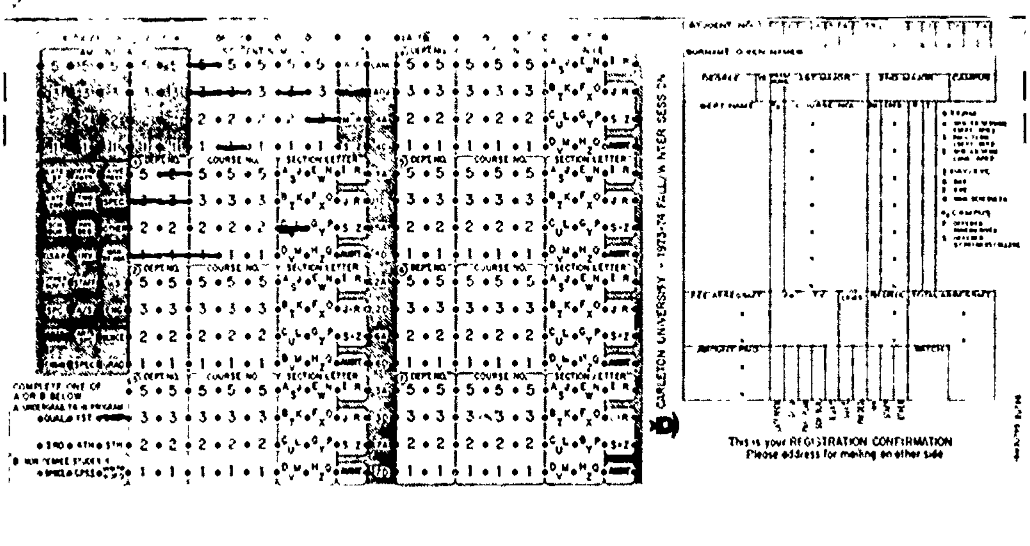

Figure 3 shows the completed academic transaction. The computer system has confirmed the student's identity by printing back his name as well as the student number read. The academic program which is recorded on the student records file is confirmed as well. For each course selection, the system confirms not only the course number, but also the department name, the course credit and when the course will be offered. This additional course information is printed to help the student detect any errors. The total course credits and the fee assessment are also printed. Lastly the student number is printed in binary notation on the T-line. This will later be used by the system to ensure no misreads of student number occur in subsequent processing. As well the presence of printing on the T-line confirms to the system that the academic data has been collected.

If an error is detected by either the student or the staff, the transaction can be cancelled by marking the position 'canc' in the shaded area of the card and re-dropping the card in a terminal.

The cancellation transaction is used to delete transactions on the wrong student number and to clean up the file after registration if students fail to make arrangements with the Business Office.

The card can become an adjustment transaction by ticking the 'adj' area. In processing this transaction, the system expects to find courses added and/or dropped from the card. Drops are indicated by marking the delete position in the shaded area beside the course to be dropped. Adds require the new course to be added to the card. All of the previous edit checks occur when an adjustment transaction is dropped. When printing confirmation of this transaction, the system will cross over deleted courses and print the new ones in available print positions. The previous fee assessment is also struck and the new course totals and assessment will be printed on the second assessment line on the card. Figure 4 is an example of a card that has been adjusted.

Fig. 3

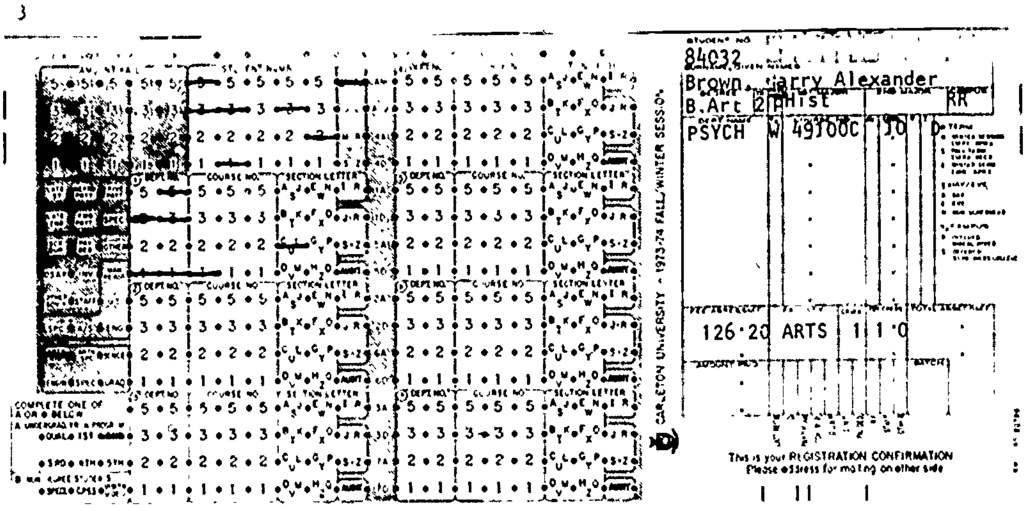

Fig. 4

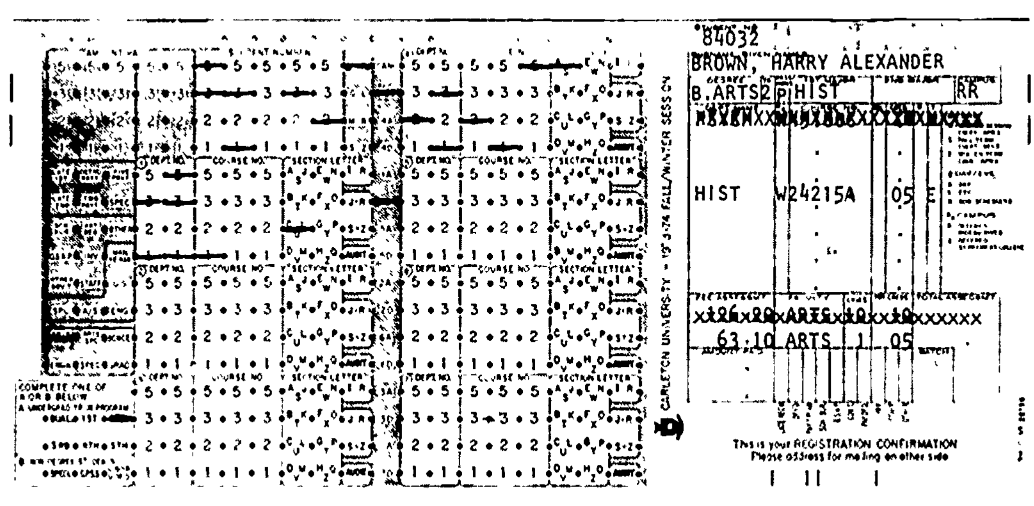

Fig. 5

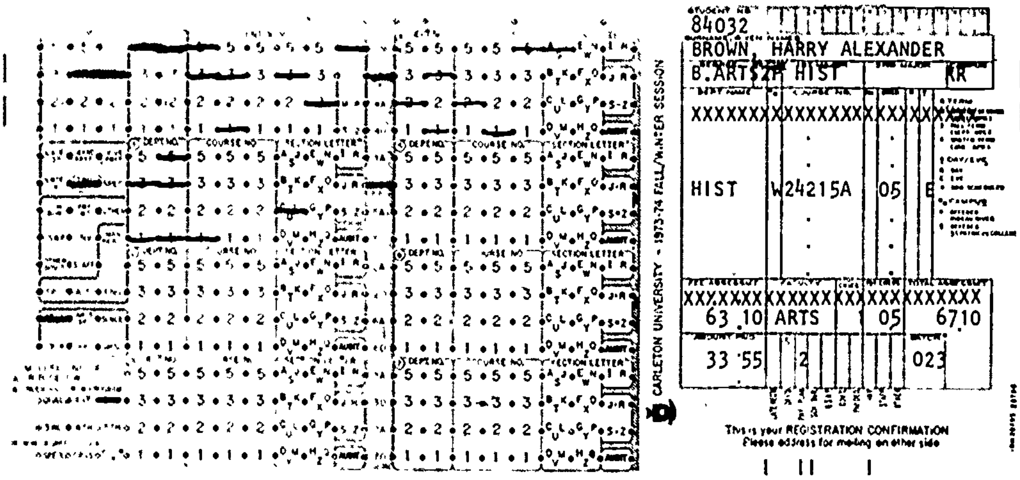

Figure 5 shows the completed transaction. The Business Office data has been added to the card by the cashier's assistant in the registration line. The card is paper clipped to the Business Office copy of the Registration and Fee Contract. At this point, the student is given his copy of the contract and the third and final copy sent to the keypunch shop where address data collection will take place. After a cash register is closed in the registration line and the cash balanced, the paper documents, T-Scan cards, cash register tapes and batch control sheets are sent back to the office for T-Scan tuition data collection. A batch-open transaction is dropped to notify the system, that a particular batch of business office transactions will now be dropped in a particular terminal. Business office transactions are processed very quickly. At the end of the batch, a batch-close transaction solicits the computer's batch totals. If the computer totals do not agree with those of the batch control sheet, the staff quickly locate the error by comparing individual T-Scan Card figures with the cash register validation on the contract. Each processed transaction now shows the amount paid as well as the payment plan selected. As with the assessment line, there is room on the card to permit the confirmation of a correction on the final drop.

In addition to the two basic transactions, and the previously mentioned batch open and close transactions, the system also supports student and course queries. Multiple student cards are also supported to enable the system to accomodate up to 21 student course selections per student.

Three years later, we are still pleased with the performance of our T-Scan system. As a bonus, we learned a lot about people and their interaction with data processing systems. We strongly suggest that thoughtful consideration of the concepts incorporated into the T-Scan terminal design is a worthwhile exercise for all data processing personnel.

HOW-TO-DO-IT:
POINTS OF INTEREST FOR THE POTENTIAL COMPUTER CUSTOMER

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ABSTRACT: The purpose of this paper is to present information which should assist potential computer customers in the process of getting into the computer age. There is no "one way" of getting into the computer age. However, in preparing to utilize computer technology one should have at least a minimum level of awareness of the following topics:

1. Developing the RFP (Request for Proposal).
2. Service bureau, in-house, time-sharing or consortium.
3. Evaluation and selection of hardware.
4. Evaluation and selection of software.
5. Financing: purchase, rental, third party lease, other.

Developing the RFP

The RFP (request for proposal) is the school corporation's vehicle of communication between themselves and the computer companies. It is a "blueprint" by which the educational data processing needs and requirements are described to prospective bidders. In essence, it is quite similar to a set of educational specifications which would be prepared as the bidding document for a school construction project.

There can be many different formats for the RFP. However, it should contain at least the following elements:

1. A statement of the types of functions expected of the system.
2. A statement of required vendor support functions.
3. A proposal format.
4. Summary forms to be filled in by the vendor. Forms should be detailed enough to provide sufficient information for hardware and software selection. Most importantly, let the vendor extract the pertinent data from his sales literature.
5. Policy matters, evaluation techniques and standards should be available to vendors.
6. Terms and conditions.
7. Expected time frame for contract award and debriefing should also be stated.
8. A firm date beyond which rebids will not be accepted.[1]

The forms provided in the RFP to obtain technical and cost information from the vendors are extremely important. They will allow for a comparison of item costs to be made between various bidders. Moreover, the forms will also show very clearly whether or not a company uses "bundled" pricing. Lindenmeyer contends that he is better able to judge cost when all components are "unbundled" i.e., costs for hardware, software, field engineering, maintenance, etc., are all separate. Whether costs are bundled or unbundled, it is quite imperative to have the amount and type of field support that comes with the initial contract spelled out in detail.

Some other factors that should be included in the RFP are: (1) a requirement for the vendor to give reference accounts who are presently using computer systems similar, if not identical, in configuration to that proposed for your installation and who have similar system requirements,[2] (2) a requirement for successful running of "benchmark" i.e., a demonstration that the computer programs being proposed to do the school corporation's anticipated workload can in fact satisfy the school's requirements[3] and (3) detailed plans for conversion and also for future expansion.

The development of a meaningful RFP usually requires having the services of a technically qualified person (hopefully the EDP manager) to assist in the preparation of the document and also to help interpret the proposals which it is soliciting.

Service Bureau, In-House, Time-Sharing or Consortium

Service bureau, in-house, time-sharing or consortium all represent approaches that may be taken to realize the advantages of utilizing computer technology. The particular approach, or combination of approaches, taken usually depends upon the needs and/or available funds of the school corporation.

In order to discuss some of the advantages and disadvantages of each of the above methods, the following brief but concise working definitions are necessary: (1) service bureau - a company which either owns, leases or has access to an electronic computer and provides computer services on its own premises to the general public for a predetermined fee,[4] (2) in-house - having a self-dependent computer system for the school corporation located in one of the corporation's facilities, (3) time-sharing - a computer technique in which numerous terminal devices located in one or more school corporations can utilize a central computer concurrently for input, processing and output functions[5] and (4) consortium - an agreement or union whereby several school corporations pool their resources to jointly acquire a computer system to be housed in a facility of one of the member corporations but to be used by all of the school corporations involved. From the above definitions we can see that belonging to a consortium is somewhat similar to either using a service bureau or to time-sharing for the member corporations except the one that has the computer system in-house.

The proponents of obtaining the advantages of computerization through service bureaus use the following justifications: (1) purchasing your own computer equipment is too costly, (2) there is a problem in finding the adequate space and environmental conditions for a computer installation, (3) it is difficult and expensive to employ a competent staff, (4) the low proportion of available computer time needed to perform the required applications makes the unutilized time very expensive, (5) difficulties are found in keeping up with the changes in equipment and in methods and (6) the ability to obtain all the advantages of EDP without employing any computer specialists.[6] The major disadvantages of using a service bureau are the turn-around time i.e., the amount of time elapsed between pick-up of input and delivery of output, the rigidity of the form of the input which makes school corporation unique variations either impossible or an additional expense, having to pay extra for each application being performed and the lack of the flexibility to experiment with new applications or to utilize the full potential of computerized decision-science techniques.

All of the disadvantages of using a service bureau become some of the advantages of acquiring an in-house computer system. The only advantage of a service bureau that might be a disadvantage of a properly planned for and organized in-house system might be the overall cost of the latter.

Time-sharing can result in a savings in both equipment and personnel while at the same time providing almost all of the services of an in-house system. The extent to which time-sharing satisfies the users' needs is usually a function of the size and application capability of the system being hooked into. However, if the time-sharing school has competent personnel and has also been allotted sufficient storage space in the main computer, it could then use the system almost as though it were in-house.

The consortium approach towards utilizing computers, if carefully planned, will allow smaller school districts to realize all the hardware and software benefits of a large in-house system.[7] This implies that: (1) the main computer is of sufficient size to adequately service all of the consortium members, (2) the professional/technical staff responsible for the design, implementation and operation of hardware and software are highly competent and innovative people and (3) that a time-sharing rather than a service bureau approach is used by the participating members.

Evaluation and Selection of Hardware

Having solicited proposals for a computer system via the RFP, the educational administrator is now faced with the need to select the appropriate hardware to meet present and anticipated data processing demands within a finite budget allocation.[8] There are probably as many techniques of evaluating proposed computer systems as there are computer systems that have eventually been purchased. In other words, there is no one method of evaluation that has proven to be applicable to all situations. About the only physical factor that reaches near concensus is that the computer obtained be at least a third generation model. The generation of a computer is determined by the technology employed in the central processing unit (CPU) and in the memory hardware e.g., first generation uses vacuum tubes, second generation uses transistors and third generation uses integrated circuits.[9]

Before beginning the task of assessing computer equipment it is necessary to summarize what data are available to be used in the evaluation process. Miller, after studying various techniques from both the industrial and governmental sectors, decided that the following major data classifications would be most useful: (1) cost data, (2) performance data, (3) hardware characteristics, (4) software support and (5) miscellaneous data.[10] Reading the following complete list of items under each major heading, written in as nontechnical a manner as possible, will more than likely reinforce the need, previously stated, to have a competent EDP manager available to help interpret the incoming bids.

Cost Data

1. Total cost.
2. Individual component costs.
3. Estimated cost to perform each benchmark job based on fixed hourly charge.
4. Maintenance costs.
5. Software costs (development, purchase, lease).
6. Educational and training costs.
7. Reprogramming costs (application programs).
8. Other discernible cost factors (transportation, installation, remodeling, buy-back, etc...).

Performance Data

1. Compilation time, by compiler, on benchmark tasks.
2. Linkload or collector time, by compiler, on benchmark tasks.
3. Execution time, by compiler, on benchmark

tasks.

4. Time needed to initiate operating system.
5. Sort timings (from sequential and random access files).
6. Readability of printed output.
7. Number and kind of machine malfunctions.
8. Average number of machine instructions generated per line of coding by each compiler.
9. Response latency to demand processing as a function of the number of active terminals.
10. Percent of CPU utilized during benchmark.
11. Proportion of "overhead" time out of total processing time not accounted for during benchmarking.
12. Convenience of operation.
13. Compatability of existing programs (number of instructions added, deleted or changed).
14. Average number of job control parameters needed.

Hardware Characteristics

1. Full memory cycle time with and without interleaving.
2. Average machine instruction time.
3. Channel speed (total and per channel).
4. Total storage -- fast memory.
5. Total storage -- slow memory.
6. Total storage -- random access.
7. Average access speed -- random access storage for data.
8. Average access speed -- random access to operating system modules.
9. Total memory available to single user program.
10. Floating point and decimal arithmetic hardware.
11. Character coding.
12. Word size.
13. Multiprocessing capability.
14. Multiprogramming capability or batch jobs.
15. Time sharing and demand processing capability.
16. Add, subtract, multiply and divide time in single and double precision for floating point and fixed point arithmetic machine instructions.
17. Real time and time of day clocks availability.
18. Expandability of memory.
19. Virtual memory capability.
20. Total number of channels available to high speed devices.
21. Total number of remote terminals capable of support with a response delay of less than three seconds.
22. Compatibility to coding other than internal coding.
23. Maximum size of directly addressable memory.
24. Maximum tape transport transfer rate.
25. Maximum transfer rate from card reader.
26. Maximum lines per minute (132 character lines) for line printer.
27. Total storage per disk pack, if packs available.
28. Compatibility to smaller or larger machine models.
29. Total power requirement.
30. Total cubic feet of air conditioning needed and BTU dissipated.
31. Total floor space (square feet) required.
32. Memory protect features.

Software Support

1. Language availability and features.
2. Maintenance support and costs.
3. Application programs.
4. Conversion assistance.
5. Utility programs available and their features.
6. Memory utilized by operating system.
7. Memory and file protect options.
8. Levels of priority permitted.
9. Machine utilization accounting routines provided.
10. Inter language compatibility (e.g., ability to write FORTRAN subroutines in COBOL using a Common data area).
11. Debugging facilities of each language.
12. Automatic restart (recovery) procedures available.
13. File management and identification procedures.
14. Capability of system to continue processing when system components fail.
15. Ease with which operating systems are generated.

Miscellaneous Data

1. Delay before system may be delivered.
2. Proximity to other systems available for backup support.
3. Compatibility to other agencies providing a receiving date to or from the bid system.
4. Reputation of the vendor for technical and maintenance support.
5. Availability of personnel trained on the system.
6. Training programs offered by the vendor.
7. Cost and quality of supportive technical manuals.
8. Availability of equipment from other manufacturers which interface to the bid system without modification.
9. Availability of software developed by independent software houses for the bid system.
10. Expandability of the total system and potential for use in systems with faster processors.
11. Mean time between failure (MTBF) for each system component.
12. Purchase options, long term lease arrangements, guaranteed pricing for anticipated life and other cost benefits.

The above lists do not exhaust all possible relevant considerations. Most vendors have system features unique to their equipment which cannot be evaluated on all bids.[11]

Most school administrators would need the assistance of a competent computer specialist to interpret the meaning and significance of many of the hardware characteristics. However, as long as qualified professional assistance is available to evaluate the hardware so that the best suited equipment is obtained, the school administrator can still effectively and efficiently utilize computer technology without becoming a hardware expert.

Aside from not using a computer professional to assist in the hardware selection process, there are other errors made in evaluating both the suppliers and the hardware. Scharf has delineated the following:

Typical errors in evaluating suppliers

1. Tendency to consider only one manufacturer seriously.
2. Tendency to look at what a manufacturer offers you, not what he has to offer.
3. Failure to define your own needs clearly and in sufficient detail for the manufacturer.
4. Lack of real will to cooperate with other potential partners in the fields of machine use, application, development and specialized staff.
5. Tendency to grossly underestimate costs.
6. Failure to evaluate the manufacturer as he really is and will be in your special situation as opposed to his general "reputation".
7. Lack of will to make extensive and systematically searching first hand contacts in order to evaluate user experience with corresponding machines and manufacturers.
8. Lack of relevant experience on the part of those participating in the data processing selection decision, especially as opposed to the manufacturer team which is both trained and experienced in this particular situation.
9. Failure to recognize that your own personnel may bring irrational thinking into the evaluation for personal reasons.
10. Failure to recognize that the manufacturer and certain of your own personnel will have the same vested interest in empire building.
11. Failure to analyze the half truths served by data processing salesmen.
12. Lack of will on the part of the manufacturer to really learn about you as a customer because he won't spend the time to find out what is really the situation.
13. Tendency of the manufacturer sales teams to be specialized, in spite of the fact that your organization may need interdisciplinary knowledge.
14. Failure to realize that the data processing salesman has extremely strong short-term motivation and weak long-term motivation.

Typical errors in evaluating hardware

1. Failure to go into depth regarding forms of parallel operations.
2. Failure to run actual tests.
3. Failure to take into account the effect of software organization and selection on hardware performance.
4. Failure to find out if the hardware is presently supported, sufficiently supported or supported under a particular software system so that it can be utilized without "do it yourself" software support.
5. Failure to calculate the marginal utility of adding certain hardware.
6. Failure to evaluate hardware costs in terms of other alternatives: "value analysis".
7. Tendency to evaluate in terms of old myths.
8. Failure to design an efficient system before calculating needed hardware capacity.
9. Failure to anticipate Parkinson's Law: the tendency of users to expand needs so as to fill the capacity of a new EDP facility within unexpectedly short time.
10. Tendency to confuse traditional needs simply because we have been unable to satisfy real needs economically before.
11. Failure to give serious consideration to independent peripheral suppliers, thus forcing yourself to take the economic consequences of the package deal even on the hardware side.[12]

Armed with the ready assistance of his computer specialist to interpret and evaluate the technical hardware specifications along with being cognizant of the above typical errors in evaluating suppliers and hardware, the school administrator will be able to approach the process of evaluating and selecting hardware in an intelligent and meaningful manner.

Evaluation and Selection of Software

In his computer dictionary, Sippl defines software as:

The internal programs or routines professionally prepared to simplify programming and computer operations. These routines permit the programmer to use his own language (English) or mathematics (Algebra) in communicating with the computer. Various programming aids that are frequently supplied by the manufacturers to facilitate the purchaser's efficient operation of the equipment. Such software items include various assemblers, generators, subroutine libraries, compilers, operating systems and industry -- application programs. Most types of programs in the computer software library are offered in several versions to run in systems configurations of different sizes and compositions.[13]

During the 1960's hardly anyone (especially educators) considered using any software that wasn't generated in-house or supplied "free" by the computer manufacturer. But users are now recognizing that software costs money and that "freebees", in most cases, aren't part of the overall package any longer.[14] Since computer programs are not in general patentable or copyright-able, the computer companies protect their software on the basis of the "trade secret" law. This law defines a trade secret broadly as "any formula, pattern, device or compilation of information which is used in one's business, and which gives him an opportunity to obtain an advantage over competitors who do not know or use it."[15] The computer companies have implemented the trade secret protection for their computer programs through a License-to-Use. This license can specify either that the use is for a specified period of time or that the use is forever. For the first case the financial arrangement is usually a monthly fee and a paid-up or full-payment lease in the second case.[16]

Contrary to popular opinion, just because a computer company has a particular software application package, does not necessarily imply that the package: (1) is completely debugged (will run without errors), (2) will satisfy your requirements or (3) will be written in a language capable of being run on your equipment configuration. Fortunately, most proprietary software is warranted. This means that the seller has the responsibility to fix whatever bugs may be noticed during the warranty period.[17]

Another factor to consider is that more often than not, the company supplied software package must be modified to suit the particular user's needs. If, in this case, the modifications will be extensive enough so that the resultant software becomes quite user unique, then the administrator should be concerned with: (1) will there be an additional charge for the modification effort, (2) is the resultant package still considered to be proprietary software or is it user owned software and (3) in either case is the software still under warranty?

The school administrator in trying to evaluate and select software should also be aware of the following typical errors in this process compiled by Scharf:

1. Failure to run actual tests on actual machines and to ensure that the evaluation team is trained and given time to do this (benchmarking).
2. Failure to measure real performance.
3. Tendency to think in traditional ways.
4. Failure to comprehend all the complex factors which affect software performance on a given machine.
5. Failure to use experienced experts for independent software evaluation.
6. Failure to recognize and calculate the amount of man effort on your own part which is necessary in order to actually use certain software.
7. Failure to use the same standards for comparative evaluation of different manufacturers' machines.
8. Tendency to evaluate on the basis of past needs, not future needs.
9. Failure to evaluate the concept of security in software.
10. Failure to evaluate the complexity of using software efficiently on a day to day basis.
11. Failure to evaluate single software parts in terms of the effect on the total economics of the software system.[18]

The preceding discussion has been primarily concerned with selecting and evaluating software application packages. The same factors also apply to the various language processors that should be capable of being run on your computer system e.g., COBOL (COmmon Business Oriented Language), FORTRAN (FORmula TRANslation), ALGOL (ALGOrithmic Language), RPG (Report Program Generation), PL/1 (Programming Language/one), BASIC (Beginners All-purpose Symbolic Instruction Code), manufacturer unique assembly language, etc.

Financing: Purchase, Rental, Third Party Lease, Other

Purchase

If a school corporation could afford an outright purchase of a computer system, it would be the least expensive method of payment. The reduced expense is a result of not having to pay the interest that is required on a multi-year purchase agreement and also because of the savings realized from the educational discounts offered by some companies on outright purchases.[19] However, if an outright purchase is made, the equipment should be of the latest model to avoid running the risk of obsolescence. This obsolescence may occur because of the introduction of better equipment, because the equipment will not handle the volume of work or because new systems concepts require a different kind of equipment configuration.[20] A rough rule of thumb that has been cited is that a computer installation with a useful life of more than five years should be purchased rather than rented. Although, in any specific case, the breakeven point is dependent on such factors as the number of shifts the equipment is used and the types of present and anticipated applications.[21] Even with the outright purchase method of acquiring a computer system there will still be the continual cost of a maintenance contract, which definitely should be acquired.

Rental

The major advantage of vendor rental agreements are the capability to easily arrange for an upgrade without the necessity and inconvenience of having to dispose of existing equipment, and the capability to easily arrange for the replacement of particular pieces of equipment which may be only marginally serviceable. The last advantage may be very important in cases of mechanical equipment subject to rapid wear e.g., card punches, printer, card readers, etc.[22] Other, more obvious, advantages of renting are the absence of a large capital outley, the assumption by the manufacturer of all maintenance costs and the removal of the risk of obsolescence for the user.[23]

Though there are several different types of rental agreements, most of them: (1) charge per piece of equipment, (2) charge for each special feature e.g., interpret feature on keypunches, and (3) have a base rental for X hours (usually around 176 hours) of actual use per month with an additional lower rate for all hours above that level (some manufacturers do not charge educational users for the excess hourly usage).[24]

Third Party Lease

Under this method of financing the educational institution purchases the equipment on an outright basis in order to take advantage of all potential educational discounts, resells the equipment to a third party who actually supplied the initial capital and then leases the equipment from the third party.[25] Though lease agreements vary, they typically have provisions such as:

1. User agrees to lease for a minimum period, say, five years, with purchase and trade-in options.
2. The lease payment includes maintenance and other charges.
3. There is no additional charge for second- or third-shift operations (except some additional maintenance charges).
4. After the minimum period, the lease charges drop to a lower rate.
5. If the lease is terminated before the minimum period is up, the user must pay a termination charge.[26]

After examining third party leasing, Kaimann and Drzycimski listed the following advantages and disadvantages:

Lessee Advantages

1. The rental payment for identical hardware is 10-30% less when leasing via a lessor intermediary.
2. The minimum monthly maintenance contract from the vendor is usually paid by the lessor.
3. The user may utilize additional system time at no direct additional rental charge.
4. A flexible schedule of rental charges might be arranged at the inception of the contract.

Lessee Disadvantages

1. A longer lease is frequently required than that offered by the vendor.
2. There is a question of vendor support with respect to personnel and software assistance to the installation
3. To utilize the full benefits of the contractual arrangements it is necessary that the income of the lessor causes him to reside in a high tax bracket.
4. At some point during the life span of the lease, the lessee might choose to complement the hardware configuration by requesting additional capacity in terms of more tape or disk drives or maintenance memory.
5. The lessor might have to assume personnel and software support functions if the vendor declines to do so.
6. Lessee opts to abandon the lessor by cancelling the lease or by not exercising the renewal option.[27]

Other

Most vendors offer a lease rental plan which includes an option to purchase the equipment. Though the provisions vary from vendor to vendor, they usually provide for educational discounts and low interest rates. The major advantages of vendor lease arrangements are the capability to easily arrange for upgrade without having to dispose of the existing equipment and the capability of readily arranging for the replacement of separate pieces of equipment which may be only marginally serviceable.[28]

Another method of acquiring a computer system is by forming a computer cooperative. These cooperatives usually will provide for the development of a data processing capability far beyond the financial limitations of any of the individual districts involved.[29] In most cases none of the participating districts will want to assume the cost of program development and/or operations that are not readily applicable to their own immediate requirements. The easiest way to resolve this potential problem is simply to share costs on a proportionate basis i.e., the costs of program development, hardware, personnel, etc., are shared proportionately by each participating district. On the other hand, management policies and other decisions relative to operating the facility would be made on an equal basis by all the member school districts.[30]

Summary

Unfortunately, there is no "cookbook" approach for getting into the computer age. However, the phases just described should serve to create a necessary, if not sufficient, level of awareness of the steps involved in organizing, planning, evaluating, financing and implementing an administratively oriented educational computer facility.

The initial action recommended is the hiring of an administratively and technically competent EDP manager far enough in advance so that he would be able to assist in each phase of the process. Then once a total plan for all uses and applications of computer technology for the school district has been drawn up, the specifications for the system are then delineated. These "specs" are for hardware, software, support services, and benchmark testing. The RFP containing all of these specs and requests is then sent to numerous vendors to solicit their bids.

At this point it should be worth noting that the best system for your needs is not always the most expensive. However, if not, closer examination may show that for the same cost of what appears to be the best but also most expensive system, other proposed systems could be expanded to include new and attractive features thus making one of them the most cost-effective choice.[31] This is quite similar to not buying the stripped-down top-of-the-line automobile, but rather buying the next model and adding on all of the desired items so that the end result is a customized machine for the same price as the top model without all the same options.

An important point to keep in mind when reviewing the vendors' responses to your RFP is simply that "any question that might not be answered by the proposal, should be treated as being negative...all commitments and promises must be in writing."[32]

Also, a complete computer facility will require other items of related equipment such as: (1) keypunching machines, card sorters, forms bursting and collating machines, special purpose storage cabinets, card files, office furniture, etc... These items should be ordered so that their delivery is either before or coincides with the time the computer is installed.[33]

Finally, approaching the process of acquiring a computer system in a haphazard manner can cause the following law of Harvey Golub to become a reality:

> No major computer project is ever installed on time, within budget, with the same staff that started it, nor does the project do what it is supposed to.[34]

FOOTNOTES

[1]Botten, L.H., Methods Used in a Recent Computer Selection Study, pp. 2-4 through 2-5.

[2]Ibid., pp. 3-8 through 3-9.

[3]Martin, B.A., "Guidelines for Contracting for Computer Related Services," Computers and Automation, p. 18.

[4]Cerullo, M.J., "Teaching About Service Bureau," Journal of Data Education, p. 7.

[5]Sippl, op. cit., p. 328.

[6]Cerullo, op. cit., p. 10.

[7]Fullum, S.J., "Use of a Time-Sharing Computer in a Regional Data Processing Center at Burlington County, New Jersey," ERIC ED087469, p. 3.

[8]Miller, W.G., "Selection Criteria for Computer System Adoption," Educational Technology, p. 71.

[9]Summers, J.K., and Sullivan, T.E., The State of the Art in Information Handling, ERIC ED051552, p. 17.

[10]Miller, op. cit., p. 72.

[11]Ibid., pp. 72-74.

[12]Scharf, T.G., "How Not to Choose an EDP System," Datamation, pp. 73-74.

[13]Sippl, op. cit., p. 292.

[14]Hansen, R.W., and Shostak, A.D., "How to Evaluate and Select Software," ERIC ED087460, p. 1.

[15]Frombolz, H.J., "Legal Protection of Computer Programs and Confidential Information," Proceedings of the COMPON 73 IEEE, p. 106.

[16]Hansen and Shostak, op. cit., p. 2.

[17]Ibid., p. 2.

[18]Scharf, op. cit., p. 74.

[19]Botten, L.H., Methods Used in a Recent Computer Selection Study, ERIC ED086208, p. H-1.

[20]Davis, G.B., An Introduction to Electronic Computers, p. 477.

[21]Ibid., p. 478.

[22]Botten, op. cit., p. H-2.

[23]Davis, op. cit., p. 476.

[24]Ibid., p. 476.

[25]Botten, op. cit., p. H-1.

[26]Davis, op. cit., p. 478.

[27]Kalmann, R.A., and Drzycimski, E.F., "Third Party Leasing," Journal of Data Management, pp. 33-46.

[28]Botten, L.H., Report of Computer Selection Study Committee, ERIC ED086207, p. 6-3.

[29]Hoffmeister, J.K., "A Locally Financed Schools Computer Cooperative," AEDS Monitor, p. 7.

[30]Ibid., p. 9.

[31]Mosmann, Charles, Academic Computers in Service, p. 151.

[32]Roberts, E.W., Data Processing Curriculum for Education, p. 206.

[33] Handy, et al., op. cit., p. 37.

[34] Graobey, J.A., "Maximizing Return on EDP Investments," Journal of Data Management, p. 28.

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