

DATABASE SYSTEM FOR COMPUTING EQUIPMENT INVENTORY

A DATABASE SYSTEM FOR THE CONTROL AND
MAINTENANCE OF COMPUTING EQUIPMENT INVENTORY

By

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ABSTRACT

It is proposed to design, develop and implement a data base system to support the requirement of the Technical Computing Services department of McMaster University with respect to their responsibilities for the control and servicing of units of computing equipment at McMaster University.

This data base contains information concerning each unit of equipment, its manufacturer, custodian, model number, serial number, purchase or lease record, maintenance record, past and present locations and service record.

This project determines various cross-sections of this information to be retrieved. This includes the development of software to create, maintain, update the data base and to produce necessary reports. The design is implemented by CDC's DMS-170 with COBOL 5 as the host language.

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INTRODUCTION

Throughout the centuries the changing nature and volume of data, combined with technological progress, resulted in the gradual evolution of data processing methods.

In this century, especially in the last two decades, the evolution has been accelerated by the urgent need for better ways of handling data. Some of the factors that created the need for more efficient data processing techniques are the large volumes of data, accuracy requirements, need for more timely information and report generation.

There are many ways of data processing, e.g. manual, mechanical and electronic. Electronic data processing is the most recent major development, which even more recently has been enhanced by data base processing methods.

Data base technology allows an organization's data to be processed as an integrated whole. It reduces artificiality imposed by separate applications and permits users to access data in a manner natural to them.

This report pertains to the development of software for creating, maintaining and updating the data base which is known as the Equipment Inventory Data base. This software is developed primarily for use by the staff of Technical Computing Services at McMaster University. From any standard terminal, a user may access the system to query the data base as to its contents, or to update information stored there, provided

enough computer memory size is available for interactive use. The language used to manipulate data is COBOL 5. Since the contents of the data base must be confidential for obvious reasons, the data base will be accessible only to authorized users. Any information can be retrieved from the data base and can be presented in any form provided one has a working knowledge of COBOL 5.

For retrieving the contents of the data base in certain forms, a few procedures have been written. A procedure contains instructions to type required input, to manipulate data in the data base, to fetch required files and to submit a job to batchmode for execution. So a nontechnical user just needs to log in, call the required procedure and feed input through the terminal. Printed outputs can be obtained or can be seen on the terminal by fetching output files after the execution is complete. This report can be referenced to make any changes required in the data base as it completely describes the contents of the data base and all other information about it.

The first chapter includes a description of an existing system, and the need for a new computerized system. It also describes the objectives of a new system, and the potential benefits of its implementation.

The second chapter discusses design considerations which include alternative ways to achieve the objectives, the advantages of data base systems over ordinary computer file organization methods, description of the available facility of DMS-170 on the CDC-6400 for implementing the system, and an overview of the system design.

The third chapter describes the implementation which includes the data base description (schema), data dictionary, creation and update of the data base, together with a description of a few application programs for query processing and report generation. This also includes control features to preserve the integrity of the system.

The fourth chapter is on evaluation and performance of the system developed. This also includes a discussion of the problems encountered during the development of the project.

CHAPTER I

SYSTEM ANALYSIS

Before designing a new system, it is necessary to acquire an understanding of the existing system, and the results desired from a new system must be determined. The analysis of the existing system and objectives of the proposed system are presented in the following paragraphs.

1.1 Analysis of Existing System

Analysis of the existing system includes gathering, recording and analyzing facts about the existing system as it uncovers major problems that must be eliminated in the new system, and it helps in knowing user requirements. To investigate the existing system and the requirements of potential users, it was necessary to interview staff of Technical Computing Services at McMaster University. Interviews with Dr. J.S. Stephens and Mrs. Jackie Macdonald and analysis of the existing system revealed the following facts.

(i) At present, information concerning each unit of equipment, i.e. its manufacturer, custodian, model number, serial number, purchase or lease record, locations and service record etc. are recorded manually in files. Maintenance, update and retrieval of information are all manual operations.

(ii) Maintenance and update of information utilizes excessive time and effort on the part of staff. This results in late updating and causes trouble in producing up to date reports. It is very easy to make mistakes in such a situation.

(iii) The present system is rigid and inflexible. If it is required to change a very minor thing, one needs to do major modifications.

E.g. if maintenance cost is increased, then the whole record on paper needs to be changed instead of just the maintenance cost. Formats of reports are also fixed (on forms). There is no flexibility of having reports with a small change or different format.

(iv) The volume of activity in the system is expected to increase substantially as the university is in the process of acquiring more equipment for computing services.

(v) The existing system is not very efficient for handling the larger volumes that might result from normal growth.

(vi) Retrieval of information is not very rapid as many files have to be searched even for a small piece of information.

To perform the above mentioned clerical operations more efficiently, it was proposed to computerize the whole system.

The above mentioned facts lead to the need for having a new system with the objectives that it would eliminate the problems in the existing system and allow expansion for future applications.

1.2 Objectives of the System

The basic objectives are as follows:

1. To maintain all information concerning units of computing equipment in such a way that it could be easily manageable in spite of large

volumes.

2. Capability of retrieving information concerning suppliers, custodians, acquisition and maintenance of equipment in batchmode as well as interactively in response to queries.
3. Capability of updating information interactively.
4. Capability of providing management with accurate and up to date reports for decision making and planning purposes.
5. Flexibility in producing reports (any format required for specific purpose).

Output

The basic outputs of this system are

(a) Periodic Reports which include

(i) Equipment Record - which lists all equipment in the database with their category, department to which they belong, purchase/lease costs and maintenance costs.

(ii) Failure Report - this lists all failures: descriptions of an equipment unit with its vendor, date acquired, department to which it belongs, etc. This is produced for all equipment in the database.

(iii) Present Location Record - this lists all items of equipment with their present locations and their status.

(iv) Purchase Report - for all departments: this lists all departments with the total cost of equipment purchased for those departments giving the total cost of equipment purchased for all departments, etc.

Note: The sample outputs are in Appendix B.

(b) Query Reports include

(i) Equipment Purchase Report for a Vendor. Here input is vendor. Output is a report which lists all the equipment purchased from that vendor.

(ii) Departmental Equipment Purchase Report. Here input is Department. Output is a report containing purchase cost of all equipment purchased for that Department.

(iii) Location Report of Terminals. Here the input is IPACS-IDs of Terminals. Output is a report containing terminal's location, model number, serial number and status.

(iv) Equipment Record for Purchase Order Numbers. Here the input is Purchase Order Numbers. Output report contains a list of equipment purchased under that purchase order number etc.

Processing

The system flow chart describes the procedures of the system, which include

1. Creating the database
2. Processing user queries interactively.
3. Updating the database.
4. Processing data in order to produce the necessary reports.

Basic Inputs used are:

- (i) Serial number of an item.
- (ii) Model number of an item.
- (iii) Department to which the item belongs.
- (iv) Vendor of the equipment.

- (v) A brief description of the equipment.
- (vi) Date on which the equipment was acquired.
- (vii) Purchase/lease cost.
- (viii) Maintenance cost.
- (ix) Account number (applicable to purchase/lease/maintenance).
- (x) Present location of the equipment.
- (xi) Equipment status.
- (xii) Purchase order number.

1.3 Benefits of Proposed System

- (i) This system can maintain and process large volumes of information efficiently.
- (ii) This system is capable of retrieving information both interactively and in batchmode.
- (iii) Files can be updated interactively.
- (iv) Up to date and accurate reports can be produced.
- (v) Any type of information, in any form, can be retrieved by writing appropriate retrieval programs without altering the database itself.
- (vi) In particular, extensions to the database contents can be easily made. New files and new fields to existing records can be added without any need to change the existing application programs.

CHAPTER II

SYSTEM DESIGN

2.1 Design Consideration [1]

After setting objectives for the new system, it should be designed to achieve these objectives. In designing a new system the following things have to be kept in mind.

- (i) Problems in the existing system.
- (ii) Objectives of the proposed system.
- (iii) Various alternative ways of achieving objectives.
- (iv) Facilities available.
- (v) Maintainability of the system.
- (vi) Query reporting considerations.

Problems in the existing system and objectives of the proposed system are explained in Chapter I.

2.2 Various Alternatives for Achieving Objectives

As described in Chapter I, it is proposed to have a computerized system. This system can be based on ordinary computer files or on a database management system. Choice between the two depends upon the advantages of one over the other. It is preferable to have a database system because of certain advantages of database over regular file management techniques explained below.

Advantages of Database System Over Ordinary Computerized System [2].

- (i) In file management there is a great duplication of data. Each

application deals with its own files, organized as it wishes. The same files may exist more than once but with different organizations. Furthermore, the same data items may exist in different forms, in more than one record in different files.

This is obviously expensive and inefficient. In a database there is no such duplication of data except for very special purposes. Essentially, an item of data should appear only once in a database. This saves storage space and time in updating and there is no inconsistency of data. Modern operating systems lay stress on parallel processing of data by multiaccess users. This becomes nearly impossible when we have duplicated data. Databases solve this problem.

(ii) In a database, records and data items within records are combined in a variety of ways called relations (for the purposes of application programs accessing the database). These add to the information content.

(iii) Since a record or a data item may be required to form part of a number of different relations, each relevant to a particular application program, the structure of a database is more complex than that of independent files. But despite its complexity and the extra time taken to access successive records or items of data, there are advantages for application programmers. E.g., only the data items of interest are seen. This ensures privacy of the rest of the database. This also means fewer conversion problems and it also reduces the role of application programs and thus ensures logical independence.

2.3 Facilities Available [1]

As explained earlier, it was decided to use a database management system for the proposed system. So one has to examine the database facilities available.

The only available database management software is Control Data Corporation's DMS-170[†]. The major components of this software package are the following:

- (1) Data Description Language: DDL which is used to describe the overall design of the database, its structure and relationships between data items.
- (ii) Cyber Database Control Systems: CDCS - This is the controlling module that monitors and interprets all database access requests from application programs that are using the schema. CDCS accepts calls from application programs, interrogates the schema and subschema for compatibility, translates data formats from the program's language to the internal format of data, and determines the requirements for ultimate input/output processing.
- (iii) The input/output processor: Cyber Record Manager. This performs execution time input/output processing.
- (iv) The user oriented language that performs the database retrievals updates and reports writing which is COBOL 5.

This DMS-170 is not a single or discrete piece of software; rather it is a collection of modules that are joined to form a database management system.

File Organization

Four file organizations supported by the Cyber Record Manager can

[†] Refer to figures on page 75 and 76.

be accessed through CDCS: Sequential, index sequential, direct access and actual key. The file organizations for this system are chosen to be index sequential as this facilitates random as well as sequential access.

Logging Facility

Logging is the recording of user interactions with database files. In case of power or hardware failure damaging some or all of the database, a backup copy of the database can be loaded and the recorded after image copies can be written to the database by the DMS-170 recover utility program.

Relational Database Facility

The relational database facility provides the capability of linking files together in meaningful relationships, so that data from several files can be accessed with a single read request. A relation defines a directed path joining areas described in the schema.

2.4 Maintainability of the System

This includes the capability of updating the database, expansion of the database and modifications of existing programs. Database facilities make it possible to maintain the data components of the system. If the programs are structured, it is easy to modify programs.

2.5 Query Processing Considerations [2]

Basically there are seven forms of queries. E is entity, A is attribute, V is value.

- Type 1: $A(E) = ?$ What is the value of attribute A of entity E?
- Type 2: $A(?) = V$ What entity, E, has a value of attribute A equal to V.
- Type 3: $?(E) = V$ Which attribute or attributes of entity E have value V?
- Type 4: $?(E) = ?$ Requests the values of all attributes of entity E?
- Type 5: $A(?) = ?$ Requests the value of attribute A for all entities.
- Type 6: $?(?) = V$ Requests all attributes of all entities having a value V.
- Type 7: $?(?) = ?$ Requests entire contents of database.

It is not feasible to include all the types for query processing but those requested by the user have been included.

2.6 Narrative Overview of the System [1]

After studying the design considerations carefully, a proposed system is designed which has four functional modules.

- (i) Creation of database
- (ii) Update of database
- (iii) Retrieval of information from database
- (iv) Recovery and restoration of database

(i) Creation of database

This part of the system is dedicated to creation of the database and is run only once, in the beginning. Creation of the database includes . Writing the schema definition.

The schema is designed, written, compiled and stored as a permanent file. The elements that comprise the database are assigned unique names and described in a manner to meet common usage requirements.

. Writing the subschema definition.

The subschemas are designed, written, compiled and stored as permanent files. Consideration is given to general usage data items to avoid unnecessary conversion. Structural conformity with the schema is incorporated wherever possible to avoid unnecessary record mapping.

. Writing the database procedures.

The database procedures are created and stored in a library.

. Defining and initializing the log files.

Log files are defined for those areas in the database, where important information is stored. Direct access permanent files are initialized as log files.

. Creating database files.

All the files in the database are index sequential as it makes access possible in random as well as sequential manner. All files are created by separate programs. Input to all files is by cards and outputs are printed hardcopies, so that one can check visually the contents of files after creation.

(ii) Update of database

This part of the system is run whenever there is a need for addition, deletion or modification of records in the database. Existing records or fields in the database can be modified or deleted and new records can be added by the update program.

Input to the update program is a file of sorted transactions sorted on transaction type and update code. The individual transactions are validated and appropriate action taken. Sorting and updating are

done through separate programs as the memory size available is not enough for both purposes. Also, it is desirable to maximize the memory available to any sort for reasons of better efficiency. Outputs of the update report are

- (a) Exception report containing error messages and bad transactions.
- (b) Update report showing the status of successfully updated records. Sample outputs are in Appendix B.
- (iii) Retrieval of information. Information can be retrieved from the database for generating reports on demand and in response to queries.

Reports on demand. This consists of programs to generate reports about the database contents. They can be run whenever reports of a particular type are needed. Different application programs can be written to produce reports in different format. E.g., (a) list the total cost of equipment purchased for each department with total purchase cost for all departments; (b) list the locations of all equipment, etc.

Query processing. This consists of separate programs for different queries. A program prompts for input, the user supplies the input and the job is submitted to batchmode for execution. E.g., (a) list the equipment purchased from a given vendor; (b) list the equipment purchased for a department; (c) specify the location of an equipment item given its serial number, etc.

- (iv) Recovery and restoration of database. During the creation and update of the database, transactions are written to log files.

The log files are used to determine which areas of the database require recovery and restoration. Backup copies of the database are made on a periodic basis by using the operating system utility routine for dumping permanent files. Then these backup copies are used to perform recovery when system failure occurs and all or part of the database is lost or otherwise unreadable.

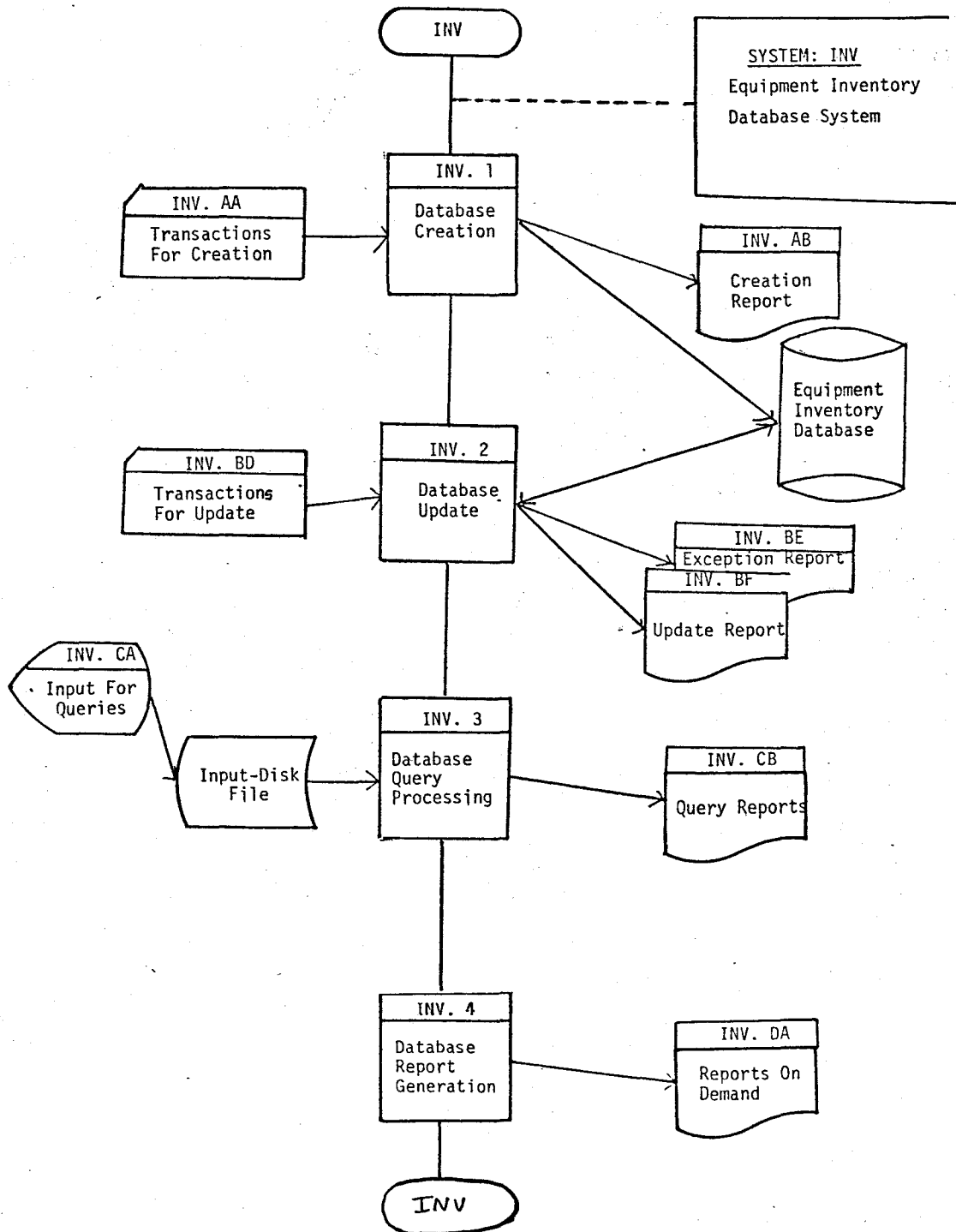
CHAPTER 3

IMPLEMENTATION

After the design of the system was completed and its capabilities approved by Dr. J.S. Stephens, it was decided to implement the design. COBOL 5 interactive programs using database files require more memory than is available on the CDC 6400, so none of the programs in this system can be run in interactive mode. Limited size of direct access files made it impossible to use the logging facility. Hence the designed system cannot be fully implemented. This chapter describes the partial implementation of the system design.

3.1 System Flowchart

This provides a high level graphic representation of the system in its entirety.



3.2 Database Description

The Equipment Inventory Database is the master depository of information upon which the system is based. It is described in various ways, as follows:

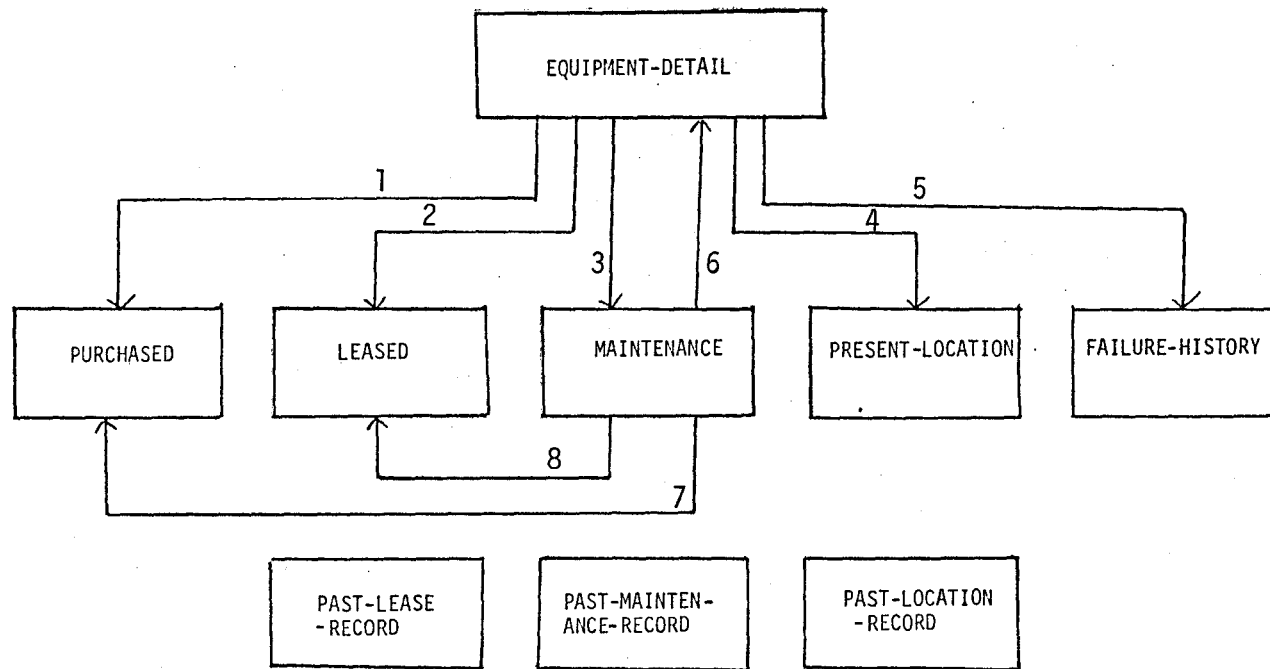
Schema [3]: This is a complete description of the database in Data Description Language (DDL) including all the names of fields, records, areas and relations.

Subschema [4]: This is a description of only that part of a database in which a particular application program is interested. It may differ from the schema in other respects including: (a) it may describe a data item in a form different from its description in the schema; (b) it may rename items in the database.

3.2.1 Schema Diagram[†]: Equipment Inventory Database

The available facility of DMS-170 database software can be used only for relational databases. Keeping this in mind, the schema is designed for a relational database which is non redundant. Schema diagram is on next page.

[†] Listing of schema is in Appendix A.



Relations:

- | | |
|-------------------------------|---------------------------------|
| 1) Equipment-Purchased | 5) Equipment-Failure-History |
| 2) Equipment-Leased | 6) Maintenance-of-Equipment |
| 3) Equipment-Maintenance | 7) Maintenance-of-Purchased-Eqp |
| 4) Equipment-Current-Location | 8) Maintenance-of-Leased-Eqp |

The following gives a pictorial view of contents of each record.

Equipment Detail

<u>Serial-No</u> X (12)	<u>Vendor</u> X (25)	<u>Dept</u> X (5)	<u>Ipacs-id</u> X (6)	<u>Model-No</u> X (9)	<u>Category</u> 9	<u>Date</u> -Acquired X (8)	<u>Description</u> -1 X (50)	<u>Description</u> -2 X (50)
----------------------------	-------------------------	----------------------	--------------------------	--------------------------	----------------------	-----------------------------------	------------------------------------	------------------------------------

Purchased

<u>Serial-No</u> X (12)	<u>Purchase-Cost</u> 9(7)V99	<u>Account-No</u> 99	<u>P-O-NO-P</u> X (6)	<u>Current-Replacement-Cost</u> 9(7)99	
----------------------------	---------------------------------	-------------------------	--------------------------	---	--

Leased

<u>Serial-No</u> X (12)	<u>Start-Date</u> X (8)	<u>Basis-of-Cost</u> -L 9	<u>Lease-Cost</u> 9(6)V99	<u>Period</u> X (3)	<u>Account-No</u> 99	<u>P-O-NO-L</u> X (5)
----------------------------	----------------------------	---------------------------------	------------------------------	------------------------	-------------------------	--------------------------

Past Lease Record

<u>Serial-No</u> X (12)	<u>Start-Date</u> X (8)	<u>Basis-of-Cost</u> -L 9	<u>Past-Lease-Cost</u> 9(6)V99	<u>Period</u> X (3)	<u>Account-No</u> 99	<u>P-O-NO-L</u> X (5)
----------------------------	----------------------------	---------------------------------	-----------------------------------	------------------------	-------------------------	--------------------------

Maintenance

<u>Serial-No</u> X (12)	<u>Start-Date</u> X (8)	<u>Basis-of-Cost</u> -M 9	<u>Maint- Cost</u> 9(6)V99	<u>Period</u> X (3)	<u>Mainte</u> X (3)	<u>Account-No</u> 99	<u>P-O-NO-M</u> X (5)
----------------------------	----------------------------	---------------------------------	-------------------------------	------------------------	------------------------	-------------------------	--------------------------

Past Maintenance Record

<u>Serial-No</u> X (12)	<u>Start-Date</u> X (8)	<u>Basis-of-Cost</u> -M 9	<u>Past-Maint -Cost</u> 9(6)V99	<u>Period</u> X (3)	<u>Mainte</u> X (3)	<u>Account-No</u> 99	<u>P-O-NO-M</u> X (5)
----------------------------	----------------------------	---------------------------------	------------------------------------	------------------------	------------------------	-------------------------	--------------------------

Present Location

<u>Serial-No</u> X (12)	<u>Bld- Room</u> X (10)	<u>Date-In</u> X (8)	<u>Status</u> X (15)	

Past Location

<u>Serial-No</u> X (12)	<u>Date-In</u> X (8)	<u>Date-Out</u> X (8)	<u>Bld- Room</u> X (10)	<u>Status</u> X (15)	

Failure History

<u>Serial-No</u> X (12)	<u>Count</u> 99	<u>Date-of-Failure</u> X (8)	<u>Date-of-Repair</u> X (8)	<u>Failure-Description</u> X (40)	

_____ is a primary key

----- is an alternate key

X stands for alphanumeric, 9 for numeric, V for decimal point

3.2.2 Subschema[†] [4]

The subschema is a detailed description of the database that is available to an application program. Thus any number of subschemas can exist in a database depending upon various application programs. Various subschemas were created for different application programs but because of the limited number of files allowed to a student, only one subschema CREATSB is implemented.

Subschema CREATSB consists of all fields and all files of the database. Its design is the same as that of the schema, except that the names of files and some of the data items have been changed for convenience. These aliases are explained in the next paragraphs.

3.2.3 General Description of Database Files and Datadictionary

Equipment Inventory Database has nine files each having one record type. All the files are index-sequential files.

SCHEMA names of files	SUBSCHEMA names of files
EQUIPMENTAREA	EQU-FILE
PURCHASEAREA	PUR-FILE
LEASEAREA	LEASE-FILE
PASTLEASEAREA	PAST-LEASE-FILE
MAINTENANCEAREA	MAINT-FILE
PASTMAINTENANCEAREA	PAST-MAINT-FILE
PRLOCATION	PR-LOC-FILE
PTLOCATION	PT-LOC-FILE
FAILURE	FAILURE-FILE

[†] Listing of subschema in Appendix A.

EQUIP-FILE contains one record for each item.

PUR-FILE contains one record for each item purchased.

LEASE-FILE contains one record for each item currently leased.

PAST-LEASE-FILE contains zero or more records for each leased item. This file will have one record for each past renewal of the lease of equipment.

MAINT-FILE has one record for each item's maintenance contract.

PAST-MAINT-FILE can have zero or more records for each item's past renewal of maintenance contract.

PR-LOC-FILE has one record for each item's present location.

PT-LOC-FILE can have zero or more records for past locations of equipment.

FAILURE-FILE can have any number of records for an item containing information about its failures.

3.2.4 The data dictionary is a catalogue of data item names, aliases, structures and their descriptions. Here picture gives the type and the number of characters in a data item.

X stands for alphanumeric, 9 for numeric, V for decimal point.

Record name: EQUIPMENT DETAIL File name: EQUIP-FILE

<u>Field-Name</u>	<u>Picture</u>	<u>Description</u>
1. SERIAL-NO	X (12)	Manufacturer's serial number of equipment; if not unique can be made so by a suffix.
2. VENDOR	X (25)	Name of the vendor of the equipment, such as IBM, CDC...
3. DEPT	X (5)	Department to which equipment belongs, such as ACS, TCS...
4. IPACS-ID	X (6)	Ipacs-identification number
5. MODEL-NO	X (9)	Model number of the equipment
6. CATEGORY	9	Category of equipment: 1 for data processing equipment 2 for peripheral equipment 3 for terminals 4 for technical equip./maint. 5 for office equipment
7. DATE-ACQUIRED	X (8)	Date on which equipment was acquired, e.g. 19781230
8. DESCRIPTION-1	X (50)	Description of equipment A description of 100 characters can be accommodated in two lines
9. DESCRIPTION-2	X (50)	

Record name: PURCHASED File name: PUR-FILE

<u>Field-Name</u>	<u>Picture</u>	<u>Description</u>
1. SERIAL-NO	X (12)	Manufacturer's serial number of the equipment; if not unique can be made by a suffix.
2. PURCHASE-COST	9(7)V99	Purchase cost of equipment.
3. ACCOUNT-NO	9 (2)	Code indicating which account number is applicable.
4. P-0-NO-P	X (6)	Purchase order number of purchased equipment.
5. CURRENT-REPLACEMENT-COST	9(7)V99	Current replacement cost of equipment purchased.

Record name: LEASED File name: LEASE-FILE

<u>Field-Name</u>	<u>Picture</u>	<u>Description</u>
1. SERIAL-NO	X (12)	Manufacturer's serial number of the equipment, if not unique can be made so by a suffix.
2. START-DATE	X (8)	Starting date of lease of the equipment.
3. BASIS-OF-COST-L	9 (1)	Code indicating whether lease is monthly or yearly, etc.
4. LEASE-COST	9(6)V99	Lease-cost of equipment for a period indicated by the above field.
5. PERIOD	X (3)	Number of days for which equipment is leased.
6. ACCOUNT-NO	9 (2)	Code indicating which account number is applicable.
7. P-0-NO-L	X (5)	Purchase order number under which equipment is leased.

Record Name: PAST-LEASE-RECORD File Name: PAST-LEASE-FILE

<u>Field-Name</u>	<u>Picture</u>	<u>Description</u>
1. SERIAL-NO	X (12)	
2. START-DATE	X (8)	
3. BASIS-OF-COST-L	9 (1)	(as for record: LEASED)
4. PAST-LEASE-COST	9(6)V99	
5. PERIOD	X (3)	
6. ACCOUNT-NO	9 (2)	
7. PAST-P-0-NO-L	X (5)	

Record Name: MAINTENANCE File Name: MAINT-FILE

<u>Field-Name</u>	<u>Picture</u>	<u>Description</u>
1. SERIAL-NO	X (12)	As in Purchased
2. START-DATE	X (8)	Starting date of maintenance contract.
3. BASIS-OF-COST-M	9 (1)	Code indicating whether maintenance cost is yearly, monthly, etc.
4. MAINT-COST	9(6)V99	Maintenance cost of an equipment for a period indicated by above field.
5. PERIOD	X (3)	Number of days of maintenance contract.
6. MAINTE	X (3)	Indicates whether maintenance is internal, external or included in cost.
7. ACCOUNT-NO	9 (2)	Code indicating which account number is applicable.
8. P-0-NO-M	X (5)	Purchase order number for maintenance contract of equipment.

Record Name: PAST-MAINTENANCE-RECORD File Name: PAST-MAINT-FILE

<u>Field-Name</u>	<u>Picture</u>	<u>Description</u>
1. SERIAL-NO	X (12)	
2. START-DATE	X (8)	
3. BASIS-OF-COST-M	9 (1)	
4. PAST-MAINT-COST	9(6)V99	(as for record: MAINTENANCE)
5. PERIOD	X (3)	
6. PAST-MAINTE	X (3)	
7. ACCOUNT-NO	9 (2)	
8. PAST-P-O-NO-M	X (5)	

Record Name: PRESENT-LOCATION File Name: PR-LOC-FILE

<u>Field-Name</u>	<u>Picture</u>	<u>Description</u>
1. SERIAL-NO	X (12)	As in Purchased
2. BLD-ROOM	X (10)	Location of equipment.
3. DATE-IN	X (8)	Date on which equipment was moved to the above location.
4. STATUS	X (15)	Status of the equipment indicating whether it is active or inactive, etc.

SUBSCHEMA name is EQUIPMENT-STATUS

Record Name: PAST-LOCATION File Name: PT-LOC-FILE

<u>Field-Name</u>	<u>Picture</u>	<u>Description</u>
1. SERIAL-NO	X (12)	As in Purchased.
2. DATE-IN	X (8)	Date on which equipment was moved to the location specified in this record.
3. DATE-OUT	X (8)	Date on which equipment was moved out from the location specified in this record.
4. BLD-ROOM	X (10)	Location of the equipment during the period between DATE-IN and DATE-OUT.
5. STATUS	X (15)	Status of the equipment during the period between DATE-IN and DATE-OUT.

Record Name: FAILURE-HISTORY File Name: FAILURE-FILE

<u>Field-Name</u>	<u>Picture</u>	<u>Description</u>
1. SERIAL-NO	X (12)	As in Purchased
2. COUNT	X (8)	Count of failures of the equipment.
3. DATE-OF-FAILURE	X (8)	Date of failure of the equipment.
4. DATE-OF-REPAIR	X (8)	Date of repair of the equipment.
5. FAILURE-DESCRIPTION	X (40)	Description of failure of the equipment.

SUBSCHEMA name for COUNT is FAILURE-COUNT

3.2.5 Description of Relationships [1]

A relation defines a directed path joining areas described in the schema. The schema specifies the particular areas to be joined in a separate entry called relation entry, thereby establishing multifile relationships. This entry assigns a name to the relation and specifies the data items to be used as join-terms to link the files.

There are eight relations defined in the schema as follows:

<u>Relation Name</u>	<u>Root File Record</u>	<u>Child File Record</u>	<u>Join Term</u>
1. Equipment-Purchased	Equipment-Detail	Purchased	Serial-No.
2. Equipment-Leased	Equipment-Detail	Leased	Serial-No.
3. Equipment-Maint- enance	Equipment-Detail	Maintenance	Serial-No.
4. Equipment-Current- Location	Equipment-Detail	Present-Location	Serial-No.
5. Equipment-Failure- History	Equipment-Detail	Failure-History	Serial-No.
6. Maintenance-of- Equipment	Maintenance	Equipment-Detail	Serial-No.
7. Maintenance-of- Purchased-Eqp	Maintenance	Purchased	Serial-No.
8. Maintenance-of- Leased Eqp	Maintenance	Leased	Serial-No.

3.3 Program Narratives and Input/Output Specifications

3.3.1 Overview of INV.1

INV.1: Creation of Database Files

As already described in the schema, the database contains nine index sequential files and all have been created by separate programs. Since index sequential files need primary keys in ascending order, all input transactions are first sorted into ascending order of primary key and then index sequential files are created. Sorting and creation of files are done by two separate programs, where files have alternate keys. All the input transactions are validated and transactions with errors are rejected. Outputs of the creation program are printed hardcopies containing rejected transactions and the contents of database files which are created.

Input specifications

File Name: EQUIPMENTAREA: Record Name: EQUIPMENT-DETAIL

Input transaction contains 166 characters, hence multiple card layout is used as follows:

1	12	13	14	38	39	43	44	49	50	58	59	60	67	80
Serial-No X (12)	Rec-Type 9 (1)	Vendor X (25)	Dept X(5)	Ipacs-Id X (6)		Model-No X (9)		Category 9 (1)		Date-Acquired X (8)				
Serial-No X (12)	Rec-Type 9 (1)	Description-1 X (50)												
Serial-No X (12)	Rec-Type 9 (1)	Description-2 X (50)												
1	12	13	14										63	80

File Name: PURCHASEAREA

Record Name: PURCHASED

1	12	13	21	22	23	24	29	30	38	39	80
Serial-No X (12)	Purchase-Cost 9(7)V99	Account-NO 9 (2)	P-0-NO-P X (6)	Current-Replacement-Cost 9(7)V99							

File Name: LEASEAREA

Record Name: LEASED

1	12	13	20	21	22	29	30	31	32	33	34	35	39	40	80
Serial-No X (12)	Start-Date X (8)	Basis-Of-Cost-L 9 (1)	Lease-Cost 9(6)V9(2)	Period X (3)	Account-No 9 (2)	P-0-NO-L X (5)									

File Name: MAINTENANCEAREA

Record Name: MAINTENANCE

1	12	13	20	21	22	29	30	32	33	35	36	37	38	42	43	80
Serial-No X (12)	Start-Date X (8)	Basis-Of-Cost-M 9 (1)	Maint-Cost 9(6)V9(2)	Period X (3)	Mainte X (3)	Account-No 9 (2)	P-0-NO-M X (5)									

File Name: PRLOCATION

Record Name: PRESENT-LOCATION

1	12	13	22	23	30	31	45	46	80
Serial-NO X (12)	Bld-Room X (10)	Date-In X (8)	Status X (15)						

File Name: PTLOCATION

Record Name: PAST-LOCATION

1	12	13	20	21	28	29	38	39	53	54	80
Serial-No X (12)	Date-In X (8)	Date-Out X (8)	Bld-Room X (10)	Status X (15)							

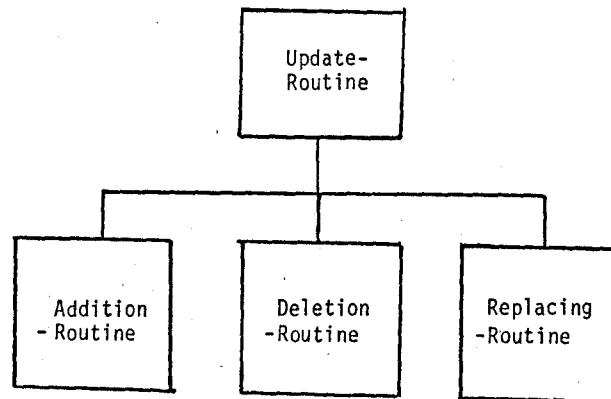
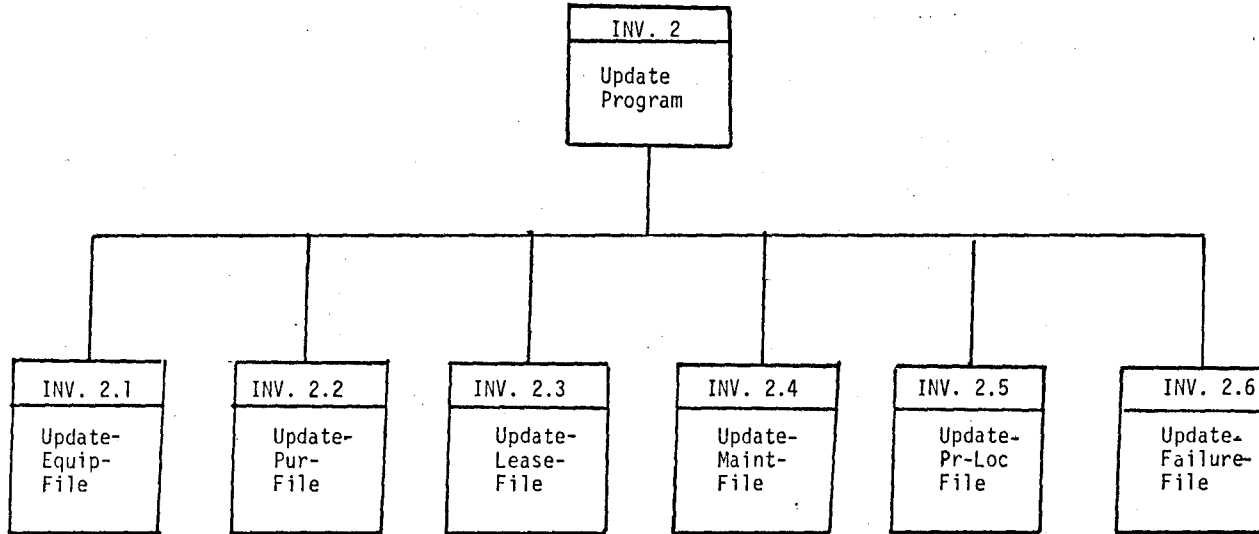
File Name: FAILURE

Record Name: FAILURE-HISTORY

1	12	13	14	15	22	23	30	31	70	71	80
Serial-No X (12)	Failure-Count 9 (2)	Date-Of-Failure X (8)	Date-Of-Repair X (8)	Failure-Description X (40)							

3.3.2 Overview of INV. 2

INV. 2: Updating the Database



Updating a database consists of

- (i) Addition of new records to a file.
- (ii) Deletion of existing records from a file.
- (iii) Changing of fields in existing records.

The database consists of nine files and users may wish to update any or all of the records in the database. Hence this program accepts a number of different types of input transactions for updating records in the database. All transactions are first sorted on ascending order of record-code and update-code.

<u>File Code or Record-Code</u>	<u>File-Name</u>
1	EQU-FILE
3	PUR-FILE
4	LEASE-FILE
5	MAINT-FILE
6	PR-LOC-FILE
7	FAILURE-FILE

<u>Update-Code</u>	<u>Action-Taken</u>
1	Addition of a record
2	Deletion of a record
3	Replacing of field in existing record

Field-code is meant for specifying the field number in a record which is to be replaced. First field of each record is a primary key which cannot be replaced. In case of addition or deletion of records or transferring existing records to the past record files, '1' is used as field-code.

Following is the list of field-codes for fields in different files.

File Name: EQUIP-FILE

<u>i = Field-Code</u>	<u>Field-Name</u>
2	VENDOR
3	DEPT
4	IPACS-ID
5	MODEL-NO
6	CATEGORY
7	DATE-ACQUIRED
8	DESCRIPTION-1
9	DESCRIPTION-2

File-Name: PUR-FILE

<u>i = Field-Code</u>	<u>Field-Name</u>
2	PURCHASE-COST
3	ACCOUNT-NO
4	P-O-NO-P
5	CURRENT-REPLACEMENT-COST

File-Name: LEASE-FILE

<u>i = Field-Code</u>	<u>Field-Name</u>
2	START-DATE
3	BASIS-OF-COST-L
4	LEASE-COST
5	PERIOD
6	ACCOUNT-NO
7	P-O-NO-L

File Name: MAINT-FILE

<u>i = Field-Code</u>	<u>Field-Name</u>
2	START-DATE
3	BASIS-OF-COST-M
4	MAINT-COST
5	PERIOD
6	MAINTE
7	ACCOUNT-NO
8	P-O-NO-M

File Name: PR-LOC-FILE

<u>i = Field-Code</u>	<u>Field-Name</u>
2	BLD-ROOM
3	DATE-IN
4	STATUS

File Name: FAILURE-FILE

<u>i = Field-Code</u>	<u>Field-Name</u>
2	DATE-OF-FAILURE
3	DATE-OF-REPAIR
4	FAILURE-DESCRIPTION

The update program consists of six update routines:

Update-Equip-File	Updates	EQUIP-FILE
Update-Pur-File	Updates	PUR-FILE
Update-Lease-File	Updates	LEASE-FILE
Update-Maint-File	Updates	MAINT-FILE
Update-Pr-Loc-File	Updates	PR-LOC-FILE
Update-Failure-File	Updates	FAILURE-FILE

Each of these update routines has three subroutines for addition of new records, deletion of existing records and replacing of fields in existing records.

All input transactions for addition and replacement of fields are validated. Bad input transactions are rejected. Valid input transactions are accepted and an appropriate action is taken, depending upon Update-code.

In case of renewal of lease for an equipment, a new lease record will be added to LEASE-FILE and an existing record will be transferred automatically to PAST-LEASE-FILE.

Similarly in case of renewal of a maintenance contract a new record will be added to MAINT-FILE and an existing record will be transferred to PAST-MAINT-FILE.

In case of change of location of an equipment a new record will be added to PR-LOC-FILE and an existing record will be transferred to PT-LOC-FILE.

In case of failure of an equipment, user will always supply 1 as failure-count but the update program will itself add 1 to the last failure count and then the record will be written to the file.

The general format of input record to be added to a file is

1	2	3	4	80
File-Code	1	1	Temp-inf	

File-code is the file code for the file to which a record is to be added.

Temp-inf are the contents of the record to be added to the file. For each record contents will be different and can be found from the data dictionary. E.g., to add a record to FAILURE-FILE the input record will be as follows:

1	2	3	4	15	16	17	18	25	26	33	34	73	80
7	1	1	Serial-No	Failure-Count	Date-Of-Failure	Date-Of-Repair	Failure-Description						
			X (12)	9 (2)	X (8)	X (8)	X (40)						

The general format of an input record when deleting from a file:

1	2	3	4	15	16	80
File-Code	1	2	Primary-Key			

FILE-CODE is the file code of a file from which a record is to be deleted. PRIMARY-KEY is the PRIMARY-KEY of the record to be deleted.

The general format of an input record when replacing a field in an existing record:

1	2	3	4	80
File-Code	i	3	Temp-inf	

File-code is the file code for a file in which a change is required.

i is the field code already defined. Temp-inf contains the primary key of the record and the new contents of ith field.

To replace the contents of the vendor field in a record in EQUIP-FILE the input transactions will look like:

1	2	3	4	15	16	40	80
1	2	3	Serial-No	Vendor	/ / / / / / / / / /		

For transferring records to past-files input transactions will be as follows:

1	2	3	4	80
File-Code	1	2	Temp-Inf	

Where TEMP-INF contains the content of the record to be added to the file so that the existing record in the file for that equipment will be transferred to the corresponding past-file.

Outputs of Update Program.

(i) Exception Report

This report prints all bad transactions with appropriate error messages. Examples of error messages:

Purchase cost is not numeric

Record written has duplicate key

Record with specified key does not exist

Category is not numeric, etc.

(ii) Update Report

This report prints the contents of all records which have been successfully updated with action taken and date of update. E.g.,

Record is added to PUR-FILE

Record is deleted from EQUIP- FILE

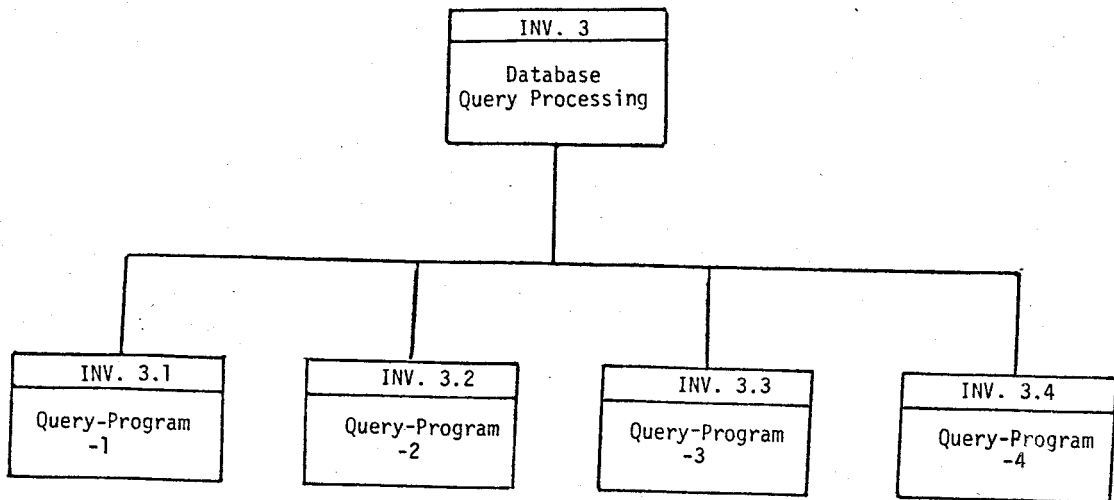
Contents of field before replacement

Contents of field after replacement, etc.

3.3.3 Overview of INV. 3

INV. 3: DATABASE QUERY PROCESSING

Query Processing - Functional Overview



Database Query Processing consists of four programs for processing four different queries. It was actually intended to be run in interactive mode so that input could be supplied through the terminal and output could be displayed on the terminal. Because of insufficient memory each of these four programs is split into three sections. The first of these sections is run in interactive mode, which prompts for input; input is supplied and written to a file. The second of these sections fetches the input file created by the first section and produces the required report. Both of these sections are compiled and stored

in files in compiled form. The third section is a procedure which fetches files of compiled programs and submits the job to batchmode for execution.

The input to the first section is a department name. Output of this program is a printed report with a list of equipment and their purchase cost, purchased for that department.

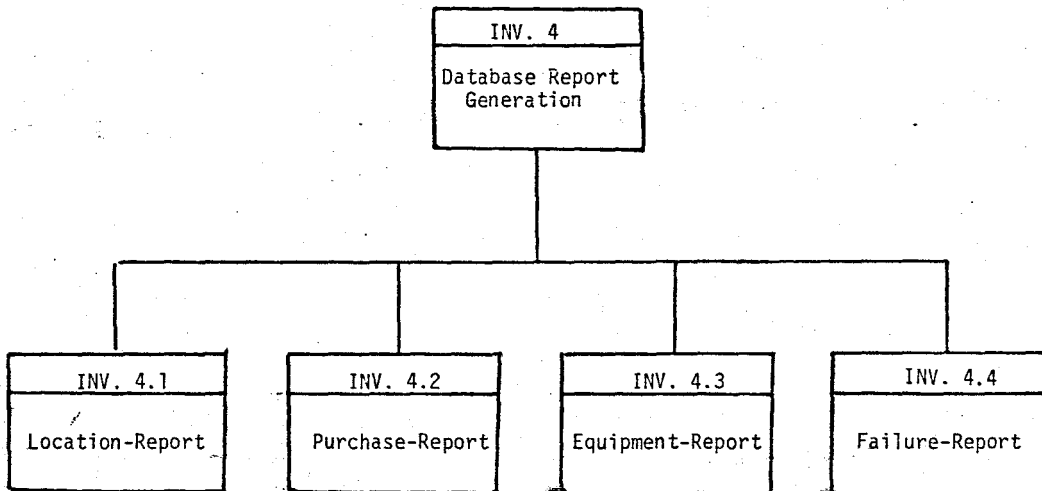
The input to the second program is the name of the vendor. Output of this program is a printed report with a list of equipment purchased from that vendor.

The input to the third program is a list of purchase order numbers. Output is a printed report with a list of equipment purchased under those purchase order numbers.

The input to the fourth program is a list of Ipacs-identification numbers of terminals. Output is a printed report of locations of these terminals.

3.3.4 Overview of INV. 4

INV. 4: DATABASE REPORT GENERATION



Database Report Generation consists of four programs which produce reports about the whole of the contents of the database. These programs can be run to produce reports on demand. First of these is a program to produce a report which lists all the equipment in the database and their locations. The second program produces a purchase report which includes purchase costs, serial-nos., model-nos. and brief descriptions of equipment in the database. The third program prints a report containing category, department, vendor, purchase/lease cost and maintenance cost. The fourth program produces a service record for each item in the database. This report contains vendor, category, brief description and failure descriptions with dates of failure and repair.

3.4 Control Features for Integrity of Databases

When a database contains data employed by many different users it is important that the data items and associations between data items not be destroyed. Hardware failures and various types of accidents will occur occasionally. The updating procedures must be such that they guarantee the integrity of the database. The integrity checks may also be designed to ensure that data values conform to certain specified rules.

For the integrity of the Equipment Inventory database, the following control features have been included: It must be accessible only to authorized users and a solution to this is a password. For hardware failures and other accidents, it is very important to use log files. Logging facility for recording images before and after update was used but was eliminated when the size of direct access files was reduced.

The integrity of the relational database is maintained in update operations by designing the relations with the minimum number of connections between relations. Whenever a relation is read, error processing module 'C.DMRST' is called via an ENTER statement. Then the status of the error code is checked before proceeding any further.

Numeric data items are checked before adding a new record or replacing a field. In order to check that correct values have been written to files, update report prints all successful updates so that one can check visually the contents of records added to the database.

Several tests were made to check the consistency of data and relationships between files. The most serious problem of data duplication

is that it can lead to a lack of data integrity. So care has been taken not to have duplicate data items in the database.

CHAPTER IV

CONCLUDING REMARKS

After the new system is designed and implemented, it is necessary to ensure that the system is operating as intended and that the original objectives of the system are being accomplished. Hence the system should be evaluated.

4.1 Evaluation of Results

The system can be evaluated in terms of objectives achieved and the observed performance of the system and supporting software. The database has been partially created, and is capable of maintaining large volumes of information, and of retrieving information by retrieval programs. Queries can be processed and required reports can be produced by feeding input through a terminal. The update program can update any record or any field in any file of the database. This program needs more memory than available, hence program is split into segments and overlay technique is used.

All the programs are written in a structured manner. Meaningful names are given to modules and data items. Comments have been included to improve readability of the programs.

The relative execution time of the system is presented by run statistics given below for a small database containing 80 records.

<u>Programs</u>	<u>Execution time (secs.)</u>
Equipment Record	26.24

Failure Report	19.70
Present Location Record	15.85
Purchase Report	29.29
Purchase Report for a Vendor	7.30
Departmental Purchase Report	10.31
Location Report of Terminals	16.35
Equipment Record for Purchase Order Numbers	7.58
Update Report	74.73

4.2 Possible Extensions of System:

It is quite possible to extend the database by adding new fields to existing files or by adding new files to the database without any changes to the existing application programs. Since the data items included in the database are of a very general nature, the system is also applicable to equipment other than IPACS computing equipment. Because of limited time and resources the system could not be implemented completely. In case of availability of resources and time, more report generation programs and more query processing programs can be written and run in interactive mode.

4.3 Discussion of Problems

A major difficulty encountered in achieving the objectives was size limit of memory. Files with alternate keys could not be created by one program but two programs were written to create each of them - one program to sort primary keys, and the other to create the file. The update program had to be split into segments and an overlay technique had

to be used. Input to this program is a presorted file of transactions.

Query processing which should actually be run in interactive mode, is now run in batchmode. Only the input is accepted in interactive mode.

In order to use the logging facility, one needs only direct access files. In the beginning log files were used but when the size limit for direct access files was reduced to 128 PRU'S, it was impossible to accommodate enough data. Hence log files could no longer be used.

The database software does not provide a locking facility at the record level, so concurrent updating by two users is possible, although one can employ permanent file locks on the access to the file as a whole.

The database software is not able to create sequential files, start statement to position root file does not position file at the stated record. It gives very misleading error messages. E.g., some records were added to a file by update program and it was indicated by update report. When the file was read, these records were not found. So I tried to insert these records again and got an error message that records already exist. So I tried to delete them and got an error message that records do not exist. The real problem was that the file was replaced after insertion of new records but not its associated index file and this created an inconsistency of data.

There is no facility to read the file or relation by an alternate key starting from the very beginning. One can read the relation or file by alternate key only by specifying the value of the alternate key explicitly. Hence to read the file completely by alternate key, one has

to sort the file on alternate key and then retrieve the first value and specify this alternate key value for access purposes.

The main problem during the summer was the transition from SCOPE to NOS, so many times units of the resources available to a user were changed, permanent files were lost, printer and card readers were out of order, delaying the development of project.

4.4 Disadvantages of Database Processing

After creating a database system, some disadvantages of database processing were realized, in comparison to file processing, and are listed below:

- (i) Major disadvantage is that it is expensive.
- (ii) It needs more memory than ordinary file processing.
- (iii) It needs more CPU time.
- (iv) After implementing database, operating costs will be higher.
- (v) Because of the increased complexity, backup and recovery are more difficult. Determining the exact time of failure and what exactly to do after that is also a problem.

APPENDIX A : A Listing of Schema and Subschema

* SOURCE LISTING * DDL 2.1 (78136) - 460 78/11/29, 22.49.55.

```

000001  /*
000002  *
000003  *
000004  * THIS IS A SCHEMA FOR AN EQUIPMENT INVENTORY DATA BASE FOR ALL
000005  * COMPUTING EQUIPMENT AT MCMASTER UNIVERSITY.
000006  *
000007  *
000008  *
000009  */
000010  SCHEMA NAME IS INVENTORY-EQUIPMENT-DB.
000011  /*
000012  *
000013  *
000014  * FOLLOWING PARAGRAPH GIVES NAMES OF AREAS AND PROCEDURES TO BE CALLED
000015  * BEFORE OPENING AREAS.
000016  *
000017  *
000018  *
000019  */
000020  AREA NAME IS EQUIPMENTAREA.
000021  AREA NAME IS PURCHASEAREA.
000022  AREA NAME IS LEASEAREA.
000023  AREA NAME IS PASTLEASEAREA.
000024  AREA NAME IS MAINTENANCEAREA.
000025  AREA NAME IS PASTMAINTENANCEAREA.
000026  AREA NAME IS PRLOCATION.
000027  AREA NAME IS PTLOCATION.
000028  AREA NAME IS FAILURE.
000029  /*
000030  *
000031  *
000032  * THIS AREA GIVES DETAILS ABOUT EQUIPMENT. NOT EXIST.
000033  * SERIAL-NO IS CREATED FOR THOSE IT DOES EXIST.
000034  * IPACS-ID IS BLANK FOR THOSE IT DOES NOT EXIST.
000035  * COUNT-OF-FAILURE IS THE LAST COUNT OF FAILURE OF THE EQUIPMENT.
000036  *
000037  *
000038  *
000039  */
000040  RECORD NAME IS EQUIPMENT-DETAIL
000041  WITHIN EQUIPMENTAREA.
000042  01 SERIAL-NO
000043  01 VENDOR
000044  01 DEPT
000045  01 IPACS-ID
000046  01 MODELCAT
000047  01 CATEGORY
000048  01 DATE-ACQUIRED
000049  01 DESCRIPTION-1
000050  01 DESCRIPTION-2
000051  PIC "X(12)"
000052  PIC "X(20)"
000053  PIC "X(5)"
000054  PIC "X(6)"
000055  PIC "9"
000056  PIC "X(8)"
000057  PIC "X(50)"

```

00 058
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00 101
00 102
00 103
00 104
00 105
00 106
00 107
00 108
00 109
00 110
00 111
00 112
00 113
00 114
00 115

```
/*
*****
*
*   THIS GIVES THE DETAILS ABOUT THE PURCHASE OF EQUIPMENT.
*
*****
```

```
*/
RECORD NAME IS PURCHASED
WITHIN PURCHASEAREA.
01 SERIAL-NO          PIC "X(12)".
01 PURCHASE-COST     PIC "9(7)V99".
01 ACCOUNT-NO        PIC "99".
01 P-O-NO-P          PIC "X(6)".
01 CURRENT-REPLACEMENT-COST PIC "9(7)V99".
/*
```

```
*****
*
*   LEASEAREA GIVES PRESENT AND PASTLEASEAREA GIVES PAST DETAILS
*   OF LEASE OF EQUIPMENT.
*   ON THE RENEWAL OF LEASE A CORRESPONDING RECORD IS ADDED.
*
*****
```

```
*/
RECORD NAME IS LEASED
WITHIN LEASEAREA.
01 SERIAL-NO          PIC "X(12)".
01 START-DATE         PIC "X(8)".
01 BASIS-OF-COST-L    PIC "9".
01 LEASE-COST         PIC "9(6)V99".
01 PERIOD              PIC "X(3)".
01 ACCOUNT-NO         PIC "99".
01 P-O-NO-L           PIC "X(5)".
```

```
RECORD NAME IS PAST-LEASE-RECORD
WITHIN PASTLEASEAREA.
01 SERIAL-NO          PIC "X(12)".
01 START-DATE         PIC "X(8)".
01 BASIS-OF-COST-L    PIC "9".
01 PAST-LEASE-COST    PIC "9(6)V99".
01 PERIOD              PIC "X(3)".
01 ACCOUNT-NO         PIC "99".
01 PAST-P-O-NO-L     PIC "X(5)".
```

```
/*
*****
*
*   MAINTENANCEAREA GIVES PRESENT AND PASTMAINTENANCEAREA GIVES
*   PAST DETAILS OF THE MAINTENANCE OF THE EQUIPMENT.
*   WHEN THERE IS NO MAINTENANCE FOR EQUIPMENT , MAINT IS BLANK.
*
*****
```

```
*/
RECORD NAME IS MAINTENANCE
WITHIN MAINTENANCEAREA.
01 SERIAL-NO          PIC "X(12)".
01 START-DATE         PIC "X(8)".
01 BASIS-OF-COST-L    PIC "9".
01 MAINT-COST         PIC "9(6)V99".
```

```

00116      01 PERIOD                PIC "X(3)".
00117      01 MAINTN                PIC "X(3)".
00118      01 ACCOUNT-NO           PIC "99".
00119      01 P-O-NO-M             PIC "X(5)".
00120
00121      RECORD NAME IS PAST-MAINTENANCE-RECORD
00122      WITHIN PASTMAINTENANCEAREA.
00123      01 SERIAL-NO             PIC "X(12)".
00124      01 START-DATE           PIC "X(8)".
00125      01 BASIS-OF-COST-M     PIC "9".
00126      01 PAST-MAINT-COST     PIC "9(6)V99".
00127      01 PERIOD              PIC "X(3)".
00128      01 PAST-MAINTN         PIC "X(3)".
00129      01 ACCOUNT-NO         PIC "99".
00130      01 PAST-P-O-NO-M       PIC "X(5)".
00131
00132      /*
00133      *
00134      * THIS AREA GIVES PRESENT LOCATION OF EQUIPMENT WITH ITS STATUS.
00135      *
00136      *
00137      *
00138      */
00139      RECORD NAME IS PRESENT-LOCATION
00140      WITHIN PRELOCATION.
00141      01 SERIAL-NO             PIC "X(12)".
00142      01 BLD-ROOM              PIC "X(10)".
00143      01 DATE-IN              PIC "X(8)".
00144      01 STATUS                PIC "X(15)".
00145      /*
00146      *
00147      * THIS AREA GIVES PAST LOCATIONS OF EQUIPMENT ,WHENEVER AN EQUIPMENT
00148      * IS MOVED TO ANOTHER PLACE A NEW RECORD IS AUTOMETICALLY CREATED.
00149      *
00150      *
00151      *
00152      */
00153      RECORD NAME IS PAST-LOCATION
00154      WITHIN PTLLOCATION.
00155      01 SERIAL-NO             PIC "X(12)".
00156      01 DATE-IN              PIC "X(8)".
00157      01 DATE-OUT              PIC "X(8)".
00158      01 BLD-ROOM              PIC "X(10)".
00159      01 STATUS                PIC "X(15)".
00160      /*
00161      *
00162      * THIS AREA GIVES FAILURE HISTORY OF EACH EQUIPMENT.
00163      * THERE IS ONE RECORD CORRESPONDING TO EACH FAILURE OF AN EQUIPMENT.
00164      *
00165      *
00166      *
00167      *
00168      */
00169      RECORD NAME IS FAILURE-HISTORY
00170      WITHIN FAILURE.
00171      01 SERIAL-NO             PIC "X(12)".
00172      01 COUNT                  PIC "99".
00173      01 DATE-OF-FAILURE       PIC "X(8)".

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00174 01 DATE-OF-REPAIR          PIC "X(8)".
00175 01 FAILURE-DESCRIPTION     PIC "X(40)".
00176
00177
00178 DATA CONTROL.
00179
00180 /*
00181      *****
00182      *
00183      *   FOLLOWING PARAGRAPH SPECIFIES THE NAMES OF AREAS, PRIMARY KEYS,
00184      *   ALTERNATE KEYS AND LOG FILES.
00185      *
00186      *****
00187 */
00188
00189 AREA NAME IS EQUIPMENTAREA
00190 KEY IS SERIAL-NO OF EQUIPMENT-DETAIL
00191      DUPLICATES ARE NOT ALLOWED
00192 KEY IS ALTERNATE VENDOR OF EQUIPMENT-DETAIL
00193      DUPLICATES ARE INDEXED
00194 KEY IS ALTERNATE DEPT OF EQUIPMENT-DETAIL
00195      DUPLICATES ARE INDEXED
00196 KEY IS ALTERNATE IPACS-ID
00197      DUPLICATES ARE INDEXED
00198 KEY IS ALTERNATE CATEGORY OF EQUIPMENT-DETAIL
00199      DUPLICATES ARE INDEXED
00200 KEY IS ALTERNATE DATE-ACQUIRED
00201      DUPLICATES ARE INDEXED.
00202
00203 AREA NAME IS PURCHASEAREA
00204 KEY IS SERIAL-NO OF PURCHASED
00205      DUPLICATES ARE NOT ALLOWED
00206 KEY IS ALTERNATE P-O-NO-P
00207      DUPLICATES ARE INDEXED.
00208
00209 AREA NAME IS LEASEAREA
00210 KEY IS SERIAL-NO OF LEASED
00211      DUPLICATES ARE NOT ALLOWED
00212 KEY IS ALTERNATE P-O-NO-L
00213      DUPLICATES ARE INDEXED.
00214
00215 AREA NAME IS PASTLEASEAREA
00216 KEY ID LEASE-KEY
00217      < SERIAL-NO OF PAST-LEASE-RECORD START-DATE OF PAST-LEASE-RECORD>
00218      DUPLICATES ARE NOT ALLOWED.
00219
00220 AREA NAME IS MAINTENANCEAREA
00221 KEY IS SERIAL-NO OF MAINTENANCE
00222      DUPLICATES ARE NOT ALLOWED
00223 KEY IS ALTERNATE P-O-NO-M
00224      DUPLICATES ARE INDEXED.
00225
00226 AREA NAME IS PASTMAINTENANCEAREA
00227 KEY ID MAINT-KEY
00228      < SERIAL-NO OF PAST-MAINTENANCE-RECORD
00229      START-DATE OF PAST-MAINTENANCE-RECORD>
00230      DUPLICATES ARE NOT ALLOWED.
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AREA NAME IS PRLOCATION
KEY IS SERIAL-NO OF PRESENT-LOCATION
DUPLICATES ARE NOT ALLOWED
KEY IS ALTERNATE BLD-ROOM OF PRESENT-LOCATION
DUPLICATES ARE INDEXED.

AREA NAME IS PTLOCATION
KEY ID PAST-LOC-KEY < SERIAL-NO OF PAST-LOCATION
DATE-IN OF PAST-LOCATION >
DUPLICATES ARE NOT ALLOWED.

AREA NAME IS FAILURE
KEY ID FAILURE-KEY < SERIAL-NO OF FAILURE-HISTORY COUNT >
DUPLICATES ARE NOT ALLOWED.

/*

* FOLLOWING PARAGRAPH GIVES RELATIONS BETWEEN DIFFERENT RECORDS AND *
* DATA ITEMS WHERE THEY ARE JOINED. *

*/

RELATION NAME IS EQUIPMENT-PURCHASED
JOIN WHERE SERIAL-NO OF EQUIPMENT-DETAIL
EQ SERIAL-NO OF PURCHASED.

RELATION NAME EQUIPMENT-LEASED
JOIN WHERE SERIAL-NO OF EQUIPMENT-DETAIL
EQ SERIAL-NO OF LEASED.

RELATION NAME IS EQUIPMENT-MAINTENANCE
JOIN WHERE SERIAL-NO OF EQUIPMENT-DETAIL
EQ SERIAL-NO OF MAINTENANCE.

RELATION NAME IS EQUIPMENT-CURRENT-LOCATJON
JOIN WHERE SERIAL-NO OF EQUIPMENT-DETAIL
EQ SERIAL-NO OF FPRESENT-LOCATION.

RELATION NAME IS EQUIPMENT-FAILURE-HISTORY
JOIN WHERE SERIAL-NO OF EQUIPMENT-DETAIL
EQ SERIAL-NO OF FAILURE-HISTORY.

RELATION NAME IS MAINTENANCE-OF-EQUIPMENT
JOIN WHERE SERIAL-NO OF MAINTENANCE
EQ SERIAL-NO OF EQUIPMENT-DETAIL.

RELATION NAME IS MAINTENANCE-OF-PURCHASED-EQP
JOIN WHERE SERIAL-NO OF MAINTENANCE
EQ SERIAL-NO OF PURCHASED.

RELATION NAME IS MAINTENANCE-OF-LEASED-EQP
JOIN WHERE SERIAL-NO OF MAINTENANCE
EQ SERIAL-NO OF LEASED.

DDL COMPLETE. 0453008 CM USED. 0 DIAGNOSTICS.
CP TIME USED= 2.137 SECONDS

* SOURCE LISTING * DDL 2.1 (78136) - 460 78/11/29. 19.42.14.

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* THIS IS A SUBSCHEMA TO CREATE ALL DATA BASE FILES FOR INVENTORY *
* EQUIPMENT DATA BASE. *

TITLE DIVISION.
SS CREATESB WITHIN INVENTORY-EQUIPMENT-DB.

* FOLLOWING PARAGRAPH GIVES CHANGED NAMES FOR AREAS AND DATA ITEMS. *

ALIAS DIVISION.
AD REALM EQUIPMENTAREA BECOMES EQUIP-FILE.
AD REALM PURCHASEAREA BECOMES PUR-FILE.
AD REALM LEASEAREA BECOMES LEASE-FILE.
AD REALM PASTLEASEAREA BECOMES PAST-LEASE-FILE.
AD REALM MAINTENANCEAREA BECOMES MAINT-FILE.
AD REALM PASTMAINTENANCEAREA BECOMES PAST-MAINT-FILE.
AD REALM PRLOCATION BECOMES PR-LOC-FILE.
AD REALM PTLOCATION BECOMES PT-LOC-FILE.
AD REALM FAILURE BECOMES FAILURE-FILE.
AD DATA STATUS BECOMES EQUIPMENT-STATUS.
AD DATA COUNT BECOMES FAILURE-COUNT.

* THIS DIVISION GIVES NAMES OF ALL FILES IN DATA BASE. *

REALM DIVISION.
RD EQUIP-FILE PUR-FILE LEASE-FILE MAINT-FILE
PAST-LEASE-FILE PAST-MAINT-FILE PR-LOC-FILE PT-LOC-FILE
FAILURE-FILE.

* THIS DIVISION GIVES DETAILS OF ALL RECORDS IN DATA BASE. *

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RECORD DIVISION.

01	EQUIPMENT-DETAIL.			** WITHIN EQUIP-FI
03	SERIAL-NO	PIC X(12).		** ORDINAL 1
03	VENDOR	PIC X(25).		** ORDINAL 10
03	DEPT	PIC X(5).		** ORDINAL 10
03	IPACS-ID	PIC X(6).		** ORDINAL 10
03	MODEL-NO	PIC X(9).		** ORDINAL 10
03	CATEGORY	PIC 9.		** ORDINAL 10
03	DATE-ACQUIRED	PIC X(8).		** ORDINAL 10
03	DESCRIPTION.			** ORDINAL 10
05	DESCRIPTION-1	PIC X(50).		** ORDINAL 10
05	DESCRIPTION-2	PIC X(50).		** ORDINAL 10
01	PURCHASED.			** WITHIN PUR-FIL
03	SERIAL-NO	PIC X(12).		** ORDINAL 1
03	PURCHASE-COST	PIC 9(7)V99.		** ORDINAL 10
03	ACCOUNT-NO	PIC 99.		** ORDINAL 10
03	P-O-NC-P	PIC X(6).		** ORDINAL 10
03	CURRENT-REPLACEMENT-COST	PIC 9(7)V99.		** ORDINAL 10
01	LEASED.			** WITHIN LEASE-F
03	SERIAL-NO	PIC X(12).		** ORDINAL 1
03	START-DATE	PIC X(8).		** ORDINAL 10
03	BASIS-OF-COST-L	PIC 9.		** ORDINAL 10
03	LEASE-COST	PIC 9(6)V99.		** ORDINAL 10
03	PERIOD	PIC X(3).		** ORDINAL 10
03	ACCOUNT-NC	PIC 99.		** ORDINAL 10
03	P-O-NC-L	PIC X(5).		** ORDINAL 10
01	PAST-LEASE-RECORD.			** WITHIN PAST-LE
03	LEASE-KEY.			** ORDINAL 1
05	SERIAL-NO	PIC X(12).		** ORDINAL 10
05	START-DATE	PIC X(8).		** ORDINAL 10
03	BASIS-OF-COST-L	PIC 9.		** ORDINAL 10
03	PAST-LEASE-COST	PIC 9(6)V99.		** ORDINAL 10
03	PERIOD	PIC X(3).		** ORDINAL 10
03	ACCOUNT-NC	PIC 99.		** ORDINAL 10
03	PAST-P-O-NO-L	PIC X(5).		** ORDINAL 10
01	MAINTENANCE.			** WITHIN MAINT-F
03	SERIAL-NO	PIC X(12).		** ORDINAL 1
03	START-DATE	PIC X(8).		** ORDINAL 10
03	BASIS-OF-COST-M	PIC 9.		** ORDINAL 10
03	MAINT-COST	PIC 9(6)V99.		** ORDINAL 10
03	PERIOD	PIC X(3).		** ORDINAL 10
03	MAINT	PIC X(3).		** ORDINAL 10
03	ACCOUNT-NO	PIC 99.		** ORDINAL 10
03	P-O-NO-M	PIC X(5).		** ORDINAL 10
01	PAST-MAINTENANCE-RECORD.			** WITHIN PAST-MA
03	MAINT-KEY.			** ORDINAL 1
05	SERIAL-NO	PIC X(12).		** ORDINAL 10
05	START-DATE	PIC X(8).		** ORDINAL 10
03	BASIS-OF-COST-M	PIC 9.		** ORDINAL 10
03	PAST-MAINT-COST	PIC 9(6)V99.		** ORDINAL 10


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001116 03 PERIOD PIC X(3). ** ORDINAL 6
001117 03 PAST-MAINTE FIC X(3). ** ORDINAL 7
001118 03 ACCOUNT-NO FIC 99. ** ORDINAL 8
001119 03 PAST-P-O-NO-M FIC X(5). ** ORDINAL 9
00120 01 PRESENT-LOCATION. ** WITHIN PR-LOC-
00121 03 SERIAL-NO FIC X(12). ** ORDINAL 1
00122 03 BLD-RCOM PIC X(10). ** ORDINAL 2
00123 03 DATE-IN FIC X(8). ** ORDINAL 3
00124 03 EQUIPMENT-STATUS FIC X(15). ** ORDINAL 4
00125
00126 01 PAST-LOCATION. ** WITHIN PT-LOC-
00127 03 PAST-LOC-KEY. ** ORDINAL 1
00128 05 SERIAL-NO FIC X(12). ** ORDINAL 2
00129 05 DATE-IN PIC X(8). ** ORDINAL 3
00130 03 DATE-CUT FIC X(8). ** ORDINAL 4
00131 03 BLD-RCOM PIC X(10). ** ORDINAL 5
00132 03 EQUIPMENT-STATUS FIC X(15). ** ORDINAL 6
00133
00134 01 FAILURE-HISTORY. ** WITHIN FAILURE
00135 03 FAILURE-KEY. ** ORDINAL 1
00136 05 SERIAL-NO FIC X(12). ** ORDINAL 2
00137 05 FAILURE-COUNT PIC 99. ** ORDINAL 3
00138 03 DATE-OF-FAILURE PIC X(8). ** ORDINAL 4
00139 03 DATE-OF-REPAIR PIC X(8). ** ORDINAL 5
00140 03 FAILURE-DESCRIPTION PIC X(40). ** ORDINAL 6

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*****
* THIS DIVISION SPECIFIES ALL RELATIONS SPECIFIED IN SCHEMA.
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PP PRIMARY KEY 00064
AL ALTERNATE KEY 00065
AL ALTERNATE KEY 00066
AL ALTERNATE KEY 00067
AL ALTERNATE KEY 00069
AL ALTERNATE KEY 00070
PR PRIMARY KEY 00076
AL ALTERNATE KEY 00079
PR PRIMARY KEY 00083
AL ALTERNATE KEY 00089
PR PRIMARY KEY 00101
AL ALTERNATE KEY 00108
PR PRIMARY KEY 00092
PR PRIMARY KEY 00111
PR PRIMARY KEY 00121
AL ALTERNATE KEY 00122
PR PRIMARY KEY 00127
PR PRIMARY KEY 00135

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SERIAL-NO FOR AREA EQUIP-FILE
VENDOR FOR AREA EQUIP-FILE
DEPT FOR AREA EQUIP-FILE
IPACS-ID FOR AREA EQUIP-FILE
CATEGORY FOR AREA EQUIP-FILE
DATE-ACQUIRED FOR AREA EQUIP-FILE
SERIAL-NO FOR AREA PUR-FILE
P-O-NO-P FOR AREA PUR-FILE
SERIAL-NO FOR AREA LEASE-FILE
P-O-NO-L FOR AREA LEASE-FILE
SERIAL-NO FOR AREA MAINT-FILE
P-O-NO-M FOR AREA MAINT-FILE
LEASE-KEY FOR AREA PAST-LEASE-FILE
MAINT-KEY FOR AREA PAST-MAINT-FILE
SERIAL-NO FOR AREA PR-LOC-FILE
BLD-ROOM FOR AREA PR-LOC-FILE
PAST-LOC-KEY FOR AREA PT-LOC-FILE
FAILURE-KEY FOR AREA FAILURE-FILE
RECORD MAPPING IS NOT NEEDED FOR REALM - EQUIP-FILE
RECORD MAPPING IS NOT NEEDED FOR REALM - PUR-FILE
RECORD MAPPING IS NOT NEEDED FOR REALM - LEASE-FILE
RECORD MAPPING IS NOT NEEDED FOR REALM - MAINT-FILE
RECORD MAPPING IS NOT NEEDED FOR REALM - PAST-LEASE-FILE
RECORD MAPPING IS NOT NEEDED FOR REALM - PAST-MAINT-FILE
RECORD MAPPING IS NOT NEEDED FOR REALM - PR-LOC-FILE
RECORD MAPPING IS NOT NEEDED FOR REALM - PT-LOC-FILE
RECORD MAPPING IS NOT NEEDED FOR REALM - FAILURE-FILE

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RELATION DIVISION.

RN IS EQUIPMENT-PURCHASED.
RN IS EQUIPMENT-LEASED.
RN IS EQUIPMENT-MAINTENANCE.
RN IS EQUIPMENT-CURRENT-LOCATION.
RN IS EQUIPMENT-FAILURE-HISTORY.
RN IS MAINTENANCE-OF-EQUIPMENT.
RN IS MAINTENANCE-OF-PURCHASED-EQP.
RN IS MAINTENANCE-OF-LEASED-EQP.

END OF SUB-SCHEMA SOURCE INPUT

RELATION STATISTICS *****

RELATION 001 EQUIPMENT-PURCHASED TRAVERSES AREA - EQUIP-FILE
AREA - PUR-FILE
RELATION 002 EQUIPMENT-LEASED TRAVERSES AREA - EQUIP-FILE
AREA - LEASE-FILE
RELATION 003 EQUIPMENT-MAINTENANCE TRAVERSES AREA - EQUIP-FILE
AREA - MAINT-FILE
RELATION 004 EQUIPMENT-CURRENT-LOCATION TRAVERSES AREA - EQUIP-FILE
AREA - PR-LOC-FILE
RELATION 005 EQUIPMENT-FAILURE-HISTORY TRAVERSES AREA - EQUIP-FILE
AREA - FAILURE-FILE
RELATION 006 MAINTENANCE-OF-EQUIPMENT TRAVERSES AREA - MAINT-FILE
AREA - EQUIP-FILE
RELATION 007 MAINTENANCE-OF-PURCHASED-EQP TRAVERSES AREA - MAINT-FILE
AREA - PUR-FILE
RELATION 008 MAINTENANCE-OF-LEASED-EQP TRAVERSES AREA - MAINT-FILE
AREA - LEASE-FILE

BEGIN SUB-SCHEMA FILE MAINTENANCE

DDL COMPLETE. 0540008 CM USED. 0 DIAGNOSTICS.

CP TIME USED= 1.635 SECONDS

APPENDIX B : Sample of Printed Reports

EQUIPMENT RECORD

REPORT DATE 11 SEPT 78

CATEGORY DATA PROCESSING EQUIPMENT

DEPARTMENT ACS

<u>SERIAL NO</u>	<u>MODEL NO</u>	<u>DESCRIPTION</u>	<u>PURCHASE COST</u>	<u>LEASE COST</u>	<u>MAINTENANCE</u>
0049	6612	CONTROL CRT DISPLAY PURCHASE AND MAINTENANCE INCLUDED IN 1151			
0190	595-1	PRINT CHAIN (512-PRINTER)	\$5,555.00		\$50.00/PM
0213	3531-1	LINE PRINTER CONTROLLER (512-PRINTER)	\$77,777.00		\$777.00/PM
0355	6612	CONTROL CRT DISPLAY PURCHASE AND MAINTENANCE INCLUDED IN 1130			
0626	512-1	LINE PRINTER	\$66,666.00		\$600.00/PM
1051	6414	CDC-6400 COMPUTER	\$999,999.00		\$5,000.00/PM
1130	6414	CDC-6400 COMPUTER	\$8,888,888.00		\$8,500.00/PM

EQUIPMENT FAILURE REPORT

REPORT DATE 11 SEPT 73

CATEGORY DATA PROCESSING EQUIPMENT

VENDOR IBM

SERIAL-NO 0626

DATE-AQUIRED 1975/12/11

EQUIPMENT DESCRIPTION LINE PRINTER

FAILURE-NO	FAILURE-DATE	REPAIR-DATE	FAILURE-DESCRIPTION
1	1975/01/21	1976/01/29	BROKEN BELT
2	1975/02/11	1975/02/25	MECHANICAL BREAKDOWN
3	1977/02/26	1977/03/12	BROKEN BELT
4	1977/05/19	1977/05/21	BROKEN BELT
5	1978/08/10	1978/08/12	BROKEN BELT
6	1978/08/15	1978/09/12	BROKEN BELT

PRESENT LOCATION RECORD

REPORT DATE 29 NOV 78

ITEM	MODEL-NO	SERIAL-NO	IPACS-ID	PRESENT-LOCATION	STATUS
1	01200A	CR-1		SSC-132	ACTIVE
2		CR-2		SSC-274	ACTIVE
3	PH3330	CR-3		SSC-132A	ACTIVE
4	PC3225	CR-4		SSC-132A	INACTIVE
5	5512	0049		SSC-132A	ACTIVE
6	595-1	0190		SSC-132A	ACTIVE
7	3551-1	3213		SSC-132A	ACTIVE
8	5612	0355		SSC-132A	ACTIVE
9	512-1	0626		GS-204	ACTIVE
10		085		SSC-132	ACTIVE
11	5414	1051		SSC-132	ACTIVE
12	5414	1130		SSC-132A	ACTIVE
13	677-03	123457		SSC-132A	ACTIVE
14		123467		SSC-132A	ACTIVE
15	001	167168		GH-229	ACTIVE
16	660	1982-0477081		GS-204	ACTIVE
17	733KSR	2345	55	GS-204	ACTIVE
18	725	2346	56	GS-204	ACTIVE
19	733ASR	2567	63	KTH-132B	INACTIVE

PURCHASE REPORT FOR ALL DEPARTMENT

DEPARTMENT -----	TOTAL PURCHASE COST -----
ACS	\$10,146,661.00
IPS	\$7,108.00
OTHER	\$1,443.00
TCS	\$20,228.00
----- TOTAL PURCHASE-COST FOR ALL DEPARTMENTS	----- \$10,175,440.00

EQUIPMENT PURCHASE REPORT FOR A VENDOR

REPORT DATE 11 SEPT 78

VENDOR IBM

ITEM	SERIAL NO	DESCRIPTION	PURCHASE COST
1	0190	PRINT CHAIN (512-PRINTER)	\$3,555.00
2	0213	LINE PRINTER CONTROLLER (512-PRINTER)	\$77,777.00
3	0626	LINE PRINTER	\$55,655.00
4	167168	IBM SELECTIVE TYPEWRITER (S.HOUSIEN)	\$777.00
5	123163743	IBM SELECTIVE TYPEWRITER (L.GIRARD)	\$655.00
TOTAL COST OF EQUIPMENT PURCHASED FROM IBM			\$151,441.00

DEPARTMENTAL EQUIPMENT PURCHASE REPORT

REPORT DATE 11 SEPT 79

DEPARTMENT ACS

ITEM	SERIAL NO	DESCRIPTION	PURCHASE COST
1	CR-2	MISC. SPARE PARTS FOR 01200A	\$7,777.00
2	0049	CONTROL CRT DISPLAY PURCHASE AND MAINTENANCE INCLUDED IN 1151	\$0.00
3	0170	PRINT CHAIN (512-PRINTER)	\$5,555.00
4	0213	LINE PRINTER CONTROLLER (512-PRINTER)	\$77,777.00
5	0355	CONTROL CRT DISPLAY PURCHASE AND MAINTENANCE INCLUDED IN 1130	\$0.00
6	0526	LINE PRINTER	\$66,666.00
7	045	BENSON LEHNER INCREMENTAL PLOTTER	\$99,999.00
8	1051	CDC-6400 COMPUTER	\$99,999.00
9	1130	CDC-6400 COMPUTER	\$9,999,999.00
TOTAL COST OF EQUIPMENT PURCHASED FOR ACS			\$10,146,661.00

LOCATION REPORT OF TERMINALS

REPORT DATE 8 SEPT 78

IPACS-ID	SERIAL-NO	LOCATION	DESCRIPTION
63	2567	KTH-132B	DATA TERMINAL WITH REMOTE DEVICE CONTROL
61	58213	SSC-131A	DATA TERMINAL
62	58915	KTH-132B	DATA TERMINAL
60	59811	SSC-131A	PORTABLE TERMINAL
59	59812	SSC-131A	PORTABLE TERMINAL
58	57892	GS-204	SILENT 700 TEXAS INSTRU.
57	57891	GS-204	SILENT 700 TEXAS INSTRU.
56	2346	GS-204	PORTABLE TERMINAL (ID NO 68)
55	2345	GS-204	DATA TERMINAL

EQUIPMENT RECORD FOR PURCHASE ORDER NO 367891

PAGE 1

VENDOR BENSON LEHNER

REPORT DATE SEPTEMBER 11 1973

<u>ITEM-NO</u>	<u>MODEL-NO</u>	<u>SERIAL NO</u>	<u>DESCRIPTION</u>	<u>PURCHASE COST</u>
1	D1200A	CR-1	VERSATEC MATRIX PRINTER-PLOTTER	\$8,348.00
2		CR-2	MISC. SPARE PARTS FOR D1200A	\$7,777.00
3		085	BENSON LEHNER INCREMENTAL PLOTTER	\$99,999.00

UPDATE-REPORT

7/8/09/13 PAGE 1

SERIAL-NO	VENDOR	DEPT	IPACS-ID	MODEL-NO	CATEGORY	DATE-ACQUIRED	ACTION TAKEN
321324	IBM	ACS		A-125-912	2	1977/12/12	ADDED TO EQUIP-FILE
2345	TEXAS INSTRUMENTS	TCS	55 7	33KSR	3	1977/12/12	ADDED TO EQUIP-FILE
2346	TEXAS INSTRUMENTS	TCS	56	725	3	1977/12/12	ADDED TO EQUIP-FILE
57891	TEXAS INSTRUMENTS	TCS	57	725	3	1977/12/12	ADDED TO EQUIP-FILE
57892	TEXAS INSTRUMENTS	TCS	58	725	3	1977/12/12	ADDED TO EQUIP-FILE
59812	TEXAS INSTRUMENTS	TCS	59	735	3	1978/08/12	ADDED TO EQUIP-FILE
59811	TEXAS INSTRUMENTS	TCS	60	735	3	1978/08/12	ADDED TO EQUIP-FILE
58213	WESTING HOUSE	IPS	61	W1620	3	1976/11/12	ADDED TO EQUIP-FILE
58915	OMRON	IPS	62	8025	3	1975/11/13	ADDED TO EQUIP-FILE
2567	TEXAS INSTRUMENTS	TCS	63	733ASR	3	1977/12/12	ADDED TO EQUIP-FILE

FILE	EQUIP-FILE	RECORD KEY	CR-3
FIELD	VENDOR	BEFORE REPLACEMENT	TEXAS INSTRUMENT
		AFTER REPLACEMENT	TEXAS INSTRUMENTS

FILE	EQUIP-FILE	RECORD KEY	CR-4
FIELD	VENDOR	BEFORE REPLACEMENT	TEXAS INSTRUMENT
		AFTER REPLACEMENT	TEXAS INSTRUMENTS

FILE	EQUIP-FILE	RECORD KEY	2345
FIELD	IPACS-JD	BEFORE REPLACEMENT	55 7
		AFTER REPLACEMENT	55

FILE	EQUIP-FILE	RECORD KEY	2345
FIELD	MODEL-NO	BEFORE REPLACEMENT	33KSR
		AFTER REPLACEMENT	733KSR

FILE	EQUIP-FILE	RECORD KEY	2345
FIELD	DESCRIPTION-1	BEFORE REPLACEMENT	
		AFTER REPLACEMENT	DATA TERMINAL

FILE	EQUIP-FILE	RECORD KEY	2346
FIELD	DESCRIPTION-1	BEFORE REPLACEMENT	
		AFTER REPLACEMENT	PORTABLE TERMINAL (ID NO 68)

FILE	EQUIP-FILE	RECORD KEY	57891
FIELD	DESCRIPTION-1	BEFORE REPLACEMENT	
		AFTER REPLACEMENT	SILENT 700 TEXAS INSTRU.

UPDATE-REPORT

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<u>SERIAL-NO</u>	<u>PURCHASE-COST</u>	<u>ACCOUNT-NO</u>	<u>P-O-NO-P</u>	<u>CURRENT-REPLACEMENT-COST</u>	<u>ACTION TAKEN</u>
167167	\$777.00	01	345678	\$777.00	ADDED TO PUR-FILE
2345	\$1,500.00	04	329678	\$1,500.00	ADDED TO PUR-FILE
2346	\$1,550.00	04	329678	\$1,550.00	ADDED TO PUR-FILE
57891	\$1,540.00	04	329678	\$1,540.00	ADDED TO PUR-FILE
57892	\$1,600.00	04	329678	\$1,600.00	ADDED TO PUR-FILE
59812	\$1,650.00	04	324125	\$1,650.00	ADDED TO PUR-FILE
59811	\$1,700.00	04	324125	\$1,700.00	ADDED TO PUR-FILE
58213	\$1,750.00	04	386123	\$1,750.00	ADDED TO PUR-FILE
58915	\$2,000.00	04	387159	\$2,000.00	ADDED TO PUR-FILE
2567	\$1,800.00	04	324125	\$1,800.00	ADDED TO PUR-FILE

UPDATE-REPORT

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SERIAL-NO	DATE-IN	DATE-OUT	BLD-ROOM	STATUS	ACTION TAKEN
2345	1977/12/12		GS-204	ACTIVE	ADDED TO PR-LOC-FILE
2346	1977/12/12		GS-204	ACTIVE	ADDED TO PR-LOC-FILE
57891	1977/12/12		GS-204	ACTIVE	ADDED TO PR-LOC-FILE
59892	1977/12/12		GS-204	ACTIVE	ADDED TO PR-LOC-FILE
59812	1978/08/12		SSC-131A	ACTIVE	ADDED TO PR-LOC-FILE
59811	1978/08/12		SSC-131A	ACTIVE	ADDED TO PR-LOC-FILE
58213	1976/11/12		SSC-131A	ACTIVE	ADDED TO PR-LOC-FILE
58915	1975/11/13		KTH-132B	ACTIVE	ADDED TO PR-LOC-FILE
2567	1977/12/12		KTH-132B	INACTIVE	ADDED TO PR-LOC-FILE
123457	1977/03/12	1978/01/12	GS-204	ACTIVE	TRANSFERRED TO PT-LOC-FILE
123457	1977/03/12		GS-204	ACTIVE	DELETED FROM PR-LOC-FILE
123457	1978/01/12		SSC-132A	ACTIVE	ADDED TO PR-LOC-FILE

SERIAL-NO	COUNT	FAILURE-DATE	REPAIR-DATE	FAILURE-DESCRIPTION	ACTION TAKEN
0626	08	1978/08/15	1978/09/12	BROKEN BELT	ADDED TO FAILURE-FILE

EXCEPTION REPORT

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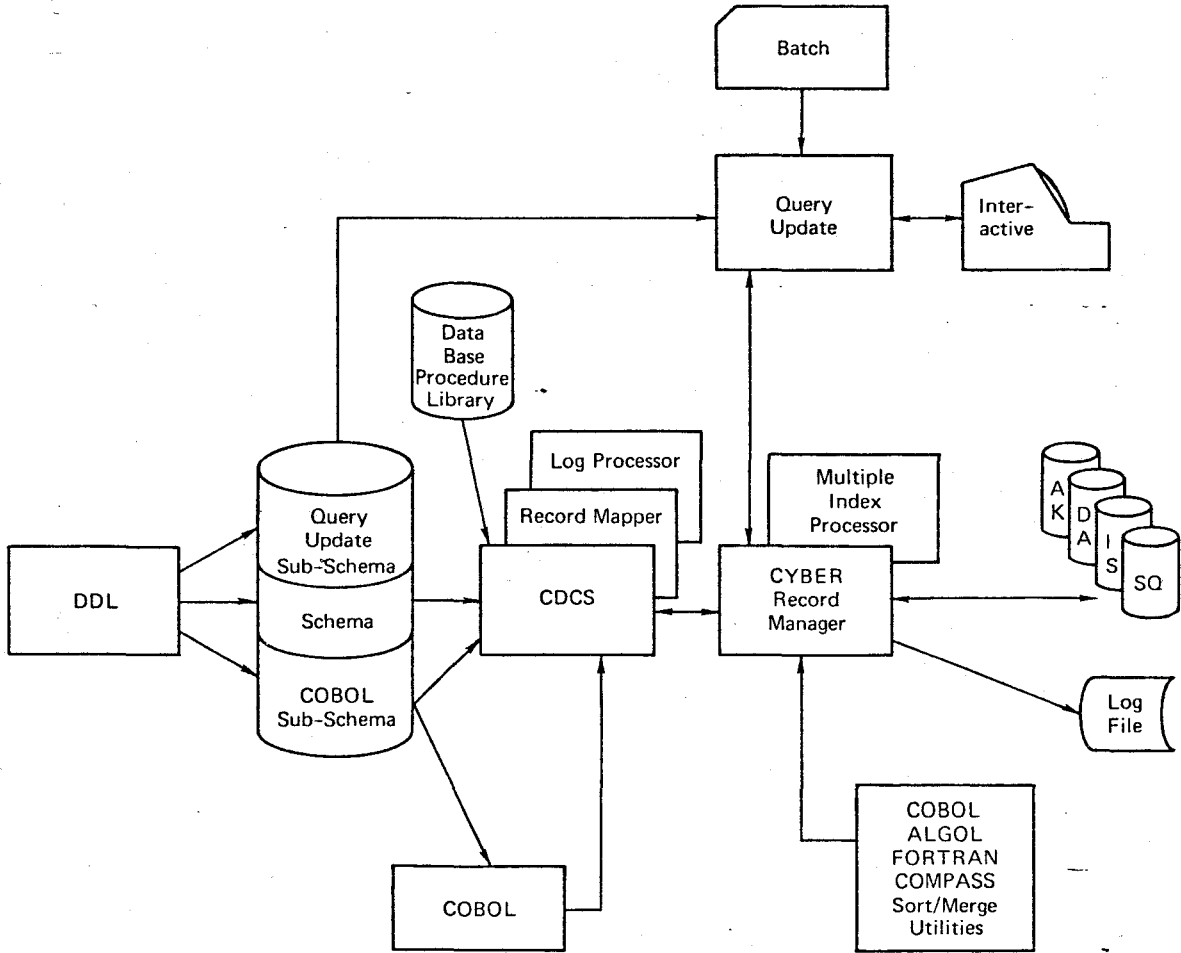
BAD RECORD

ERROR MESSAGES

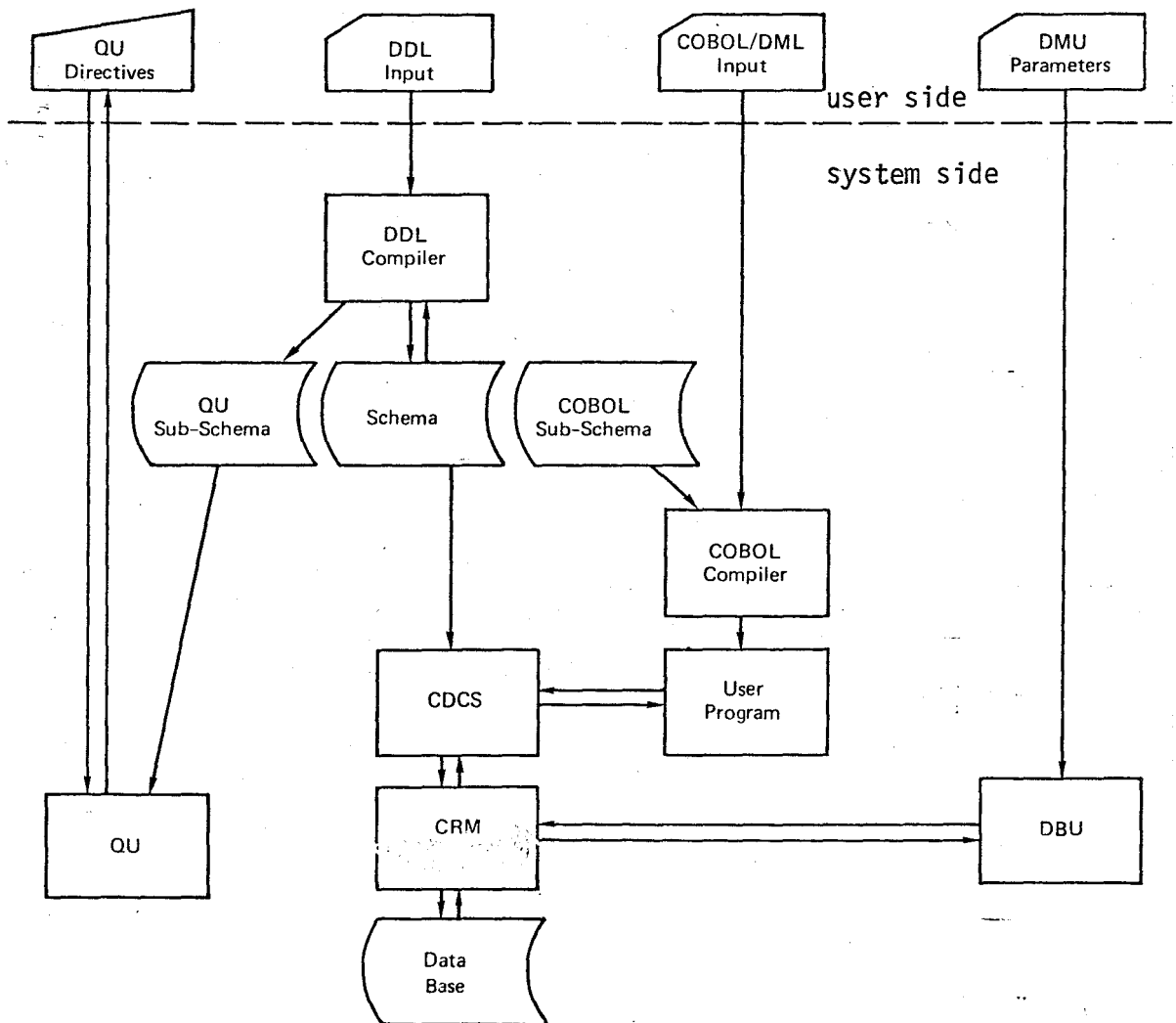
183321325	501	LINE	PRINTER		NO RECORD CONTAINS SPECIFIED KEY
312321325					NO RECORD CONTAINS SPECIFIED KEY
443123467	197811210000170000901042154				ERROR IN FIELD CODE
6112345	GS-204	19771212	ACTIVE		RECORD WRITTEN HAS DUPLICATE KEY
6112346	GS-204	19771212	ACTIVE		RECORD WRITTEN HAS DUPLICATE KEY
61157891	GS-204	19771212	ACTIVE		RECORD WRITTEN HAS DUPLICATE KEY
61157892	GS-204	19771212	ACTIVE		RECORD WRITTEN HAS DUPLICATE KEY
61159812	SSC-131A	19780812	ACTIVE		RECORD WRITTEN HAS DUPLICATE KEY
61159811	SSC-131A	19780812	ACTIVE		RECORD WRITTEN HAS DUPLICATE KEY
61158213	SSC-131A	19761112	ACTIVE		RECORD WRITTEN HAS DUPLICATE KEY
61158915	KTH-132B	19751113	ACTIVE		RECORD WRITTEN HAS DUPLICATE KEY
6112567	KTH-132B	19771212	INACTIVE		RECORD WRITTEN HAS DUPLICATE KEY
61259892					NO RECORD CONTAINS SPECIFIED KEY
613123457	SSC-132A	19780112	ACTIVE		RECORD WRITTEN HAS DUPLICATE KEY

APPENDIX C

The following figure includes major database management features and it presents the total DMS-170 system. [1]



The DMS-170 processing environment. [1]



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