# INFORMATION PROCESSING IN THE MIT ADMISSIONS OFFICE

by

Daniel E. Breen

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Signature redacted

Signature of Author _____
Department of Electrical Engineering
and Computer Science,
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Signature redacted

Certified by _____
Thesis Supervisor

Signature redacted

Accepted by _____
Chairman, Departmental Committee on Theses

Abstract -

Information Processing in the MIT Admissions Office

by Daniel E. Breen

Thesis supervised by James D. Bruce,

Associate Dean, MIT School of Engineering

The current Admissions office data processing system suffers from several problems. Among these problems are: poor communications between the Admissions office and the Office of Administrative Informational Services (OAIS), which runs the computer used by the Admissions office; large turnaround time; and a high cost/benefit ratio.

Modifications to the existing system are proposed which reduce the cost and complexity of the current system, among them a proposed reduction of the Applicant file from 1800 bytes to 460 bytes. Several alternate data processing systems are also proposed. Cost estimates for the conversion of the Admissions office system to a manual system, and several interactive systems (TSO/370, MULTICS, and a PDP 11/45 based COS-500 system) are prepared. The results of these estimates indicate that a considerable savings can be realized with conversion to several of the systems, with the largest savings realizable on the MULTICS and COS - 500 systems.

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## Definition of Problem

The Admissions office, like any organization which handles large amounts of data, must concern itself with finding the most effective methods for collecting and processing that data. The present organization of the Admissions office data processing system has several major flaws. This paper will explore the weaknesses of the present system and attempt to develop alternatives to it, keeping in mind the constraints with which the system must operate. Among these constraints there are obvious ones such as speed and cost, and also more subtle ones, such as presenting the applicants with an application form which helps dispel the image of inhumanness which MIT often projects. Care must also be taken to account for the ability to handle peak loads on the system, since the periods where the loads on the system are the highest are also the periods where the information is needed the quickest. The throughput of the system must therefore be able to match the peak demands of the system, rather than the average demands of the system.

The first step in any attempt at optimization of a system should be obtaining a complete understanding of that system, so in that light, the first step here will be a description of the present system.

Current System Description

In order to get a view of what the current system does, we will follow the steps taken when a typical application is processed. A graphical representation of the flow of information is given in figure 1.

When an inquiry for information is received by the Admissions office, a preliminary application is sent out. When this preliminary application is returned, an application packet is sent out which contains the following:

Final Application
Secondary School Report
Teacher Evaluation Forms (2)
Evaluation of Applicant Form
College Board Score Card
Set of Early Evaluation Form Address Labels
Financial Aid Application
Educational Counselor Name and Address

A second set of actions also takes place when the preliminary application is returned. Information from the preliminary application is used to produce several punched cards (all Admissions office cards are color coded - these cards are known as "green cards"), which are used to create a record in the Applicant file. Upon creation of the record, the computer produces several other cards with the applicant's ID (name & birthdate), known as the history cards. When the forms from the final application packet are returned, the quantitative information on them is coded onto various of the history cards (generally one or two cards are used for each form), and the cards are

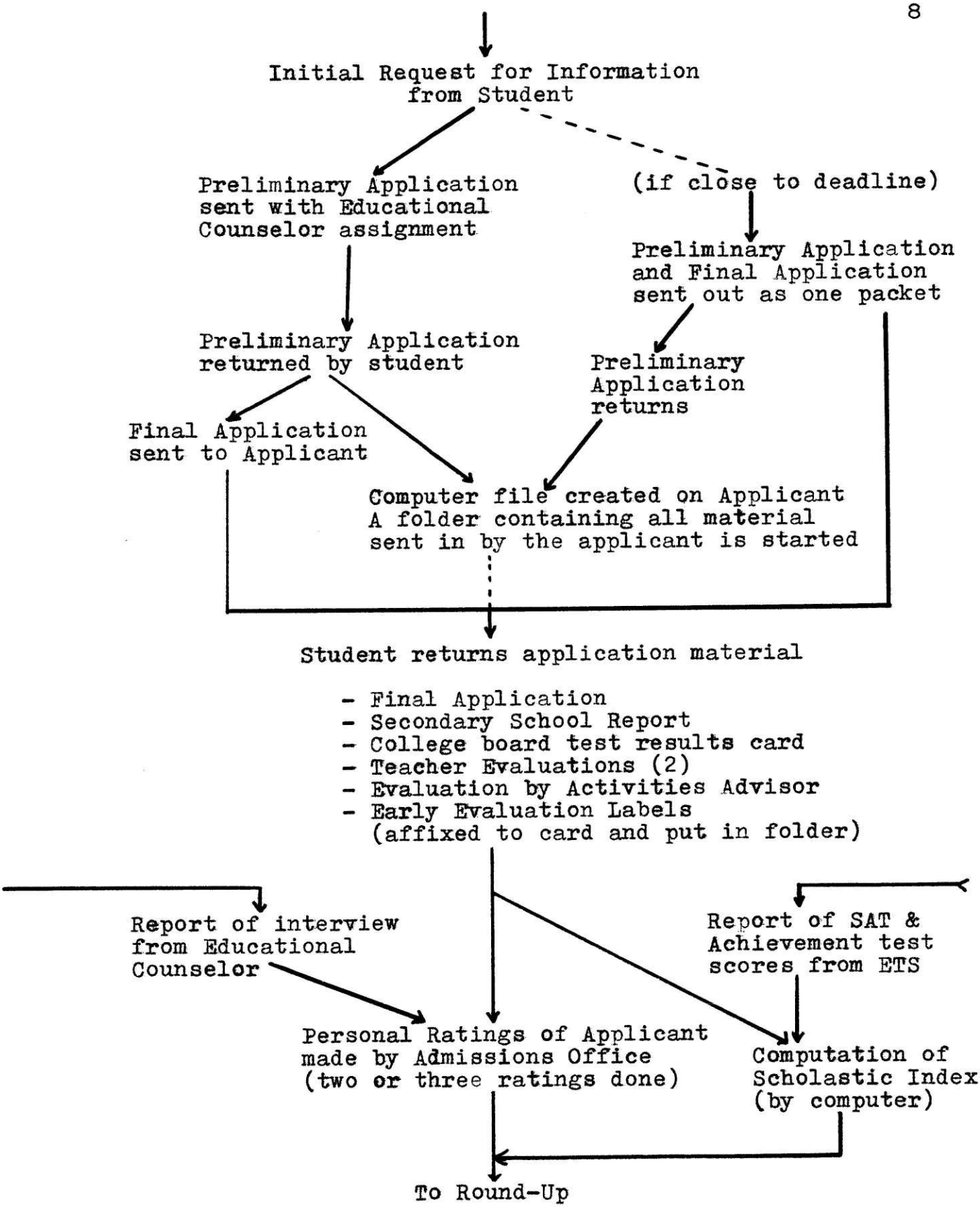
Initial Request for Information from Student
Preliminary Application sent with Educational Counselor assignment
(if close to deadline)
Preliminary Application and Final Application sent out as one packet
Preliminary Application returned by student
Preliminary Application returns
Final Application sent to Applicant
Computer file created on Applicant
A folder containing all material sent in by the applicant is started
Student returns application material
- Final Application
- Secondary School Report
- College board test results card
- Teacher Evaluations (2)
- Evaluation by Activities Advisor
- Early Evaluation Labels (affixed to card and put in folder)
Report of interview from Educational Counselor
Report of SAT & Achievement test scores from ETS
Personal Ratings of Applicant made by Admissions Office (two or three ratings done)
Computation of Scholastic Index (by computer)
To Round-Up

Figure 1

submitted as part of the weekly update to the Applicant file.

When all the information concerning an applicant has been received by the Admissions office (or when only one or two selected pieces of data are missing) the computer outputs a summary sheet for the applicant and the applicant's folder is read and rated on a scale of 4 to 10 by either: a) one of the staff members of the Admissions office, or b) an outside reader on the MIT faculity or staff. Each applicant's case is read either two or three times - twice if the two readers agree on the rating which the applicant should receive, three times if the first two readers disagree by more than one point in thier rating. This rating is a subjective evaluation of the applicant's character and promise; another index - the Scholastic Index - measures the more quantitative aspects of the applicant's potential. The scholastic index is produced automatically by the computer when all parts of the application pertinent to the index have been received. The Scholastic Index is based on a formula which takes as input the applicant's rank in class, high school grades, and the maximum scores received on the SATs and Achievement tests.

After all of the applicants cases have been read and given a personal rating, round-up is started. In the round-up process, all of the cases are brought together in one room, and the final decision on who to admit is made. This decision is generally based on the personal

rating and the scholastic index. A grid is formed with the scholastic index as the horizontal axis, and the personal rating being the vertical axis, with the maximum scores in each being in the upper left hand corner. Unless there is some unusual exception, the cases in the lower right hand section are not accepted, the cases in the upper left hand section are accepted, and the cases in the middle are reviewed on an individual basis and accepted, rejected, or for a few, put on the waiting list. The applicant is notified of the decision, and (if accepted) given a card to return stating if he/she will enroll.

The processing of the applicant's material is the primary job of the information system. The output of this processing is in the form of statistics, lists and labels.

The current system, which uses a 370/145 batch processing system run by the Office of Administrative Information Services, runs a weekly file update. At that time all additions, corrections, and deletions are input to the file; in addition, listings, data cards, and statistics are produced.

## Problems with the Existing System

Many problems have arisen with the existing information processing system. Some of them are problems with the day-to-day running of the system, requiring few or no programming changes to correct, others are in the ability of the Admissions office and OAIS to function as a team, and some are problems with the present implementation of the system. These problems are of a different nature than the one shot type of error, which, except when they occur in statistically significant quantities, are of little interest. This discussion will center on the more fundamental aspects of system implementation, and will not deal with the day-to-day aspects of the system implementation, except in a general manner.

- Speed

The large turn-around time that the present system requires - one week - severely limits the usefulness of the system. At critical times in the information processing cycle, the total time between receiving mail and the entry of that information into the computer files may take two or three weeks - if there are no errors. If there are errors in the coding or keypunching of the information, it will take at least one additional week, since errors are not detected until the punched cards are run in the update procedure.

This long delay time makes an accurate description of the current state of any application almost impossible.

The situation where an applicant is told that the Admissions office has not received a piece of information, when it has, in fact been in the Admissions office for several days is an important example. This situation arises when the "Laundry list" is sent out in the middle of January. The laundry list is a letter sent to every applicant who has not submitted all his/her application material, which describes what information is missing.

- Poor Communications

Poor communications between OAIS and the Admissions office causes several important, but rather unrelated problems. It is difficult - almost impossible - to tell exactly what a program does from the documentation which the Admissions office receives. One manifestation of this is that the Admissions office often requests the production of "gentops" - programs in a quick report producing language - when there already exists a cataloged program which does the same thing. Another manifestation of this problem is that scheduling is done on a precedence basis; to avoid omitting necessary programs from one year's schedule, the scheduling of programs tends to be copied from what was done the previous year. The format of the output of any particular program is not well defined, which also tends to contribute to this problem. If a job has not been used recently enough or often enough so that the Admissions office is familiar with the output,

the only sure way of knowing what the program produces is to run it (unless there is enough justification to spend the time and money to have someone from OAIS sit down and figure it out).

Another problem that falls under the heading of poor communications lies in the difficulty of having programming errors corrected quickly. When the Admissions office discovers a bug in a program, it takes some time for the error to be corrected - especially if the error is small and annoying - not big enough to disrupt the operation of the Admissions office. For example, in the production of the E-3 stickers which contain the grades received in secondary school, the field which specifies what foreign language was taken does not print out. This error was noted in January 1974; as of January 1975, the error was still there. There are several reasons why this problem occurs: there is no direct communication between the user (the Admissions office) and the programmer who does the work on the system; the programs are not documented well enough to give a clear description of what the program is doing; the account representative for the Admissions office is changed by OAIS just often enough that there have been several limbo periods where no one at OAIS has both responsibility for, and the understanding of the Admissions office procedures; finally, each OAIS representative must serve several users, limiting the

amount of time that can be spent on any one problem.

Finally, lack of communications results in outdated programs, with the effect that the cost of the system is increased, and the usefulness is reduced. For example, many of the output procedures do not work off the data base directly, but instead create work tapes that are then used to produce the output. As stated in a 1970 report to the Admissions office on the operational effectiveness of the current system, prepared by OAIS staff:

> The efficiency of the system can be increased by reprogramming output procedures to run directly off the data base, doing away with the work tapes entirely, and by combining several jobs which run conceptually as a package into a single program. An example of the latter is the package for new applicants which includes an E-3 card, punched applicant data cards, and a 3 x 5 card if the applicant is a member of a selected ethnic group; at the present time these are three programs which could be consolidated into one.

As of April, 1975 the particular problems cited in that report have not yet been corrected; work tapes are still needed, and there are still several programs which must be run to produce this output.

- Cost

Perhaps one of the greatest problems with the current system is the cost, or perhaps more correctly, the cost effectiveness. The Admissions office is facing the same budgetary pinch that the rest of MIT is facing, with the result that a critical examination of all aspects of Admissions office operations has taken place. The cost

of the current system is a major part of the budget, and the perceived usefulness is low. The Admissions office pays over $ 20,000. for the computational services which are supplied by OAIS. In addition, a large clerical force is maintained to prepare input to the computer and to file information. If the combined expense of computational and clerical services can be reduced without lowering the output quality, a primary goal of the Admissions office will have been reached.

- Seasonality

The demands for processing by the Admissions office are highly seasonal. Very little processing is done between the end of March and the end of October. The processing reaches a peak during January and February, when the bulk of application material is received and evaluated (see appendix I, the Admissions office application processing calendar, and figure 2, the summary of OAIS processing hours charged to the Admissions office for 1973-74). It is primarily during this peak period - November to March - that the Admissions office needs the information handling capabilities that the computer provides. During other parts of the year, the clerical staff of the Admissions office is idle for a good portion of their time, and is therefore wastefull of Admissions office money.

| Month | Time | Cost ($ 100./hour) |
|---|---|---|
| June | 290 min. | $ 480. |
| July | 210 | 350. |
| August | 260 | 430. |
| September | 470 | 780. |
| October | 560 | 930. |
| November | 620 | 1030. |
| December | 650 | 1080. |
| January | 780 | 1300. |
| February | 850 | 1420. |
| March | 245 | 410. |
| April | 285 | 480. |
| May | 300 | 500. |
| Total | 5520 min. | $ 9200. |

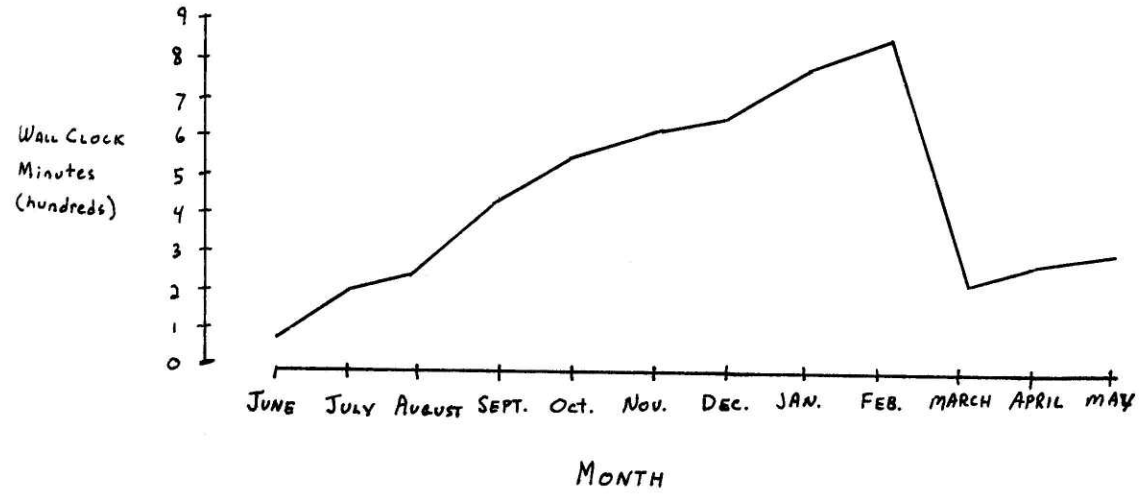


Figure 2
Wall Clock Hours Charged
to Admissions Office 1973 - 74

General Modifications to the Admissions Office System

Some of the current bottlenecks in the Admissions office can be addressed without changing the basic structure of the data processing system.

- Update log

Perhaps the simplest change in the current procedures which reaps a significant savings is the elimination of the update log (a record of all transactions occuring in an update). The Admissions office uses the update log for only one task - that of sorting out entries for which there no corresponding records in the Applicant file. If this were replaced with a log which listed only the unmatched cases, the utility of the output would remain the same, while the printing cost would essentially go to zero (the ratio of mismatches to total cards submitted is low, and the mismatches produce one line of output vs one line of output for each field on the correct cards). Since the update log can be up to 700 or 800 pages long, and the cost of each page is 15¢ (.25¢/line x 60 lines*), the savings would be considerable - a 500 page update costs $ 75. With ten to fifteen update logs in the 500 page range, the total savings for the year would be significant.

- I.D. Matching

The ability to match a piece of mail with the appropriate

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* OAIS defines a line as a physical line from the line printer, rather than a fixed no. of characters as in some other systems.

I.D. in the admissions files is very important, and problems with mismatches consume a large amount of time. This is especially true with applicants from Asian countries, who often reorder their names from one form to another, and those who use their middle names instead of their first name. Another place where this problem arises is in the reports from the Educational Counselors, where often both the name of the EC and the name of the applicant are hand written. A partial solution to both problems can be obtained if the application packets are numbered, with the same number on all of the material to be returned to the Admissions office. The form the EC returns after the interview (or a card to be included with the form) could be included in the application packet, using the same sticker with the EC's name that is now included in the application packet - but affixed to the form rather than attached to a page in the application booklet. The applicant could then bring the form with her/him to the interview, and give it to the EC to be filled out. A numerically ordered list would be made of the ID - application number pairs, which would be updated as each application is sent out. If any ID problems are encountered, the number on the form could be used to find the correct ID. The problems associated with this system are: 1) the cost of maintaining the list, and 2)people using old forms or sending in material on plain stationary. The cost of maintaining the list would be small since sending

out the application packets is primarily a manual task, and an additional step in this process would not take much time. The second problem, while frustrating, is one that the Admissions office can exercise little control over, short of requiring that only the forms MIT provides be used. Mismatches which result from the reordering of names (as in many Asian cases) and respellings (especially when apostrophies and spaces are involved) would be much easier to correct.

A prettier way of doing essentially the same thing would involve having the computer print the name and birthdate on the top of each form. However, the cost of printing would be prohibitive, and ID errors would be carried through on each form when they occur.

Another approach which would involve essentially no cost is that of coding the ID using only the characters which the Educational Testing Service uses (only A - Z, no spaces or special characters), or coding the ID in the normal manner and having the computer ignore all characters other than A - Z. This would reduce the problem of mismatches when the CEEB cards are entered into the file, and also eliminate the problems caused by variations due to apostrophies and spaces.

- Arrangement of Application Forms

The application forms are, for the most part, well arranged - both from the applicant's point of view, and from the Admissions office point of view. The only places

where the application packet could be improved are in the Final Application form. In the section asking for information about the applicant's family, there are sections asking if each of the applicant's parents are alive, and then the relationship of the legal guardian. A better construction, in terms of readability, is to provide a set of boxes to be checked if the appropriate conditions are met. The boxes could specify the various relation selections which are recognized by the computer. This change in format would improve readability - checked boxes are easy to identify, and only one area would have to be scanned rather than the three that are now checked. There is also some obscurity in the section which asks during which years Trigonometry, Chemistry and Physics were studied. The responses to these questions are about equally divided between listing grade levels and listing calendar years. A series of boxes to be checked indicating grade levels would improve the readability of this section.

- Marked Card Readers

One alternative to the current process of coding information onto cards and then keypunching the cards is conversion to a marked card reader system. Much of the information on the history cards is numeric in nature, or limited to a few choices. This type of information is the kind that is best handled by marked card equipment. However, the information density on a marked card is generally half that of a punched card. This would mean, for example,

that the number of cards required to encode a secondary school report would be four as opposed to the current two.

The major problem that the Admissions office would have with a marked card system is the inability of a marked card system to handle alpha characters. This would mean that the Admissions office would have to have a keypuncher to punch the "green cards", the final card, and in some cases, the endorsement card.

A low speed marked card reader will cost approximately $ 3500. Maintainance for such a device (HP model 7260A) would be about $ 50./month. For the applications the Admissions office has, the disadvantages of the price of the equipment and the inability to handle alpha characters outweigh the advantages the Admissions office would see in such a system.

- Understandability of the Current System

There are certain portions of the current system which would be more valuable if they were easier to use. One place where the Admissions office would gain from simplified procedures is in the creation of special one time unscheduled job requests (gentops), and the proper utilization of the regularly scheduled jobs.

All of the jobs which have been run as gentops in the last four years have fit into a few well defined areas. Because of this, the work involved in searching through the file dictionary to find the proper selection mnemonics can be eliminated by the creation of a special

request form for unscheduled jobs. Two such special job request forms (figures 3 and 4) have been prepared. The design of these forms eliminates the necessity of being familiar with the structure of the Applicant file and School file for all but the most unusual requests. This therefore greatly reduces the time and effort needed to produce special jobs.

The second place where understanding needs to be improved - in the proper utilization of existing jobs - would be greatly facilitated by a definitive manual which lists the functions and outputs of the currently implemented jobs. The current user's manual supplied by OAIS does nothing more than list the jobs, who supplies the input, and what subroutines the job calls; leaving the burden of documentation on the Admissions office. If the Admissions office is to continue using OAIS's system, a top priority should be placed on the preparation of a useful user's manual.

ADMISSIONS OFFICE UNSCHEDULED JOB REQUEST

from Applicant File

Output:

Punch ___

Print on:

___ Unlined white paper
___ Stock
___ 3 Part
___ 5 Part
___ S.A. Labels ___ 1 up ___ 2 up ___ 4 up

Print:

___ Name & Home Address
___ Name & Reply Address
___ Other (specify on back)

Number of Copies ____

Sort:

___ Alpha ___ Zip Order ___ School Order ___ Other

Select:

YR = ___ Year (current year if blank)
SX = ___ Sex F = Female, Blank = Male
EG = ___ Ethnic Group B = Black, I = American Indian, O = Oriental, S = Spanish American, P = Puerto Rican, M = Mexican American
CZ = ___ Citizenship X = Non-citizen, Z = Considered U.S., C = Canadian, Blank = U.S.
AE = ___ Early Decision Action A = Admit, H = Hold, D = Discourage
A1 = ___ Initial Action A = Admit, U = Waiting List, N = Not Admitted, B = Foreign Admissable, Blank = No Action
A2 = ___ Final Action A = Admit, N = Not Admit, Blank = No Action
CR = ___ Course Preference
NM = ___ National Merit Scholar S = Semi-finalist or Finalist

Zip Code ZH ___ Home
ZL ___ Reply
ZP ___ Parents
ETS No. UA ___ High School
___ Other (on back)

Range

Figure 3

ADMISSIONS OFFICE UNSCHEDULED JOB REQUEST
from School File

Output:

Punch ___

Print on:

___ Unlined white paper
___ Stock paper
___ 3 part
___ 5 part
___ S.A. labels { ___ 1 up, ___ 2 up, ___ 4 up }

Number of copies ____

Sort: ___ File order (School Order) ___ Zip order
___ Other:

Print:

___ Title
School Name
School Address
___ Other
(specify on back)

Title { ___ Principal; ___ Chairman, Math Dept.; ___ Chairman, Science Dept.; ___ Chairman, Music Dept.; ___ Chairman, Guidance Dept. }

Select:

___ SC School Code (ETS No.)
___ ZP H.S. Zip Code
___ ST Status of School Blank = H.S., D = Discontinued
E = Now Elementary School, J= Now Jr. High School
___ Other (specify)

Range

figure 4

## An Entirely Manual System

This section will postulate an entirely manual system, explore the work that must be done to maintain this system, and evaluate the costs and relative strengths of the system. It must be pointed out that this is only one possible way such a system could be implemented, there are undoubtedly many other equally valid implementations. However, the decisions which led to this design will be examined, and the rationale behind this particular construction will be defended.

Basically, there are two different methods of storing information on paper. These methods can be called the ledger, or list oriented system, and the file oriented system, The ledger system records all the information it stores in a book, and has the advantage that it is more portable and generally easier to work with. However, it has the disadvantage that adding new entries to the list requires a reordering of the list, and individual records cannot be easily removed for inspection. The file system has the advantage that it is easy to correct and reorder; it is more ungainly and tends to have entries misfiled easily. The proposed system will have a combination of the two systems - the ledger system will be used for the school checkbook, where there is generally enough information to devote an entire page to each school, and the file system will be used for the applicant status

list, where the amount of information in each record (one applicant) is relatively small. The record for an individual applicant (E-3 card) will be kept in a file for ease of updating, and changes will be transfered to the applicant status listing (file) and school checkbook (ledger).

- Outline of the Proposed System

This system would keep essentially the same outward appearance as the current system, except that several mailing labels would be filled out by the applicant to be used in place of the computer generated ones currently produced. The burden of the clerical work falls on the Admissions office rather than the student (as is the case in some admissions systems) because the Admissions office would like to present an application which deemphasizes the impersonal nature of forms as much as possible. An application form which is designed for use as a file record would be a violation of this principle. The material presented to the admissions officers should also be kept as close to its present form as possible, on the presumption that this system's purpose is to serve the admissions officers and assist them in making their decisions, and the present system is organized in the way that they have designed to best meet their needs.

When a case is made up (preliminary application received), an E-3 card is created, which would have room on it for the information that is currently recorded there.

In addition, the applicant's name would be added to the applicant status list, and in the school checkbook under the applicant's high school. The applicant would also be referred to an EC for the required interview at this time. When any subsequent application material is received, that information would be added to the E-3 card, and a change card would be made up containing only the new information. This change card would be kept together with the E-3 (and have all subsequent changes recorded on it) until the next revision of the school checkbook and applicant status list. At that time, all the change cards would be separated, and the changes would be recorded in both the school checkbook and applicant status list. A new change card would be created for any subsequent changes. When any new information is received, the clerk adding the information to the E-3 card would have to check to make sure that no special conditions, such as the case being ready for review, have occured. When these special conditions occur, they would be handled essentially the same as they are now handled. The clerk would also have to notice if the change would affect the applicant file statistics. If the statistics are affected, then a "ticket" would be submitted to the statistician, who would record what changes had occured in the statistics. This ticket could be in the form of a color coded computer card (there does not have to be anything written on the card, the card itself would be the information), which would have the

advantage of being countable by running the card through a card sorter. The statistician would have the job of sorting and counting the tickets, and adding or subtracting the totals from the previous statistical counts.

An out card (when the E-3 card is removed from the file to be sent to another office, an out card, describing where the E-3 card is, is substituted for the E-3 card) similar to the one presently used also would be needed, but should contain more information (what portion of the application material has been received) to compensate for the loss of information provided by the history card file, which would not be needed. The laundry lists to the applicants and their schools, would be handled as a single task, disrupting the normal flow of information for the time required for the preparation of these letters. The scholastic index would be computed by hand, with the aid of a calculator. As in the selection of cases for review, the selection of cases ready for computation of the scholastic index would be done by the file clerks when information is entered onto the E-3 card.

- Benefits and Drawbacks

There are several areas where a manual system would have a lower performance than the present computer aided system. The error rate of a manual system would be higher than it currently is, due to the fact that a manual system requires data to be transfered from one form to another more often. The manual system also provides no guarantee that the information on one set of records will be the

same as on another. Adequate error detection procedures would be prohibitively costly. The Admissions office would also have the difficulty of interfacing with other offices at MIT, such as the Registrar, the Financial Aid office, and the FAC. These other offices would have to duplicate much ot the Admissions office work at some times of the year, since the information could not be transfered automatically as is now the case.

The Admissions office would not be able to automatically record information from the College Entrance Examination Board. While the CEEB cards which are not matched to an applicant in the file are now checked by hand, all of the cards would have to be checked in a manual system. This checking procedure would produce a longer delay time between the receipt of the CEEB cards and their entry into the files, and would also disrupt the other operations which would normally be going on in the office.

The response time of this system to unusual requests, such as listing all minority applicants, or the production of an infrequently used statistical report would be much greater due to slower human searching speeds.

- Cost

The estimation of cost will be calculated on the basis of peak system demand. The added manpower required during the period November to March will determine how many people would have to be hired, although they will not be needed during the rest of the year. The original

recording operation in this system will be considered to remain the same, and all listed expenses will be considered to be in addition to that initial expense.

The biggest expense in operating this system is in the time spent in locating an applicant's file. About 6/10 minute per file is required to locate a random applicant's record in a card file. This time is multiplied several times in the transfer of a piece of information from file to file. The following matchings between information and the applicant's files will occur during the course of one year:

- CEEBs Approximately once per month the Admissions office receives SAT and achievement test scores. During the time period in question, these average to about 8,000 scores each. The process of matching IDs, recording scores, and checking if a SI must be computed will take about one minute per file (the time required to match CEEB scores and the appropriate applicant is less than 6/10 min. because both files are alphabetized). 8000 scores x 1 minute x 4 batches of scores = 32,000 minutes, or 533 hours.
- Referral Every person who sends in a preliminary application (a total of about 8,000 people) is referred to an Educational Council member for an interview. In this referral

process, there can be a maximum of three look-ups to perform the matching, and then the assignment must be recorded and both the applicant and the EC member must be notified.

8,000 applicants x 2 minutes = 16,000 min., or 266 hours.

- Computation of Scholastic Index

About 5,000 of the applicants submit enough information to allow computation of the SI. The SI computation (there are two SIs computed) requires time to locate a file, the computation of each SI requires a short computation, and then the results must be recorded. The computation of each applicant's SI (total) takes two minutes.

5,000 applicants x 2 minutes = 10,000 min., or 167 hours.

- Recording and Checking Inputs

While the original recording of the data in the system can be considered to be the same as in the present system, there is an additional cost involved in the copying of the information onto the change card, and a cost involved in checking the case at the time of each input to see if any

special actions need to be taken. If this cost is taken as 2/3 minute per piece of information received, the total cost, based on 13 pieces of information for each case*, and an average of 5,000 completed cases is:

5,000 applicants x 13 pieces of information x 2/3 minute = 43,300 minutes, or 722 hours.

- Updating the Applicant Status List and School Checkbook

If all the active cases (those who submit most of their application material) are changed once per month (a good bet considering there are 13 pieces of information), updating these two lists will involve about 5,000 operations per month. Involved in this operation are two lookups (one for each list) and the subsequent corrections. This combination of operations takes about two minutes to complete.

2 minutes x 5 list updates x 5,000 corrections = 50,000 minutes, or 833 hours.

The total of these operations is about 151,000 minutes, or about 2,500 hours. The average clerk puts in about

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* The case consists of the Secondary School Report, the Final Application, three endorsements, an EC report, personal ratings, the SI computation, mid-year grades, college board scores (approx. 3), and the action taken.

6.5 hours per day (9am - 5pm = 8 hours - 1 hour for lunch and .5 hours for two 15 minute breaks), and works about 150 days in this 5 month period. The total number of additional workers that must be hired is 2.6, if the load is averaged out over the entire period. This figure does not take into account several overhead costs associated with this manual system. The time spent on special requests to the system, such as special mailings, the manual shuffling of all the added paper, and the problems encountered in the overcrowding of the already crowded office space available with additional workers are not accounted for. In addition, the figures used to compute this total were the results of short test periods. The actual time required by a clerical worker to perform these operations would increase with the length of time spent performing them. If we allow for 1.4 additional workers to compensate for these factors, and to bring the total to an integral number of workers, we arrive at a total of four additional workers. At 6,500 dollars per worker per year (the average salary of a starting clerical worker), the total increase is $ 26,000. However, we can subtract the cost of the computer -roughly $ 21,000., and the cost of the keypuncher - 6,500 dollars. The total added cost of this system is about - 1,500 dollars, which is well within the margin of error for these computations. The total cost change can therefore be considered to be zero.

Reduced Reliance on the Computer

If the decision is made to continue using the present system, a possible alternative is to reduce the Admissions office's reliance on the computer. The computer is especially well suited to several types of tasks. Among the tasks the computer excells at are: printing mailing labels and listings, sorting files, computing the scholastic index, and producing statistics. If the Admissions office were to leave these tasks to the computer, while performing the other clerical tasks that the computer now does by hand, a considerable savings would be obtained. The material which would be done by hand must be hand coded onto punched cards already, and the types of information the computer would not be storing are needed primarily when the Admissions office is experiencing its slack period (approx. March to September). The information that the Admissions office keeps in the applicant file could be limited to:

| | |
|---|---|
| Preliminary Application Information | Name |
| | Birthdate |
| | Sex |
| | Reply Address |
| | EC number |
| | ETS School Code |
| Final Application | Early Action Request |
| | Change of School Indicator |
| | Citizenship |
| | Ethnic Group Code |

| | |
|---|---|
| Personal Ratings | Raters Initials & Rating |
| Secondary School Report | Grade sum<br>Rank in class<br>Percent to college<br>Class size<br>Principal's Recommendation |
| Interview Report | EC number or Staff initials |
| Recommendations (3) | Code describing the person submitting the recommendation |
| College Board Information | Current Format |
| Action Information | Actions Taken |

With this information, the computer would be able to generate the outputs important to the Admissions office during most of the year. Statistics, the school checkbook, the applicant status listing, laundry list, the scholastic index, and the most often requested gentops could all be produced by this system.

The amount of processing required by this system would be reduced due to the decreased amount of input processing (fewer cards, less information on each one, and fewer errors due to the decreased information content), reduced file size, and reduced output of the system. The information that was formerly kept in the applicant file could be coded directly onto a modified E-3 card.

The reports that this system would not produce are the non-parent name list, course preference list, geographic distribution counts, interview statistics, and source

of application counts. All of these reports are produced in the slack periods of the year. Since the clerical help is available anyway, it would be more cost effective to produce these manually.

The size of the Applicant file could be reduced from the present 1800 bytes of information to a total of 460 bytes (300 bytes for financial aid information) if only the following information was kept on file:

| Item | Length of field |
|---|---|
| Name | 30 |
| Birthdate | 6 |
| Sex | 1 |
| Address | 55 |
| Zip Code | 5 |
| School Code | 6 |
| Change of School Flag | 1 |
| Group Code | 1 |
| Citizenship | 1 |
| Early Action Request Flag | 1 |
| Grade Sum | 2 |
| Rank in Class | 3 |
| Class Size | 4 |
| Percent to College | 2 |
| Principal's Recommendation | 3 |
| Interview | 4 |
| Endorsements | 3 |
| CEEBs | 10 |
| Evaluations | 18 |
| Actions | 4 |
| Total | 160 bytes |

Storing the information in this form requires a few changes in the format of the information stored. The dates of actions and the date of receipt of the application material would not be included in this file. In order to get that information, one would have to go back to the applicant's

folder. Only the reply address of the applicant would be stored in this file, because that is the one used during this part of the year. The parent's name and address are not included since the Admissions office does not send any mail to the parents. Only the best college board scores are kept, since they are the ones used in the computation of the SI, and these scores are stored as two digits each, since the last digit is always zero.

This method of storing information would also require that the file management system be able to reference two different files at the same time (the applicant and school files). While this is not an unusual ability, it is one that OAIS does not exercise most of the time, prefering to store the same information in many places in different files.

Consideration should also be given to a two file system. An abbreviated file system such as this one could be run for the major part of the year, and then after the peak demand is over the information could be switched over to a larger file. This would have the advantage of allowing the information needed for the financial aid analysis to be entered only after the admissions decisions were made, allowing the abbreviated file to be cut to 160 bytes. When the file is expanded to allow the Financial Aid office to use the file, the additional information needed to run the listings and statistical

reports not possible with the smaller file could be added. This larger file could have fewer applicant records in it, due to the fact that a good portion of the applicants in the current file do not pursue their applications past the preliminary stages, and therefore are uninteresting to the Admissions office.

Adding the information which was left out of the smaller file would be done over a longer period of time, and would not have the strict time constraints that are presently placed on the system.

Interactive Systems

There is much to be gained in the conversion of the Admissions office system from a batch system to an interactive system. The time the Admissions office takes to get the information into the file would be decreased drastically. Error detection routines can be used to monitor the input, catching errors as they occur, rather than after a delay of several days. An online video display system would eliminate the need for most of the bulky reports that are now produced, allowing instead direct and instantaneous access to the desired information. On such a system, statistics would more accurately reflect the current state of the system. The total number of hard copies of information kept in the Admissions office (punched cards, file cards, E-3 cards, applicant summaries) could be reduced to one or no hard copies per person. This reduction in paper would result in a corresponding reduction in paperwork.

Interactive systems do have their price, however. It is generally more efficient (in terms of computer costs) to run a program in a batch environment than it is to run it in an interactive environment.

In the domain of interactive systems, this paper will evaluate three alternative computer systems. The first two systems to be evaluated will be TSO/370, and the MULTICS system, while the third will be the DEC COS-500 system. The nature of interaction with the systems differs -

in the case of the first two systems, the Admissions office would be a user in a large community information system, while in the third system, the Admissions office would be the owner of the system. While estimating the cost and utility of the three systems has some common ground, the purposes of this paper will be better served if some common estimates are developed for TSO and MULTICS, and then some independent estimates are made for the COS-500 system.

The costs of the TSO and MULTICS systems are dependent on factors such as CPU usage, main memory usage, storage charges, connection time, and I/O charges. In order to get an estimate of these charges, we will first estimate the cost of the current system using the same parameters. There are some problems with comparing the charges for the batch system which OAIS runs and an interactive system, not the least being that the system would have to be redefined and rewritten for it to operate in an interactive environment. The basic types of file manipulation would be the same (assuming the file structure does not change greatly), but the I/O routines used on OAIS would not be suitable for the interactive environment. This problem will necessitate the final cost estimates be a range of costs rather than a more precise figure. With this in mind, we will proceed to the point of estimating the cost of running the system now in use on the first two time sharing systems under consideration.

The rate structure of OAIS differs substantially from most present computer systems. The charges for OAIS services are accounted for in only two catagories. The costs of CPU, main memory, storage, and development are reflected in a charge for the time the computer is in use. This charge is based on wall clock hours of computer use. The present charge for this is $ 125. per hour. The second charge is a print charge of $ 2.50 per 1,000 lines of output.

In recent months, OAIS has been studying the possibility of changing their billing from a charge per wall clock hour to a more conventional method of billing. In the studies they have made, they have kept track of several variables, among them cpu time and wall clock time. It is therefore possible to prepare an estimate of the ratio of wall clock time to CPU time. The figures used in the computation of this ratio are from January 1975 to March 1975. All jobs run by the Admissions office (project KDD) were used to compute this ratio. In addition, the figure used for the CPU time was the sum of both the CPU time of the program, and the overhead CPU costs directly attributable to that program. For the three month period, the total wall clock time was 38.23 hours, the CPU time was 3.5745 hours, and the overhead time was 1.363 hours. The total of the CPU and overhead times was 4.9375 hours. The ratio of wall clock time to CPU/overhead time was 7.74:1.

The wall clock/CPU ratio cannot be used directly in figuring the yearly CPU costs of running this system on another computer due to the fact that the Admissions office system was not run on the 370/145 for the whole year. OAIS changed their processor from a 370/135 to a 370/145 in December 1974. However, by comparing the average wall clock hours charged to the Admissions office for the same three months in the two years prior to the installation of the 370/145 to the first three months of 1975, we can obtain a speed relationship. One problem is encountered in the comparison of the two time periods. During March 1974 there were fewer updates done than in either March '73 or '75. In both 1973 and 1975 the updates were done weekly, while in 1974 only two updates were done during the month. For this reason, the month March 1974 will not be used in this comparison. Whether the average was computed by averaging the monthly averages, or taking the averages over the entire period, the results were quite consistent - the ratio of speeds of the different processors was 1:1 (see figure 5).

We can now develop comparitive costs for running the OAIS system on other machines. The total cost will consist of several factors - the cost of CPU time, the Main Memory charges, the online storage charges, charges for cards read and punched, and the print charges.

The CPU time will be expressed as a function of wall clock time (as derived in the previous section) -

Monthly Wall Clock Hours Charged to Admissions Office

| Year | January | February | March |
|---|---|---|---|
| 1973 | 13.0 | 12.4 | 12.0 |
| 1974 | 12.9 | 14.2 | 4.1* |
| 1975 | 16.8 | 9.5 | 12.0 |
| Average 1973,1974 | 13.0 | 13.3 | 12.0 |
| Ratio - Monthly Averages | .77 | 1.4 | 1.0 |

$\frac{\text{Sum of Averages}}{3}$ 1.06 (:1)

$\frac{\text{Average of 73,74}}{\text{Average of 75}}$ 0.998 (:1)

* March 1974 is not counted due to a difference in the number of jobs run in previous and subsequent years.

Computation of Average Run Speed Ratio of 370/135 and 370/145

figure 5

1/7.74 or 0.129 x wall clock time. Main memory charges are also a function of wall clock time (job run time). Since the standard amount of memory requested by OAIS jobs is 64k, we will use that figure in the computation of the main memory charges, multiplying it by the total yearly job run time. The print charges will be figured on the basis of 2.5 million lines of printing. This figure is based on an OAIS estimate made half way through the current fiscal year. The approximate number of cards read by OAIS is 140 boxes x 2000 cards each = 280,000 cards; the approximate number of cards punched is 8,000 x 12 = 96,000 cards. The charges for online storage would be the charges for program storage, applicant file storage, and school file storage. By far the largest of these is the applicant file, which takes 14.4 million bytes of storage (8,000 applicants x 1800 bytes). The total online storage would be 15.7 million bytes. Since the applicant file starts with essentially zero length, and then grows for the first 1/2 year, this total storage size is only for about 2/3 of the year.

This set of values (figure 6) can be used to compute the theoretical cost of running the present system on other computers. This is the cost of running exactly the same system, which will not be either possible or desireable on the time sharing systems we are going to consider. This cost will be used as a benchmark; the cost range of a similar interactive system will be expressed

CPU

100 hrs wall clock time (current charge) x 0.129 =

12.9 hours CPU time

Main memory (per hour wall clock time) = 64k bytes

Print Charges 2.5 Million Lines

Online Storage

14.4 Million Bytes Applicant File
1.0 Million Bytes School File
0.3 Million Bytes Programs

15.7 Million Bytes Total

Cards Read

140 Boxes x 2,000 Cards = 280,000 cards

Cards Punched

8,000 Applicants x 12 Cards Each = 96,000 Cards

Current System Usage Values

figure 6

relative to this figure.

Because estimation of the comparitive costs of interactive vs. batch systems is somewhat of a black art, the most valuable tool in making such comparisons is the experiences of others in the field. For comparisons of the runtime of the same programs on the computers under consideration in this study, approximate figures were obtained from Mr. Roger Roach, Manager of Systems Programming in MIT's Programming Development Office. The runtime of the 370/145 compared to the 370/165 was estimated at 13:1; compared to the Honeywell 6180 it was estimated at 6.5:1.

The relative speeds of batch and timesharing systems of similar function is extremely variable, however. Estimates by Mr. Roach and Mr. Jay Goldman of the RDMS project gave as a reasonable range a factor of 1 to 2 times the batch system cost for converting to a timesharing system on the same computer. While there is much room for optimization of the current system, a figure of 2x the batch costs will be used to allow for the added support costs which would be incurred by the Admissions office, with a range from 1.5 to 2.5 times the batch cost being reasonable.

TSO/370

TSO, run on the IBM 370/165 at MIT's Information Processing Center (IPC), takes into account many different factors in the computation of system charges. The items that the Admissions office would be charged for in the applicant file system are: CPU time (computed at TSO rates of $ 11/min.), disk I/O, disk usage, card input, card output, and number of lines printed. TSO CPU rates (rather than OS/370 rates) and disk storage rates are used in order that this system will more closely approximate the environment needed for a time sharing system. The CPU time for the IBM 370/165 is taken as 1/13th of the CPU time of the 370/145. The computations for the charges for our hypothetical batch system on TSO are listed in figure 7. The prices for the various services are from the current "Rates for Computer Services" document issued by the IPC. The estimated operating cost of an interactive system on TSO will be between 1.5 and 2.5 times the batch costs. Since the estimated batch cost is $ 11,800., the estimated cost of the interactive system will be between $ 17,700. and $ 29,500. The center of this range is $ 23,600., about the current operating cost.

The alternate figures for the storage charge on TSO are for the normal rate of charge for disk tracks in the first instance, and a special bulk rate in the second case. This bulk rate is for rental of one entire 2314 disk platter, which has the capacity for about 30 million

CPU

12.9 hours x $ 660./hr. x 1/13 relative speed = $ 654.

Main Memory

100 hrs. x 64k bytes/hr. x $ 42./64k bytes = 420.

Online Storage

15.7 million bytes x 250 days x 2¢/13,030 bytes = 6024.

or $600./month x 12 months (2314 spindle rental)
= $ 7200.

Lines Printed

2.5 million lines x $ 1.65/1,000 lines = 4125.

Cards Punched

96,000 cards x $ 3.30/1,000 cards = 317.

Cards Read

140,000 cards x $ 1.65/1,000 cards = 231.

Total $ 11,771.

Estimated Batch System Cost on TSO

figure 7

bytes of storage. If the Admissions office requirements grow much above what they now are, it would become more economical to take advantage of this special arrangement.

Since storage is such a major portion of this bill, the cost of this system would be substantially reduced if the amount of information stored in this file were reduced to the 460 bytes suggested in the section on reduced reliance on the computer. Even if we allow for 500 bytes of information to allow for future expansion of the system, the total size of the applicant file would be 8,000 applicants x 500 bytes = 4 million bytes. The total storage requirements would be 5.3 million bytes, which would cost about $ 2,000. The total cost of the batch system would be about $ 7,700., and the range of interactive costs would be from $ 11,600 to $ 19,300.

MULTICS

The MULTICS system, run on the MIT IPC Honeywell 6180 computer, has a rate schedule which is much less involved than the one for TSO. The charges for MULTICS are based on CPU, main memory, lines printed, cards punched, and online storage charges. The computation for these charges are shown in figure 8.

In MULTICS there are again two different rates which can be used for online storage. The first rate listed is standard price per page of disk storage. The rate listed second is a special rate for non-backed up storage. Non backed up storage is not, however, entirely non backed up, as it is dumped to a tape about once per week. The Admissions office could take advantage of this special storage, without losing any of the reliability of the system if a record of all changes made to the file between backups were kept on backed up storage. Through proper management of such a system, the best of both worlds can be achieved.

The memory charge in MULTICS is not a charge for the number of pages in core, but rather a charge for swapping pages into core. The system takes into account both the number of page faults, and the total number of users on the system when the accounting for the memory charge is done. Thus the memory charge will vary from run to run, independent of the amount of core used. In

CPU

12.9 hours x $ 375./hour x 1/7.5 relative speed = $ 645.

Main Memory

(12.9 x 1/7.5)hours x 34.9 $\frac{\text{memory units}}{\text{CPU hours}}$ x $ 18. = 1080.

Online Storage

15.7 million bytes x 250 days x 2¢/4k bytes
= 19,625.

or

15.7 million bytes x 250 days x .5¢/4k bytes = 4906.

Printing

2.5 million lines x $ 1.65/thousand lines = 4125.

Cards Punched

96,000 cards x $ 1.65/thousand cards = 158.

Total $ 10,914.

Estimated Batch System Cost on MULTICS

figure 8

the "Report on Charging for Memory Services" by R. Frankston dated 1/25/73, the algorithm for computing memory usage is developed. While the parameters used in that algorithm have changed in value, the basic structure of that algorithm remains the same - it is based on the average use of the CPU and memory, and their relative costs. In computation of the average load on the system, the then current pl1 compiler was considered to be representative. The Admissions office system is fairly large and complex, roughly equivalent in scope to that of the pl1 complier. The Admissions office programs can therefore be considered to be fairly close to the average load on the system. By finding the current ratio of CPU hours to thousand memory units of a typical user, we will be able to approximate the CPU: memory usage ratio of the Admissions office system. A sampling of MULTICS users editing and compiling pl1 programs produced a ratio of 1:34.9, which we will use in the computation of the memory charges.

As in the TSO estimate, the range of the interactive cost estimate will be from 1.5 to 2.5 times the batch estimate, or from $ 16,400. to $ 27,300., with the center of the range at $ 21,800.

Again, if the Applicant file size were reduced to the size suggested in the section on reduced reliance on the computer, the estimated range of cost for this system would be $ 10,900 to $ 18,200.

Purchase of a Dedicated System

An alternate to buying services or time on a large scale computing facility is the purchase of a small scale system which can be dedicated solely to the Admissions office data processing needs. One such system which has the capabilities needed is Digital Equipment Corporation's COS-500 system, based on the PDP 11/45 computer. A system with 40 megabytes of disk storage (more than enough to store the Applicant file, School file, and all the programs needed to operate the system), CPU with 64k main memory, a card reader, fancy hard copy device, and three terminals would cost about 57 thousand dollars (see figure 9). After the initial outlay, the cost of maintainance (provided by DEC on contract) would be $ 4140. per year. There would be several advantages to having such a system. The system would eliminate the need for the keypunch and operator, since corrections would be made directly into the Applicant file. The two Mag Card Selectrics the Admissions office owns at present also would not be needed, due to the hard copy device (sending out the decision notices to the applicants could be automated). Updating the Applicant file could be done online, providing the ability for immediate error correction facilities, and increasing the speed of adding information to the files. The amount of waste paper produced is also decreased, since hard copy would be needed only when information is taken out of the office.

Purchase Price

| | |
|---|---|
| Controller for Two 20 Megabyte Disks (and disks) | = $ 25,000. |
| PDP 11/45 CPU with 64K Memory | = 18,000. |
| Card Reader | = 5,000. |
| Terminals - 3 VT50 Terminals at $ 1,250. each | = 3,750. |
| QUME Hard Copy Device (4 type fonts, variable pitch) | = 5,000. |
| Total Purchase Cost | = $ 56,750. |

Monthly Maintenance

| | |
|---|---|
| VT50 $ 22. each x 3 | = $ 66. |
| Disks and Controller | = 106. |
| Card Reader | = 50. |
| CPU and Main Memory | = 75. |
| QUME Hard Copy Device | = 48. |

Total Monthly Maintenance = $ 345.

or $ 4140. per year

Purchase and Maintenance Costs of COS-500 System

figure 9

System Development Costs on an Interactive System

The initial cost of an interactive system is going to be composed of hardware costs (if any) and software development costs. This section will try to arrive at a reasonable estimate for the software costs. The software support of the host system will be assumed to be adequate to support a higher level language and file management for large files.

The Applicant file management system has at its core an update program which enters almost all the information into the system. There are about 130 different fields of information that the update program must recognize. Other programs manipulate the file to produce statistics and various different formats of output. In order to estimate the amount of time that is required to develop a system in a time sharing environment, reference will be made to the development costs of a similar system which was developed on the MULTICS system. During the summer of 1974 an Educational Council Referral system was developed on the MULTICS system. This system is similar to the Admissions office system in many ways. The same types of information were inputs to the system, and the same error checking types of procedures were implemented. The number of different types of inputs was 33 on the EC referral system, and the number of output formats was four. While the complexity of this system is not as great

as the applicant file system, scaling this system up to the applicant file system size would provide an estimate of the cost of developing the applicant file system. The total cost of developing the EC referral system was about $ 1800., of which roughly half was for computer charges. If the cost is multiplied by the ratio of the input fields - (a measure of the amount of information the system handles), 130/33, or 3.9, then the cost of development of the applicant system would be about $ 7,000. However, when the size of the object code produced is compared, a ratio of 10:1 is more likely. Taking into account the different languages (pl1 for the EC system vs. pl1, cobol, and Autocoder for the Admissions system), a figure of 8:1 seems to be a reasonable estimate. The range of development costs would therefore be approximately 10 to 16 thousand dollars.

There are several things which must be noted about this estimate: First, the figures include the charges for computer time and must be cut in half for the development cost of the system where the computer is owned by the Admissions office. Secondly, the development costs of a system with reduced capabilities would be proportionally reduced. Last, if the system is developed on MULTICS, the development costs could be greatly reduced if the Relational Data Management System (RDMS) is used.

RDMS is a generalized data-base management system, implemented on MULTICS in pl1*, which provides the general

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* Work is now in progress to implement RDMS on the TSO system.

file manipulation operations required in the admissions system. While an interface would have to be provided between RDMS and the Admissions office users to provide the simplified editing procedures the Admissions office requires, it would be possible to reduce both development costs and maintenance costs with the RDMS system. The RDMS system is not without its price, however, as a surcharge of 40% of the MULTICS charges is levied to defray the costs of RDMS development and maintenance. However if the base of users upon which RDMS operates is increased, the proportional cost of RDMS will decrease.

There are also some very significant drawbacks to developing an interactive system. The Admissions office would be responsible for the upkeep of its own system, and would have to develop a new system to be run under the new environment. The cost of development is a substantial investment. The Admissions office would have to have an employee responsible for the operation of the system, and would be responsible for the continuity of the system when there are personnel changes. The employee in charge of the system would not have to be attending to the system full time (after the system is established), and could distribute their time between several Admissions office duties. For any programming changes, the Admissions office could exploit the wealth of competent programmers within the MIT student body. Most programs under development have enough lead in time that the irregularities of the student

work schedule would not severely hamper development. The Admissions office might further reduce the cost of system development through sponsorship by the UROP program. It is worth noting that the Admissions office already employs one staff member who works about half time on the Admissions office - OAIS interface, and one part time student in the operation of the system. The problem of lack of continuity when the staff member in charge leaves could be solved by the hiring of one of the student programmers. The Admissions office has already established precidence in this type of assimilation. Many of the Admissions office staff are former students, hired into staff positions.

## Conclusion

There are many issues involved in the choice of an optimal system. There are advantages to be found in all of the systems which have been considered, and the decision of which alternative the Admissions office should pursue involves value judgments in regards to the relative importance of these factors.

The major issues which must be considered and weighed against each other are: cost, reliability, ease of use, ease of interfacing with other systems, and ease of development of the various systems.

The two systems which offered the best cost performance over the span of five years were the MULTICS system (operating with a reduced size applicant file), and the COS-500 system (figure 10).

The MULTICS system has the advantages of greater reliability (larger systems tend to fail by a graceful degradation, rather than a complete breakdown), and greater ease in the initial system development, due to a more advanced operating system. The MULTICS system also wins in the ease of interfacing with other systems, as it has a much larger variety of I/O devices which it can use.

The COS-500 system has the advantages that the present structure of the applicant file (1800 bytes per applicant) could be stored on the system, with ample room for growth, and the system would be easier to use, since

| SYSTEM | DEVELOPMENT COSTS | YEARLY COSTS | PURCHASE PRICE | YEARS TO BREAK EVEN | CHANGE IN COST (5 YRS) |
|---|---|---|---|---|---|
| OAIS | - | 27.0 | - | - | - |
| TSO | 14.0 | 23.6 | - | 4.1 | -3.1 |
| TSO with smaller file size | 9.2 | 15.5 | - | 0.8 | -48.3 |
| MULTICS | 14.0 | 21.9 | - | 2.7 | -11.5 |
| MULTICS with smaller file size | 9.2 | 14.6 | - | 0.7 | -52.8 |
| COS-500 | 7.0 | 4.1 | 57.0 | 2.8 | -50.5 |
| MANUAL | - | 26.0 | - | - | -5.0 |

note: All costs are in thousands of dollars

figure 10

Relative Costs of the Systems Under Consideration

all of the hardware would be located in the Admissions office.

If the span of years under consideration is increased, the COS-500 system becomes increasingly more economical; conversely, if the size of the initial outlay is more important, the MULTICS system would be a wiser choice.

Of the other systems considered, the one most cost effective would be TSO. However, TSO provides essentially the same service as MULTICS, but is slightly harder to work with in an interactive mode. The use of RDMS would not be cost effective, since the Admissions office would have to provide some support and management regardless of the system, and the development costs are not a large enough percentage of the total costs.

ENTRANCE 1975 APPLICATION PROCESSING CALENDAR

1974

| | | |
|---|---|---|
| September | 19 | Begin sending final applications to 1974 cases. |
| October | 17 | Begin reading Early Action cases. |
| | 30 | OAIS: Personal Rating Cards<br>Resubmit unmatched CEEB scores |
| November | 1 | Early Action deadline |
| | 6 | OAIS: Print Laundry Lists to EA's |
| | 7 | Send Laundry Lists. |
| | 20 | OAIS: Run E-3 stickers. |
| | 22 | Put Stickers on E-3 cards. |
| | 28-29 | Early Action Round-Up |
| December | 2 | Begin reading cases for Early Evaluation.<br>Mail EA letters. |
| | 4 | OAIS: Run update and stickers on late EA cases for late decisions. |
| | 5 | Put stickers on E-3 cards. |
| | 6 | EA clean-up |
| | 11 | OAIS: Update file; run list of EA admits. |
| | 13 | Release list of EA admits. |
| | 16 | Begin sending Early Evaluations to candidates. |

1975

| | | |
|---|---|---|
| January | 1 | Application deadline |
| | 2 | Prepare cases for group readings. |
| | 3 | Group reading starts. |
| | 13 | December CEEB's due. |
| | 15 | OAIS: Resubmit unmatched CEEB scores<br>Run brown cards for one endorsement-missing cases (except those missing EC reports) |
| | 16 | Begin reading one endorsement-missing cases. |
| | 22 | OAIS: Print Laundry Lists to all finals or those with three pieces of evidence.<br>Run list of probable admits for SFAO.<br>Run brown cards (personal rating cards) for interview-missing cases.<br>Run seventh semester grade report forms. |
| | 23 | Send Laundry Lists<br>Laundry List for Principal's recommendation.<br>Send seventh semester grade report forms to schools.<br>Begin reading interview-missing cases. |
| February | 1 | Send follow-up letter to deferred admits.<br>EA admits to Julie for letters. |

**Appendix I**

| | | |
|---|---|---|
| Feb. Cont. | 10 | January CEEB's due. |
| | 12 | OAIS: Run brown cards for two endorsements-missing cases.<br>Resubmit unmatched CEEB scores. |
| | 13 | Begin reading two endorsements-missing cases. |
| | 19 | Staff meeting to discuss Round-Ups<br>Group reading complete. |
| | 22 | OAIS:-- Special Weekend Run:<br>EC-Admissions Match - Merge<br>E-3 stickers (group and regular)<br>Brown cards for three endorsements-missing cases<br>Raters and course listing |
| | 24 | Begin reading three endorsements-missing cases. |
| | 24,25 | Post group E-3 stickers. |
| | 26 | Group Round-Ups begin.<br>OAIS: Final clean-up on applicants for regular round-up (including School List, Distribution Report).<br>Run foreign E-3 stickers.<br>Punch action cards and student aid control cards. |
| | 26,27 | Post regular E-3 stickers. |
| | 28 | Post late E-3 stickers and foreign E-3 stickers.<br>Early Evaluation complete. |
| March | 3 | General Round-Up begins. |
| | 5 | Foreign Round-Up begins.<br>Minority Groups Round-Up begins. |
| | 8 | February SAT's due. |
| | 11 | End of Round-Ups. |
| | 17 | OAIS: Run zip-ordered Admitted Address List (and correct). |
| | 19 | OAIS: Rerun Admitted Address List.<br>Run School List for telephone calls (4 copies). |
| | 20 | Duplicate Address List. |
| | 21 | Mail Action Letters and release Address List. |
| April | 9 | OAIS: Raters and Course Listing |
| | 15 | Aid notices sent. |
| | 21 | Review Waiting List. |
| May | 1 | Candidates' Reply Date |
| | 7 | OAIS: Run School List with actions - exclude college transfe |
| | 14 | Clean up Waiting List.<br>OAIS: Run Freshman Admitted and Coming List<br>Main transfer to Registrar's PS file including Interphase students; weekly thereafter. |
| | 15 | Check Admitted and Coming List. |
| | 21 | OAIS: Run special update on Admitted and Coming List.<br>Run final grade reports on Admitted and Coming. |
| | 22 | Freshman Admitted List Masters produced - check with FAC Office. |
| | 28 | OAIS: Non-parent Name List for FAC Office. |

| | | |
|---|---|---|
| June | | Re-order all forms for 1976. |
| | 4 | OAIS: School listing for posting of actions on school cards, excluding CT's.<br>Zip order address list for EC Office.<br>Run applicant summary statistics. |
| | 5 | Begin count of schools and students for admitted and coming for President's Report and Profile, excluding CT's. Keep up-to-date thereafter. |
| | 9 | Record graduation data on school cards. |
| | 11 | OAIS: Print Advanced Placement labels for working cards.<br>Run Course Preference Lists (alpha and course order). |
| July | 2 | Sort Advanced Placement Materials. |
| | 9 | Gather data for President's Report: Counts, Georgraphic Distribution, Interview Statistics.<br>OAIS: Run geographic distribution, source of application counts. |
| | 30 | Run final grade stickers on 1975's. |
| August | 4 | Send 1975 E-3 cards to Microfilm.<br>Check 1976 cases and punched cards. |
| | 7 | OAIS: Run statistics cards. Exclude CT's, and sort on columns 77, 78, and 79. Refer to program documentation.<br>After-the-fact statistics package<br>CEEB averages. |
| September | 3 | Begin sending finals to 1976 applicants, with referrals.<br>OAIS: Applicant summary statistics |
| | 10 | OAIS: Final 1975 Update<br>Final 1975 School List and Alpha List (excluding CT's). |
| | 17 | OAIS: Create Future Applicant File. |

CCB:JC

Appendix II

Sample E-3 Card

ENTER

LAST NAME FIRST MIDDLE TITLE EX

REPLY ADDRESS

HOME ADDRESS

BORN | SOC. SEC. NO. | SEX | CIT. | GROUP

| CODE | SECONDARY SCHOOLS | REP. |
|---|---|---|
| | | |
| | | |
| | | |

SAT and Achievement Test Scores

High School Grade Summary

| PERS. RAT. | BY / DATE | PERS. RAT. | BY / DATE | PERS. RAT. | BY / DATE |
|---|---|---|---|---|---|
| | | | | | |

SCHOL. REV. BY

| FORM | BY | DATE | MAILED |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

NOTES ON ACTION:

CLERICAL NOTES:

CARBON ACTION:

SOURCE:

| | MO. | DAY | YR. |
|---|---|---|---|
| PREL. RCVD. | | | |
| FINAL RCVD. | | | |

☐ MED. REP.

☐ REVIEWED

☐ A-60

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