

FEASABILITY OF A DATA BASE MANAGEMENT SYSTEM
FOR THE COLLEGE OF ARTS AND SCIENCES

by

David Joe Ljungdahl

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Approved by


Major Professor

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I. INTRODUCTION TO THE PROBLEM

This report deals with the need for an automated budget information system in the College of Arts and Sciences at Kansas State University, Manhattan, Kansas. At the present time all budget information is kept in a single volume binder. It is prepared once a year by the data processing center on the campus at Kansas State. The current budget information consists of a listing, by department, of which there are twenty-six in the College of Arts and Sciences. The listing for each department contains information concerning each employee. This consists of name, rank, payroll information, classification, monthly basis, tenths time, and a breakdown of the individual's dollar and tenth amounts by funding source. A summary of totals for the dollars and tenths allocated to the department by funding source is also included. The final item is a total dollar amount allocated for office equipment and supplies.

Once this budget is printed any subsequent changes are entered in the ledger by hand. Some of the more numerous changes to be penciled into the ledger consist of; the addition of GTA'S, GRA'S, faculty, or staff, as well as any resignations. Also included are changes of funding sources for an individual's tenths and dollars. This is currently the only provision for recording changes in any of the budget listings. This method requires a considerable amount of time and effort to keep the information current. Since each department receives a copy of the original budget, it too must make any changes by writing on its copy of the budget. This procedure of reflecting changes by writing on the original could lead to a discrepancy between what the dean's office and

an individual department show for balances on their respective copies of the budget. Besides the fact of being prone to error, this present method for including changes is also very time consuming. If one considers the dean's office and the fact that one must maintain the records and record all changes in employee status as well as changes in dollar and tenth amounts for all twenty-six departments as well as ones own, it can easily be seen that a vast amount of time is spent keeping the records current by manual methods. This procedure for updating and making changes in the different budget items is less than satisfactory if complete up to date information is to be available in the dean's office as well as in the individual departments.

One of the main budget items that needs to be watched closely is the number of tenths each department has allocated. Specifically, the dean's office would like to know the number of tenths assigned and the number of free tenths classified by the different fund sources.

The present means of keeping the budget information current lacks speed as well as the ability to produce reports and other useful information to aid in budgeting matters. It also does not have the ability to combine data to form meaningful functions in the areas of budget planning and comparisons between departments as well as other statistical functions.

Since the dean's office maintains student records, it could also be mentioned that it would be possible to include these in the computer system at some future date. By including the student records in the system it would then be possible to have on-line graduation checks. This procedure would make the task of clearing a student for graduation much easier than the manual procedure now utilized.

By automating this system many improvements may be realized. A set of objectives will illustrate this point:

SHORT-RANGE OBJECTIVES:

- 1.) Provide quick and easy access to current budget information to aid decision making
- 2.) Provide a means for keeping budget information current at all times
- 3.) Provide the dean's office and the departments with current budget information when requested
- 4.) Provide statistical information for planning purposes

LONG-RANGE OBJECTIVES

- 1.) Have all student records in the system for on-line access
- 2.) Provide graduation checks on-line
- 3.) Offer an on-line budget planning procedure

Computerization will not only enable a large reduction of time spent keeping the budget information current, but will also provide added benefits which may be derived by analyzing the available data to provide a better overall picture of the budget condition throughout the College of Arts and Sciences. The capacity to use the budget data for many more purposes will be realized since the computer can perform the vast number of complex data manipulations necessary to provide the desired results. Until now the data has been available in a very basic form and very little has been done with it due to the amount of manual effort required for any type of statistical summaries or comparisons. By using a computer for the budget information system this will no longer be the case.

An automated budget information system could consist of a computer and it's related peripheral devices for information manipulation and storage, and an interactive terminal for communication with the computer. The person

requiring information from the system would sit at the terminal and input his request on the keyboard, with the responses being viewed on a (CRT) display device. The form of the requests would be kept relatively simple so that almost anyone who desired information from the system could obtain it with ease.

In defining the requirements for construction of an automated budget information system there are three general areas to consider;

- I. General System Capabilities
 - 1.) on-line file creation
 - 2.) on-line file update
 - 3.) on-line file access
- II. Input/Output Requirements
 - 1.) keyboard entry of information and query processing
 - 2.) CRT (cathode ray tube) output of query results, and display of prompting messages for input of information
 - 3.) hard copy (line printer) for reports and listings
- III. Reports And Listings
 - 1.) available and in use tenths by department
 - 2.) listing of all file creations
 - 3.) faculty and GTA listing by department
 - 4.) listing of all updates by department
 - 5.) annual budget listing
 - 6.) tenth and dollar conditions by department
 - 7.) listing of tenths becoming free in the near future
 - 8.) from-to tenth totals by department and by source within department

SYSTEM MODULES AND THEIR FUNCTIONS:

The computerized budget information system will require a set of modules to perform certain functions within the system in order to properly maintain the information. Figure 1 shows these modules and their relation to the data base, and Figure 2 shows the communication between these modules.

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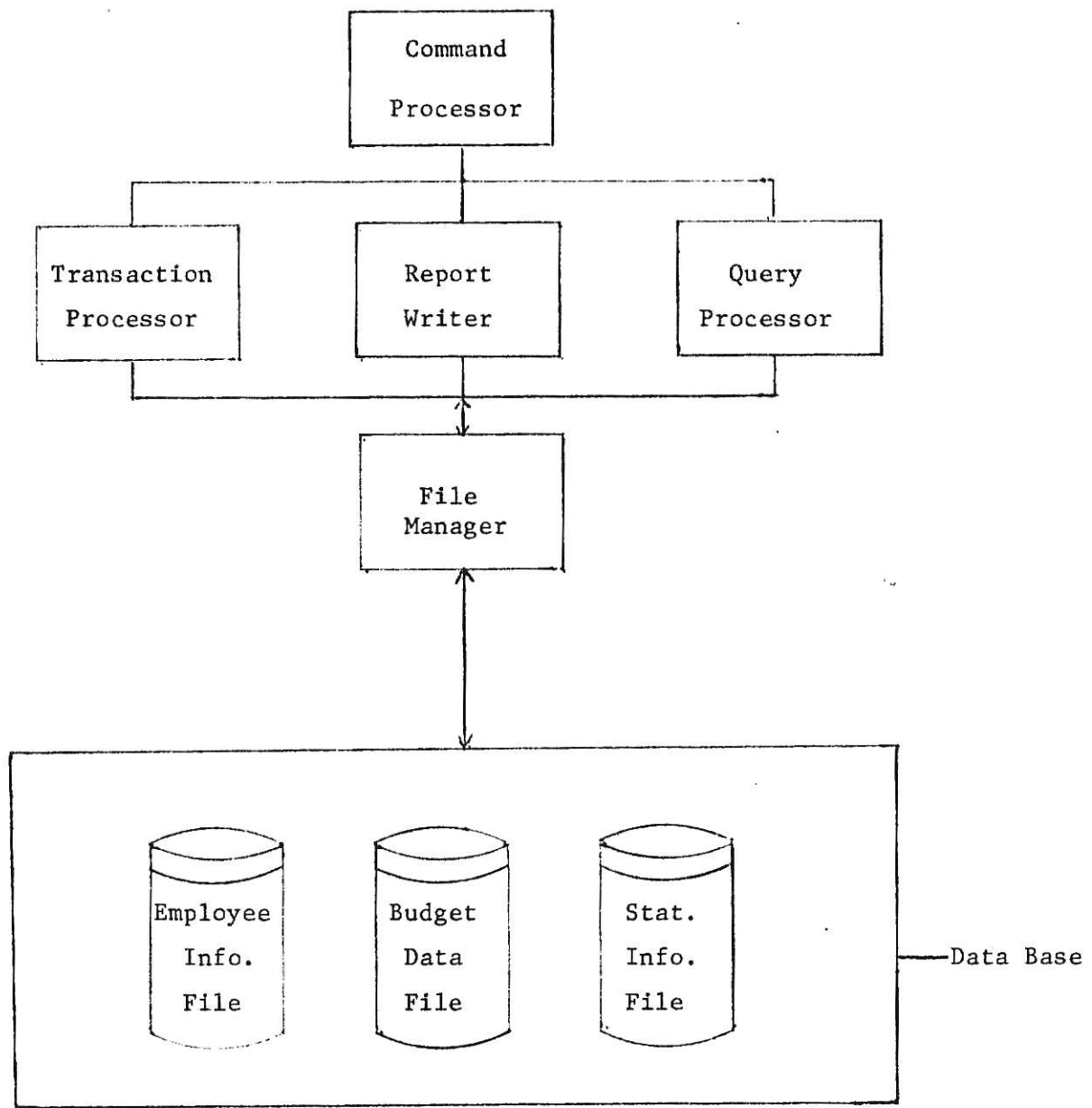


Figure 1
System Modules

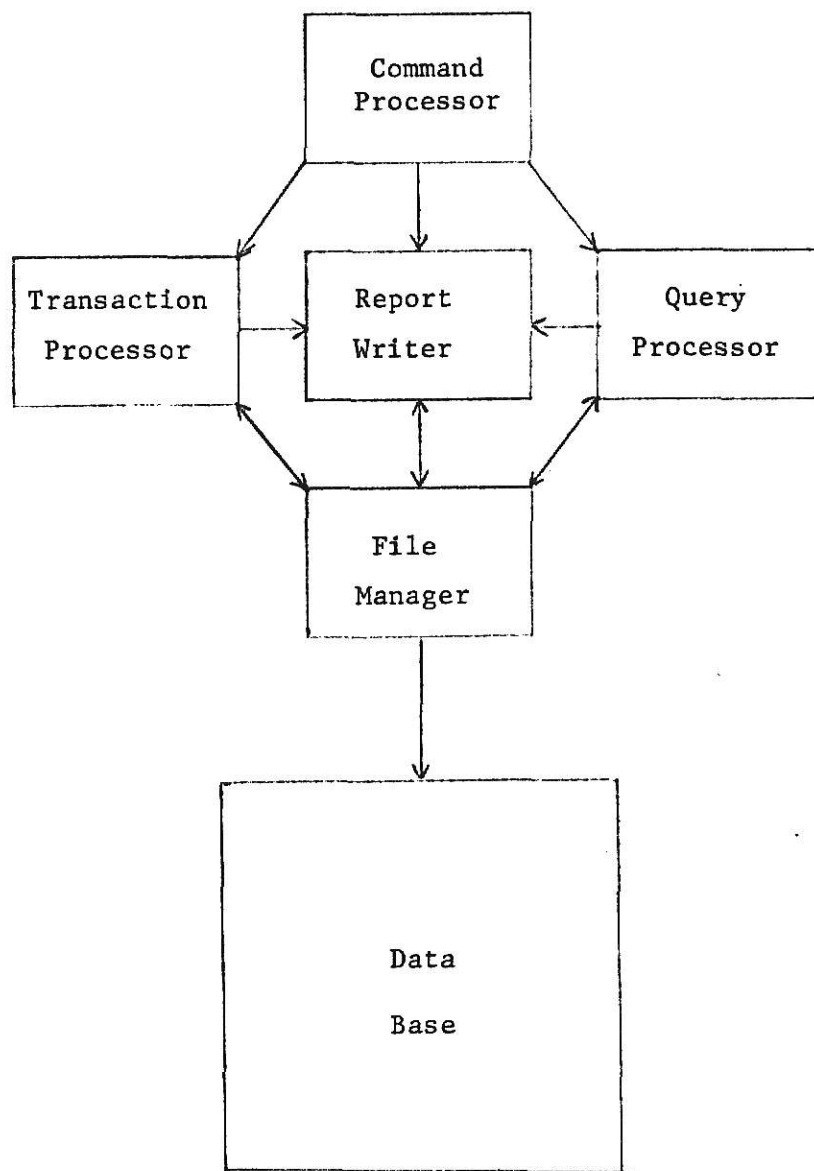


Figure 2
Communication
Between
System Modules

COMMAND PROCESSOR

The command processor will be responsible for accepting commands from the console keyboard and then determining if the command is valid. If the command is invalid, a message should be transmitted to the person at the console which displays the illegal command and advises the operator that the command is invalid. If the command is valid, the command processor then determines if the command consists of a query or a transaction which will effect records in the data base. If the command is a query it is passed along to the query processor, otherwise it is passed to the transaction processor for processing.

QUERY PROCESSOR

The query processor module will perform the task of breaking the query into its component parts. The main parts are; the department for which the information is desired, the information type which is needed, and the form the output is to take. The output may be on the CRT display unit or take the form of a printed report on the line printer. Once the information in the query is broken down into its component parts control will pass to the file manager module for completion of the query. After the required information is obtained by the file manager control passes back to the query processor which is responsible for output of the desired information.

TRANSACTION PROCESSOR

The transaction processor will handle all of the transaction other than queries. It will be responsible for breaking transactions down into their component parts, and then passing the requestion for the required

data to the file manager. Once the file manager has obtained the records required from the data base it will pass them back to the transaction processor which will perform the necessary operations on the records in compliance with the transaction being processed. Next the records will be sent back to the file manager for re-entry into the data base.

FILE MANAGER

The file manager is responsible for retrieving records from the data base in accordance with requests from the query processor and the transaction processor. It will function as a librarian for the data base. It must be capable of handling any request for single or multiple records from the sections of the data base that are requested. A statistical section might also be included in the file manager module. This section would keep records on which files are accessed most often, etc. This could be useful for evaluation of file structures and organization methods which could lead to increased efficiency in the future. Also this type of information could be useful to Arts and Sciences, showing which departments have the greatest number of budget transactions, which funds are most active as (determined by the number of transactions concerning them), and so on.

Another section of the file manager should be included, this being a file backup routine. This section would transfer all of the files in the data base, which resides on a disk storage unit, to a backup storage medium such as magnetic tape. This procedure is necessary so that in the event the disk pack was damaged, thus destroying the files, a copy of those files would be available to restore them to another disk pack.

REPORT WRITER

The report writer will be responsible for processing requests for

reports. The reports required are; tenths summary by department, listing of updates, faculty and GTA listing by department, annual budget listing, tenth and dollar summary by department, and listing of tenths becoming available in the near future. The report writer may be invoked directly by the command processor or indirectly from the transaction processor or query processor. It will then obtain the required records from the data base via the file manager and print the requested report.

SOFTWARE CONSIDERATIONS

The software needed to implement this system would be fairly straightforward in regard to the modules which handle the inputs and outputs, which are; the command processor, transaction processor, query processor, and report writer. The module requiring the most planning and design would be the file manager. In design of this module, the physical file organization method to be used would bear considerable thought. No matter how the files are structured and linked, the file organization will be relatively complex.

II. DATA ORGANIZATION

The budget information is divided into two main areas; unclassified and classified. Unclassified refers to faculty and classified refers to employees such as office help and departmental technicians. Unclassified is funded from six sources: General Fees, Restricted Fees, Sponsored, Bureau of General Research, Engineering Experiment Station, and Agricultural Experiment Station. Two of these sources are subdivided: General Fees is composed of Federal Fees, General Revenues, and General Fees. The Agricultural Experiment Station is composed of General Revenue, Restricted Fees, Federal Hatch, and Federal Hatch Project. Classified money is funded from five sources: General Fees, SRO, BGR Restricted Fees, Restricted Fees, and Agricultural Experiment Station. The Agricultural Experiment Station is subdivided into two subsources: General Revenue and Restricted Fees. See Figures 3 and 4 for more information on these divisions.

DATA BASE STRUCTURE

In automating the budget information system the budget data for each department will be grouped together to form a consolidated file structure, or data base. The data base will consist of three types of files: master employee information, budget information, and statistical information.

1.) Master Employee Information File

This file will contain an entry for each employee consisting of payroll information, salary source (S) in tenths and dollars, classification, and monthly basis. See Figure 5.

2.) Budget Information File

This file is subdivided into two main divisions: classified and unclassified. Each of these is further divided into total amounts for free and assigned dollars, free and assigned tenths, and original allocations of tenths and dollars. Next, the individual classifications are broken down by sources and subsources. Each source and or subsourse contains four data items:

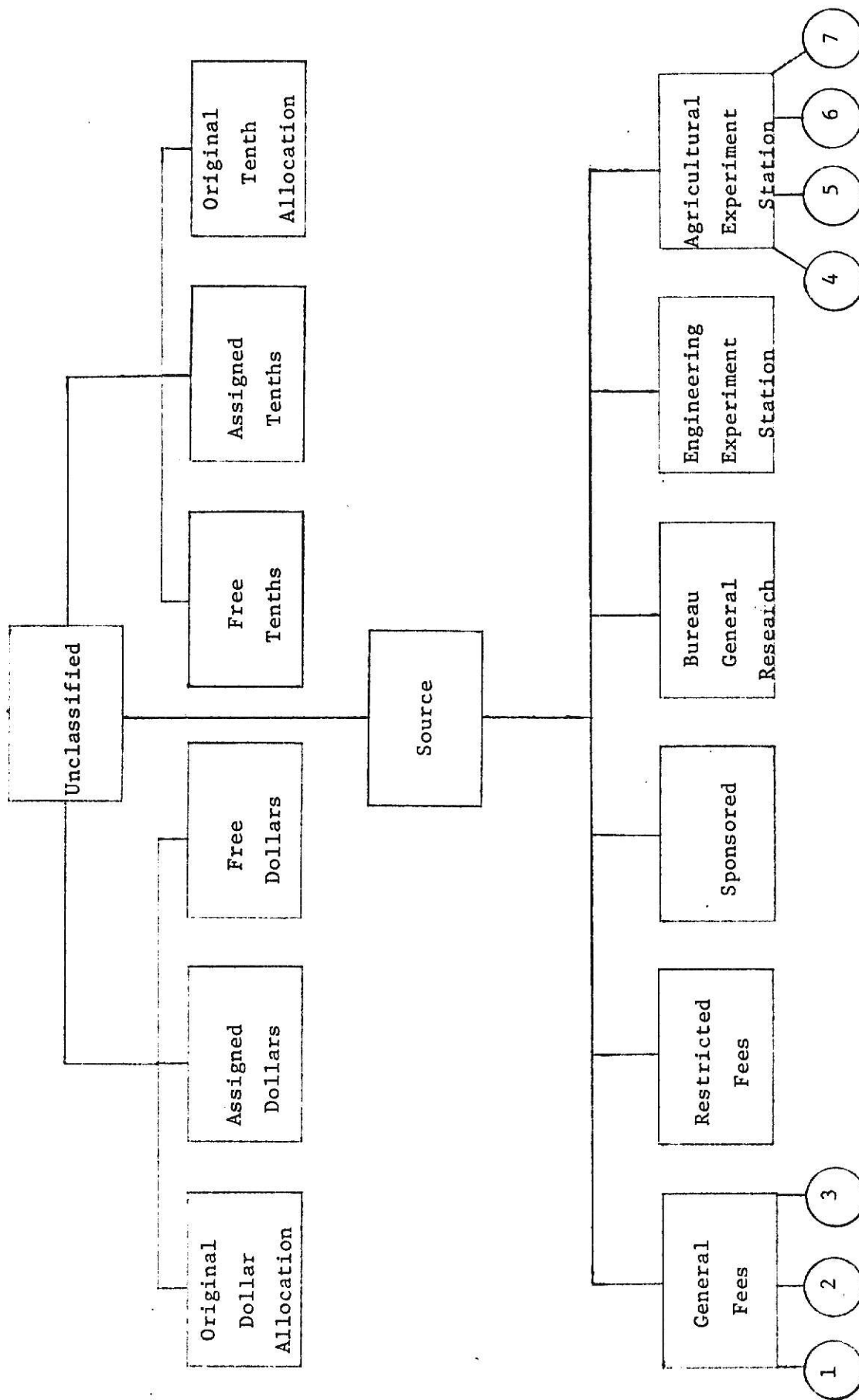


Figure 3

Unclassified Data Structure

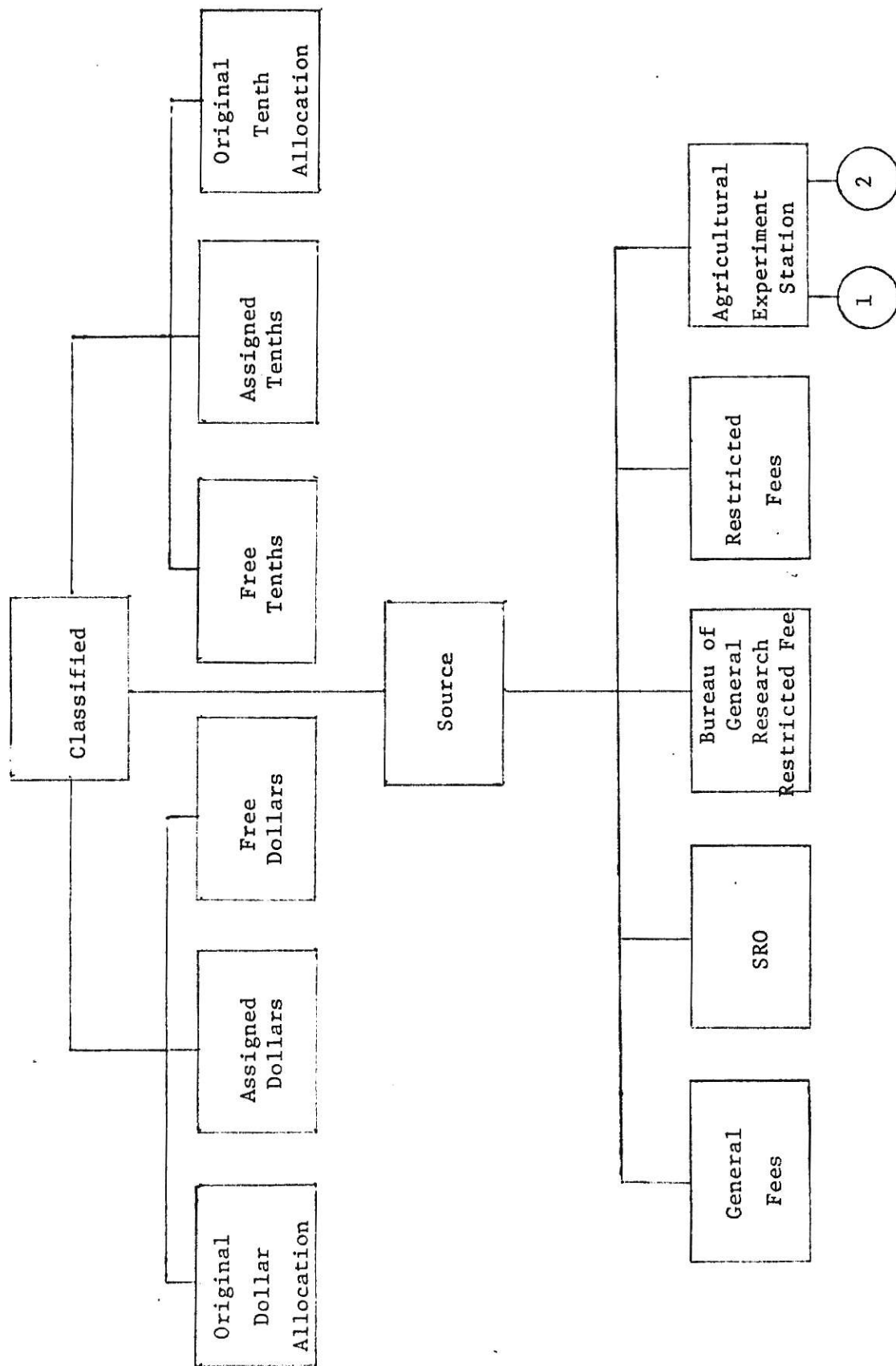


Figure 4

Classified Data Structure

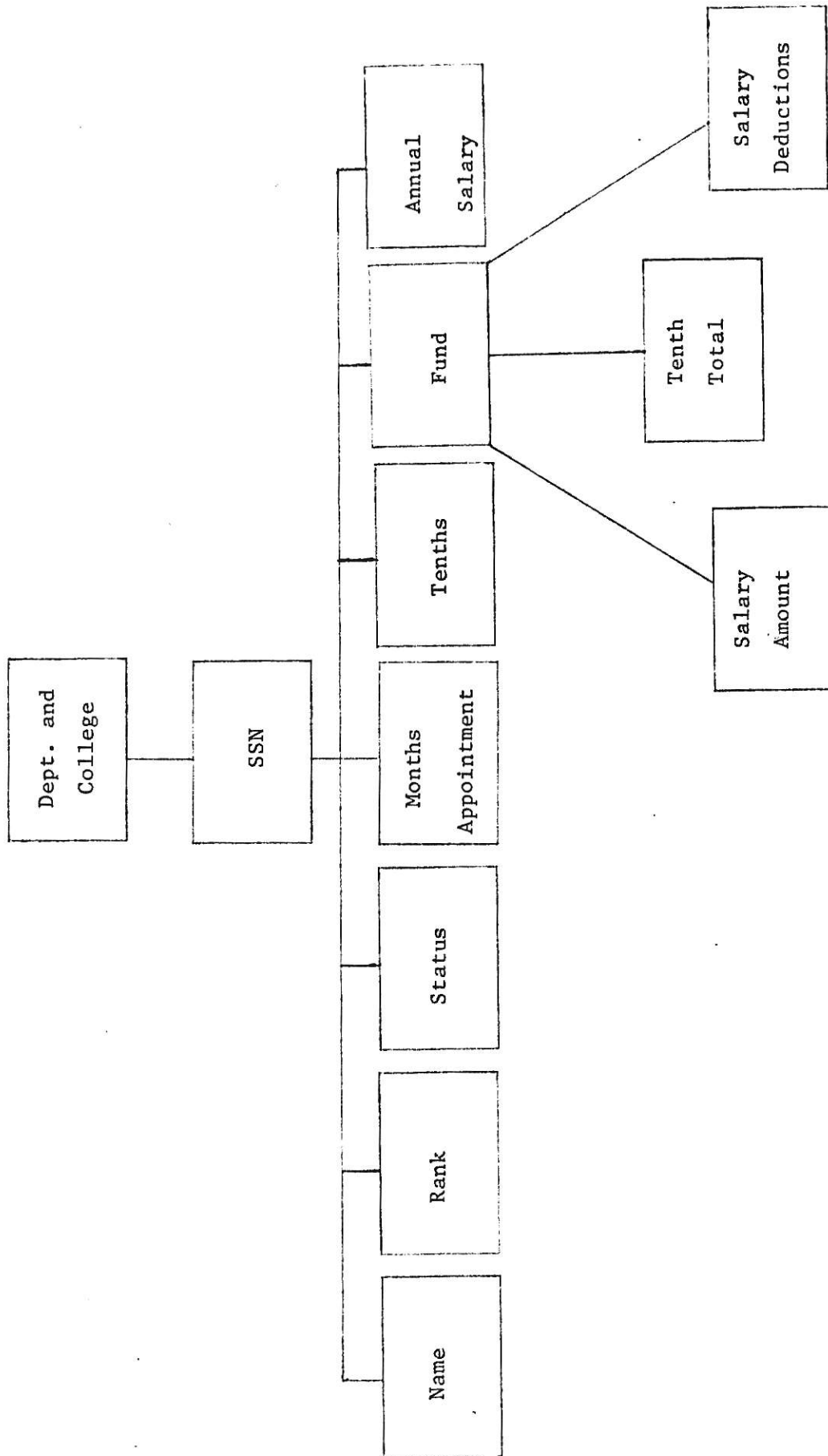
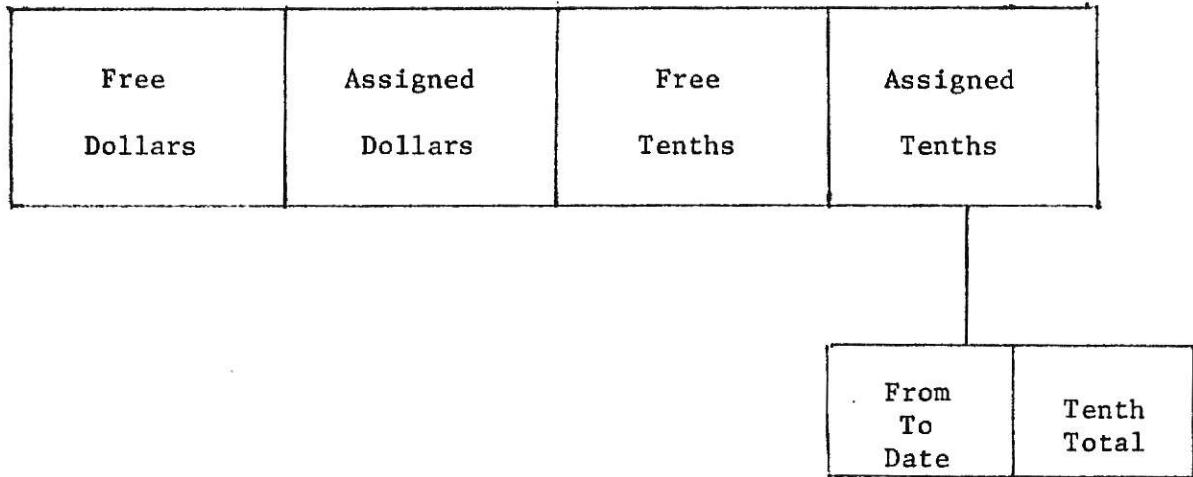


Figure 5
Employee Information Record

Structure of data items for each source not containing subsources.



Structure of data items for each source containing subsources.

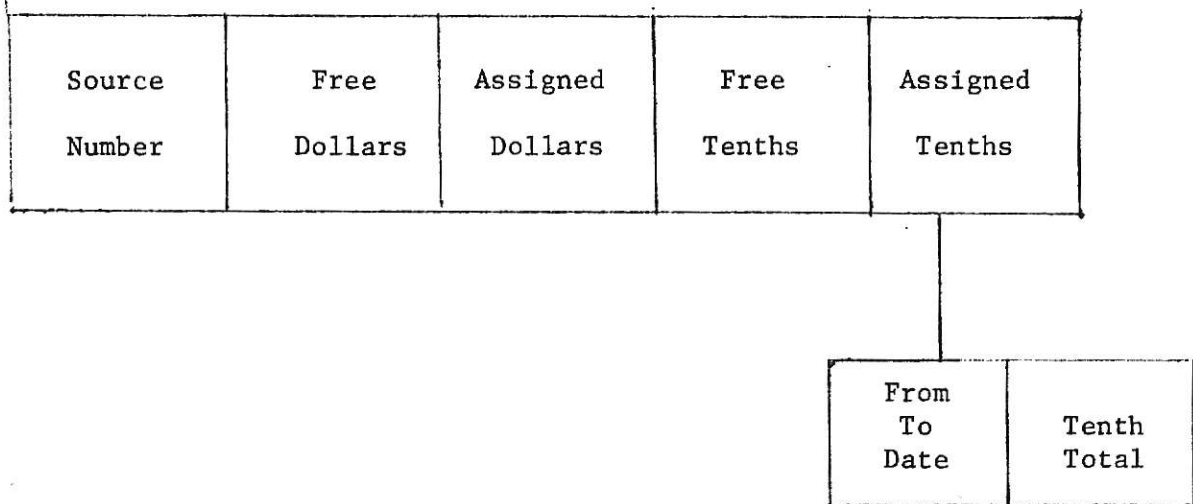


Figure 6
Data Items

free dollars, assigned dollars, free tenths, assigned tenths. The data item for assigned tenths is further divided into a from-to structure in which the tenth totals are stored together with from-to dates. See Figure 6. The dean's office will have identical data structures; there will be two of each, one for the dean's office faculty and staff, the other will contain totals for all departments.

3.) Statistical Information

This file will contain information generated by transactions which may be required for reports, such as a list of employees added since the physical year budget was produced, any changes effecting dollar and/or tenth values, changes in from-to tenth allocations, etc. This file will contain an entry for each department.

USE OF THE DATA BASE

There are two types of system inputs which will utilize the data base: transactions and queries.

TRANSACTIONS:

- I. Faculty Leaves KSU
 - A. Return salary to free dollars, deduct salary from assigned dollars.
 - B. Return tenths to free tenths, deduct tenths from assigned tenths.
 - C. Update from-to tenth totals.
 - D. Place entry in statistical file.
- II. New Faculty Arrives
 - A. Create master employee information record.
 - B. Deduct tenths from free tenths.
 - C. Deduct dollars from free dollars.
 - D. Add tenths to assigned tenths according to from-to dates.
 - E. Place entry in statistical file.
- III. Leave Without Pay
 - A. Deduct tenths from assigned tenth according to from-to dates.

- B. Return tenths to free tenths.
- C. Update status in employee master information record.
- D. Place entry in statistical information file.
- IV. Change of Monthly Basis (9 or 12 month)
 - A. Update information in master employee record.
 - B. Adjust from-to tenth totals.
 - C. Adjust dollar totals.
 - D. Place entry in statistical information file.
- V. Source Of Salary Change
 - A. Update free and assigned tenths totals according to from-to dates.
 - B. Update free and assigned dollar totals.
 - C. Update information in master employee information file.
 - D. Place entry in statistical information file.
- VI. Sabbatical Leaves
 - A. Add (partial amount) of salary to free dollars and subtract (partial amount) of salary from assigned dollars.
 - B. Add assigned tenths (according to from-to dates) to free tenths.
 - C. Change status in employee master file.
 - D. Place entry in statistical information file.
- VII. Change In Tenths Time
 - A. Update tenths information in employee record.
 - B. Update the number of tenths according to from-to dates for assigned and free tenths.
 - C. Update free and assigned dollars.
 - D. Place entry in statistical information file.
- VIII. Department Hires GTA or GRA
 - A. Create master employee record.
 - B. Subtract tenths from free tenths.
 - C. Add tenths to assigned tenths according to from-to dates.

D. Subtract dollars from free dollars and add to assigned dollars.

E. Place entry in statistical information file.

IX. Loaning And Borrowing Tenths

A. A subjective decision is made in the dean's office as to the source from which the tenths are to be borrowed. An entry should be placed in the statistical information file of the borrower stating which department received the tenths and which department loaned the tenths.

QUERIES:

Queries used to gain information from the data base might include:

- 1.) How many tenths are free for Department X
How many tenths are assigned for Department X
How many dollars are assigned for Department X
How many dollars are free for Department X
- 2.) Expand the above queries to include specific fund sources
- 3.) Ability to check from-to dates for tenths assigned by department and source
- 4.) Ability to gain employee master record information
- 5.) Combine file entries in order to produce statistical information, i.e. ability to ask for the mean annual salary for professors in the engineering college, or compare women's salaries to men's within departments and/or the College of Arts and Sciences

An example transaction and its effects upon the data base might look like this:

John Doe is hired by the Computer Science Department as a GTA for nine months. His salary will be \$320/month for four tenths time. His classification will be unclassified. The fund source will be restricted fees.

The following are the steps the computer would execute:

Step 1 - Create an entry in the master employee information file for the Computer Science Department.

Step 2 - Add four tenths to the assigned tenths data item for the restricted fees source which is in the unclassified budget information file for the Computer Science Department (the from-to dates are September - May).

- Step 3 - Subtract four tenths from the free tenths
- Step 4 - Add \$2,880 to assigned dollars (Restricted Fees)
- Step 5 - Subtract \$2,880 from free dollars (Restricted Fees)
- Step 6 - Make an entry in the statistical information file for computer science stating that John Doe was hired as a GTA, the tenths amount, dollar amount, and from-to dates for his tenths.

The following procedure would be employed by the person at the terminal wishing to enter John Doe into the system:

- 1.) Enter transaction identifier code to identify the transaction as an employee addition)
- 2.) Read prompting message to determine which information to enter
- 3.) Enter the information.
- 4.) Repeat Steps 2 and 3 until the transaction is complete.
(A message would be displayed signifying this fact.)

STORAGE REQUIREMENTS

The following tables present the amount of storage required for the data base (these are estimates and should not be taken as firm requirements).

Table 1

Employee Information Records

Number of Records	Length in Bytes	Total for 27 Departments
1	100	2,700
10	1,000	27,000
20	2,000	54,000
30	3,000	81,000
40	4,000	108,000

Table 2
Unclassified Record Lengths

Record Name	Length in Bytes	Total for 27 Depts.
General Fees	132	3,564
Restricted Fees	40	1,080
Sponsored	40	1,080
BGR	40	1,080
Engineering Experiment Station	40	1,080
Agricultural Experiment Station	176	4,752
Total Length	468	12,636

Table 3
Classified Record Lengths

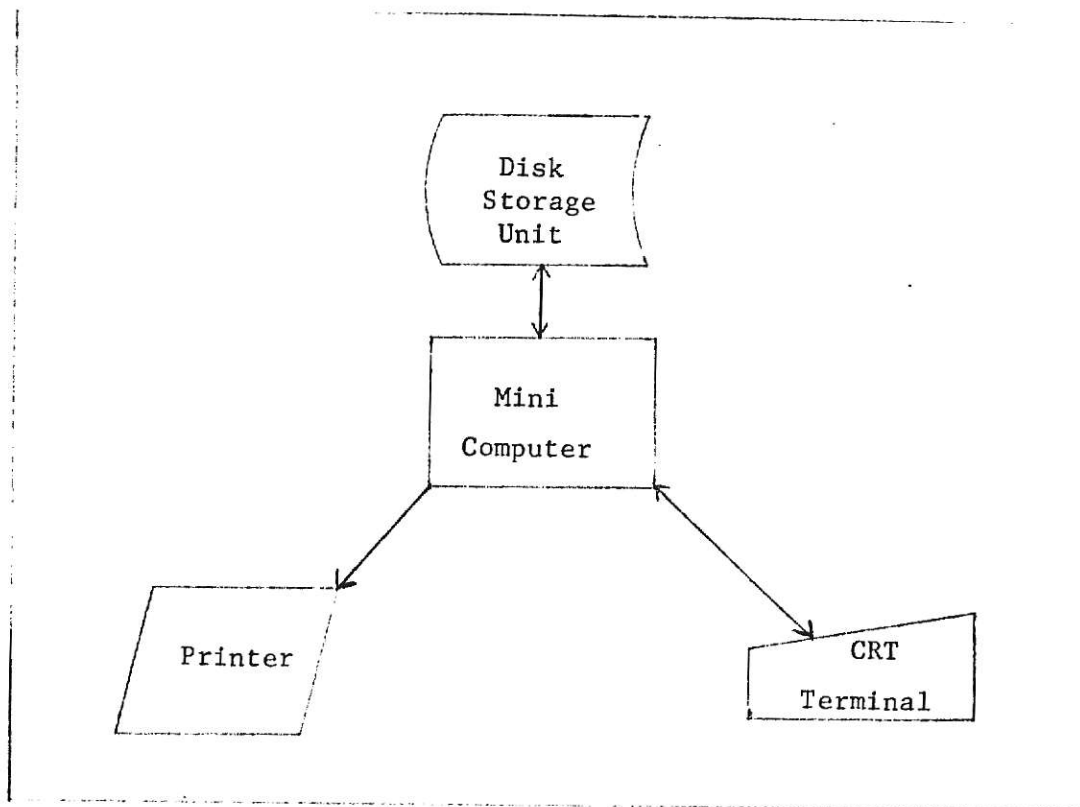
Record Name	Length in Bytes	Total for 27 Depts.
General Fees	40	1,080
SRO	40	1,080
BGR Restricted Fees	40	1,080
Restricted Fees	40	1,080
Agricultural Experiment Station	88	3,240
Total Length	248	7,560

III. PROBLEM SOLUTIONS, COSTS, AND COMPARISONS

There are four conceivable alternatives which could be employed to solve the computing requirements.

- 1.) Provide a complete mini computer system to be located in the dean's office.
- 2.) Use a centralized mini computer facility by recording information on cassette tape in the dean's office for processing at the mini computer facility.
- 3.) Use a centralized mini computer facility via teleprocessing.
- 4.) Use the IBM 370/158 in the KSU Computing Center via a telephone line connection.

SOLUTION #1



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This solution involves using a complete mini computer configuration. System components include a mini computer, line printer, disk storage unit, and CRT terminal. The system would be located in the dean's office.

ADVANTAGES AND DISADVANTAGES

This proposal would provide for a centralized facility. There would be no need to depend on any other equipment for support of the computing requirements. The system could be used at any time as opposed to the possible discretion of the host facility in a teleprocessing environment.

The main disadvantage to this centralized facility is the cost/use ratio. This system would not be used enough to keep the machine busy at all times. The cost of this system would be very high, especially if related to the amount of time the machine is actually used.

COST

Central processing unit with 8K memory
CRT terminal
2.1 megabyte disk storage
80 line per minute printer

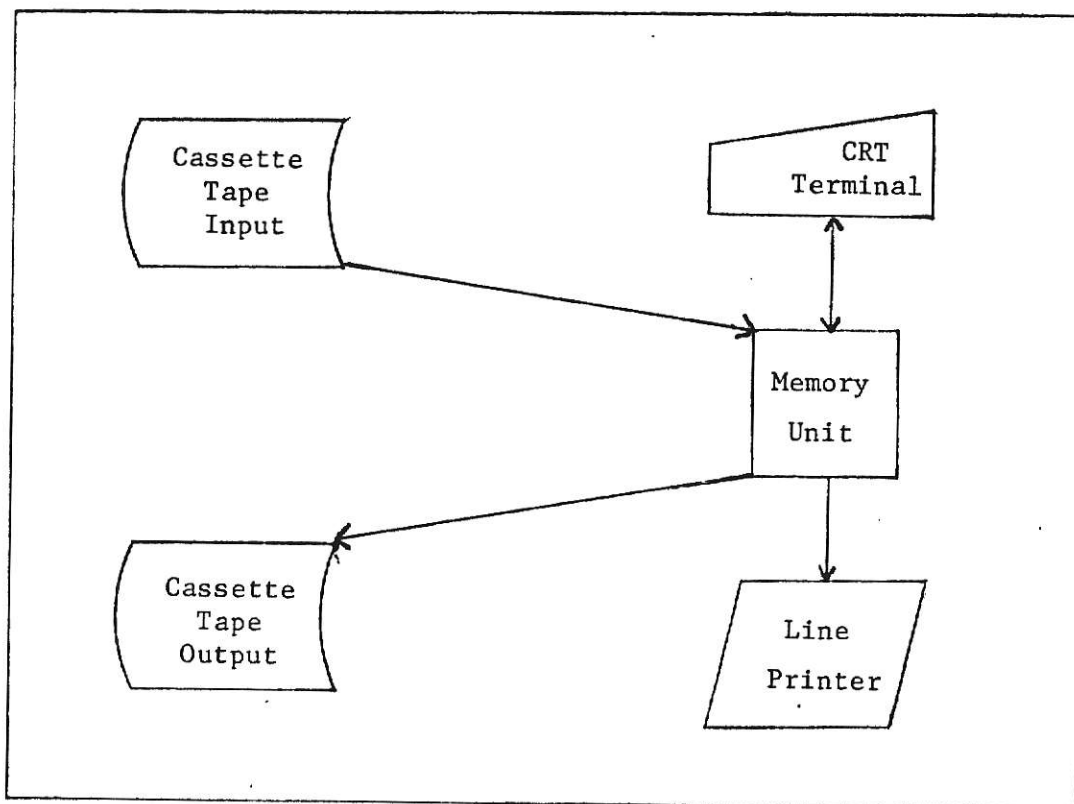
Total purchase cost	\$32,100
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Maintenance	\$180/month
System Software	\$400
Programming Cost	\$900

Initial cash outlay	\$33,400
Continuing costs	\$183/month maintenance

SOLUTION #2

This solution would provide a data entry terminal in the dean's office. The terminal would consist of a CRT display unit with programmable memory, a dual cassette tape drive, and line printer.



This system would provide access to current budget information via an updated cassette tape which could be accessed from the data entry terminal.

The daily transactions would be entered on the terminal, which would write them on tape. At the end of the day, or a designated period, the tape would be sent to a central processing facility for processing and production of an updated tape which would contain current budget information. Information from the tape could also be printed if desired.

ADVANTAGES AND DISADVANTAGES

By using the data entry terminal system, the user is freed from purchasing all of the equipment necessary for storing, manipulating, and printing the required data. The only things with which the user must be concerned are entering the daily transactions for recording on tape and entering queries for information items at the terminal console.

One of the major disadvantages is the possibility that the computer in the central processing facility may go down preventing processing of the tapes.

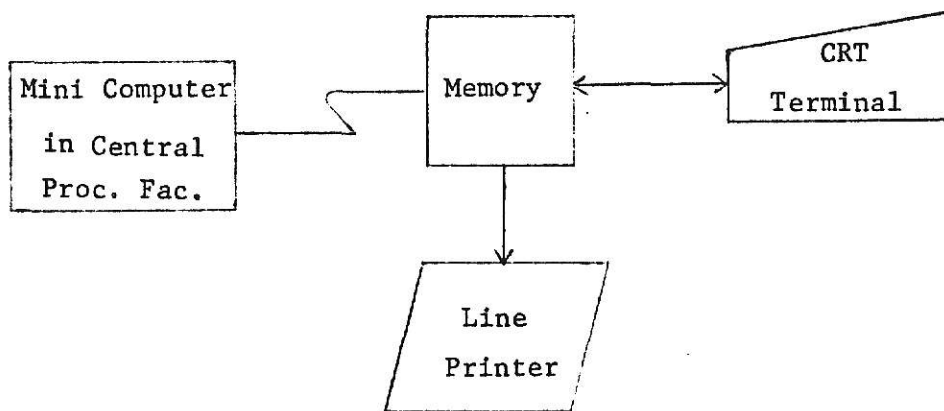
COST

CRT terminal (4K memory)	\$4,700
Printer (60 lines per minute)	2,000
Two portable cassette drives (zipper)	1,000
Initial cash outlay	\$7,700

CPU cost \$12 - \$15/hour
Programming cost \$1,000

SOLUTION #3

This solution involves using CRT terminal and telecommunications.



The CRT terminal in the dean's office would communicate with a mini computer located in a centralized processing facility via a dial-up telephone line connection. All queries and transactions would be transmitted directly to the mini computer for processing. Information coming from the mini would be displayed on the CRT and could also be printed on the line printer.

ADVANTAGES AND DISADVANTAGES

This solution has merit in that the dean's office could use the facilities of a complete mini computer system without the great cost of such a system, the only cost being in the hardware necessary to communicate with the mini computer and to display the information.

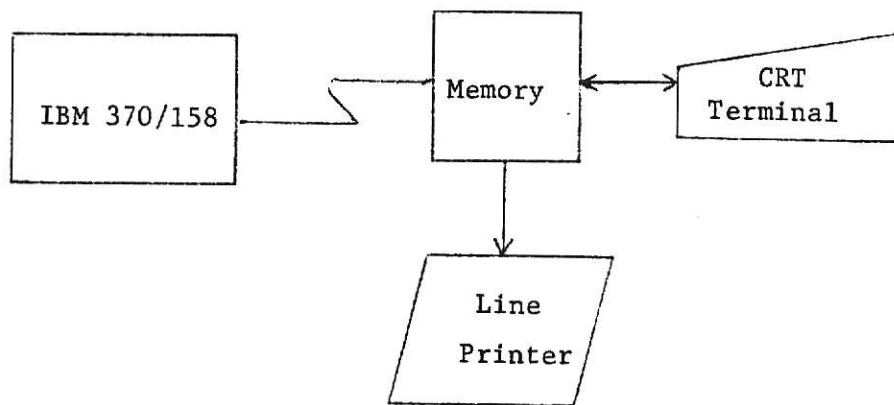
A disadvantage would be that the dean's office could only use the facilities of the mini computer at such times as the facilities are up and running.

COST

Programmable asynchronus line adaptor	\$ 450
Two cables	130
Two modems	600
CRT	1700
Printer (60 lines per minute)	<u>2000</u>
Initial cash outlay	\$4880
CPU cost \$12 - \$15/hour	
Programming cost \$900	

SOLUTION #4

This solution involves the use of the university computing center facilities. A telephone line connection between a CRT terminal and the IBM 370/158 would be employed. The dean's office would be equipped with a CRT terminal and a line printer.



ADVANTAGES AND DISADVANTAGES

In looking at the advantages of utilizing the IBM 370/158 two time frames should be considered; short term (up to 1 year) and long term. The short term would be considered a developmental phase in which the software would be developed and debugged. The cost would be low relative to the long term or

production phase. The lower cost of the development phase would be due to the use of a leased IBM 2741, \$5/hour connect time charge, CPU cost, and programming cost which is estimated at \$750. By using the IBM 370/158 system, a savings in software development would be realized since a high level language would be used. Looking at the long term time frame, certain costs would be high. Since the CRT terminal would interface to the system through CMS (the conversational monitor system), the connect time charge of \$5/hour would mount up. The CPU charge would also be a big cost factor.

COST

CRT	\$1500
Printer (60 lines per minute)	2000
Line set (port)	<u>600</u>
Initial cash outlay	\$4100
CPU cost	\$ 120/hour
Connect time	\$ 5/hour
Programming cost	\$ 500

GENERAL CONSIDERATIONS

Objectives met:

The following objectives are met by these proposed solutions:

- 1.) Provide quick and easy access to current budget information to aid decision making
- 2.) Provide a means of keeping all budget information current
- 3.) Provide the dean's office and the departments with current budget information when requested
- 4.) Provide the ability to have all student records in the system
- 5.) Provide graduation checks on-line
- 6.) Offer a budget planning procedure
- 7.) Provide statistical information for planning purposes

EVALUATION OF SOLUTIONS

Several factors should be considered in evaluating any system. The type of applications to be added to the system at some future date should be considered. This is necessary so as to insure that the system will be capable of handling a larger work load without having to make drastic changes in the amount of equipment required. If more equipment capacity is required, then make sure that the foundation components will easily allow for upgrading.

When comparing any systems, cost/benefit analysis is very important. Looking at Solution #1, the cost is high and the usage ratio is relatively low. If the usage is not high enough for the computer system to be busy a majority of the time, the vast computing resources are not being utilized to their potential.

Solution #2 presents an alternative to the problem of low cost/benefit ratio. By eliminating some expensive equipment; the mini computer, line printer, and disk storage unit, and requiring only the data entry terminal and a slower line printer the cost/benefit ration is greatly increased. This is possible since the monetary outlay is vastly smaller in relation to use of the equipment purchased. The very expensive equipment is in the central processing facility, where it can be used more and can be cost effective due to the many applications being processed daily.

Solution #3 is very similar to Solution #2 in that both utilize the concept of using the mini computer in the central processing facility. The only difference between these two solutions is the method used to get the data to and from the host computer.

Solution #4, which involves using the IBM 370/158, would provide benefits such as reduced software development time and the ability to use a high level language. There are two costs to be considered; the short term and long term. The short term would provide a relatively inexpensive way to develop the system software. The long term costs would tend to make the total cost for this solution quite large.

IV. CONCLUSION

In evaluating the alternatives, the main concerns are cost/benefit, ease of use, and future expansion capability. All four solutions satisfy the requirements of future expansion capability and ease of use. Solution #1 is very expensive and would not satisfy the cost/benefit requirement due to the limited use of the equipment. Solution #4 would provide a relatively inexpensive means of software development in the short term. Once the software is developed and the system is brought up for production, the total cost of this solution will tend to increase with time due to the connect time and CPU charges. Solutions #2 and #3 are very similar. They both would make system expansion transparent to the user since all system expansion such as programming, extra storage, and equipment modifications are resolved by the central processing facility. A choice between Solution #2 and Solution #3 would depend on the amount of time the mini computer system in the central processing facility will be available for processing the data and the requirements of Arts and Sciences concerning timely availability of budget information.

In regard to the afore mentioned central processing facility, it should be mentioned that such a facility could not only provide services for the college of Arts and Sciences, but for all colleges within the university.

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AN ABSTRACT OF A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Computer Science

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1975

This report consists of a feasibility study performed for the College of Arts and Sciences concerning the automation of their budget information system.

A description of the procedures currently in use by the dean's office for maintaining the budget information, along with some items which they would like added to the system are presented.

The budget data items and their respective structures are presented for inclusion in a data base. The system software modules for implementation of the automated system are also described.

Some possible solutions to the problem are presented and compared, offering a variety of methods for meeting the requirements of the automated budget information system.