A WEB BASED COMPLAINTS MONITORING AND MANAGEMENT INFORMATION SYSTEM

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Abstract

The concept of a Web Based Complaint Monitoring and Management Information System revolves around distributed database management and web technologies. The research work is focused towards exploiting state of the art technology evolving a practical computer based system for Military Engineering Services. The main components are databases, Interfaces, and data transfer through Wide Area Network using normal civil/military telephone lines. The database of the system contains data regarding complaints registered by the complainee, stores held/consumed and workers available/detailed. By monitoring activities this system provides an efficient and effective tool in identifying and minimizing the leakages of material resources, managing the human resources, ensuring complaints are honored, and ensuring time management. The system is capable enough in supporting the top management to give rapid and fast decisions based on the facts provided by the system. The software is developed using real time replicated concepts of distributed data base management system. Advantages of a replicated system are locality of reference, reliability, availability, and best load distribution with minimal cost of communication. The distributed system consists of three different nodes: Data Node, MIS Node, and DSS Node.

Data Node is designed to capture the data at base level. In an MES organization it can be identified as Chowkis. All complaints made by complainee are entered at Data node. Similarly detailing of worker, issue of stores, time recording for completed and uncompleted jobs, and recording of reasons for uncompleted tasks are done at this level. Data Node contains replicated database.

Management Information System (MIS) Node is a step higher to data node. It provides summaries to the Garrison Engineers for equipping them with real information as a tool to monitor resources effectively and efficiently. Microsoft Access 2000 RDBMS has been used for developing the database. Active Server Pages (ASP) with Visual Basic Scripting, Hyper Text Markup Language (HTML), Dynamic HTML and Active Data Objects (ADO) has been used to develop dynamic web pages for processing the required information. Personal Web Server provides web services. MIS Node also contains replicated database for DSS Node. Data synchronization is done by MIS node with DSS Node.

Decision Support System (DSS) Node to represent the Commanders Military Engineering Services (CsMES) office is evolved to monitor the summaries of data formulated at respective MIS nodes to ensure the correctness of direction and availability of resources similar to MIS node technologies are exploited during development of this node.

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Introduction

1.1 Introduction

Military Engineering Services (MES) is over hundred years old department. With the advent of British Empire in the Sub-continent, the engineering requirements of the Army preponderated over other departments. Consequently, a Military Board was set up in 1841 and a Public Works Department for execution of Civil as well as Military works was placed under its control. In the middle of nineteenth century, the Military Board was abolished and works department was placed under civil control. With increase in works in 1866 the works department was sub-divided and Military works branch set up to exclusively take care of works for the Army. Fifteen years later, it was placed under the control of a Director General who had direct communication with Commander-in-Chief. Around 1919 the works services were placed under Quarter-Master-General for a short period of time.

On re-organization of the Army in 1923 the control of the works organization renamed as 'Military Engineer Services' (MES) was vested direct with Engineer-in-Chief. Chief Engineers were placed at command level namely, Chief Engineer Eastern command Calcutta, Central Command Agra, Southern Command Poona and Northern command Rawalpindi. Besides, there was one Deputy Chief Engineer Baluchistan at Quetta. After independence in 1947, Engineer-in-Chief headed this organization and had Commanders MES located at six garrisons. In 1960, Government of Pakistan reorganized MES to cope with increased workload on Inter Services basis and Directorates of Works and Civil Engineering (DW & CE) with necessary staff was set up for each

service i.e. Army, Navy and Air force. Further in the year 1972, DW & CE for Defense Production was also raised to execute the works due to meeting the needs of expanding defense industries.

1.2 MES Infrastructure

MES as a department deals with construction and maintenance of buildings, roads, airfields, bridges, electric & water supply, sewerage, sui gas, drainage, furniture and stores etc. To handle all these services, MES has different cadres like B&R (Building & Roads), E&M (Electrical & Mechanical) and F&S(Furniture & Stores) which are considered to the specialized in their respective fields. It is an inter-services organization to provide such services for Army, Navy, Air Force and DP Division. With increased needs and commitments, additional staff became necessary, and in 1960, a Director of works and Chief Engineer with requisite organization were established at each Service HQ for close liaison, effective and efficient planning and execution of work. Responsibility for furniture in Navy and PAF Wings rests with MES whereas in Army it is handled by QMG's Branch. Maintenance/repairs and minor works in MES Army Wing are controlled by Station HQs. MES has also a Wing for Ministry of Defense Production to undertake these services. Similarly there is MES School at MCE Risalpur where different types of courses are run for the MES officers and other supervisory and technical staff. Overall infrastructure at army level is given in fig 1.1.

Organization Chart at DW & CE Level

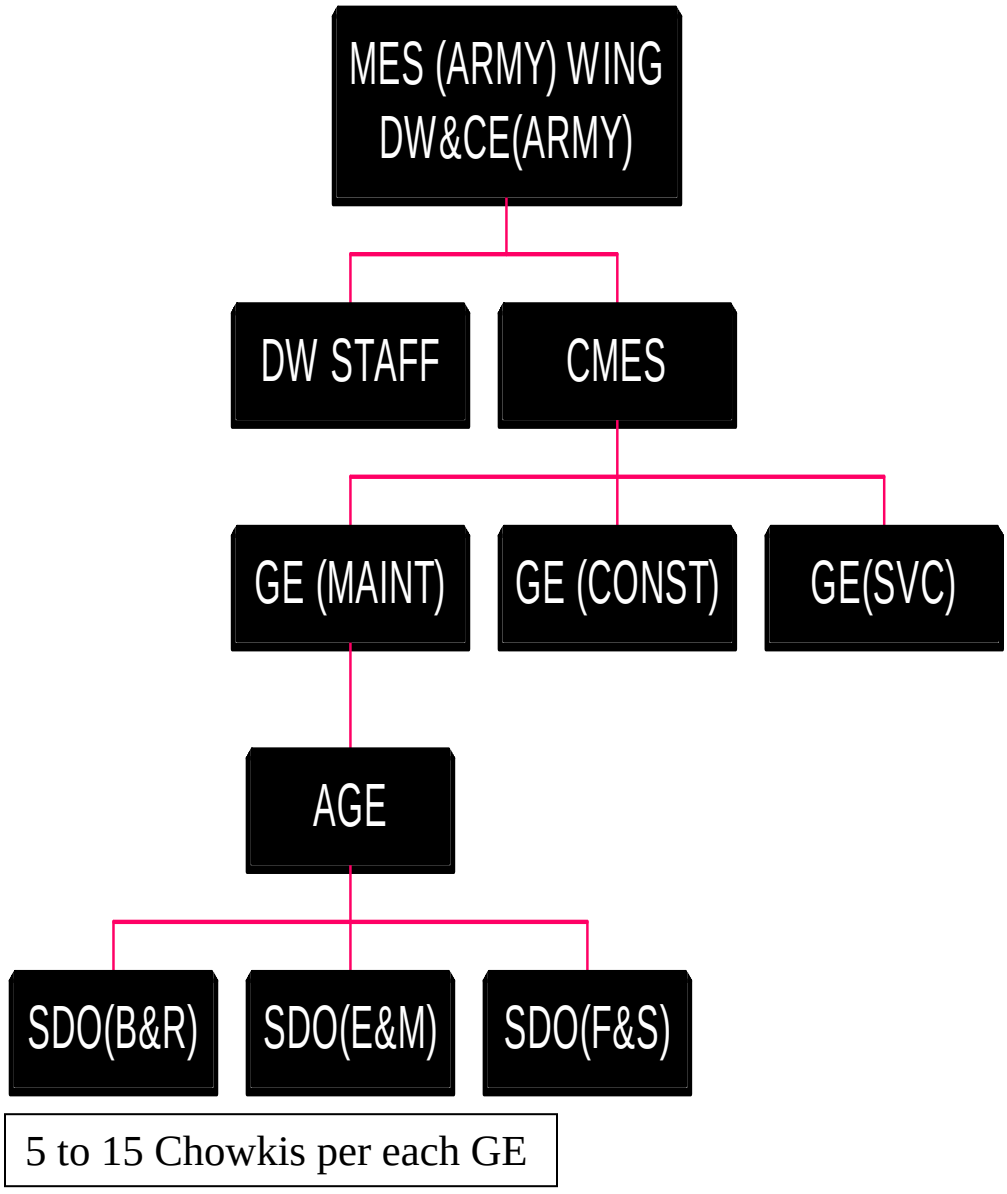


Figure 1.1 Organization Chart at DW & CE Level

1.3 Existing Complaint Monitoring System and Resources Management

C4I Directorate, Generals Headquarter Rawalpindi developed a Chowki level Complaint Monitoring System in Microsoft Access 97 for Chaklala Chowki of GE (Army) West. It was developed as prototype that has now been amended as a general-purpose system that can fit into any wing (army, air force, navy) of the MES organization.

1.3.1 Allocation Of Resources

Quartering Directorate, Generals Headquarter is sanctioning authority for all types of financial allocations. Commanders Military Engineering Services (CsMES) are allocated yearly funds for purchase of running stores from the local market. CsMES further allocates these funds to their under command Garrison Engineers (GEs). In case if stores are not held with the GE then he initiate minor work Performa that contains estimated amount required for completing the work. For all kinds of new work or works requiring huge amounts major work performa's are initiated. Major and minor work performas are then forwarded to Station Headquarters. Station Headquarters after necessary scrutiny forward the work performas to Quartering Directorate for necessary sanction. Once amount is sanctioned it is placed at the disposal of the garrison engineers for execution through approved government contractors. Once the user reports the completion then CsMES and GEs carries out technical check through its staff. On approval of technical check requisition contractor initiates bill and Unit accountant issues the payments to the contractors. Old maintenance involves smaller works therefore they are executed through smaller contractors who are called Term Contractors or TC.

Induction, Postings and Promotions policies of MES department is regulated at Engineer-in-Chief branch General Headquarters Rawalpindi. A board of officers assembles at Engineer-in-Chief (E-in-C) branch Generals Headquarters and carries out inductions and promotions of personals of all grades (except RTE). This board is headed by E-in-C, and DW&CE of all the wings are its members. Induction of RTE's is carried out by respective DW&CE. Inter wing posting transfer are ordered by E-In-C whereas, DW&CE, CMES and GE are authorized to do the internal postings with in their area of jurisdiction.

1.3.2 Kind of resources held with MES

Chowki level is the lowest level which is headed by an Incharge Chowki. There are 25 to 30 personals held at each chowki. Chowki has get its own store yard and few chowkis have got one pickup for carrying equipment and stores. Garrison is the next higher level, which is headed by a grade-18 officer. There are 1000 to 1500 personals (tradesman and Laborers). Each garrison has sufficient funds for purchase of stores; also approved government contractors are at the disposal of the garrison engineers to execute minor and major works. There are three to five light and heavy vehicles at garrison level. Third level is the station level that is headed by Commander MES. It is the top-level management at any station. Here all major policies are made and decisions are given. Presently MES is holding very less number of computers. CMES at Rawalpindi station has One Pentium-II computer with two printers (1X Laser printer and 1x Dot Matrix printer). Only GE Army (East) has one 486DX4 computer at chaklala chowki.

1.3.3 Identification of Grey Areas

Following are identified as gray areas :

- Leakages of funds due to not having record keeping.
- Over staffing / irrelevant staff / ghost staff / workers
- Procedural delays.
- Huge Maintenance Load / Record keeping of Maintenance Load.
- Large amount of paper work is involved.
  Delays in Information processing and record keeping of ongoing projects / major and minor works
- Record keeping of stores held and consumed causing pilferage of stores.
- Record keeping of efficient and in efficient workers.
- Record keeping of uncompleted jobs.
- Delays in responding to users.
- Record keeping of utility bills and handing taking over of residential and non-residential accommodations.
- Record keeping of Inventories for all new and old buildings that includes both residential and non-residential accommodations.

1.4 Research Scope

Pakistan is undergoing through an economical crisis, which have been resulted due to many problems. The research work is aimed at addressing certain areas where computer technology can be exploited to initially identify unnecessary leakage of resources and ultimately emerges as an integrated Management Information system to manage control and monitor resources effectively and efficiently. Almost everywherecomputer based systems are needed for record keeping

and monitoring the resources. However, MES can be targeted as one of the areas concerned to Armed Forces and effort was needed since long to evolve a computer-based solution for monitoring and managing complaints and allocating resources.

A Web Based Complaint Monitoring And Management Information System (WCMIS) for MES has been proposed in this thesis to cater for all activities related to complaints registered at different Chowkis. The WCMIS would support key management interfaces and activities in various functions of the complaint monitoring like complaints recording, complaints completed, uncompleted complaints, reasons for uncompleted complaints, detailing of workers, availability of stores, stores consumed on different residences, cost incurred on a complaint and suppliers of different stores. This system has been provided extensive search facilities on almost all data items of a record. Search on a record facility would enable the management to monitor the available resources from all the possible angles.

1.5 Goal of the Thesis

To develop a fully operational Web Based Complaint monitoring System which should be capable enough to help the management in various work areas, like

a. 100% Complaints Record Keeping
b. Utilization of Human Resources.
c. Stores management
d. Ensuring that complaints are honored
e. Time Management

1.6 Outline of the Thesis

The thesis is composed of six chapters. First chapter gives general overview of the MES organization, Statement of the problem, the area of research, the goals of the thesis.

The second chapter discusses the literature reviews categorized on the basis of project constituents, the concepts of back-end database systems, front-end tools, and web server's techniques of distributed data systems, are addressed.

The third chapter introduces related methods and tools available in the market like web technology, database engines, ASP, Active X Data Objects and networking. The criteria of selection of methods and tools for this project are also presented.

The fourth chapter contains complete design details of proposed solution. It Include phase wise system study of the organization and then building its conceptual and physical model and implementation strategies.

The fifth chapter discusses coding details, test data and expected results. Moreover, results of proposed implemented system are also presented.

The sixth chapter summarizes the facilities provided by the system and reviews its capabilities and limitations. In the last section, Usefulness of the proposed computer based solution is also evaluated and indicating better results is also shown. Recommendations for the future development of the system are also discussed as the last part.

Chapter 2

Literature Review

2.1 Introduction

There are different approaches available to design and develop such system. Oracle Developer, SQL Server, and Microsoft Access are the available choices for the database systems as back-end tools. Similarly choices for the graphical user interface designing are Oracle8i, Developer 2000, Visual Basic, Microsoft Access, and ASP/HTML. Data communication can be achieved using a WAN through dedicated links, existing telephone lines or leased lines. IT Professionals have also identified different techniques available for data transfer. As per researchers such projects can be computerized through exploiting databases as back-end, GUI oriented front-end development tools and remote connectivity. Here effort will be made to select relevant, precise and accurate data pertaining to these areas.

2.2 Database Systems / Back-end Concepts

Database technology is one of the rapid growing areas of computer science. The term data refers to the bare facts recorded in the database in form of attributes. They may be items about people, places, events, or concepts. On the other hand information is processed data that is that is useful for making decisions. Information is derived from the stored data by rearranging, selecting, combining, summarizing, or performing arithmetic, logical or relational operations on the data. In practice, people use both terms interchangeably. Thus a database is a collection of stored “operational data” used by the application systems of some particular enterprise. A database system provides a centralized control of its operational data, which is one of

the most valuable assets. The database should be designed to be a representation of the organization and its operations. [Ricardo 90]

In an enterprise using a database system, a person who has the central responsibility for the maintenance and updating of the operational data is called Data Base Administrator (DBA). All accesses to database are through DBMS, which is the software that allows one or many authorized persons to use and/or modify data. In other words DBMS is a software package that sets up storage structures, loads data, provides updates, controls concurrency, and does backup and recovery for the database. Major advantages of database system are that: many users can share the stored data, uniform standards for the storage and retrieval of data can be enforced, strict security procedures can be applied, Data integrity can be maintained, redundancy and inconsistency are minimized. [Meltzer 69]

Some of the important terms that are commonly used in database literatures are as under:

Term	**Definition**
Anomaly	An inconsistent, incomplete, incomplete, or contradictory state of database.
Access Control	Making sure that data are accessed only in authorized ways.
Attribute	Characteristics or properties that describes the entity
Audit Trail	It records all access to the database, keeps information about the requester, the operations performed, the terminal used, the time, data items and values involved.
Authentication	Verifying the identity of the user.
Abstraction	Anything-in real world that is abstract and cannot be represented directly by a printable value e.g. a

	student, a course. These are basically properties.
Binary Relation ship	Relation ship between any two entities or attributes.
Blocks	Data is stored in fixed size units called Blocks.
Blocking Factor	The number of logical records in a block.
Candidate Key	A super keys such that no proper subset of its attributes is itself a super key.
Composite Key	When a key consist of more than one attribute.
Concurrency	Needed when transactions are permitted to proceed simultaneously. Used to avoid Lost updates, Uncommitted Updates and inconsistent analysis
Dependencies	Type of relationship between the attributes.
Domain	The set of values permitted for each attribute.
Foreign Key	It is an attribute of an entity that is the primary key of another entity.
Integrity	Refers to correctness and consistency of stored data.
Indexing	Creating an Index, a table that tells where particular records are stored.
Inconsistency	A state in data is contradictory.
Primary Key	A candidate key that identifies an entity Uniquely.
Recovery	Process of restoring the data to correct state.
Relationship	Association between entities.
Schema	It is a framework into which the values of the data items are fitted. “Conceptual Schema” is a complete description of the information content of the database, including every record type with all its fields. “External Schema” is the way a user see the record. It is written in the Data Definition Language (DDL) such as C++,VB etc. “Internal Schema” is data

	structure and file organization used to store data on physical storage devices.
Tuple	In a relational model each row is called a Tuple
Transactions	A transaction is unit of work on the database. To start a transaction "BEGIN TRANSACTION" is used. To end a Transaction "COMMIT" or "ROLLBACK" is used. Commit is successful termination Rollback means to Unsuccessful termination or undo something.

As already specified that information is processed data. Query is information asked by the user. Database is a query answering system for the stored data. Whenever a user or application programmer executes a query on the stored data DBMS interrupts this query and checks its validity. If it is a valid query, it is executed. Database system is a layered system of software (as shown in fig 2.1), which coordinates answer to the query.

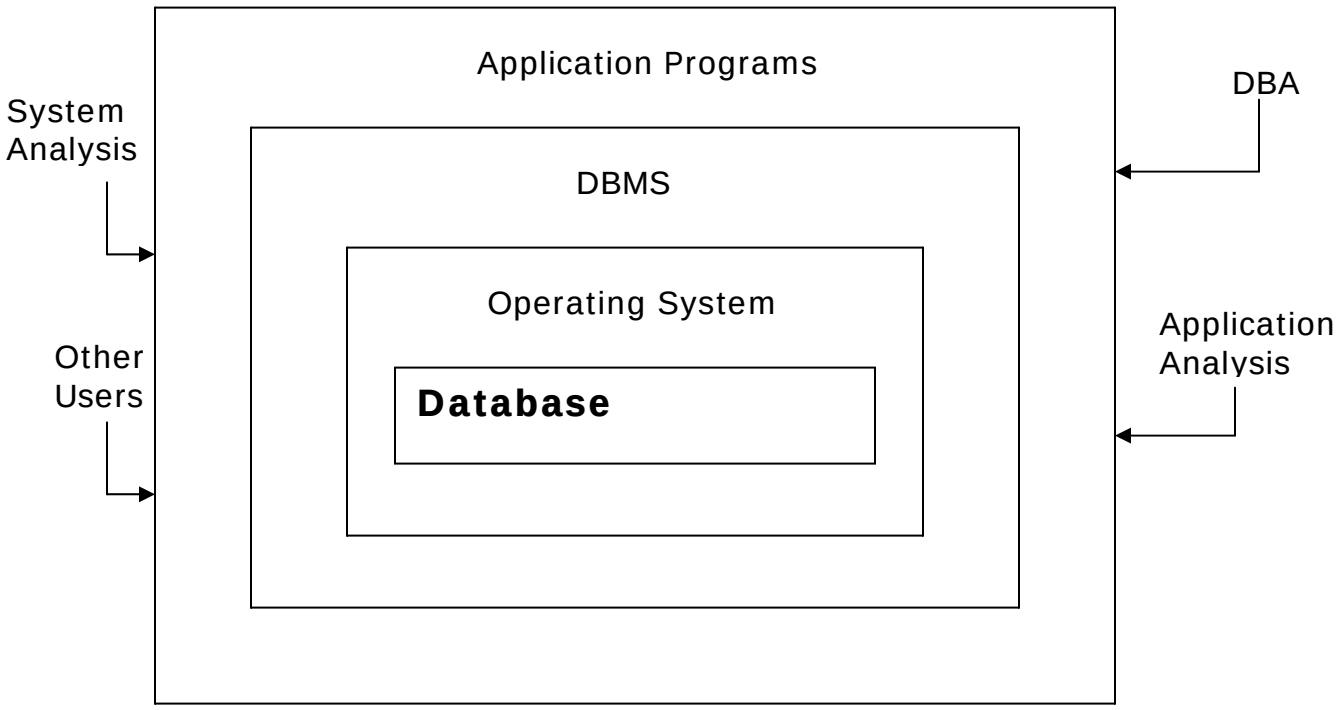


Fig 2.1 Database a Layered System of Software

2.2.1 Operations on a Data

The data stored in the system is partitioned into one or more databases. In this project there is one main database containing all data of the system. Its replicated copy is placed at other locations. A database is a repository for stored data it is either integrated or shared.

2.2.1.1 Integrated Data

This type of database is unification of several otherwise distinct data files, without any partial/complete redundancy amongst them. No duplicate records are admissible. For example a given database contain Suppliers records giving supplier ID, supplier name, company name, address, phone. All these records must be distinct; no duplication of records should exist in the database.

2.2.1.2 Shared Data

Individual pieces of data in the database may be shared by different users so that all may have access to the same data (may be for different purposes) such sharing is a consequence of the fact that the database is integrated. Another fact (that the database is integrated) is that any given user will normally be concerned only with some subset of the total database; moreover, different user will overlap in many different ways. The term “share” frequently extended to cover, not only sharing as described, but also concurrent sharing i.e. the ability of several different users to actually access the database, possibly even the same piece of data at the same time.

2.2.2 Architecture of Database System

The architecture of database systems provides a framework for describing general database concept and explaining the structure of individual system. The architecture of database can be divided into

three general levels: Internal, Conceptual, External level. These are briefly described as under [Ricardo 90]:

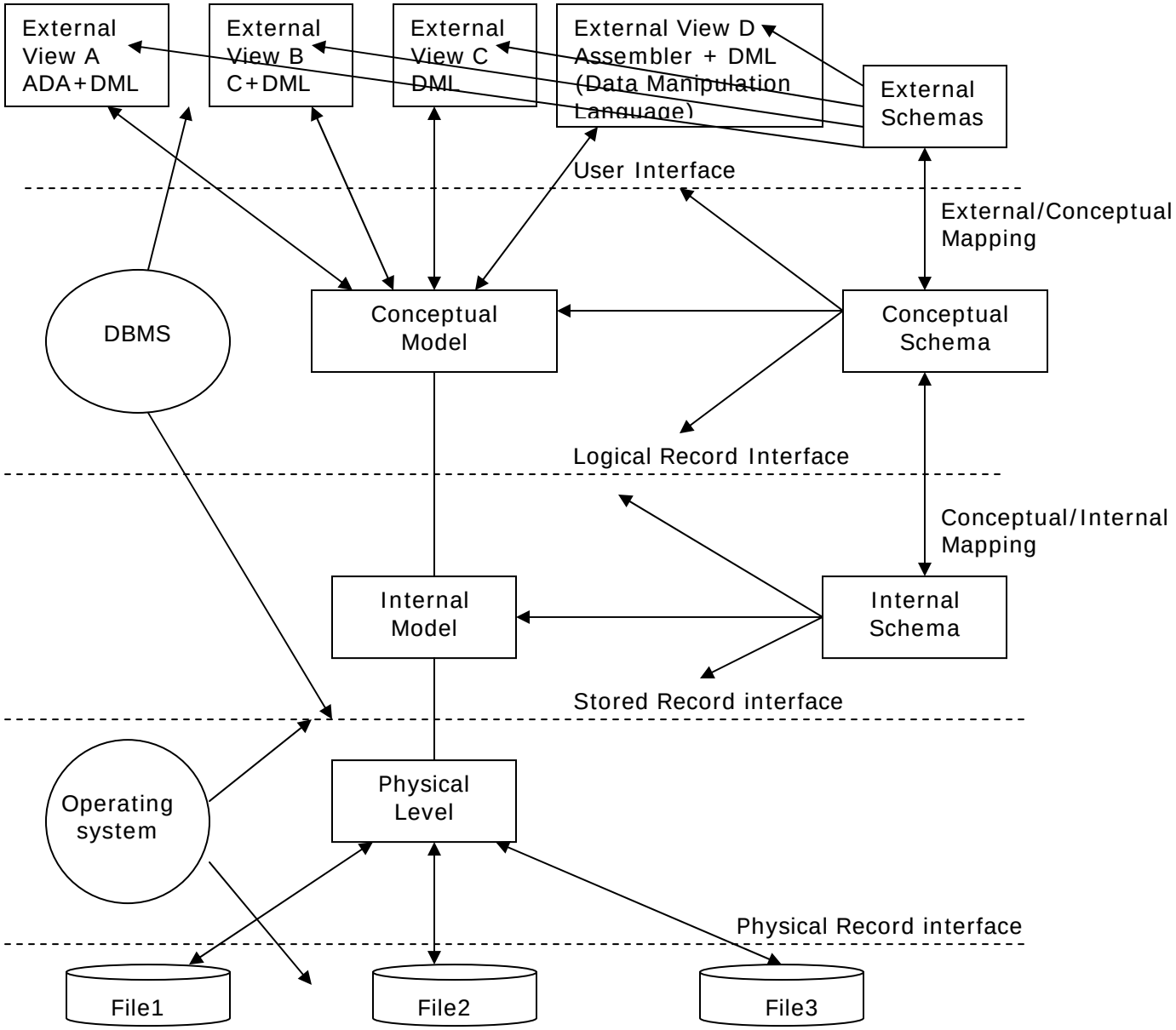


Fig 2.2 Three-level database architecture

2.2.2.1 Internal Level

This level is the closest to the physical storage, i.e., the way in which data is stored. The internal model is very low representation of

the entire database. Internal model consists of multiple occurrences of multiple types of internal record. The internal record is a stored record. The internal schema describes the internal model. The internal schema defines various types of stored record and also specifies what indexes to data exist, how stored fields are actually represented, and what is the physical sequence of stored records.

2.2.2.2 External Level

This level is closer to the users. That is concerned with the way in which the individual users view the data. The users are either application programmers or remote terminals. Each user has a primitive language at his disposal. For application programmers, user's language is a conventional programming language like COBOL, C++ etc. Such data language is concerned with the data storage and retrieval of information. Each user is provided with the workspace for transferring or receiving data from the database. The external model consists of the multiple occurrences of multiple types of records.

2.2.2.3 Conceptual Level

The conceptual model the entire information content of the database. This consists of multiple occurrences of multiple types of conceptual records. A conceptual record is not necessarily the same record or a stored record. The conceptual model is defined by means of conceptual schema, which includes definition of each of the various types of conceptual record. In general, the conceptual model is a view of the total database content, and conceptual schema is a definition of this view.

2.2.3 Function of Database Management system

Database Management System (DBMS) is software that handles all access to the database. Figure 2.2 describes the function of database management system [Date 86]:

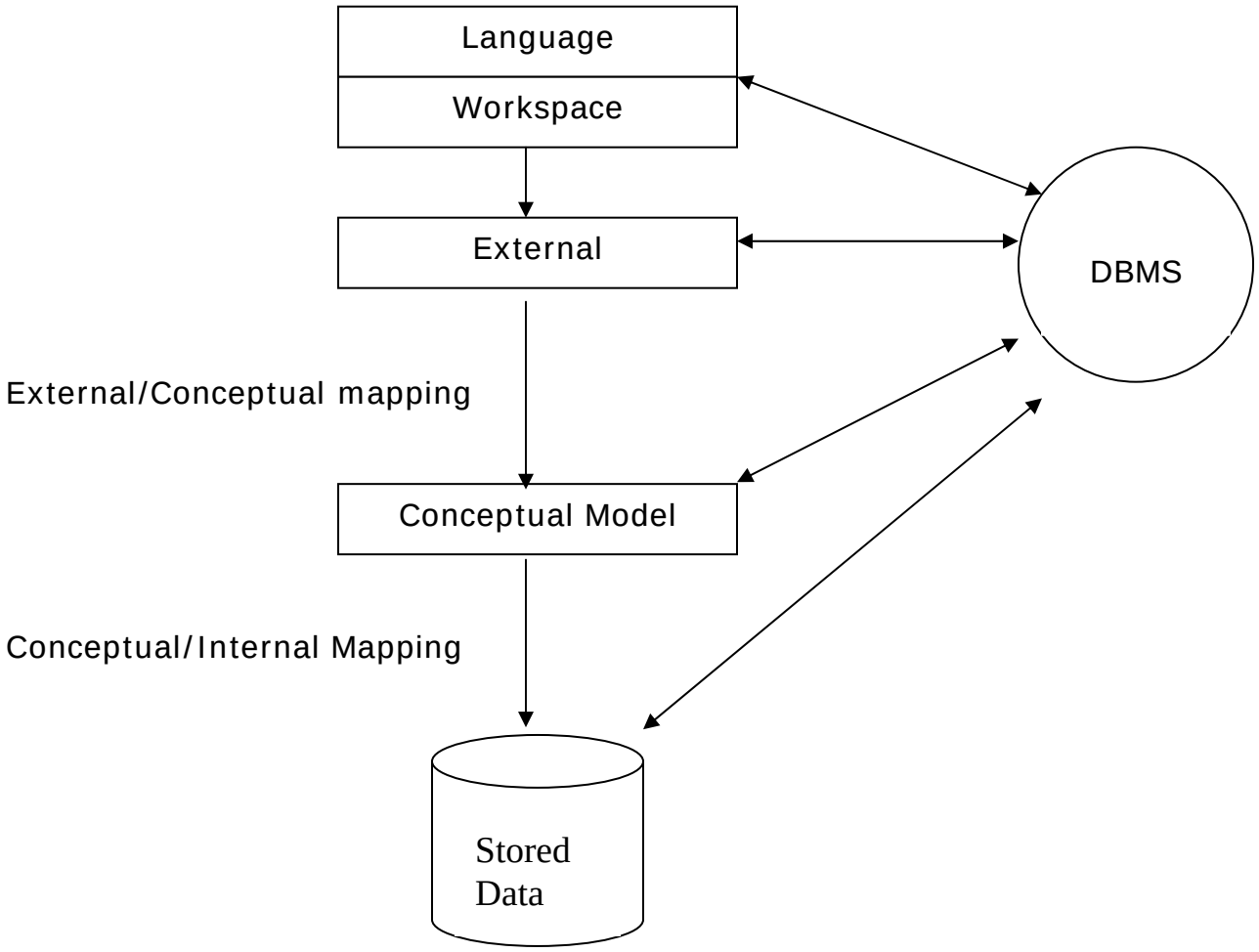


Fig 2.3 Function of DBMS

When a user issues a request by using some data language, DBMS intercepts the request and interprets it. The DBMS inspects the external schema, the external/conceptual mapping, the conceptual schema, the conceptual/internal mapping, and the storage structure definition. Then it performs the necessary operations on the stored database. The DBMS retrieves all required stored record occurrences,

constructs the required conceptual record occurrences, and then finally constructs the required external record occurrence. The DBMS is also responsible for applying the authorization checks and validation procedures.

2.2.4 Keys

A key is a data item, which allows distinguishing records from each other [Ricardo 90]. There are different types of keys, which are described here for reference: A Super key is an attribute or a set of attributes that uniquely identifies an entity. A Candidate key is a super key such that no proper subset of its attributes is itself a super key. A field (attribute) or a combination of fields that provides unique identification of a record (Tuple) for manipulation of tables is called as a Primary key. It may be a single attribute or a composite key. In fig 2.9, ItemCode represents Primary key. A field (attribute) or combination of fields in a table that are part of Primary key of some other table is called as a foreign key. In fig 2.9, SupplierCode is foreign key.

2.2.5 Storage Structure

DBMS uses different techniques to allow rapid and direct retrieval of records for both on-line and batch applications, retrieval of data on the basis of relationships between records, and retrieval of data on the basis of the value of a non-key field. There are many ways of storage and retrieval of data, but some of the commonly used are described below:

2.2.5.1 Inverted File

Inverted files are commonly used to allow the DBMS to retrieve records on the basis of the value of a non-key field, which may or may

not have the unique value (Primary Key), is referred to as a secondary key. Because of this it is used only for data where there is no duplicate records. Indexing on a secondary key field creates an inverted file.

2.2.5.2 Linked List

Adding an extra field to each data record creates a linked list. The field contains a pointer, the address of the next record in the logical sequence being created. This data structure is dynamic and is very efficient in addition or deletion of records.

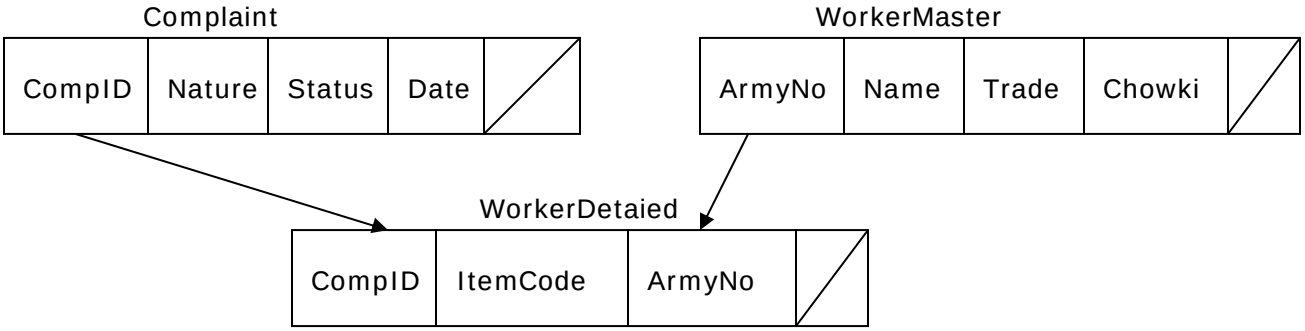


Fig 2.4 Linked List

2.2.5.3 Trees

A tree is a data structure that consists of a hierarchy of nodes. The nodes contain the data and are connected by links. At the highest level, there is a single node called, the root of the tree. The root may have any number of dependent nodes, called its children, are directly below it. These children may have their further descendants. This structure is the most appropriately used by operating systems.

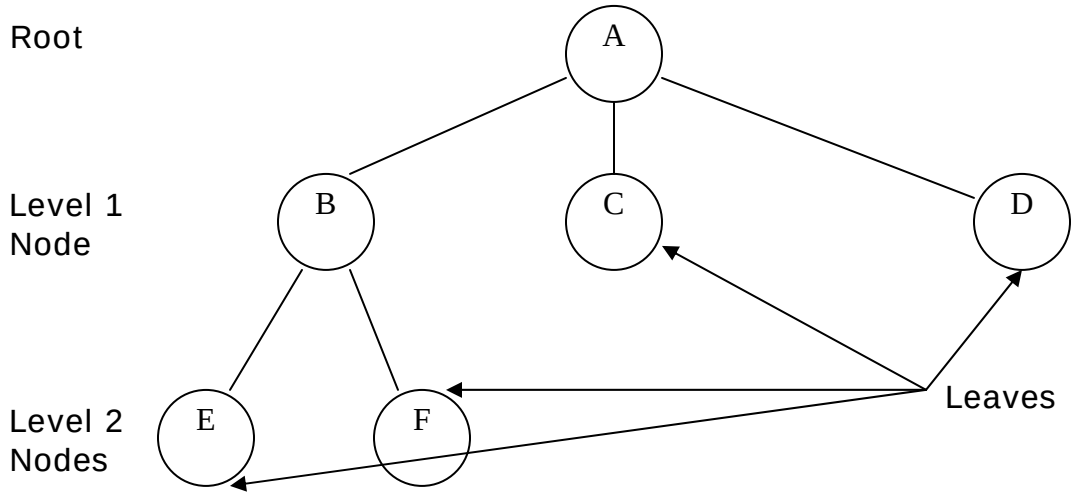


Fig 2.5 Tree

2.2.6 Entity Relationship Model

An entity is any object that exists and can be distinguished from other objects. Ii is a place, person, event, object, or concept in the real world that we wish to represent in the database by defining its attributes. The entity-relationship model (E-R model) is used to express the logical properties of the database in an enterprise schema. The implementation of E-R model actually uses the diagrams to create the database structure. The items in the model represent the “things” in the real world, and the relationship between these real world things is expressed by a relationship symbol of the model. One of the most useful and attractive features of the E-R model is that it provides the graphical method for depicting logical structure of the database. Figure below shows few symbols, along with names, meanings, and usage for the representation of entities.

Following Fig 2.6 presents the Entity Relationship

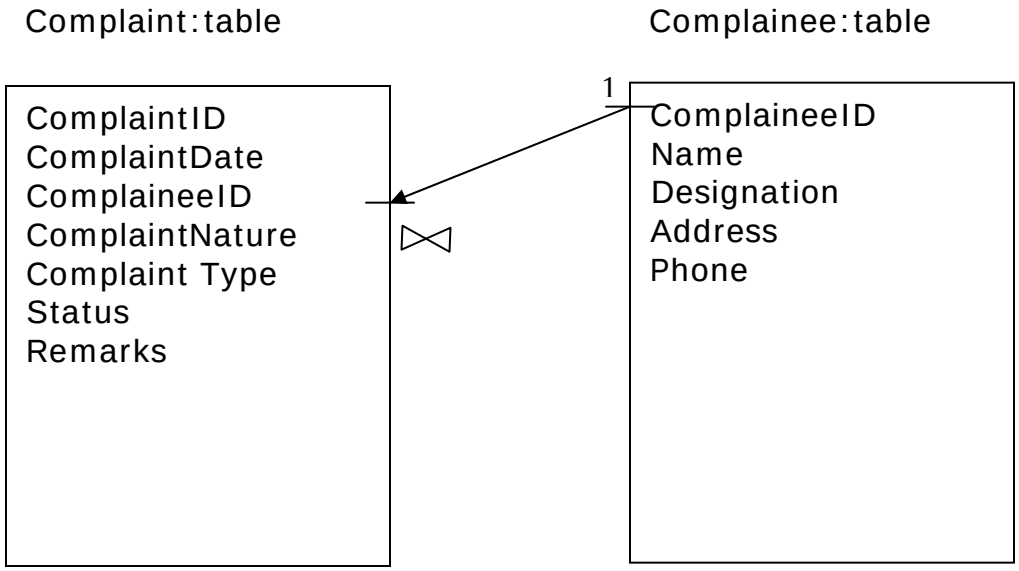


Fig 2.6 Entity Relation Between Two Tables

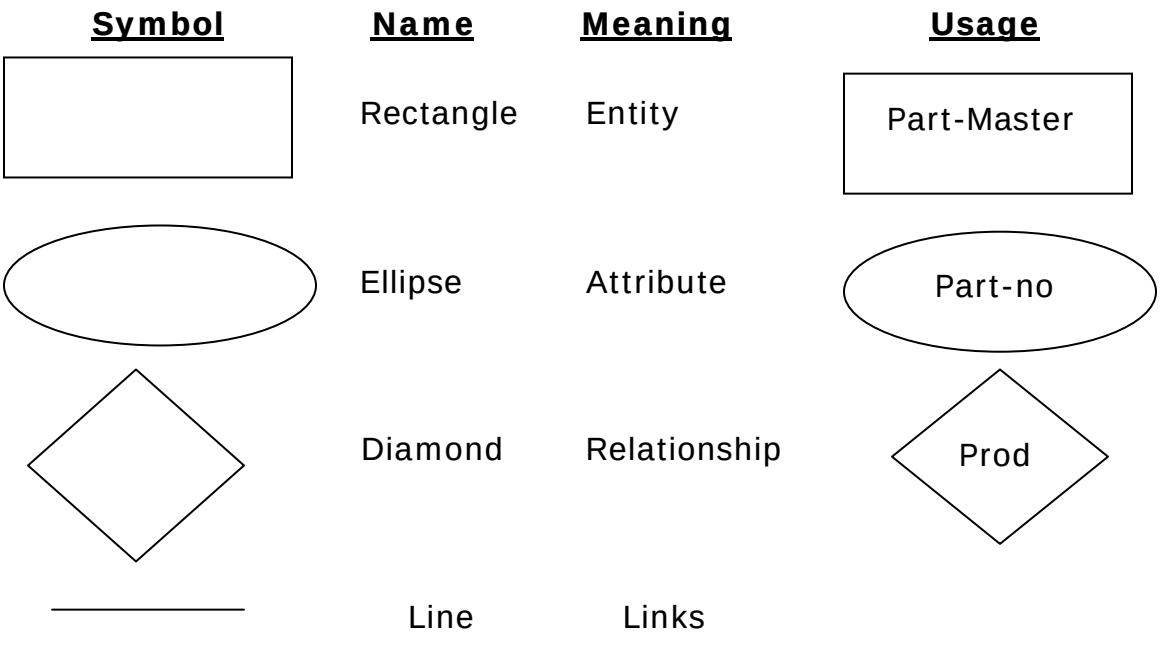


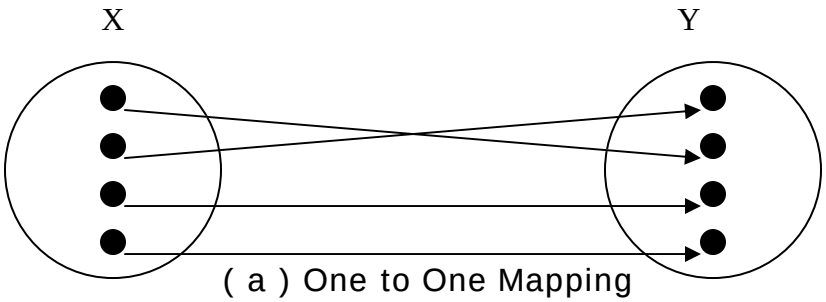
Fig 2.7 Symbols for E-R model

2.2.7 Relationship, Types, Cardinality

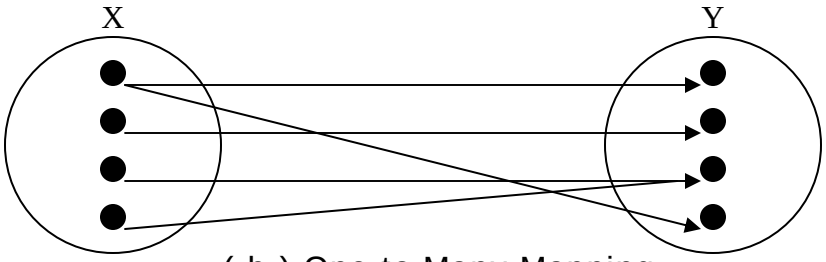
Relationship is “association between entities” or a relationship among entity set is simply an ordered list of entity sets. Entities are usually linked by associations or relationships, which are connections between the instances. The keys of the related entities are used as attributes of the relationship set.

Most commonly used types of the relationships in a data model are binary and ternary. However a relationship set can be defined by linking any number of entity sets. Therefore, the general relationship set is an n-ary relation.

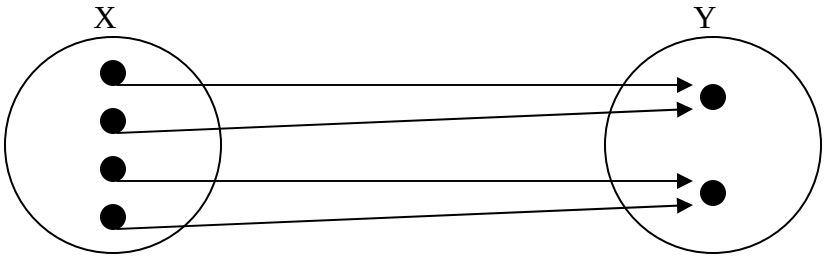
The cardinality of a relationship is the number of entities to which another entity can be mapped under that relationship. There are four types of mapping as shown in the diagram below:



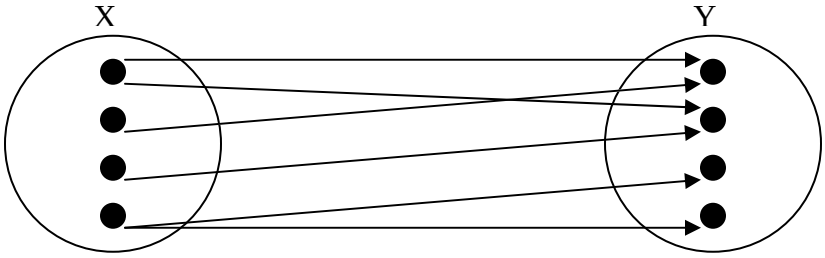
(a) One to One Mapping



(b) One to Many Mapping



(c) Many to One Mapping



(d) Many to Many Mapping

Fig 2.8 Cardinality of Relationship

Fig 2.8 (a) represents one to one mapping from X to Y. Each entity in X is associated with at most one entity in Y.

Fig 2.8 (b) represents one to many mapping from X to Y. Each entity in X is associated with many entities in Y.

Fig 2.8 (c) represents many to one mapping from X to Y. Each entity in X is associated with at most one entity in Y, but each entity in Y is associated with many entities in X.

Fig 2.8 (d) represents many to many mapping from X to Y. Each entity in X is associated with many entities in Y and each entity in Y is associated with many entities in X.

2.2.8 Data Models

Data models are used for representation and manipulation of information within the framework of a database system [Date 85]. A data model consists of three components:

- A collection of object types.
- A collection of operators.
- A collection of general integrity rules.

For example, in the relational data model, the objects are relations and domains, the operators are those of the relational algebra, and the following integrity rules are followed:

a. No component of a primary key can have a null value.

b. Every non-null foreign key value must match some existing key value somewhere.

The object types are the basic buildings of any database that conform to the model. The operators provide a means for manipulating a database that is composed of valid instances of the object types. The integrity rules constrain the set of valid states of databases that conform to the model. There are three important database models that have been used:

- Hierarchical data model.

- Network data model.
- Relational data model.

2.2.8.1 Hierarchical Data Model

The hierarchical data model uses the tree as its basic data structure. Nodes of the tree represent data records or record segments, which are the portions of data records. Links or pointers between nodes represent relationships. The highest level of the tree is known as root node. The root node may have any number of dependents; each of these may have any number of lower-level dependents, and so on, to any number of levels.

2.2.8.2 Network Data Model

The network data model uses a network or plex structure, which is a data structure consisting of nodes and branches. Unlike a tree, a plex structure allows a node to have more than one parent. The nodes of the network represent records of various types. Relationship between records is represented by the links, which become pointers in the implementation.

2.2.8.3 Relational Data Model

The relational data model is currently most popular technology, because it is conceptually simple and understandable by information system professionals. It uses the data values to imply relationships. E.F. Codd [Ricardo 90] conceived the relational data model. It is based on a relation, a two-dimensional table. Rows represent records and columns show the attributes of the entity. Relational databases use a model to show, how data in a record are logically related. Relational

tables show logical, not physical relationships. A relation Work Center, used in this project, is described in fig 2.5 below:

Stores: Table

Primary Key Foreign Key Domain

ItemCode	ItemName	SupplierCode	AU	UnitPrice	UnitIn Stock	Reoderlevel
01	Cement	11	Bags	430.00	133	50
02	Bricks	12	Nos	15.00	2500	1000
03	Bulbs	13	Nos	12.50	560	200

Fig 2.9 Structure of table (relation) Stores

Table name (relation) = Stores

Entity identifier = Stores

Primary key = ItemCode

Foreign key = SupplierCode

Attributes = Columns titles (ItemCode, ItemName, SupplierCode, AU, UnitPrice, UnitIStock, ReorderLevel)

Tuple = Row or record

Domain = A full column value

An entity has a number of attributes. Inside the box is a set of data items. Each row of the data items relates to a particular entity. Each column contains a particular type of item relating to a particular attribute. Above the box are the names of attributes; the leftmost column of the box is the entity identifier. The table of data represented is referred to as Relation (fig 2.9). A database constructed using Relations is referred to as a Relational Database. A relational database is constructed from "flat" arrangement of data items.

The Rows of the table are referred to as a 'tuple'. A tuple is a set of data item values relating to one entity. A tuple of two values is called a pair. A tuple containing N values is called N-tuple. The table shown in fig 2.9 has 3 tuples.

2.2.9 Relational Database Management Systems (RDBMS)

A relation must have the following components to be fully relational [Codd 72]:

1. Structure.
2. Capabilities to manipulate data.
3. Integrity Rules.
4. Data Languages.

Each component is described below one by one.

2.2.9.1 Structure

The structure elements of an RDBMS are:

Relations = Tables

Tuples = Rows or Records

Attributes = Columns or Fields

Keys = Primary key. Foreign key

2.2.9.2 Relation

The relational data model is based on the concept of 'Relational Algebra'. The concept of two-dimensional formats or the representations of rows and columns (format of matrix) in a tabular form is called as "Relation" or "Table". Relational Model shown in fig 2.5 is a two-dimensional format as the data are recorded in a tabular format. This format is known as "Relation". A relation consists of number of records (Tuples) and columns (domains) arranged in the form of a table. All relations have three major parts:

- Name

- Degree
- Cardinality

In fig 2.9, Name is represented by the "Title" or the "Entity Identifier" (Stores). Degree is the number of columns associated with the table or relation (degree is 7, i.e. there are 7 attributes or fields associated with the table), and cardinality is the, number of rows in the table (cardinality is 3, i.e. there are 3 rows or records associated with table).

2.2.9.3 Types of Relations

There are two types of relations:

- Base relation

  The Base relations are those, which are created prior to use- in form of relating fields they are called, as "TABLES" and they exist as physical files.

- Derived relation

  The derived relations are those, which are derived from the Base relations. They do not exist as physical file. The derived relations are called as "VIEWS". They may include other derived relations i.e., "VIEW" of a "VIEW".

2.2.10 Integrity Rules

There are two rules that are important while designing a database.

- Entity Integrity

  No component of a primary key value may be NULL i.e., the primary key of a base relation is not allowed to be NULL.

- Referential Integrity

If a base relation includes a foreign key, then it must have a primary key to match in some other relation, or wholly be a NULL.

2.2.11 Data Languages

The most of the database systems including Microsoft Access uses a nonprocedural language (SQL) to communicate with its database kernel. SQL is so popular, that all the application development tools are SQL-based, because Microsoft Access uses SQL as its query language and makes available numerous tools to support its system. Microsoft Access provides SQL interface to the database through interactive forms developer. It has capabilities of transferring its data files from Microsoft Access data file into table structure of SQL Server database, and capability to interface with formats of Third Generation Languages such as "C", “C++”, Visual Basic" etc through ADOs.

The SQL statements are divided into three types:

DDL = Data Definition Language

DML == Data Manipulation Language

DCL = Data Control Language

These three types are known as Data sub languages.

2.2.12 CODD's Rules

Codd's Rules provide a method for theoretical evaluation of a product, it is claimed that it actually provided framework of Relational Database Management System development. All rules can be listed as:

0. Single Foundation Rule

RDBMS must manage every aspect within itself, without using an external language. Processing should not be done with external storage.

1. Information Rule. Information can be represented in one and only way that is TABLES.

2. Guaranteed Access. Access to tables follows the sequence of Table-name, Tuple, and Attribute. Every step of data guarantee has been identified. Access to your work area involves qualifying the USERNAME and PASSWORD.

3. Systematic Treatment of NULL. Should be able to operate with NULL. Operations with null should be performed by single command. NOT NULL values are provided. NULL is useful in arithmetic operations.

4. Active On-line Catalog. The RDBMS should maintain Data Dictionary tables to keep track of current state of the database. These tables contain information on Tables definitions. Views, Column definitions, Synonyms and every other type of database.

5. Comprehensive Data Sub Language (DSL). RDBMS should have Transactional DDL, DML, and DCL.

6. View Updating Rule. Each distinct row of a view must correspond to a distinct and uniquely identifiable row of the base table.

7. High-level Global Insert, Delete and Update. By a single command replacements, additions, and deletions should be possible.

8. Physical Data Independence. Recording on the database should be left to the desecration of the type of system used.

9. Logical Independence. Should not be re-compiled. Programming effort should not be wasted as to changing logic, depending on storage style.

10. Integrity Independence. Data available should pose no limitations in terms of integration. The limits of systems used should only be taken into considerations.

11. Distribution Independence. Should look like a Centralized system to the user.

12. Non-Sub-version Rule. In case of help rendered by other languages, rules governing RDBMS should not be implemented.

2.2.13 Normalization

Normalization is a step-by-step process for replacing relationships between data with relationships in two-dimensional tabular form. The basic objective of this logical modeling is to develop a good description of data, its relationships and its constraints [Ricardo 90]. In other words, for a good relational model, it is very important to identify a suitable and stable set of relations. For this purpose, the normalization is the only process by which this can be achieved. By following principles of normalization, a highly flexible database model can be designed. This database can be extended when new attributes, entity set and relationships are encountered. The process of normalization reduces redundancy in the database and ensures that the database is free of certain updates, insertion, and deletion anomalies. An anomaly is the inconsistent, incomplete, or contradictory state of the database. In the presence of these anomalies, it is almost impossible to represent the correct information and also there is possibility of losing some information. When certain

updates are performed, the data may become inconsistent over a period of time.

Dr. Codd, who identified the causes and defined three principles for normalization known as "Normal Forms", first carried out research towards these anomalies. The updation, insertion, and deletion anomalies are caused by three basic dependencies; functional dependencies, multivalued dependencies, and join dependencies.

2.2.13.1 Functional Dependency

It is type of relationship between the attributes and is defined as “If A and B are attributes or sets of attributes of relation R, we say that B is functionally dependent on A if each value of A in R has associated with it exactly one value of B in R.”

It is written as A $\longrightarrow$ B read as “A functionally determines B”

2.2.13.2 First Normal form (1NF)

A relation is in 1NF if and only if every attribute is single- valued for each tuple. In other words non of the value appears twice in a relation.

2.2.13.3 Second Normal form (2NF)

A relation is in 2NF if and only if it is in 1NF and all the non-key attributes are fully functionally dependent on the key.

Full functional dependency is defined as “In a relation R, attribute B of R is fully functionally dependent on an attribute or set of attributes A of R if B is functionally dependent on A but not functionally dependent on any proper subset of A.”

A 1NF relation that is not 2NF can be transformed into an equivalent set of 2NF relations by performing PROJECTIONS on the

original relation in such a manner that it is possible to get back original by taking the JOIN of the projections. Projections of this type are called LOSSLESS PROJECTIONS. Basically to bring a relation in 3NF the non-full functional dependent determinants are removed from a relation and placed in a separate relation along with their dependent attributes.

2.2.13.4 Third Normal form (3NF)

A relation is in 3NF if it is in second normal form and no non-key attribute is transitively dependent on the key. A transitive dependency occurs when one non-key attribute determines another non-key attribute. This definition of 3NF is the original one developed by Codd. It is sufficient for relations that have a single candidate key, but was found to be deficient in case where there are multiple candidate keys and where candidate keys are composite and overlapping. BCNF is therefore improved definition of 3NF.

2.2.13.5 Boyce-Codd Normal form (BCNF)

A relation is in BCNF if and only if every determinant is a candidate key. For a relation with only one candidate key, third normal form and BCNF are equivalent. All relations that are in BCNF are also 3NF. It is not necessary that a relation must be in 2NF before it satisfy BCNF.

2.2.13.6 Fourth Normal Form (4NF)

A relation is in 4NF if and only if it is in Boyce-Codd normal form and there are no nontrivial multivalued dependencies

2.2.13.7 Fifth Normal form (5NF)

A relation is in 5NF if no remaining nonloss projections are possible, except the trivial one in which the key appears in each projection.

2.3 Front End Tools

2.3.1 Web Technology

The World Wide Web shortly written, as the Web is one of the most popular services provided via Internet. There are thousands of web sites available to the browser. The browser has vide choice of exploring exotic destinations with the excitement of playing a video game, listening to a music CD, or even doing virtual shopping, banking, and on-line payments. Virtual universities are available to the students all over the world. One can get registered on-line to a virtual university with teachers delivering lectures from different parts of the world. The most appealing aspect of the Web and Internet is that any body can publish his/her pages, and place it as a web site in the Internet. Basically the web is collection of all browsers, servers, files, and browser-accessible services available through the Internet. Intranets are small Internets designed for an organization which wants to avail the facilities of the web technology but do not want to share its data with other remote users. In the following sections some fundamental concepts related to web technology are discussed.

2.3.2 The Internet and the Web

The Internet was developed more than three decades ago with funding supplied by the US Department of Defense [Jawroski 99]. Originally designed to connect the main computer systems of about a dozen universities and research organizations. Today the Internet is accessible by hundreds of millions of computers worldwide.

The World Wide Web, or simply the web or the WWW for short is one of the most popular services provided via the Internet. The web

allows computer users to locate and view multimedia based documents/ data components on almost any subject. It provides an intuitive, easy, graphical interface. The web is the collection of all browsers, servers, and files and browsers accessible services available through the Internet. First time the concept was realized in 1989 by a computer scientist named Tim Berners-Lee [Jaworski 99]. Its original purpose was to facilitate communication between research scientists. Berners-Lee working at the council European Pur La Recherché Nuckaire (CERN), the European Laboratory for Physics located in Geneva, Switzerland, designed the web in such a way that documents located on one computer on the internet or intranet could provide links to documents located on other computers on the internet or intranet.

The Internet and the web have literally exploded into what seems certain to become the world's premier communication mechanism. As we have entered the new millennium, the Internet and the WWW will surely be listed among the most important and profound creations of humankind.

2.3.3 The Hyper Text Markup Language

The Hyper Text Markup, or HTML, is the lingua franca of the web [Bayross 01]. It is used to create web pages and is similar to the codes used by some word processing programs, notably Word Perfect. HTML uses ordinary ASCII text files to represent web pages. The files consist the tags that specify how the text is to be displayed. The use of tags to define the elements of a web document is referred to as markup. Some tags are used to identify headings, paragraphs, and hyperlinks. Still others are used to insert forms, images, multimedia objects and other features in the web documents.

2.3.4 Types of Web Pages

There are two types of web page named as static web pages and dynamic web pages.

2.3.4.1 Static Web Pages

A static web page is one whose content consists of some HTML that was typed directly into a text editor and saved as an HTM or HTML file [Wrox 00]. In it the author of the page completely determines the exact contents of the page in HTML. The content (i.e. text, images, hyperlinks etc) and appearance of a static web page is always the same. In other words a static web page is a pure HTML page. Steps involved in browsing a static page are:-

a. A web author writes page composed of pure HTML, and save it with in an .htm file.
b. Sometime later, a user types a page request into their browser, and the request is passed from the browser to the web server.
c. The web server locates the .htm page.
d. The web server sends the HTML stream back across the network to the browser.
e. The browser processes the HTML and displays the page.

2.3.4.2 Dynamic Web Pages

To make a web page dynamic, the hard coded pure HTML source is replaced with a set of instructions, which generate HTM for the page at the time the user requests the page. In other words page is generated dynamically on request. Steps involved in browsing a dynamic page are [Wrox 00]:

a. A web author writes a set of instructions for creating HTML and saves these instructions within a file.

b. Sometime later, a user type a page request into their browser, and the request are passed from the browser to the web server.

c. The web server locates the file of instructions.

d. The web server follows the instructions in order to create a stream of HTML.

e. The web server sends the newly created HTML stream back across the network to the browser.

g. The browser processes the HTM and displays the page.

Dynamic pages are thus interactive web pages that serve fresh information every time they are requested. Active server pages (ASP), Visual Basic (VB) Script or Java Script are technologies for building dynamic and interactive web pages.

2.3.5 Web Client / Browser

To access information stored in the form of web pages, users must connect to a web server. Once connected an interface that displays the contents of the web page is required.

Computers that offer the facility to read information stored in web pages are called “web clients”. Web clients run a special software called “Browser” that allows them to:-

a. Connect to an appropriate server.

b. Query the server for the information to be read.

c. Provides an interface to read the information returned by the server.

Some of the most popular browser software that clients run to allow them to query web servers for information are Netscape Communicator and Microsoft Internet Explorer, the latest versions of these browsers support the Java Script and VB Script both. Today’s web browsers extend Mosaic’s GUI features with multimedia capabilities and with browser programming language such as Java, Java Script and VB Script [Bayross 99].

2.3.6 Web Server

Web pages are created using HTML syntax. These pages must be organized and stored at a central computer. The organization of web pages into directories and files stored on the Hard Disk (HDD) of a central computer is called “Web Site” creation. Computers that store web pages into directories and files and provide these files to be read are called “servers”. They act like service providers that service the need for information [Bayross 99]. The server computer runs special software called ‘Web Server’ software that allows:-

a. Web site management.

b. Accept client’s request for information.

c. Respond to a client’s request by providing the page with the required information’s.

Some of the most popular software, which servers run to allow them to respond to client request for information, is Internet information server (I.I.S), Apache Web Server, Netscape Server, and Microsoft Personal Web Server.

Web server software stores and manages web pages when required; the web server accepts requests for these web pages, retrieves these web pages from Its HDD and sends the page back to the client who requested for it.

2.3.7 Protocols And URL

The Web uses the Internet as its communication medium; it must follows Internet communication protocols. A protocol is a set of rules governing the procedures for exchanging information. The Internet’s Transmission Control Protocol (TCP) and Internet Protocol (IP) enable worldwide connectivity between browsers and servers. In addition to using the TCP/IP protocols for communication across the Internet, the web also uses it own protocol, called the Hyper Text Transfer Protocol (HTTP), for exchange between browsers and servers.

HTTP is used by browsers to request documents from servers to return requested document to browsers. Fig 2.5 below shows browsers and servers communication via HTTP over the Internet or Intranet.

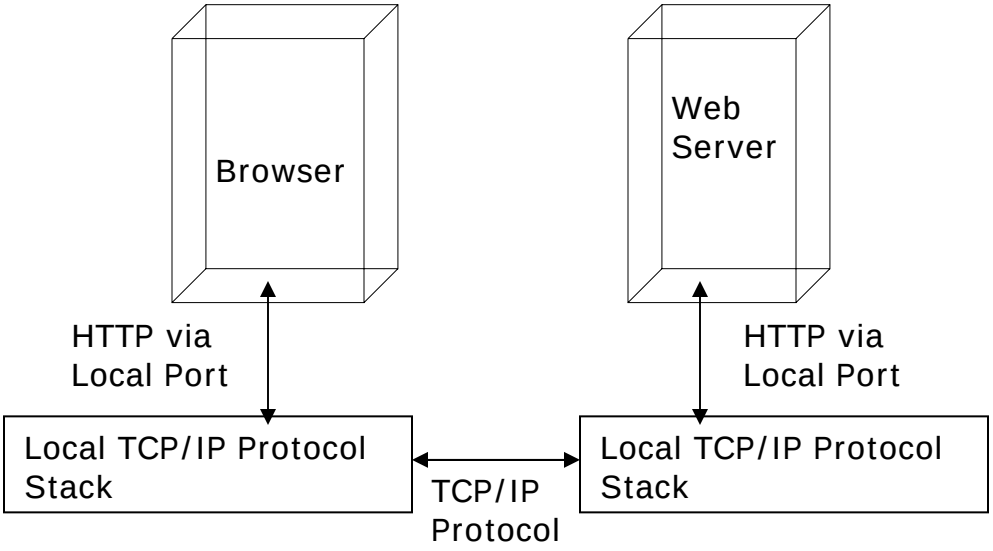


Fig 2.10 Browsers and Web Servers Communication

A client makes an HTTP request by means of a uniform Resource Location (URL). This URL could be typed in to 'Location' window of browser, be a hyperlink or be specified in the 'Action' attribute of an HTML <form> tag. From URL, the web server determines that it should activate the gateway program listed in the URL and send any parameters passed via the URL to that program. A client's browser retrieves a web page from the server and displays the web page in the browser. The communication steps between a client and web server can be summarized as follows [Bayross 99]:

2.3.7.1 Establish Connection

The client must give IP address of the web server along with the sub protocol i.e. HTTP to establish connection with web server. HTTP

protocols can be accessed by protocol name and a specific “port number”. HTTP protocol by default wore port number 80. for example, if the IP address of the for the server is 131.100.2.107 and communication must be established using HTTP then any client attempting to connect would have to pass the IP address as: http//131.100.2.107 to the Internet Service Provider (ISP) whose gateway is being used to access the internet.

2.3.7.2 Client Issues a Request and Server sends response

When a browser connects to a web using an appropriate protocol name, IP address and port number, the web server treats this connection to be a request for the “Default Web Document”. The web ser then dispatch the default web page to the client. If the client requires to view any other web page then the client can specify the web page name along with the connection information as under

Protocol://servername:port number/ web page name

When an appropriately structured, HTTP request, is received from a browser, the web server will try to locate the web page requested. If the web page exists, the server responds by providing the page to the browser. If the page is not found then appropriate Error message is sent as a response to the browser.

2.3.7.3 Sever Terminates the connection

It is the server’s responsibility to terminate the TCP/IP connection with the browser after it responds to the browser’s request. However, both the browser and the web server must manage an unexpected closing of a connection as well. In other words, if the user

clicks on the browser's "Stop" button, the browser must close the connection.

Also a computer crash by either a browser or a web server must be recognized by the surviving computer, which in turn, will close the connection.

2.3.8 Common Gateway Interface Concepts

The Common Gateway Interface (CGI) is a specification defined by the WWW consortium (W3C), defining how a program interacts with a HTTP server. The CGI provides a middle ware between WWW servers and external databases and information processing, retrieval, and formatting tasks on behalf of WWW servers.

A CGI program is computer program that is started by the web servers in response to an HTTP request. CGI program are developed in C, C++, Visual Basic Script (VB Script), ASP, Perl, Java, Java Script, TCL, REXX, Python, Icon, Apple Script, Unix Shell Script and even Dos Batch Files.

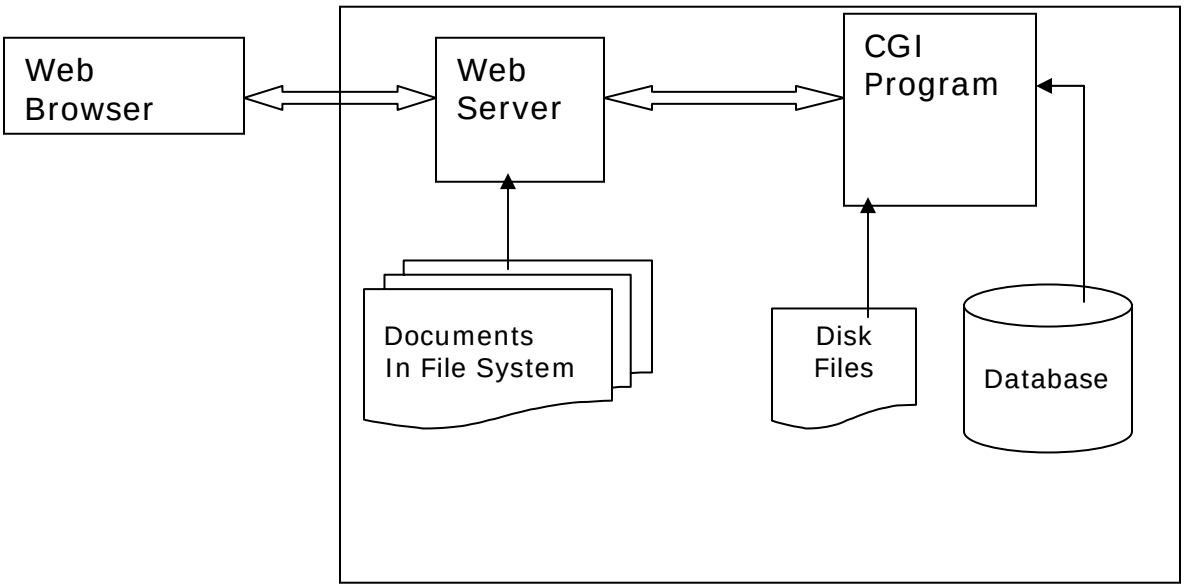


Fig 2.11 explains the working of CGI Programming

As shown in the above figure, a web browser running on a client machine exchanges information with a web server using the HTTP. The web server and the CGI program normally run on the same system, which the web server resides on. Depending on the type of request from the browser, the web server either provides a document from its own document directory or executes a CGI program.

To web server is configure by informing it of the directory where the CGI program reside. The URL specifying a CGI program looks like any other URL, but the web server can examine the directory name and determine whether URL is normal document or a CGI program.

2.3.9 Client Server Model

The client server terminology can almost perfectly be applied to the web technology. The machine that runs the web server software could be remote machine setting at the other side of the network, or even other side of the world, or it could be one's own home machine. The user's browser acts as the client. In other words server is one that stores, processes and distributes data and the clients accesses server for information [Wrox 00].

Keeping the client server model in mind designers of web technology has developed two types of scripting languages. The two types are server side and client side scripting described as under:-

2.3.9.1 Server Side Scripting

A script is a type of computer code that can be used to make a Web page dynamic [ASP101.com]. For example, a script could be used to include a "number of visitors" counter that increments each time someone visits a Web page. Or a script could be used to include a

countdown to a special event: "only *x* more days", where *x* decreases by 1 every day. Creating scripts is an advanced Office feature that requires programming knowledge.

A script is interpreted by the web server is called a server side script. A server side script is an instruction set that is processed by the server, and which generates HTML. The resulting HTML is sent as part of the HTTP response to the browser.

Presently server side scripting is created in following languages:

2.3.9.1.1 Active Server Pages (ASP)

ASP is a powerful server-based technology from Microsoft, designed to create dynamic and interactive HTML pages for World Wide Web. ASP integrates with latest technologies like ADO, COM+ and XML for producing intelligent, and dynamic web pages.

2.3.8.1.2 Cold Fusion

Cold Fusion is a product of a company named Allaire. It also enables servers to access data as the server builds HTML page. Like ASP, Cold Fusion pages are readable by any browser. Cold Fusion uses proprietary set of tags, which are processed by the cold fusion server software. Cold Fusion lacks some of the internal ASP objects.

2.3.9.1.3 Java Server Pages (JSP)

JSP is also a new technology that allows combining markup (HTML or XML) with Java code to dynamically generate web pages. JSP requires plug-ins to use it with IIS 4.0. One advantage of JSP is that it is Java based and is therefore portable, but it requires more resources and is slower while running at server end.

2.3.9.1.4 Personal Home Page (PHP)

PHP is anew server side scripting language for creating dynamic web pages. When the visitor opens the page, the server's processes the PHP commands and then send the results to the visitor's browser just as with ASP or Cold Fusion. PHP runs on Windows NT and many Unix versions. A downside of PHP is that it has to be down loaded separately and go through a series of quite complex steps to install it and get it working on the machine. PHP requires special setup for use with Microsoft IIS and Netscape Server's. PHP session management is non-existent and inferior to ASP [P2Pwrox.com]

2.3.9.2 Client Side Scripting

A script that is interpreted by the browser is called a client side script. A client side script is also an instruction set but the web server does not process it. Instead, it is sent to the browser (as part of HTTP response) and is processed by the browser. The browser on the monitor then displays the result.

There are four major client side technologies used for creating web pages. These are:

2.3.9.2.1 JScript / Java Script / VB Script: Scripting

Scripting has been present in Internet Explorer since version 3, and in Netscape Navigator/ communicator since version 2. Internet Explorer Versions 3, 4 and 5 support both Jscript and VBScript, while Communicator 4.5 and 5 supports only JavaScript. VBScript may be added to Navigator with the aid of proprietary add-in.

Scripting languages provide dynamic capabilities. Main disadvantage with client side scripting is that they are dependent on

the browser's implementation of the language, so not all browser support all scripting languages.

2.3.9.2.2 Java

Java is a cross platform language. In other words it is platform independent language for developing web applications. Java was first used as web technology in the mid 1990's. Java code is used in the form of Applets, which are essentially Java components that can be easily inserted into web pages with the aid of the <Applet> Tag. Java enjoys better functionality than scripting languages and provides strong security features. Java requires special plug-ins to integrate ActiveX Controls.

2.3.9.2.3 Active X Controls

An ActiveX control is a self-contained program written in C++ or Visual Basic. When added to a web page, an ActiveX control provides a specific piece of client-side functionality such as database access. ActiveX controls are added to HTML pages via <object> tag. Microsoft developed ActiveX controls. They are not supported on any Netscape browser prior to version 5. ActiveX technology is also applicable to sever-side functionality in the form of ActiveX Components.

2.3.9.2.4 Dynamic HTML (DHTML)

Both Microsoft and Netscape introduced DHTML with their version 4 browsers, to advertise additional scripting features such as the ability to animate pages and graphics without a page refresh. DHTML was introduced with intension to create a greater appeal to the designer and developers. The main innovation introduced in dynamic HTML was ability to manipulate any feature on the web page directly using client side scripting.

2.4 Distributed Database Systems

A distributed database system is one in which multiple database sites are linked by a communications system is such a way that the

data at any site is available to users at other sites . Normally each site or Node has a complete data processing system, with its own data administration function, personnel, users, hardware, and software, including a local database, database management system, and communications software. At least, a site must have memory and a communications processor [Ricardo 90].

In distributed system sites are usually geographically remote and are linked by a telecommunications system. Distributed system can also be build by linking microcomputers through a local area network (LAN). Another possibility is that the database system may reside on a single computer and the data it self may distribute across different devices. Ideally, users need not be aware of the true location of the data they access, and the system appears to be a local database to them.

2.4.1 Advantages of Distributed Databases

A distributed system can have following advantages over a single, centralized system [Ricardo 90].

2.4.1.1 Local autonomy: The most important objective of any distributed system is to allow the user to have more direct control over the system that he or she uses. If each site has its own system, more of the basic data processing functions such as systems analysis, applications programming, operations and data entry can be done locally, resulting in greater local control and user satisfaction.

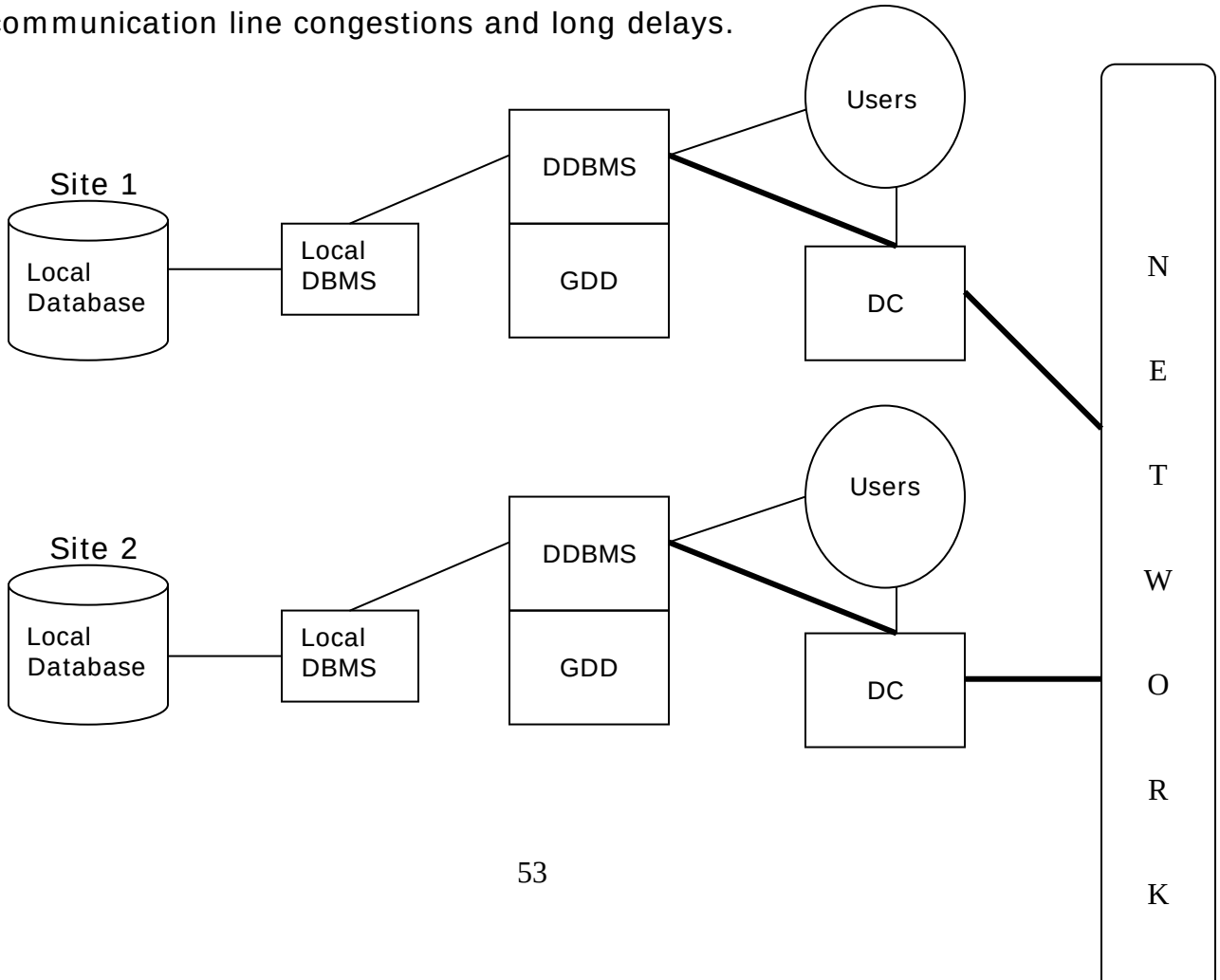
2.4.1.2 Improved Reliability: A distributed system is more reliable than a centralized one, because processing is done at several sites, so failure of a single node does not halt entire system. If a link fails, it can be isolate, but rest of the system can continue to operate.

2.4.1.3 Better Data Availability: Distributed database systems often provide for replication of data. If a node fails, or the only link to a node is down, its data is still available, provided that a copy is kept somewhere else in the system.

2.4.1.4 Increased Performance: A distributed system is basically modular, allowing new processors to be added as needed. Depending on the network topology, or physical layout, new sites may be easy to integrate.

2.4.1.5 Reduced Response Time: A distributed system should be so designed that data is stored at the location where it is used most often. This allows faster access to local data than a centralized system serving remote sites. However, in a poorly designed distributed system, the communications greater response time.

2.4.1.6 Lower Communications Costs: If a data used locally is stored locally, communications costs will be lower. It will also reduce communication line congestions and long delays.



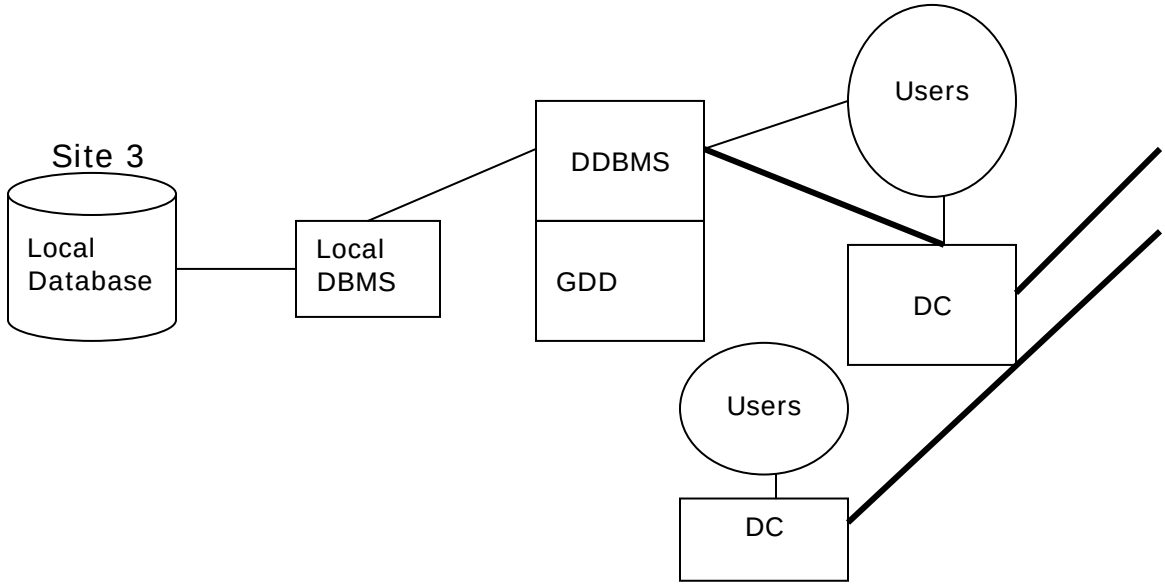


Fig 2.12 Components of Distributed Database System

2.4.2 Components of Distributed Database System

A distributed database system has normally following four types of software components [Ricardo 90]:

2.4.2.1 Data Communication Component (DC). The DC is a software at each node that lings it to the network. It is responsible for providing the firs five layers of the OSI architecture. The DC Component includes a complete description of the network's nodes and lines. For each node it identifies processing performed, storage capacity, processing power and its current state. For each link it identifies, nodes it connects, type of link, bandwidth, protocols required and the present state of the link.

2.4.2.2 Local Database Management Component (DBMS): The local DBMS Component is a standard data base management system, responsible for controlling the local data at each site that has a database. It normally has its own data dictionary for local data.

2.4.2.3 Global Data Dictionary (GDD): The GDD is a repository of information about the distributed database. It includes list of all data items with their location and other information about data stored any where in the distributed system.

2.4.2.4 Distributed Database Management Component (DDBMS): The DDBMS component is the management systems for the global database. It has many functions like:

- **Location transparency**: Ideally the user need not specify the node at which data is located, but acts as if all data is stored locally accessed by local DBMS.
- Locates the Data: After receiving a request for data, the DDBMS consults the GDD to fine nodes or node where the data is stored.
- **Processes Queries**: Queries can be local, remote or compound. In case of remote query DDBMS passes request to the DBMS at that node.
- Provides network wide concurrency control and recovery procedures.
- In heterogeneous system that is if local DBMS are different major translation is needed. This includes changing from the query language of one DBMS into another, and changing data models and data structures. If both hardware and DBMS are different, both types of translation are needed.

Chapter 3

Methods And Tools

3.1 Introduction

This chapter describes the project methodology or in other words strategy adopted for developing the system. Various tools that has been used in the project under the headings of web technology, Database engines, Active server Pages, ASP and Data Stores Access, Open database Connectivity ODBC, OLE-DB, ActiveX Data Objects and networking technique used for distributed processing are discussed. These tools were used because they are the best available combinations and most popular web development techniques in the market. Another reason for selecting these tools was that they are the Microsoft products and are considered as integral part of working with windows on Internet. Microsoft Windows 2000 Professional and Enterprise Edition IIS 5.0 and ASP 3.0 are more naturally integrated resulting in a more streamlined overall package for web development. In the end of the chapter strategy adopted for distributed database systems has been discussed.

3.2 The Web

The Web Technology has been used to develop the front-end interface. The Web pages have been developed using HTML DHTML, and Microsoft Front Page. These plate forms were used to develop static pages.

Netscape Navigator, Microsoft Internet Explorer and Opera Browser support Visual Basic (VB) Script and JavaScript. Java and VB script are important tool for current and future web development. This project has been developed using the scripting capabilities provided by Microsoft Internet Explorer 5 (J Script-5). The Netscape Navigator 4.5 (Java Script 1.3) and Opera 3.5 (Java Script1.1) are not used because of the reasons that Internet Explorer is the default browser of the Personal Web Server/Internet Information Server, which are default web server and a product of Microsoft.

Microsoft Front page and Microsoft Interdev are used as editors for editing the programs. Obviously Note Pad, the most popular editing tool was used wherever needed.

To make the web pages work dynamically DHTML, ASP script and VB Script has been used. These scripts are used to display the pages onto the screen after processing the required info. VB script and Java script are the new and powerful programming languages for the World Wide Web. It enables the development of truly interactive web pages. It is also the essential glue that integrates Java Applets, Active X Controls, browser plug-ins and other web objects, permitting developers to create distributed applications for use over the internet and over intranets as well.

3.3 Data Base Engine

Database engine that has been used in the project is Microsoft Access 2000. Microsoft Access is an interactive relational database management system for Microsoft Windows. Microsoft Access takes full advantage of the graphical power in windows giving visual access to data and simple, direct ways to view and work with the information using powerful formatting and connective capabilities. Microsoft Access is an easy and fast way for building and plotting data in the form of tables. Microsoft office 2000 has been used for the reasons below [http//Microsoft.com]:

a. It has capabilities of generating a form, table as a web page (MS Access Data Pages).
b. Prevents unauthorized access from scripts in data Access pages.
c. Using North wind sample database located on read-only share gives new users ease at initial design and connectivity stage.
d. Using the image control in a Data Access Page.

e. WebBot components are not present in Office 2000 developer.
f. Use Microsoft Jet ANSI-92 compliant SQL.
g. Auto Wizard available to convert Access table into SQL Server for using Microsoft Data Engine (MSDE).
h. Incoming Named pipe connections supported on Windows 95 and Windows 98. That is the reason we can install MS-Office 2000 on Windows 98 and Window 95 as well.
i. Default Language support for Visual Basic Editor and Microsoft Script Editors.
j. MS-Access 2000 includes few Office Web components like Get value Method, Records Set label, and HTML Data property.
k. Hijri calendar support in Data Access Pages and web Pages.
l. To use Microsoft access we need 16 MB of RAM for the Operating system plus an additional 8MB of RAM for Access and it requires 161 MB Hard disk space.
m. Microsoft Access 2000 can be installed on network server in shared mode.

3.4 Active Server Pages (ASP)

Active Server Pages (ASP) is a powerful server – based technology from Microsoft, designed to create dynamic and interactive HTML pages. ASP is now considered an integral part of working with windows on the Internet or Intranet [http//P2Pwrox.com]. ASP has capabilities of integrating With the latest versions of exciting new technologies such as ADO, Com+ and XML. The Aim of using ASP is to effectively handle and transfer the information that we need for our web pages. ASP is a great tool for creating dynamic web pages; it works by allowing us the functionality of programming language. We write programming code that will generate the HTML for the web page dynamically. So, whenever a user browses to our web site and requests one of our ASP Pages the ASP code is processed at that time by a special piece of software-the WEB SERVER. This processing generates, the HTML, which is then passed to the browser and used to create the page itself, on the users screen. One of the powerful features of ASP technology is that it must be executed on the computer that supports it, we

can view ASP-driven web pages from any computer and with any modern browser. Using HTML tags and scripting language develops ASP code.

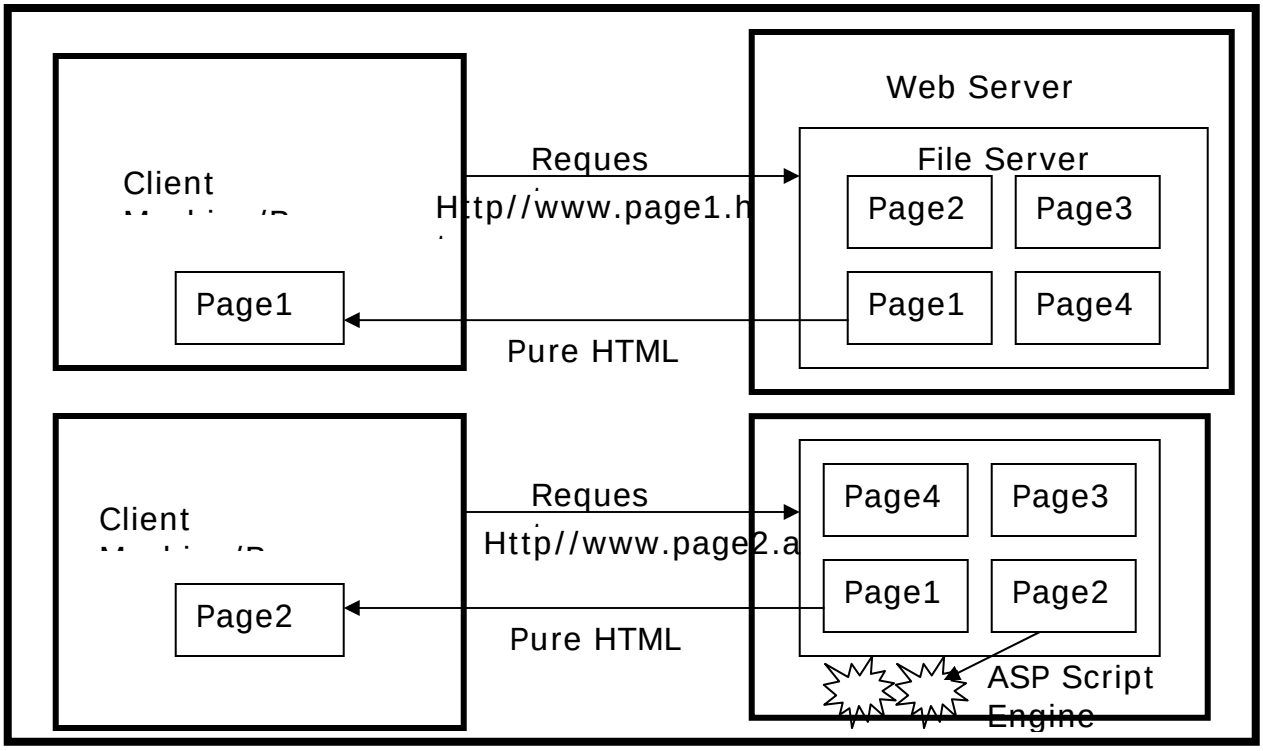


Fig 3.1 ASP Code is Browser Independent

The Fig 3.1 shows that ASP code is executed on the web server, and generates pure HTML, the client machine does not need to provide any kind of ASP support at all. Basically the web browser handles .htm

and .asp pages exactly the same way because from the web browser's point of view, the process involves sending a page request to a web server and receiving a stream of pure HTML [Wrox 00]. In this project VB scripting and ASP language has been used for creating dynamic web pages. Microsoft officially announced ASP to the world on July 16, 1996. ASP Version 1.0 gained worldwide, recognition when it was bundled with Version 3.0 of Microsoft's Internet Information Server (IIS) Web Server in March 1997. It has been gaining popularity steadily since then. Towards developing this project Personal Web Server 4.0 (Internet Information Server 4.0). It supports the new ASP version 2.0 that offered considerable enhancement over ASP 1.0 including an enriched model for managing communications between browser and web server. With the

Windows 2000, updated version of Internet Information Server version 5.0 and a new version of Active Server Pages version 3.0 has been released. Moreover, 11S 5.0 is more naturally integrated with the Windows 2000 Operating system, but it is more resource heavy because in order to run it we need minimum 64MB RAM whereas most of the user in the MES Organization are having computers with maximum 32MB RAM.

3.5 ASP And Data Store Access

Many organizations use databases of one sort or another to store the data required in the creation of their web Pages, and also to store data that is entered by the end users and captured by the pages. But it goes further than data bases-there are data sources of many other formats, such as mail systems, legacy mainframes, spread sheets and word processed text files. Data stored in these formats might also benefit from being published on the web; therefore there was dire need to extend database access techniques. Microsoft uses the term Universal Data Access (UDA) to refer to data access techniques. As part of UDA strategy, Microsoft developed a technology known as OLE-DB. We can Use OLE –DB (Object Linking and Embedding Data Base) with ASP . OLE_DB is the new standard data access-programming interface from Microsoft that is designed to replace ODBC (Open Data Base) connectivity and provide wider coverage of different types of data stores[Wrox 00].

OLE_DB and ODBC used with ASP, via a set of programming interfaces Known as ActiveX Data objects, or ADO. Through the WWW, intranets and other browser, based applications, the Web Browser is becoming one of the most widely used interfaces between data and end-user. The ActiveX scripting programs are placed into our ASP Pages giving it capability to access data stores and populate our pages dynamically with the most current, up-to-date information.

3.6 Open Database Connectivity (ODBC)

Open Database Connectivity is another version of connectivity that is used with Windows 95 and Windows 98. It is a standard for accessing data. ODBC allows the programmer to get basic information held in any kind of database. It was designed to allow the programmer to use a common set of routines to access the data stored in databases, regardless of the type of database in which the data was stored [msdn.Microsoft.com/vstudio/odbc/]. This means that once the programmer was connected to the database using ODBC, they could manipulate the data without worrying exactly where the data was stored, or which type of database was storing it. In other words ODBC provides Inter operability across multi-platforms. It provided interface transparency- so the programmer could access an oracle database in the same way that they accessed a SQL Server database. ODBC allows us to get a data without worrying about the nuts and bolts of the hosting database application. In this project ODBC has been used to manipulate Microsoft database because in this project no other kind of data store is being used.

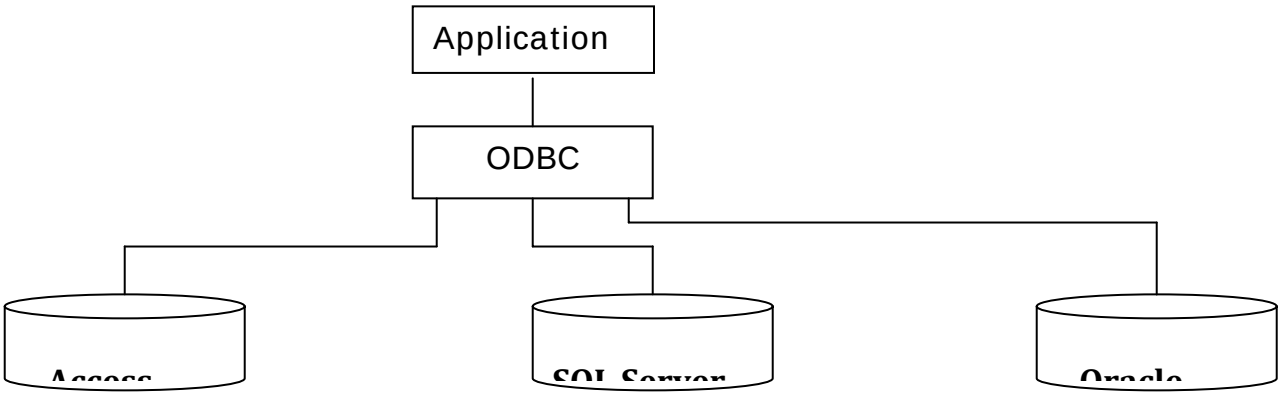


Fig 3.2 ODBC

3.7 Object Linking and Embedding Data Base(OLE-DB)

Before defining OLE-DB let us define a new term Data Store. A database applications store data using the structure we have seen many times. Tables, Records and keys, whereas a data store is any persisted collection of information e.g. it can include a Data drive, word document, outlook Express E-mail, or an excel Spread Sheet etc. So to access the data contained within these data stores. There is a problem with using ODBC here. Generally, the information contained within each of the other media does not fit neatly into a database–type format and more often than not, ODBC can't help you get at that kind of data. As a future strategy for Intranet designing OLE-DB will be used as a universal Data Access technology [Wrox 00].

OLE-DB is the next step in the evolution of the anonymous data store. As well as being more generic than ODBC, Microsoft has done a great deal of work to ensure that OLE- DB is faster and easier to use than ODBC. Eventually it may well replace ODBC.

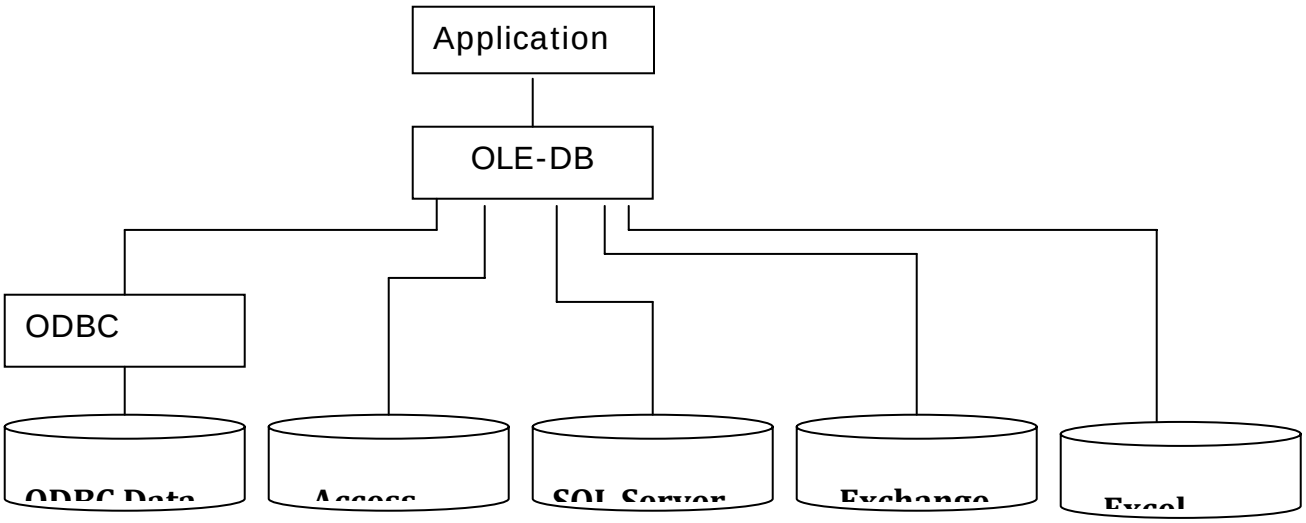


Fig 3.3 Data Access Using OLE-DB

The idea behind OLE-DB is very similar to the idea behind ODBC but as we can see from diagram OLE-DB in fact allows access to a

much broader range of data stores. OLE-DB even supports database connections through ODBC, so that effectively the generic OLE-DB layer will allow us to connect to our legacy databases through our existing ODBC connections [msdn.Microsoft.com/vstudio/ole-db/].

3.8 ActiveX Data Objects (ADO)

Database connectivity through ODBC or OLE-DB introduces the notion of data providers and data consumers. The relationship between a data provider and a data consumer is fairly obvious. A Data provider is something that provides data, and the data consumer is something that uses that data. There can be many different types of Data Providers – one for each different type of data store.

Microsoft it self has made available quite a number of data providers for different types of data stores. For example including Microsoft.Jet.OLEDB.4.0 providers for Access. There are different providers for Their SQL-Server, Oracle, Exchange Server, Excel and FoxPro. For SQL-Server (MSDE) the data provider is SQLOLEDB.

In fact, each data provider is a unit of code, written in a language such as C++ or Java. Which uses ODBC/OLE-DB objects to provide the instructions required to communicate and pass data between the data store and data consumer [Wrox 00].

ODBC/OLEDB objects themselves are very low-level objects. Scripting languages like VB Script (and even languages like Visual Basic), are simply not sufficiently powerful to allow us to manipulate these objects (although of course, languages such as C++ and Java are). That's why we take advantage of the data provider/data consumer mechanism to pass the data between the data store and the ASP page across a number of intermediate layers.

Data consumer comes in the form of a set of objects known as the ActiveX Data Objects (ADO). ADO is an interface that allows our ASP to talk to ADO, which in turn talks to ODBC/OLE-DB, which in turn gets Information from our data store. We are actually using ASP to talk to ADO, which in turn talks to ODBC, which is turn gets information form the Data store [P2Pwrox.com].

ADO is a set of objects that allow programmers to program their data access logic from languages like Visual Basic as well as scripting languages. ADO is a higher-level model then ODBC/OLE-DB, which means that it simplifies some of the complexities of programming with ODBC /OLE-DB. Thus ADO is much easier to use with ODBC/OLE-DB.

The ADO layer sits neatly between the applications itself and the ODBC/OLE-DB. In fact ADO is a superset of Data Access objects (DAO) and Remote Data Objects (RDO) that are used in database programming in Access or Visual Basic. In fact ADO is one of a set of components, which are known collectively as the Microsoft Data Access components (MDAC).

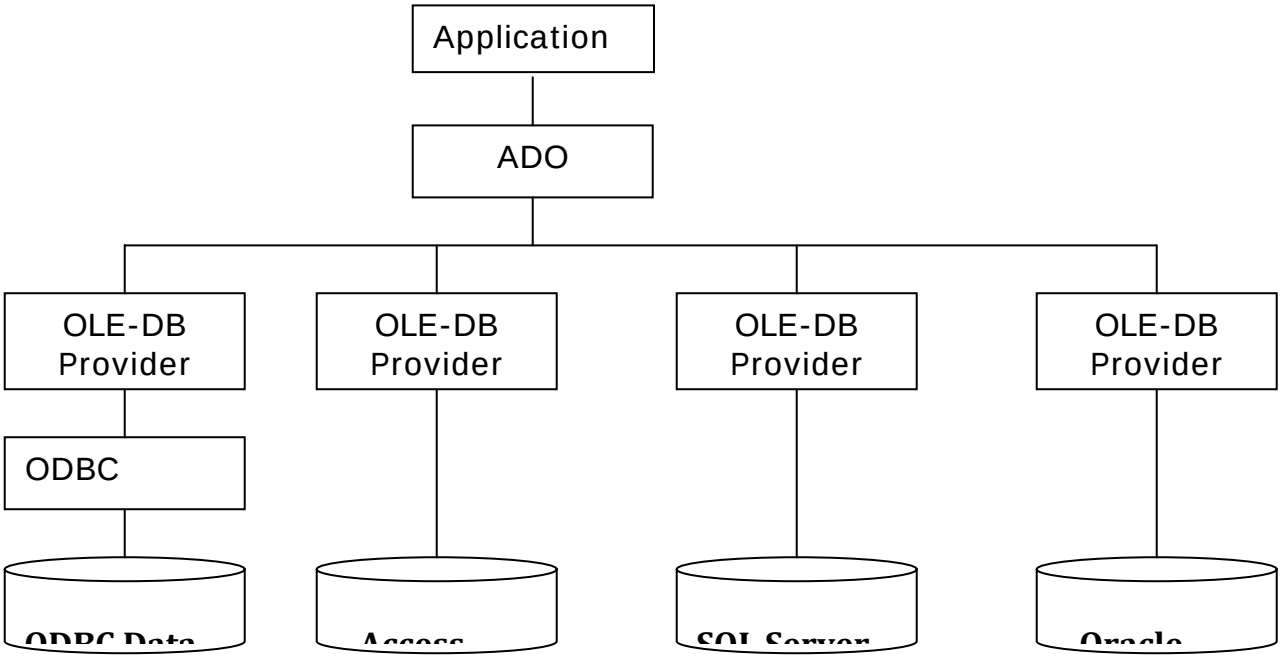


Fig 3.4 ADO Layer Between Application & OLE-DB Layer

Following table shows the different Products with their releases of ASP, ADO and PWS:

Product	Released with
IIS 3.0	ASP 1.0 & ADO 1.0
IIS 4.0, PWS 4.0 (NT 4 Option Pack)	ASP 2.0 & ADO 1.5
Windows 98	PWS4.0, ASP2.0 & ADO1.5
Visual Studio 6.0	ADO 2.0
Office 2000, Internet Explorer 5.0	ADO 2.1
Windows 2000, IIS 5.0	ASP 3.0 & ADO 2.5

3.9 Distributed Processing Tools In MS-Access

Microsoft Access is an excellent tool which provides extraordinary support for distributed database systems both on LANs and WAN. There are varieties of methods available in Microsoft Access that can be used to place database in distributed environment. These techniques are explained as under [Microsoft Access 94]:

3.9.1 On-Line Collaboration:

Microsoft Access has the capabilities to invoke Net Meeting built in software in windows 98. It provides a facility to exchange complete database file from one location to another location (that is copying files between two remote locations). Both remote locations must be

running NetMeeting. In DDBMS On-Line Collaboration can be used to transfer files between two different sites in real time. Once the files are being transferred all the participants can see it on the screen and can edit contents of Access database file.

In the case of this project On-Line collaboration was not considered much suitable because there are five to fifteen chowkis under each GE and similarly there are three to four GE's under each CMES. If each chowki or GE sends a separate .mdb file then large number of .mdb files will gather at both GE and CMES nodes. Next step will be to import the objects (tables, queries, forms etc) and then append them into one single database for creating comparative statements. The above procedure was practiced but it was not found feasible because the user has to perform too many complex steps. The aim was to provide simple, easy, efficient and more professional method of accessing the data.

3.9.2 Database Splitter:

This procedure splits a Microsoft Access database into two files: one that contains the tables and one that contains the front-end design that is queries, forms, reports, macros, modules and data access pages. This way users need to access the data, can customize their own forms, reports, pages and other objects while maintaining a single source of data on the network. This approach requires leased lines between Data and MIS nodes or is better suited for LAN environment.

3.9.3 Linked Tables:

Microsoft Access provides two choices for using data from an external data source. You can Import the data in a new Microsoft Access table that is way to convert data from a different format and

copy it into Microsoft Access. Importing can be automated by use of Macros. Link the data, which is way to connect data from another application without importing it. Linking data enables you to read and in most cases update data in the external data source without importing it. Microsoft Access uses different icons to represent linked tables and tables that are stored in current database. If you delete the icon for a link you delete the link table, not the external file itself. Linked table is a strategy that is best suited for leased line or LAN. In this project we can use linked table method between Data and MIS node provided if MES arranges Leased Lines.

3.9.4 Replica

In Microsoft Access, a replication contains one or more copies of the access database files at different locations. This copy of the .mdb file includes its tables, forms, queries, reports, macros and modules.
A replica is a member of replica set and can be synchronized with other replicas in the set. Changes to the data in a replicated table in one replica are sent and applied to other replicas. Synchronization between a replicas set is **bi-directional**. It was because of this bi-directional synchronization feature, which restricted me from applying the full replica technology in this project. User wanted to hide the data of one chowki from another chowki. It was because of this requirement partial replica was resorted. In full replica due to bi-directional synchronization data of one chowki was appended into the data of another chowki.

3.9.5 Partial Replica

Partial replicas are the replicas that contain only a subset of records in a full replica. To create a partial replica, you specify a filter

that restricts the data that's synchronized to a subset of the full database. By using partial replicas, we can synchronize a replica with only the data that you need, rather than with an entire database. Filter is property of partial replica with it we can create partial replica that contains specific data according to the criteria. Filter property has a limitation that it can be applied to only one field in only one table in a complete set of relationship. For example, a business might store its entire sales database at the headquarters office but replicate only regional data to its regional offices across the country. The database at HQ's office will be a full replica whereas, you can create partial replica for each regional office that contains data relating to that region only. Each partial replica synchronizes with full replica of database at headquarters office.

3.10 Strategy Adopted

Creating partial replica at each Data node (Chowki's) from MIS node (GE) and creating partial replica at MIS node from DSS node (CMES) is the strategy adopted for following reasons.

a. Partial replicas have the benefits for replicating data over LAN and WAN. By restricting which data is replicated, partial replica can reduce the amount of data transferred over a LAN or a long-distance carrier. It can reduce network traffic and lower telecommunication cost.
b. A partial replica makes the database effectively smaller, since you need only replicate the portions that you work with frequently.
c. Synchronizing a partial replica takes less time, and the replica itself requires less disk space.

d. Partial replicas can help restrict access to data (one regional office can not have access to another regional office).
e. Special data design structure has been developed after lot of efforts. This design was meant to filter the records of each Data node during the synchronization phase.
f. When Chowki#1 synchronizes its database with full replica at MIS (GE's) node then only records of Chowki#1 will be updated at both ends. In other words after Synchronization with main replica (Which contains records of all the Chowkis) Chowki#1 will not contain any data of any other Chowki. This has been achieved by incorporating ChowkiNo field in all the parent (level one) tables of the database. Filter property was then applied while creating Partial Replicas at each Chowki. Due to this filter property data of all other regional office is filtered or discarded when one regional office synchronizes its data with main replica of the database.

3.11 Technology used in the Research

WCMIS has been developed using latest techniques of software engineering that includes Web engineering, Distributed Data Base Systems (DDBMS) and Networking. Web pages have been designed and developed using HTML, DHTML, Active Server Pages (ASP), VB Scripting, Active X™ Data Objects (ADO), and Sequenced Query Language (SQL).
Microsoft® Access 2000 RDBMS has been used for database management. Microsoft® Personal Web Server (PWS) is desktop Web server that has been used to host a Web site on the MES intranet, it supports easy use of databases with support for ActiveX™ Data Objects and the Microsoft® Access drivers.

Wide-area networks have been established for data communications because of the large distances involved between different nodes. Existing PASCOM or Civil telephone lines have been used for this purpose. Microsoft® Dialup Server and Dialup networking are the software tools used for establishing the connection between remote locations.

Chapter 4

System Analysis, Design and Implementations

4.1 Introduction

This chapter describes the system study, proposed subsystems, data model of the system, and the modules implemented. It also discusses introduction to each module, Graphical user interface, different queries and summaries generated.

The salient feature in the development of an efficient computerized system is the software development. The purpose of Software development is to transfer the complete proposed system into the executable computer programs. Programming is not simply a science but there is a touch of art involved in it. There are, however, a number of clearly identifiable steps that are always involved in the programming phase and those provide a convenient framework. These steps are

- Define the problem.
- Plan a solution.
- Maintain the program

Thus the purpose of the programming task is to code, debug and test each program before and after integrating them into the modules. The development of the modules is the most complicated and time-consuming stage of the system development. The programs have to be developed in order to have the consistency or compatibility with the proposed system, each module has to response properly according to the input and output requirement of the system, Implementation means the process of transforming present system into a new computerized system. There are several options available, which are listed below:

- Direct Conversion.
- Gradual Conversion.
- Pilot Conversion.
- Parallel Conversion.

4.1.1 Direct Conversion

Direct method stresses upon the introduction of a completely new system without any reference to the existing system. The old system is abandoned and the new system becomes completely operational. This is not suitable because the chances of failure are more than other conversion methods.

4.1.2 Gradual Conversion

This technique allows one program at a time to replace an activity of the existing system. Gradually, the present system is over thrown by the newly designed system. Small-scale operations are conducted first to confirm that change over will be successful. When the new system is completely tested, the old system is not used anymore and the new system completely takes over.

4.1.3 Pilot Conversion

In this conversion method, new system is implemented in a part of the organization and it is tested. If it proves the required results, the system is implemented in the whole organization. As the new developed system works as one unit so the pilot conversion is also not suitable.

4.1.4 Parallel Conversion

This is the technique in which the existing system and the new system runs simultaneously. Data is processed or moved through systems concurrently and when the new system is checked out, the operation of an old system is abandoned.

4.1.5 Proposed Conversion Plan

Most feasible conversion plan, which suits best, is the parallel conversion. It is selected because it provides an opportunity to compare the results of the existing system with those of the developed system. Another advantage of this technique is that the risk of failure is converted. Although this type of implementation is slightly expensive, however, the system will be safe and the procedure should be followed for some time until it is confirmed that the newly designed system is working perfectly.

4.1.6 The Software Life Cycle

The Software life cycle is the collection of phases through which a software product passes from initial conception through retirement from service [Pressman 97]. All software products go through the four phases. These phases are: Requirements definition, System and software design, Implementation and testing Phase, integration and system testing, and operation and maintenance. Requirements analysis and definition phase determines customer's needs and product constraints. Design phase determines the structure and organization of the software system. Writing the code in any suitable programming language. Implementation and unit testing phase verifies that each program units meet its specification. In integration and system system testing phase each individual program is integrated and tested and system is delivered to the user. Operation

and Maintenance involves which were not discovered in the earlier stages of the life cycle [Sommerville 92]. The software life cycle is most widely accepted software development model because it offers a means of making the development process more visible. Following Figure shows the Life cycle model:

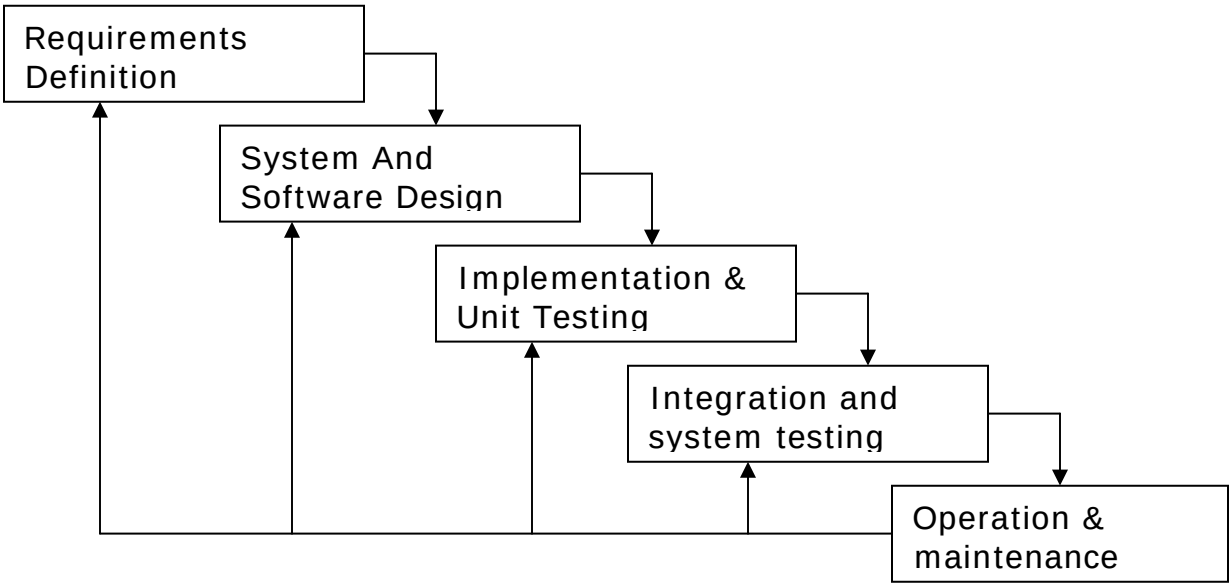


Fig 4.1 The Software Life Cycle

4.2 System Study

Military Engineering Services (MES) is one of the engineering services providers for all the cantonments in Pakistan. It is a public service organization that deals with extra ordinary workloads. Management of the MES was facing many problems in getting correct and updated information therefore they were keenly interested in computerizing its enormous and diversified data. For the sake of generality and broad engineering services base, military engineering services has been selected as model for preliminary study, analysis and implementation. Main objectives of this study are:-

a. To design and develop the system as a project that involves basic concepts of Database Systems, Web engineering and distributed processing system.

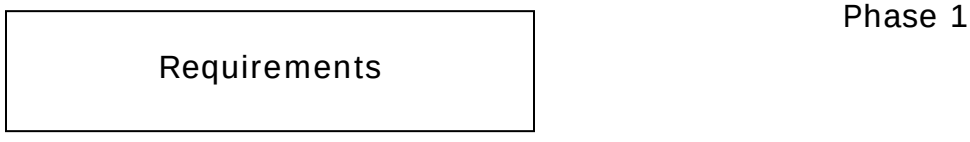
b. To translate the requirement of the organization into logical structures, which would then be implemented.

c. To institute detailed documentation to be used for future understanding and/or modifications of the software package so developed.

To achieve the objectives top-down design strategy has been used to translate the requirements into a working system by breaking it down into a series of phases, where each phase adds more details to the overall design. A top-down design approach starts by identifying the major components of the system, decomposing them into their lower level components and iterating until the desired level of detail is achieved [Jalote 98]. This study has been used to gain understanding of the concepts of the over all system together with sufficient details at each phase to gain knowledge as to how specific functions are to be implemented.

A web based complaint monitoring and management information system requires studying all the procedures and process being followed in the MES engineering starting from the registering of the complaints to the final completion of the complaints. It also includes detailing of workers, quantity of stores available in the stock, and the stores consumed.

As already said this study of the complaint system consists of four phases each with its own specific objective. Fig 4.1 shows the top down design approach adopted in implementation of the project.



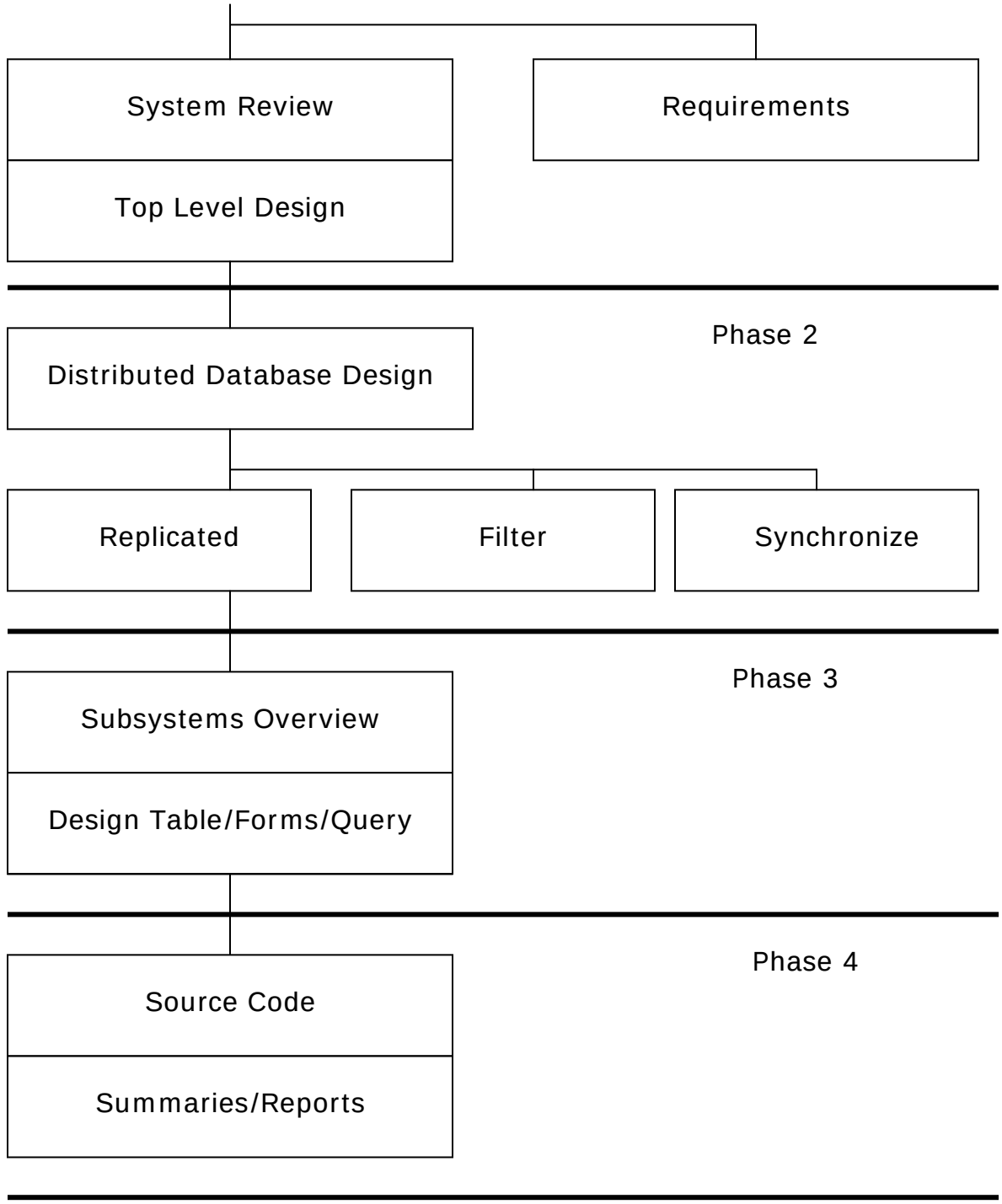


Fig 4.2 Top Down Phases of Design

Phase –1

In this phase system was discussed with the user and requirements were noted. At this stage external processing requirement were identified. It yielded the following requirement of the user:-

a. Complaint Summaries Nature wise.
b. Complaint Summaries Chowki Wise
c. Complaint Summaries Date wise.
d. Calculating total number of complaints completed and uncompleted.
e. Reasons for uncompleted complaints
f. Worker detailed on a complaint
g. Number of complaints completed by a worker.
h. Stores available at each chowki.
i. Stores consumed on the complaints.
j. Re order level of the stores.
k. Supplier's details and the stores supplied by them.

At this phase plan was made as to how to go about the system, which can fulfill the specified requirements.

Phase –II

The objectives of this phase were to develop a data model for the functions identified in phase-I that could work in distributed processing environment. A design was to be developed which could be workable in replicated database system. Filtration was required to carry out on all the records during synchronization. Therefore design of database was developed in such a manner that record on which referential integrity was imposed could be filtered by specifying the given criteria.

Phase-III

At this stage detailed overview of the phase II was taken, then study to design a detailed layout of the graphical user interface with the user were developed. The GUI were developed after carrying out detailed analysis and design of the system by using the flow charts, data flow diagrams, state transition diagram, data dictionaries and tables with their relationships.

Phase-IV

This phase comprises of the implementation of the individual functions/systems. In this phase source coding and listing was done to generate the required summaries. Also search engine was coded on almost all the data items. Following core functions were selected for implementations.

- Summary of complaints.
- Summary on-date.
- Stores Available summary.
- Stores consumed summary.
- Workers detailed summary.
- Reasons of uncompleted complaints.
- All these functions are provided with extensive search capabilities on various data items/columns of a particular record.

4.2.1 Existing Manual System

1. All Chowkis are equipped with PASCOM/CIV tel.
2. Complaint is registered by the complainer through telephone or personally.
3. E&M and external services like water supply, gas and elect complaint Chowkis are functional round the clock.

4. B&R Chowkis are usually closed on closing hours and then E&M Chowkis take care of B&R complaints and registers the complaints for the next day.

5. Three shifts are scheduled as under.

(1) 0700 - 1500 hrs

(2) 1500 - 2000 hrs

(3) 2000 - 0700 hrs

6. Complaint is registered on the register as per fol specimen.

(1) Complaint No

(2) Time Received

(3) Tel/Name/Rank of the Complainer

(4) Nature of Complaints

(5) Name of Worker Detailed

(6) Time Sent

(7) Final Status of the Result

(8) Remarks

(9) Signatures ICC/SDO/AGE/GE

8. Complaint are of two types.

(a) Complaint involving stores

(b) Complaint not involving stores

9. Stores possess following status.

(a) Stores Available (SA)

(b) Stores Not Available (NA)

(c) Procurement on Local Purchase (LP)

10. If the complaint does not involve the stores, the complaint is rectified within 24 hrs completion report submitted by the worker on the return.

11. The register is signed and stamped by IC Chowki every day at 0700 hrs for the previous day complaints.

12. The register is put up to the GE and CMES periodically.

13. Complaints involving the stores are conveyed by the worker to the IC Chowki who sends a complaint chit to store yard for issue of stores through charge hand/Work Mystery.

14. In cases if stores required are not avail then procurement action is initiated by the chowki.

15. The entire procedure is summarized as a flow chart shown in the Fig 4.3.

4.2.2 Problems in Existing Manual System

Following are the problems in the existing manual system.

a. Chowkis are located at considerable distances from the management. Due to distance involved and inadequate transport facilities available with chowki information passing via manual means was always slow and untimely.

b. There are five to fifteen chowkis under each GE. To simultaneously monitor all the chowkis for complaint status, workers detailing, and stores monitoring was a real problematic area for the management.

c. All chowkis are maintaining their own registers for complaints. This register is place for signature of management (that is GE & CMES) periodically. Once singed they are sent back to their respective chowkis. Thus data regarding complaints registered was not readily available with the management.

d. All the GE's purchase stores from local purchase stock depot. The store items were received at central stockyard located at GE's site. Central stockyard does not keep the store with it; rather it is transferred to the respective

chowkis. The management receives report on stock position once a month from the chowkis. Thus stocks data available with the management was always one month old.

e. There are about- 1000-1800 personals under one GE. These employees work at different places. Management faces difficulties in keeping record of employment of its personals at different chowkis.

f. Management does not have any consolidated record of complaints that are not completed and reasons for them being left uncompleted.

These above were some serious problems that existed with the management. This new web based system has been designed in such a manner that it will eliminate these problems that were being faced by the management in monitoring of the complaints. It will make the working smooth and efficient by identifying and minimizing the resources leakages.

4.3 Conceptual Models Evolved

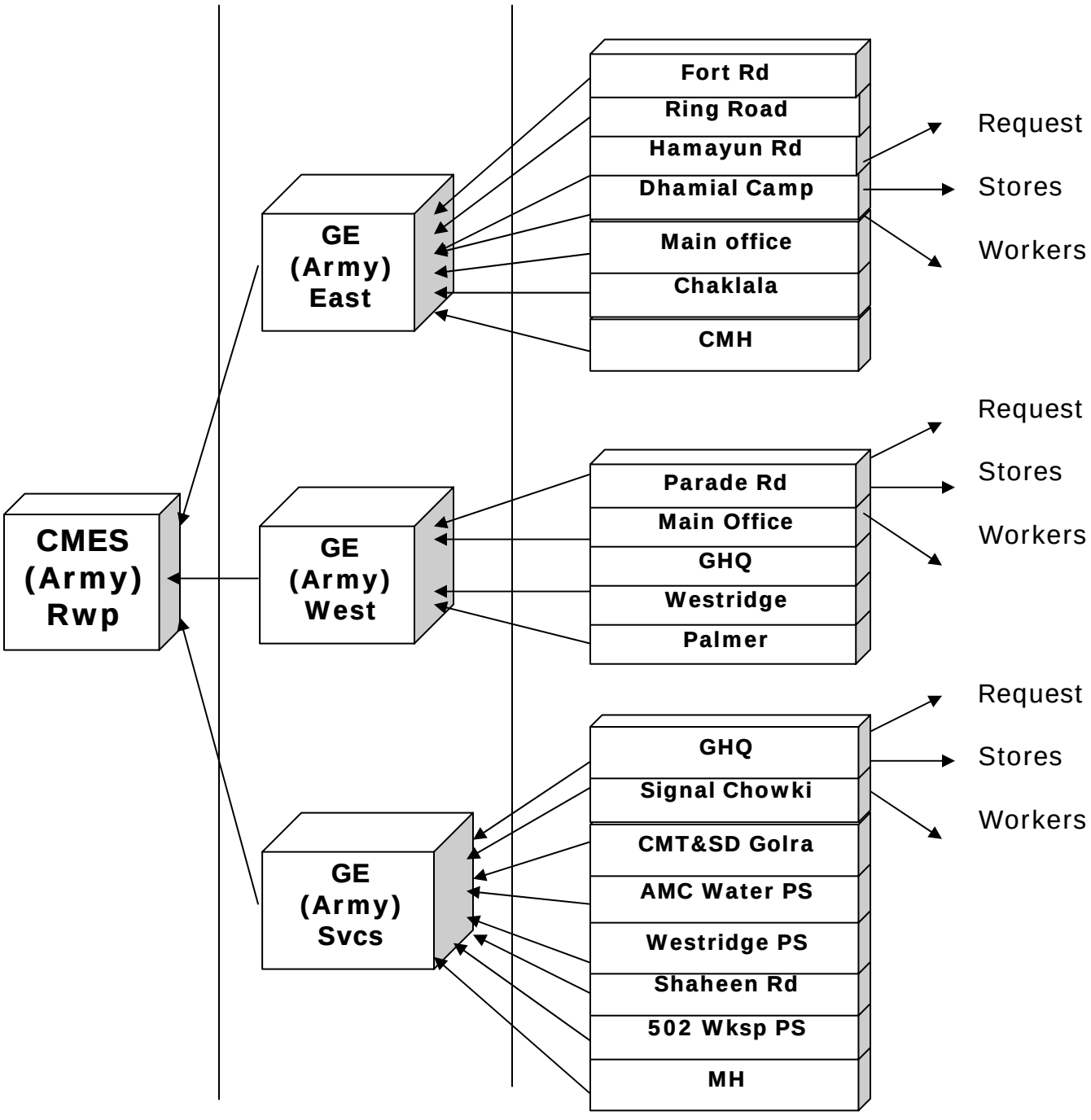


Fig 4.3 Conceptual Model

4.3.1 DATA NODE

Chowkis are Data Nodes. All the complaints made by complainer are registered at data node. Workers are detailed and stores are issued for the complaints, and data entries are done accordingly at the Chowkis. Progress on the work is recorded once worker returns from the work assigned to him. Stores issued or consumed on a complaint are also recorded at this node.

A data node contains the partial replica of the main database. Main database resides at MIS node. Data node will synchronize its data every day at the end of the working hours or synchronization can be done at the beginning of the next day. MIS nodes will thus get up to date data for generating the summaries.

4.3.2 MIS NODE

MIS node represents the Garrison Engineers (GE's) in the MES organization. Main database will be kept at MIS node, whereas its partial replicas will be kept at Data nodes. Summaries are generated at MIS node for the best utilization of the manpower and resources. At this data entries will be done for DSS node in the partial replica of DSS node's database. It will also synchronize its data with DSS node through WAN.

4.3.3 DSS NODE

It is the top-level node. Commanders MES (CsMES) office is the Decision Support System (DSS) Node. This node consists of the main database for all MIS nodes. Data entry for summaries to be generated at DSS node will be made in the replicated database residing at MIS nodes.

4.4 Conceptual Models

4.4.1 Logical Flow Chart of the System

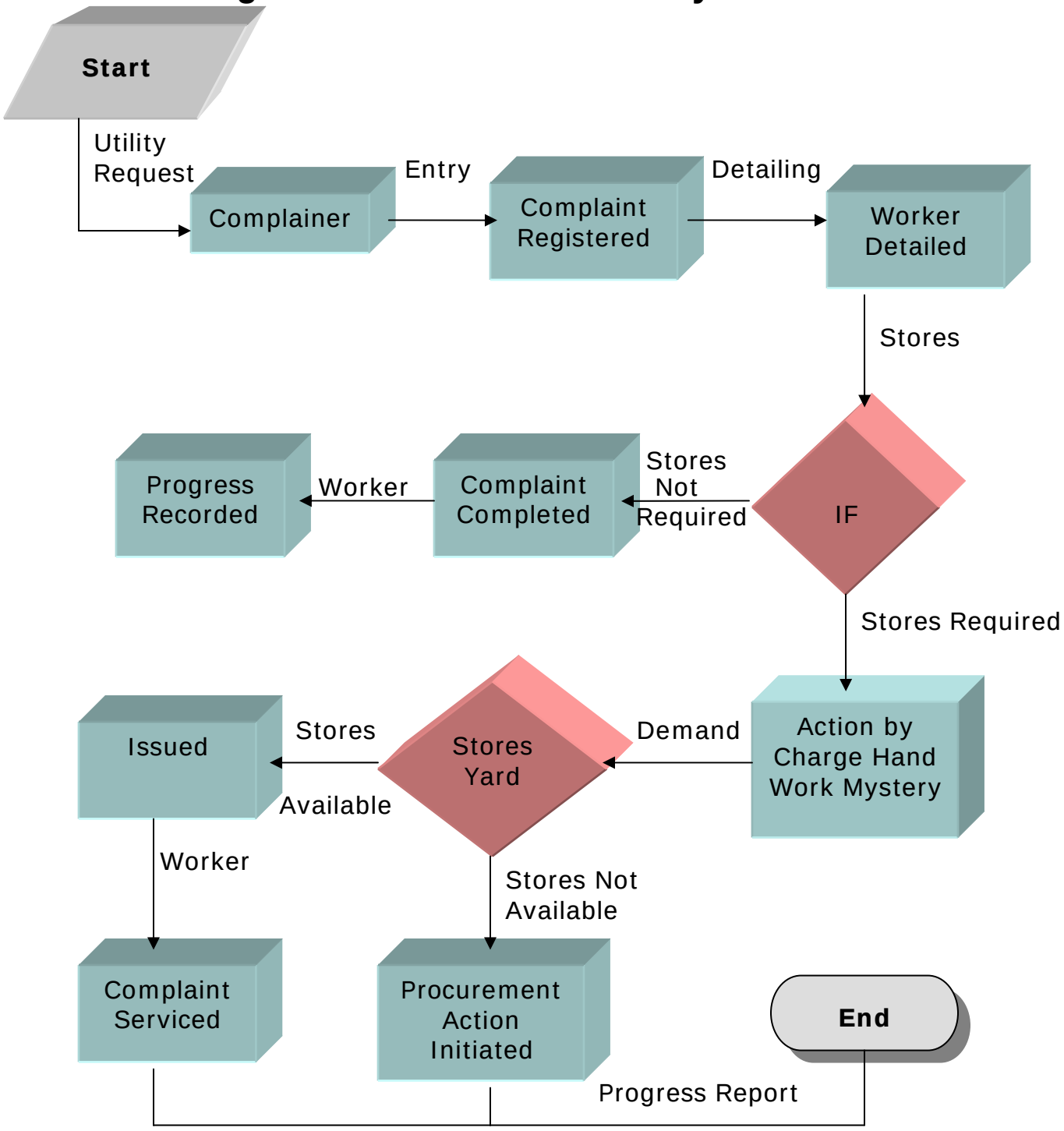


Fig 4.4 Logical flow Diagram of the System

4.4.2 Data Flow Diagrams (DFD)

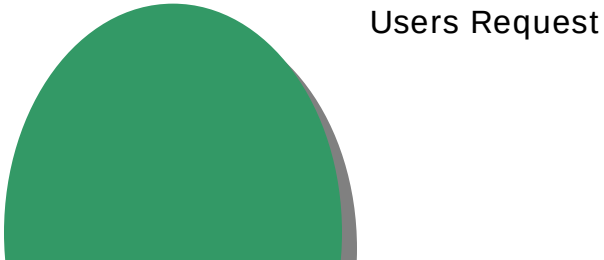
Data flow diagram (DFD) is the most important tool used by the system Analyst. It is called as modeling tool. DFD are the first tool used by an analyst to model system components. It is a graphical technique that depicts the information flow and the transforms that are applied as data move from one input to output. DFDs may be partitioned into level that represents increasing information flow and functional details. At level O DFD, also called a fundamental system model or context model, represents the entire software element as a single bubble with input and output data indicated by in coming and outgoing arrows [Pressman 97].

Three types of diagram have been defined for this project they are as under:

4.4.2.1 Context DFD or Level 0 DFD

This diagram shows the relationship between the system and its environment. A bubble represents the entire system, and the external entities are shown as squares from which input flows and to which out put is directed. No information about the structure of the system it self is pictured in a context DFD. Fig 4.5 shows the context DFD.

Context Level Diagram



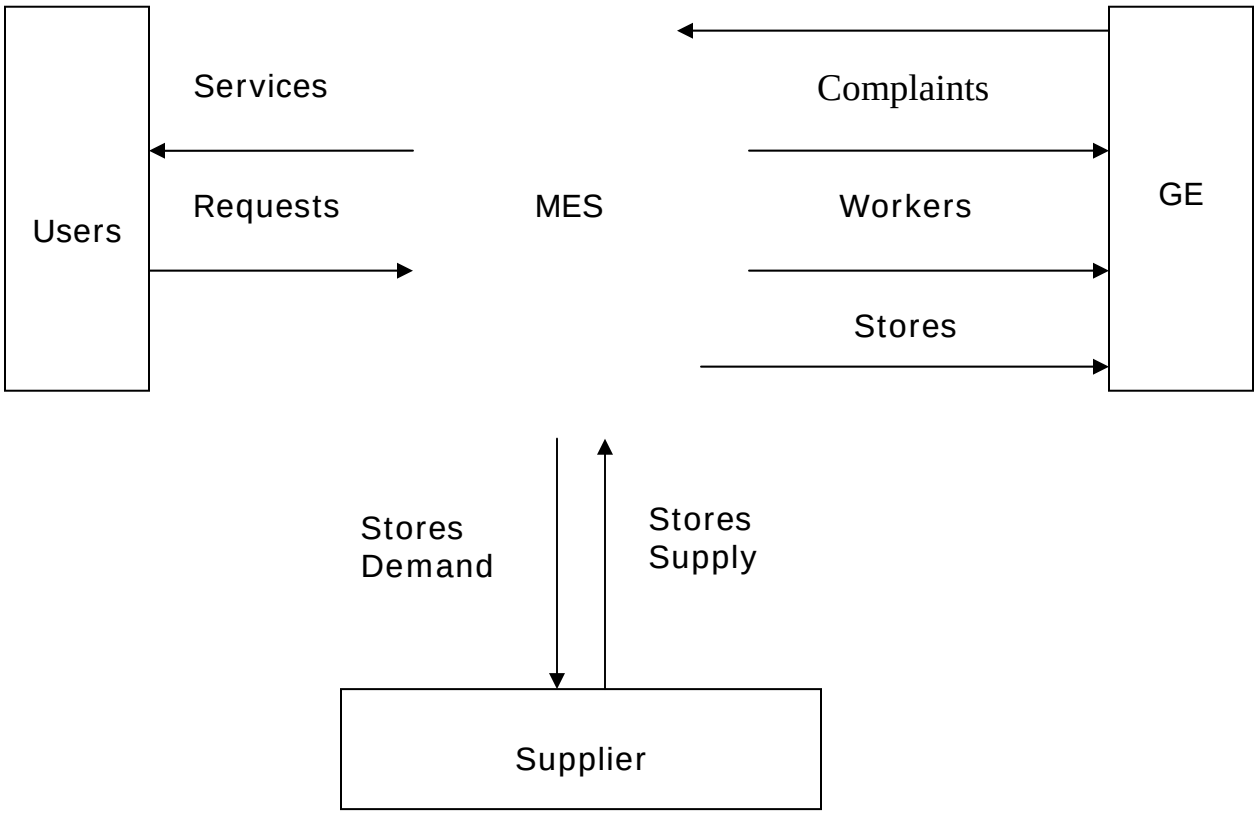


Fig 4.5 Context Level Diagram

4.4.2.2 Level 1 DFD

Level 1 diagram is diagram showing the system itself. It pictures the major processes along with the external entities, data stores, and data flow. Fig 4.6 shows level 1 diagram for complaint monitoring system. It is a single top-level diagram of the system, and does not describe each process in detail. Parts of this diagram can be exploded or expanded using more detailed sub diagrams.

Level 1 Data Flow Diagram

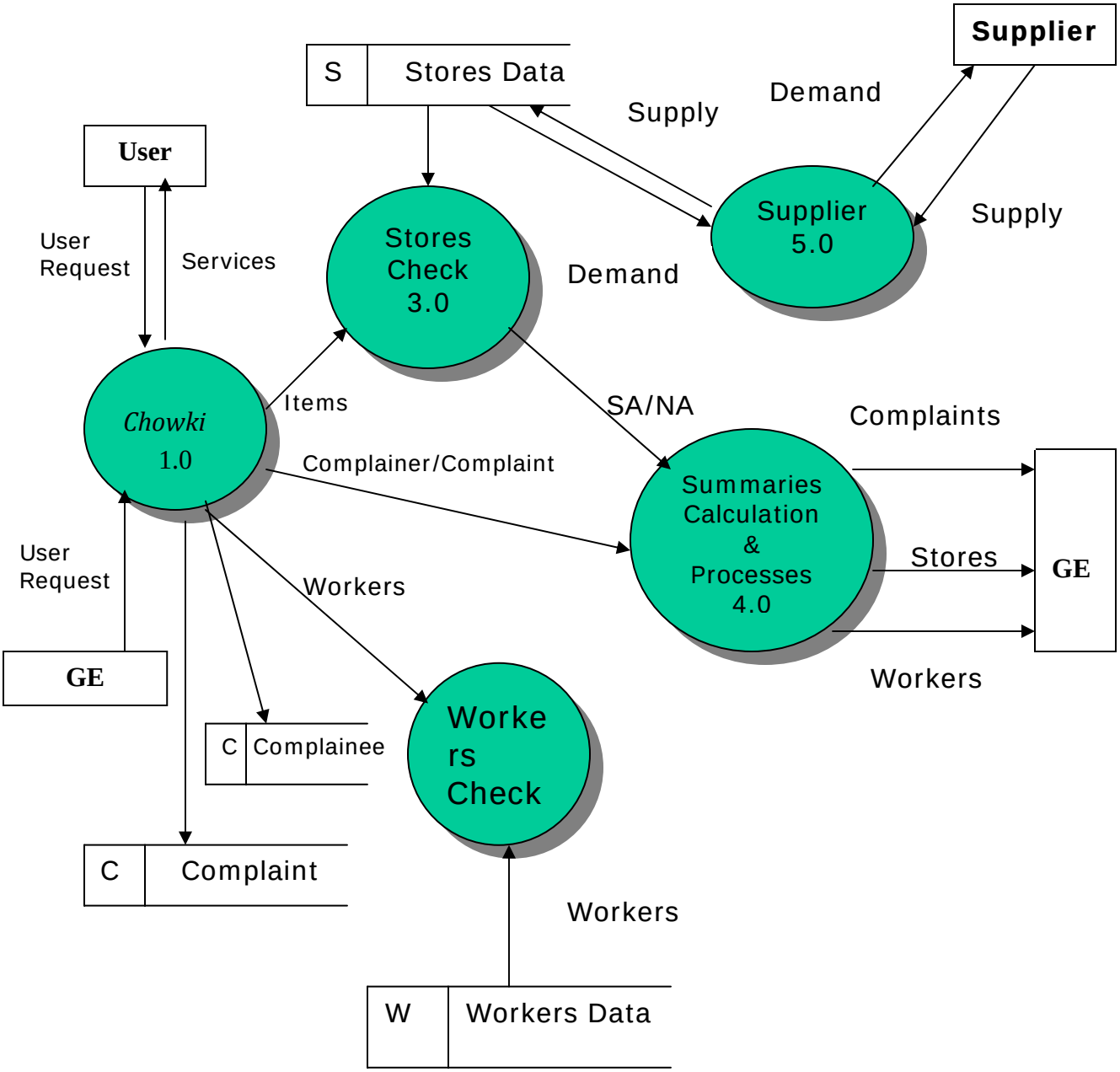


Fig 4.6 Level 1 DFD

4.4.2.3 Level 2 DFD

Detailed DFD are “explosions” of higher-level representations and are detailed pictures of major processes of sub systems. They are likely to be used by designers in their own work rather than for presentations to users or managers. Fig 4.7, 4.8 and 4.9 shows detailed DFD for this system, exploding the processes of diagram at level-1 develops these DFD.

Exploding Bubble 1.0

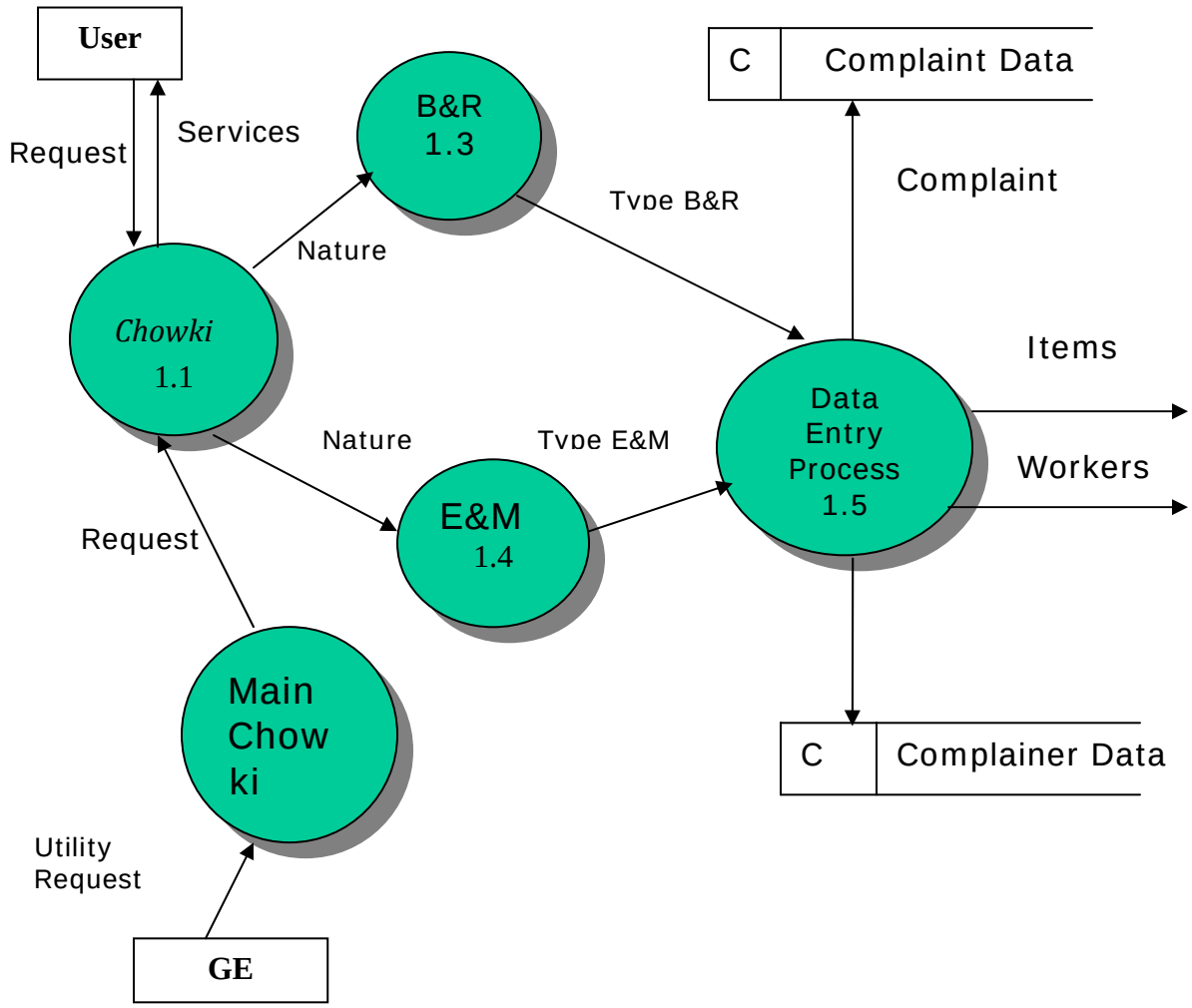


Fig 4.7 Detailed DFD by Exploding Bubble 1.0

Exploding Bubble 2.0

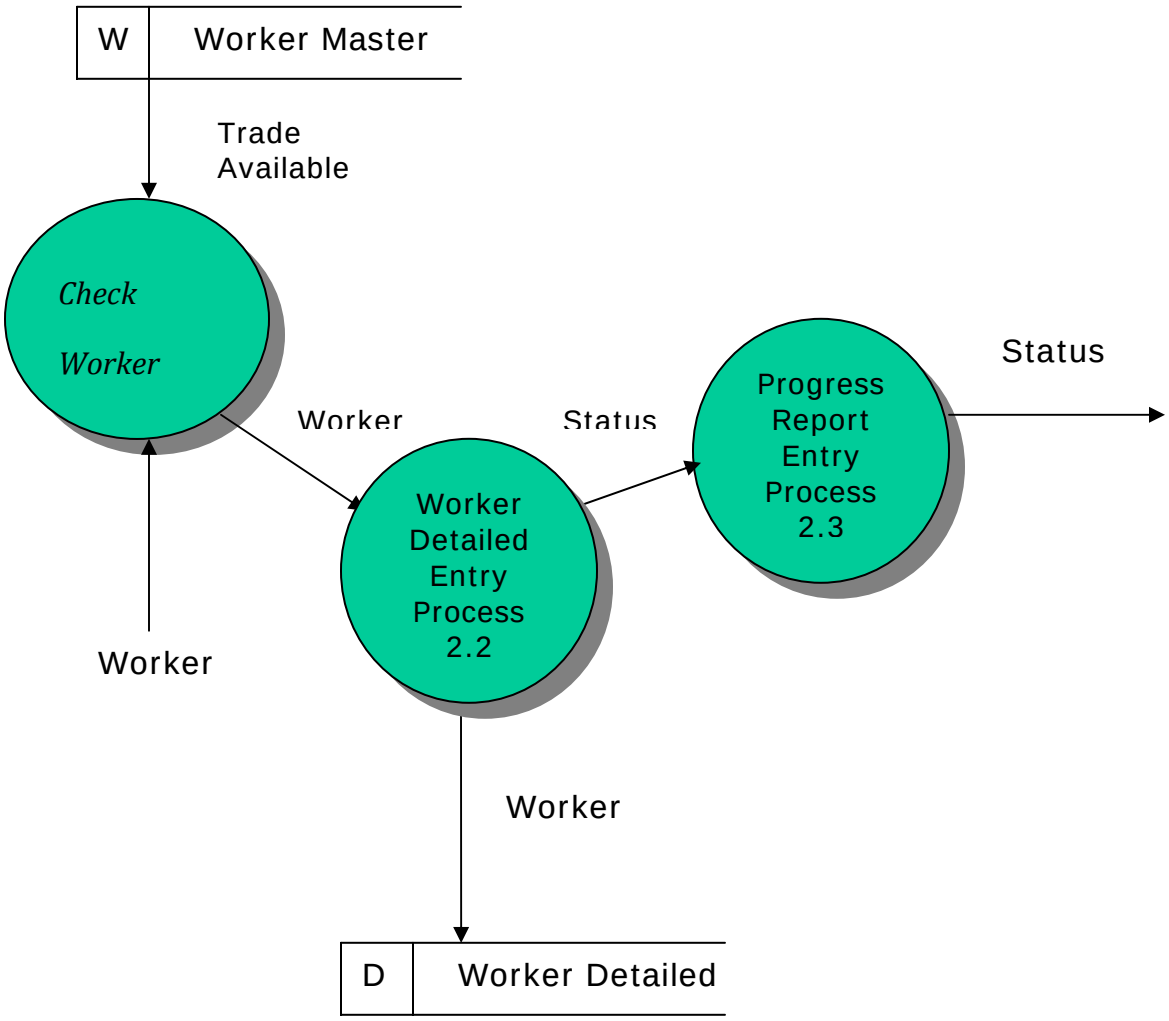


Fig 4.8 Detailed DFD by Exploding Bubble 2.0

Exploding Bubble 4.0

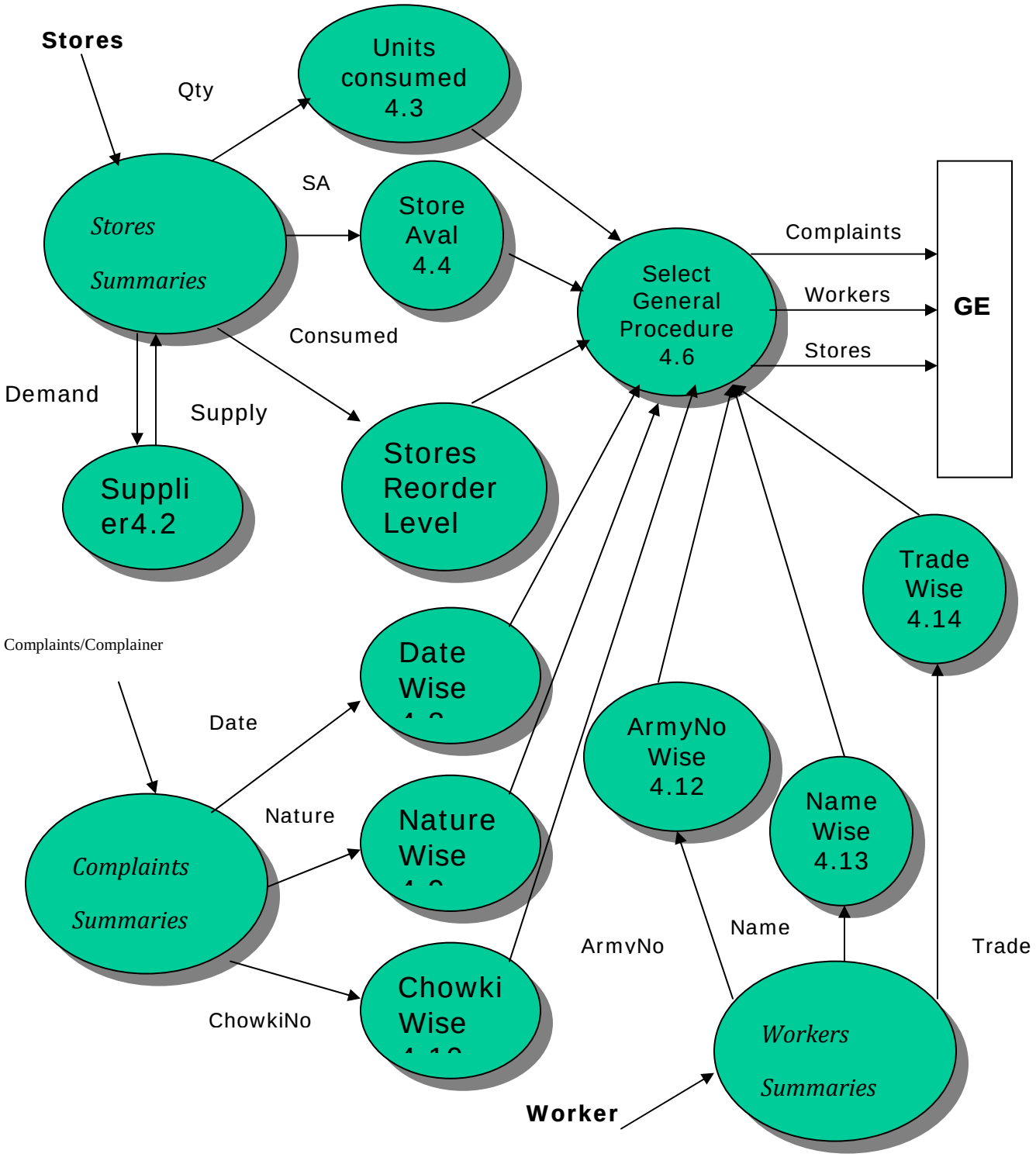


Fig 4.9 Detailed DFD by Exploding Bubble 4.0

4.4.3 State Transition diagram

The state-transition Diagram (STD) represents the behavior of a system by depicting its state and the events that cause the system to change state. In addition, the STD indicates what actions (e.g. process activation) are taken as a consequence of a particular event. A state is any observable mode of behavior. For example in fig 4.10 below for monitoring and management information system there are following states:

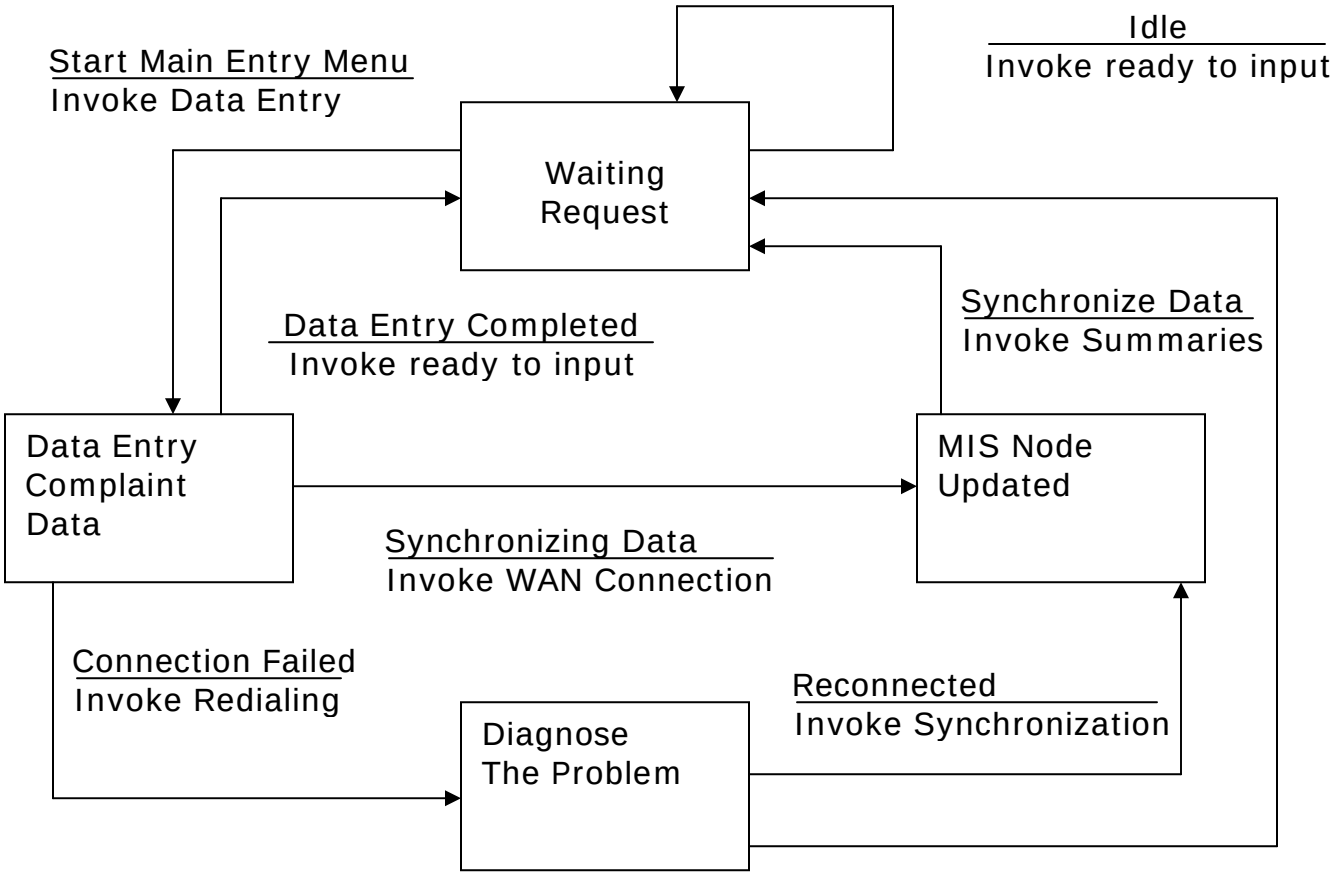


Fig 4.10 State Transition Diagram of the System

4.5 Physical Model of Data And MIS Node

As already stated in conceptual model that main database file will reside at MIS node whereas, the Data node contains the replicated database of MIS node. Thus the data model for both MIS and Data node will be exactly the same. In this section data model, data dictionary and entity relationship diagram has been briefly discussed:

4.5.1 Data Dictionary

A Data Dictionary (DD) is a repository of information that describes the logical structure of the database. It has entries for record type, data type and other information like location of the record or data item in the distributed database systems. DD not only store the database schema but can be useful in creating and processing the database. The DD contains “Metadata” that is data about the data in the database.

Computer Aided Software Engineering tools (CASE) tools are available in the market which help the designer of database in developing and maintaining the DD. It is useful for:

a. Collecting and storing information about data in a central location.
b. Securing agreement from users and designers about meanings of data items.
c. Communicating with users.
d. Identifying redundancy and inconsistency in data items name.
e. Keeping track of changes to data items.

DD for this project has been developed as shown under:

Data Dictionary

Sno	Entity	Attributes	Type	Location	Remarks
1.	Complainee	ComplaineeID	Number	MISNode	PrimaryKey
		Name	Text	MISNode	
		Designation	Text	MISNode	
		Phone	Number	MISNode	
		Address	Text	MISNode	
2.	Complaint	ComplaintID	Number	MISNode	PrimaryKey
		ComplaineeID	Number	MISNode	ForeignKey
		ComplaintDate	Date/Time	MISNode	
		ComplaintNature	Text	MISNode	
		ComplaintType	Text	MISNode	
		ChowkiNo	Number	MISNode	
		FinalStatus	Yes/No	MISNode	
		Remarks	Text	MISNode	
3.	WorkerMaster	ArmyNo	Number	MISNode	PrimaryKey
		Trade	Text	MISNode	
		Name	Text	MISNode	
		BirthName	Text	MISNode	
		InductionDate	Date	MISNode	
		PresentAddress	Text	MISNode	
		HomePhone	Number	MISNode	
		ChowkiNo	Number	MISNode	
		Grade	Number	MISNode	
		Domicile	Text	MISNode	
4.	ChowkiNo	ChowkiNo	Number	Node	
		Address	Text	MISNode	
		Phone	Number	MISNode	
Sno	**Entity**	**Attributes**	**Type**	**Location**	**Remarks**

5.	WorkerDetail	ArmyNo	Number	MISNode	
		ComplaintID	Number	MISNode	
		ItemCode	Text	MISNode	
		UnitsIssued	Number	MISNode	
		TimeSent	Date/Time	MISNode	
6.	Stores	ItemCode	Text	MISNode	PrimaryKey
		SupplierID	Number	MISNode	ForeignKey
		ItemName	Text	MISNode	
		AU/ItemUnit	Number	MISNode	
		UnitPrice	Number	MISNode	
		UnitInStock	Number	MISNode	
		ReorderLevel	Number	MISNode	
		ChowkiNo	Number	MISNode	
7.	UnitsIssued	ItemCode	Text	MISNode	
		UnitsOrder	Number	MISNode	
		OrderDate	Date	MISNode	
		DeliveryDate	Date	MISNode	
8.	Supplier	SupplierID	Number	MISNode	PrimaryKey
		CompanyName	Text	MISNode	
		SupplierName	Text	MISNode	
		Phone	Number	MISNode	
		Fax	Number	MISNode	
		Address	Text	MISNode	
9.	GEArmyID	GEArmyID	Number	DSSNode	
		Address	Text	DSSNode	
		Phone	Number	DSSNode	
10.	DSSComplaint	ComplaintNature	Text	DSSNode	
Sno	**Entity**	**Attributes**	**Type**	**Location**	**Remarks**

		Total	Number	DSSNode	
		Completed	Number	DSSNode	
		Incompleted	Number	DSSNode	
		GEArmyID	Number	DSSNode	
11.	DSSWorker	Trade	Text	DSSNode	
		Tradewise Total	Number	DSSNode	
		Detailed	Number	DSSNode	
		GEArmyID	Number	DSSNode	
12.	DSSStore	StoreType	Text	DSSNode	
		QtyUsed	Number	DSSNode	
		AU/ItemUnit	Text	DSSNode	
		GEArmyID	Number	DSSNode	

4.5.2 Data Models

Following are the tables designed for the system.

4.5.2.1 MIS Node

4.5.2.1.1 ChowkiNo:Table

S/No	***Field Name***	***Data Entry***
1	ChowkiNo	One time data entry
2	Address	One time data entry
3	Phone	One time data entry

4.5.2.1.2 Complainee: Table

S/No	*Field Name*	*Data Entry*
1	ComplaineeID	User Fed
2	Name	User Fed
3	Designation	User Fed
4	Address	User Fed
5	Phone	User Fed

4.5.2.1.3 Complaint :Table

S/No	*Field Name*	*Data Entry*
1	ComplainID	User Fed
2	ComplaintDate	System Generated
3	ComplaintNature	Combo Selection
4	ComplaintType	Combo Selection
5	ComplaineeID	User Fed
6	FinalStatus	Combo Selection
7	ChowkiNo	User Fed
8	Remarks	Text

4.5.2.1.4 Stores:Table

S/No	*Field Name*	*Data Entry*
1	ItemCode	User Fed
2	SupplierCode	Combo Selection
3	ItemName	Combo Selection
4	AU/ItemUnit	Combo Selection
5	UnitPrice	User Fed
6	UnitInStock	User Fed
7	ReorderLevel	User Fed
8	ChowkiNo	User Fed

4.5.2.1.5 WorkerMaster:Table

S/No	*Field Name*	*Data Entry*
1	ArmyNo	One time entry
2	Trade	One time entry
3	Name	One time entry
4	BirthDate	One time entry
5	InductionDate	One time entry
6	Grade	One time entry
7	Domicile	One time entry
8	PresentAddress	One time entry
9	HomePhone	One time entry
10	ChowkiNo	One time entry

4.5.2.1.6 WorkerDetailed:Table

S/No	*Field Name*	*Data Entry*
1	ArmyNo	Combo Box Selection
2	ComplaintID	User Fed
3	ItemCode	Combo Selection
4	Unitsissued	User Fed

4.5.2.1.7 UnitsIssued:Table

S/No	*Field Name*	*Data Entry*
1	ItemCode	Combo Box Selection
2	UnitsOrder	User Fed
3	OderDate	User Fed
4	DeliveryDate	User Fed

4.5.2.1.8 Supplier

S/No	*Field Name*	*Data Entry*
1	SupplierID	One time entry
2	CompanyName	One time entry
3	SupplierName	Combo Selection
4	AU/ItemUnit	Combo Selection
5	UnitPrice	User Fed
6	UnitInStock	User Fed
7	ReorderLevel	User Fed
8	ChowkiNo	User Fed

4.5.2.2 DSS Node

DSS node has been designed with following data model:

4.5.2.2.1 GEArmyID

S/No	*Field Name*	*Data Entry*
1.	GEArmyID	One time data entry
2.	Address	One time data entry
3.	Phone	One time data entry

4.5.2.2.2 DSSComplaint

S/No	*Field Name*	*Data Entry*
1.	ComplaintNature	User Fed
2.	Total	User Fed
3.	Completed	User Fed
4.	Uncompleted	User Fed
5.	GEArmyID	User Fed

4.5.2.2.3 DSSWorker

S/No	*Field Name*	*Data Entry*
1.	Trade	User Fed
2.	TradeWise Total	User Fed

3.	Detailed	User Fed
4.	GEArmyID	User Fed

4.5.2.2.4 DSSStores

S/No	*Field Name*	*Data Entry*
1.	StoreType	User Fed
2.	QuantityUsed	User Fed
3.	AU/ItemsUnit	User Fed
4.	GEArmyID	User Fed

4.5.3 Entity Relationship Diagram (E-R Diagram)

An E-R diagram are used to express the logical properties of the database in an organization schema. It has been used to express the logical structure of the model. Fig 4.11 below shows the E-R model.

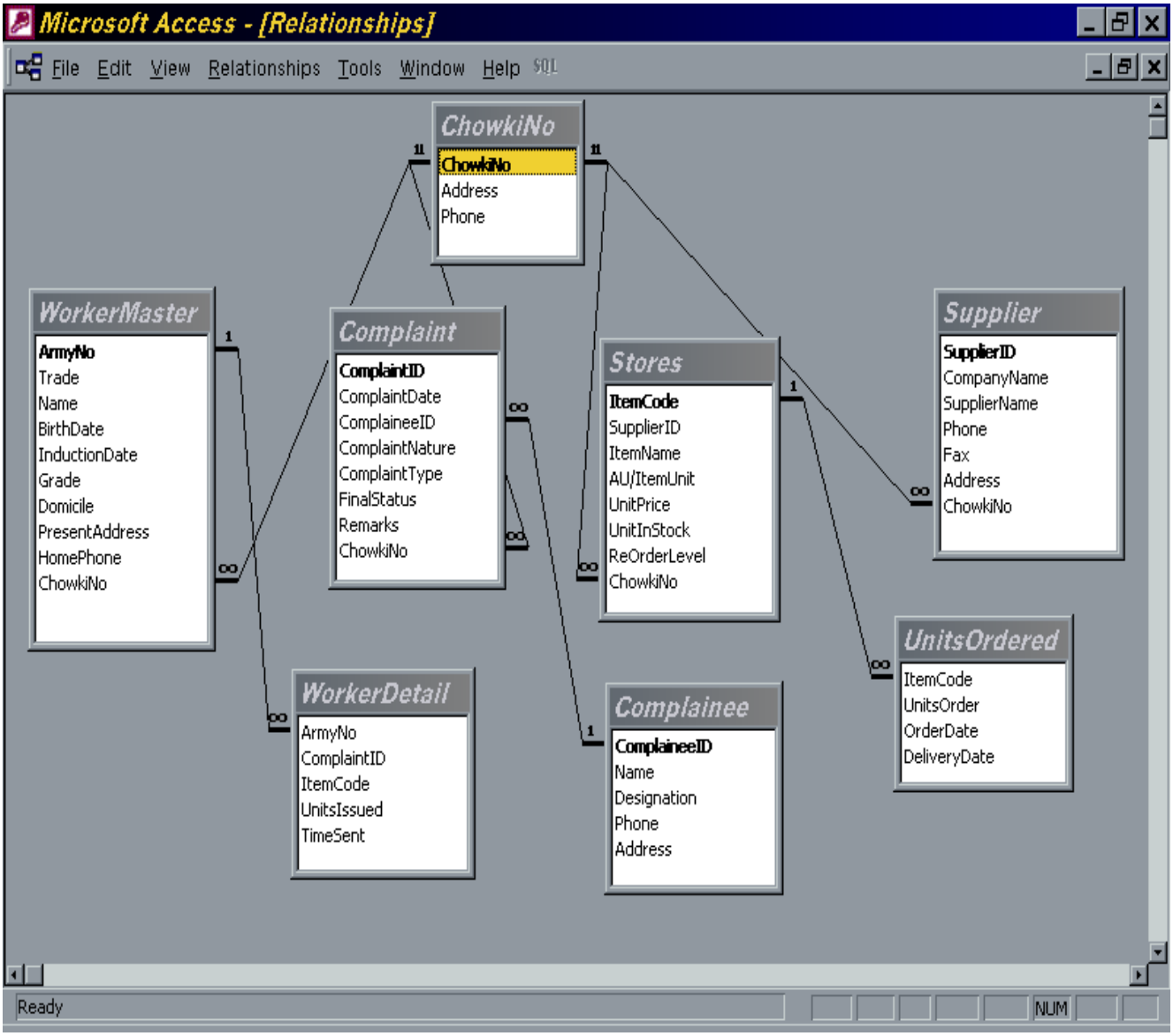


Fig 4.11 E-R model

4.6 Implementation Strategies

4.6.1 MIS Node

The implementation of this system has been designed for monitoring and management of users complaints in a public service organization like MES. For implementation a front-end screen has been

designed in HTML. It will act as Home Page for this system as shown in the Fig 4.12

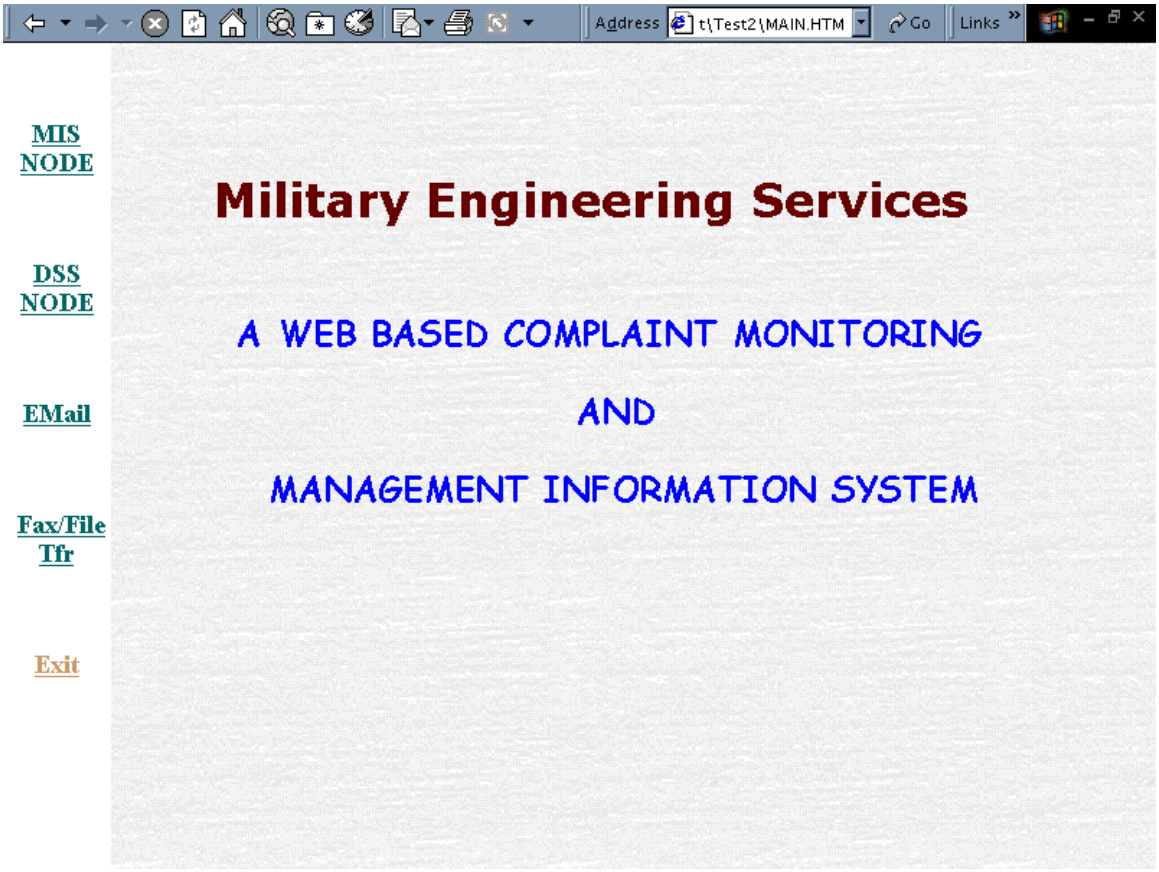


Fig 4.12 Home Page

At the bottom following hyperlink have been given to the user:

a. MIS Node: This hyper link has been created for providing link with the management information system prepared for the garrison engineer.

b. Data Updates: An MIS node contains Partial replica of Decision Support System (DSS) Node. A hyperlink has been created to open the Partial Replica for data entry. Data entry has been designed in Microsoft Access.

c. Few additional facilities like Fax, Email, Dialer and File Transfer has been provided on home page using software named Super Voice and Microsoft Outlook Express.

d. Besides above, few hyperlinks have been provided to explain the history of the MES, the organizational structure of the MES, its mission, and the help on the system.

4.6.1.1 User Authentication Screen

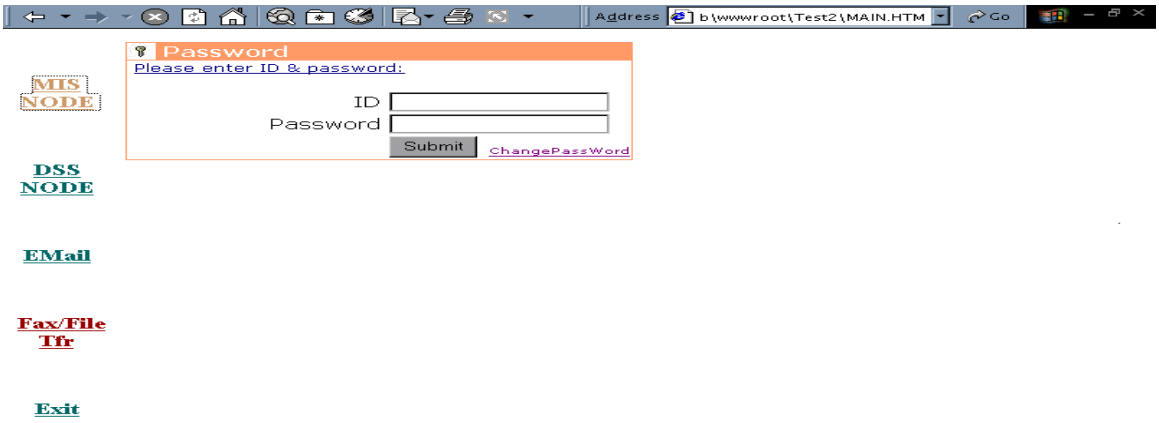


Fig 4.13 Password Screen MIS Node

This screen has been shown in the figure below. It appears once the user clicks the MIS Node option at the Home Page. At this screen user will enter the User ID and Password that will be verified and user will be granted access to the MIS node. The Authentication procedure has been coded in ASP script.

4.6.1.2 Select Screen

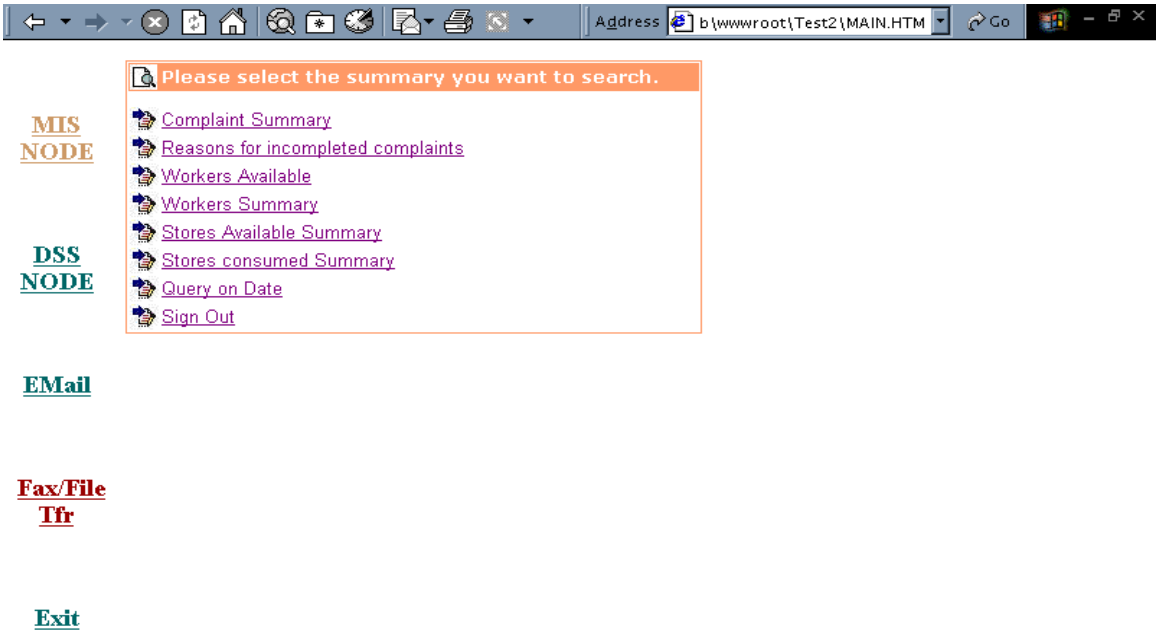


Fig 4.14 Select Screen MIS Node

Once the user is authorized to access the database the next screen that will interface with the user is selecting the type of summary to be browsed. The various options that are displayed are shown in the figure 4.14 above. Hyperlink is created on each option. As the user at MIS node clicks the choice of summary he wants to browse the next screen that will appear will be Search screen asking which field is to be searched as shown in the next paragraph.

4.6.1.3 Search On Complaints Summary Screen

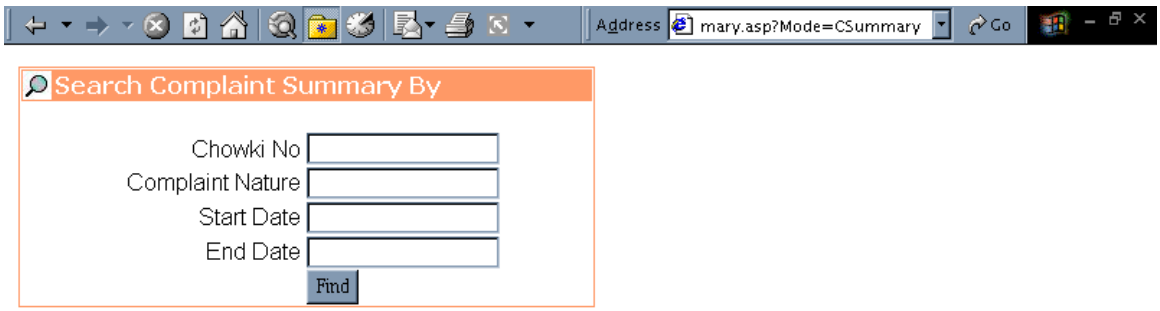


Fig 4.15 Search Screen for Complaint Summary

This screen provides search on various fields. These fields are “ChowkiNo”, “ComplaintNature”, and “Start Date”, “End Date”. If we do not give any option and click the “Find” button, data of all the Chowkis, and data of all nature type will be displayed. But if we specify some criteria for example if nature type “B&R internal” is given than data for that very nature will be displayed for all Chowkis. If along with nature Chowki No is given then data for only that Chowki will be displayed. Similarly if garrison engineer wants to see summary of some specific period than he can give the “Start date” and “End date”. Fig 4.15 above shows the search screen for the complaints summary.

4.6.1.4 Complaints Summary Screen

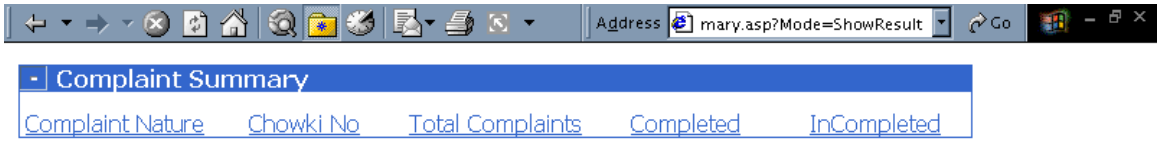


Fig 4.16 Complaint Summary Screen

Fig 4.16 above shows the columns that are displayed for complaint summary. These coloumns are

- Complaint
- ChowkiNo
- Total Complaints rgistered till date.
- Complaints completed
- Complaints uncompleted)

The coding has been done in ASP and VB scripting using ADO.

4.6.1.5 Search Screen for Complaint with Reasons

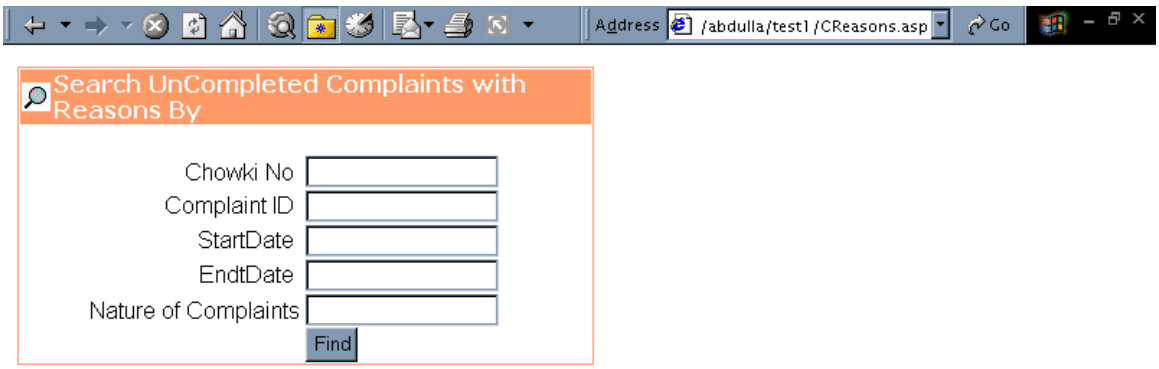


Fig 4.17 Search Screen Complaints With reasons

It is the second option in the summaries selection list. Search screen provides search facilities on following fields

- ChowkiNo
- Complaint ID
- Complaint Nature
- Reasons for Complaint Left Uncompleted

By specifying any search criteria user can get the report according to his choice. Above three search options provide sufficient search facility to find out the reasons for the complaints that were left uncompleted. Fig 4.17 shows the search screen for Complaint Reason Screen.

4.6.1.6 Complaint with Reasons Screen

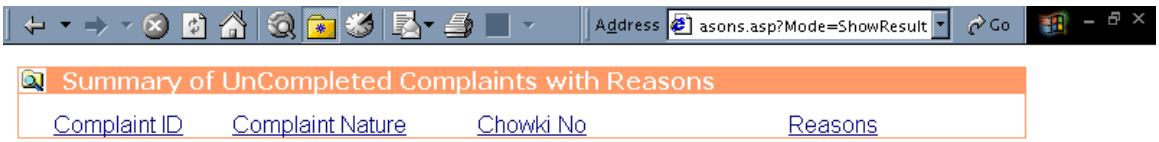


Fig 4.18 Summary Uncompleted Complaints Screen

Figure 4.18 above shows the fields that are displayed when search criteria is specified. The fields displayed are

- Complaint ID
- Complaint Nature
- ChowkiNo
- Reasons for uncompleted complaints

4.6.1.7 Search Screen for Workers Detailed

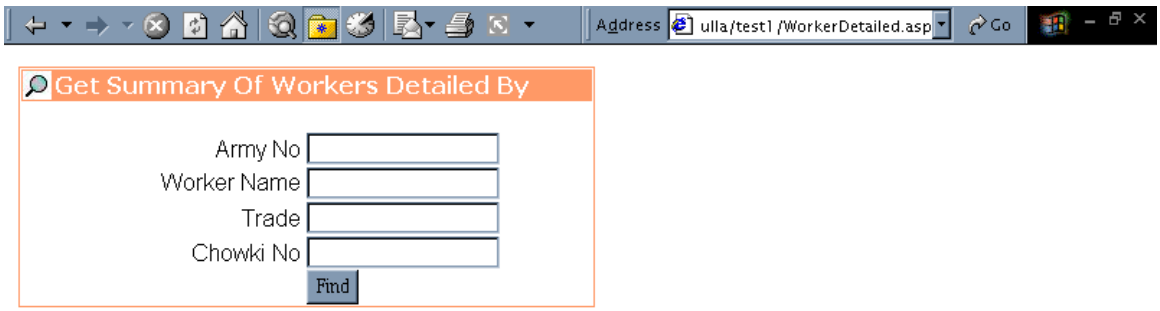


Fig 4.19 Search Screen Workers Detailed

The option displays the worker details. The fields that are displayed are Army number, Name, Trade, ChowkiNo, and Address. These fields are also provided in the search screen thus management can search for available workers on any Chowki, also if he wants he can get summary trade wise or name wise search can also be done.
Fig 14.19 shows the search screen and figure 14.18 displays the actual data according to specified criteria. If no criteria are given and only a find button is clicked than data will be displayed without filtration.

4.6.1.8 Workers Detailed Summary

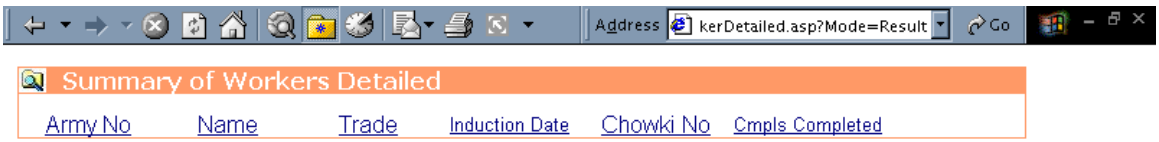


Fig 4.20 Workers Detailed Summary Screen

Fig 4.20 shows the search screen for Workers summary. This summary calculates the number of complaints that are completed by a worker along with his particulars. Fields displayed are

- Army No
- Name
- Trade
- Induction Date
- ChowkiNo
- Complaints Completed

4.6.1.9 Search Screen Stores Available Summary

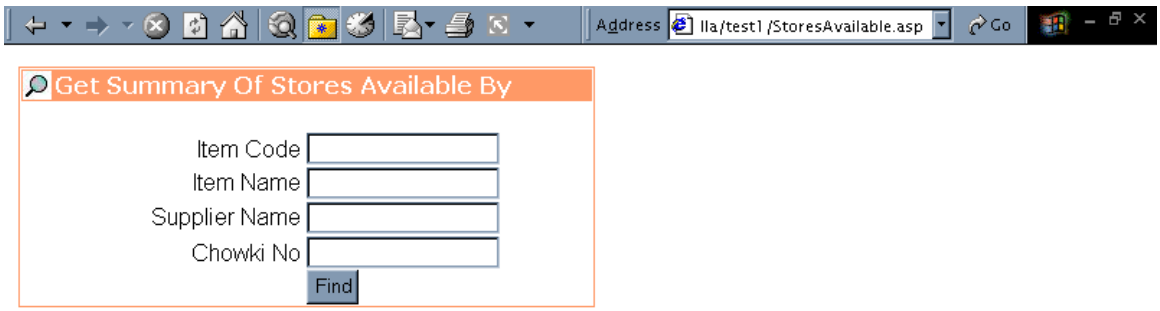


Fig 4.21 Search Screen Stores Available

Fig 4.21 depicts the search menu for store available. Search has been provided on the Item Code, Item Name, Supplier Name and ChowkiNo. If no criterion is specified and users click the “Find” button complete data of all the items for all the chowkis will be displayed. Management can easily find out which chowki is short of what store and can timely replenish the stores.

4.6.1.10 Stores Available Summary

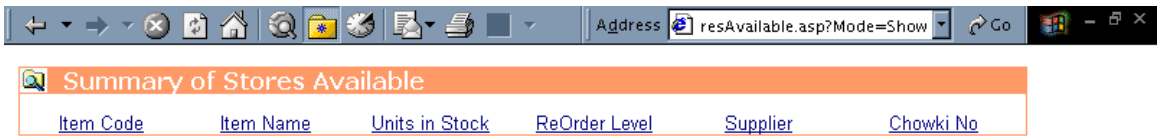


Fig 4.22 Stores Available Summary

Fig 4.22 shows the fields or columns that will be displayed. Stores available summary displays the data of stores that are available or held by different store yards at different chowkis. The fields it displays are:

- Item Code
- Item Name
- Units in Stock
- Reorder Level
- Supplier Name
- ChowkiNo

4.6.1.11 Search Screen for Stores Consumed Summary

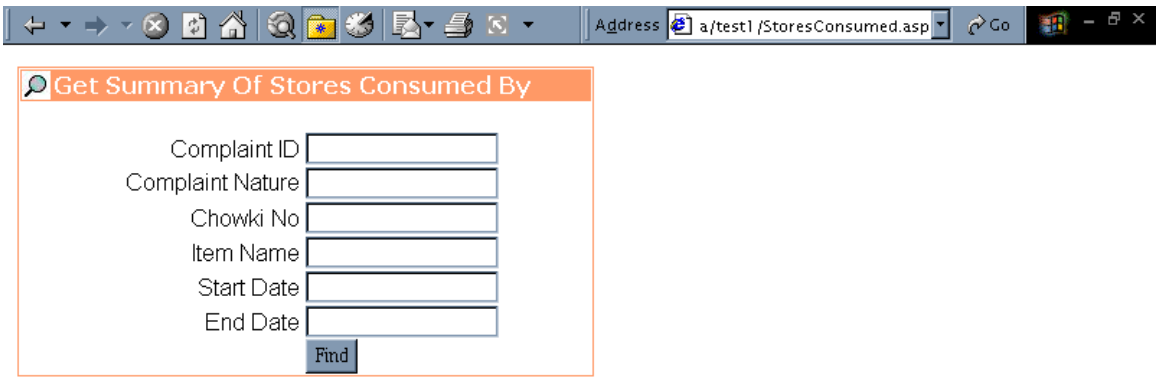


Fig 4.23 Search Screen Stores Consumed

Search has been provided on complaint ID, Complaint Nature, ChowkiNo, Item Name, Start Date, End Date as shown in the fig 4.23 above. If no criteria is specified than on clicking “Find ” button the data of all the items consumed and of all the chowkis will be displayed.

4.6.1.12 Stores Consumed Summary

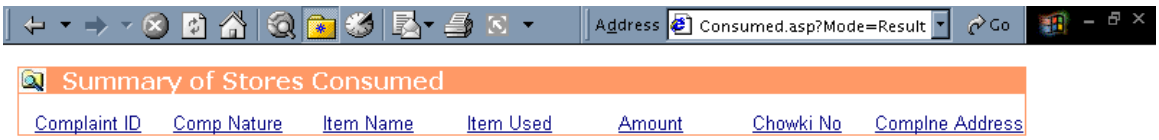


Fig 4.24 Summary of Stores Consumed

Fig 4.24 shows the data display screen for stores that has been consumed on different complaints. It also calculates amount incurred on each complaint. Fields that are displayed are as under:

- Complaint ID
- Complaint Nature
- Complainer Address
- Item Name
- Item Used
- Total Amount Incurred
- Chowki Number

4.6.1.13 Query on Date

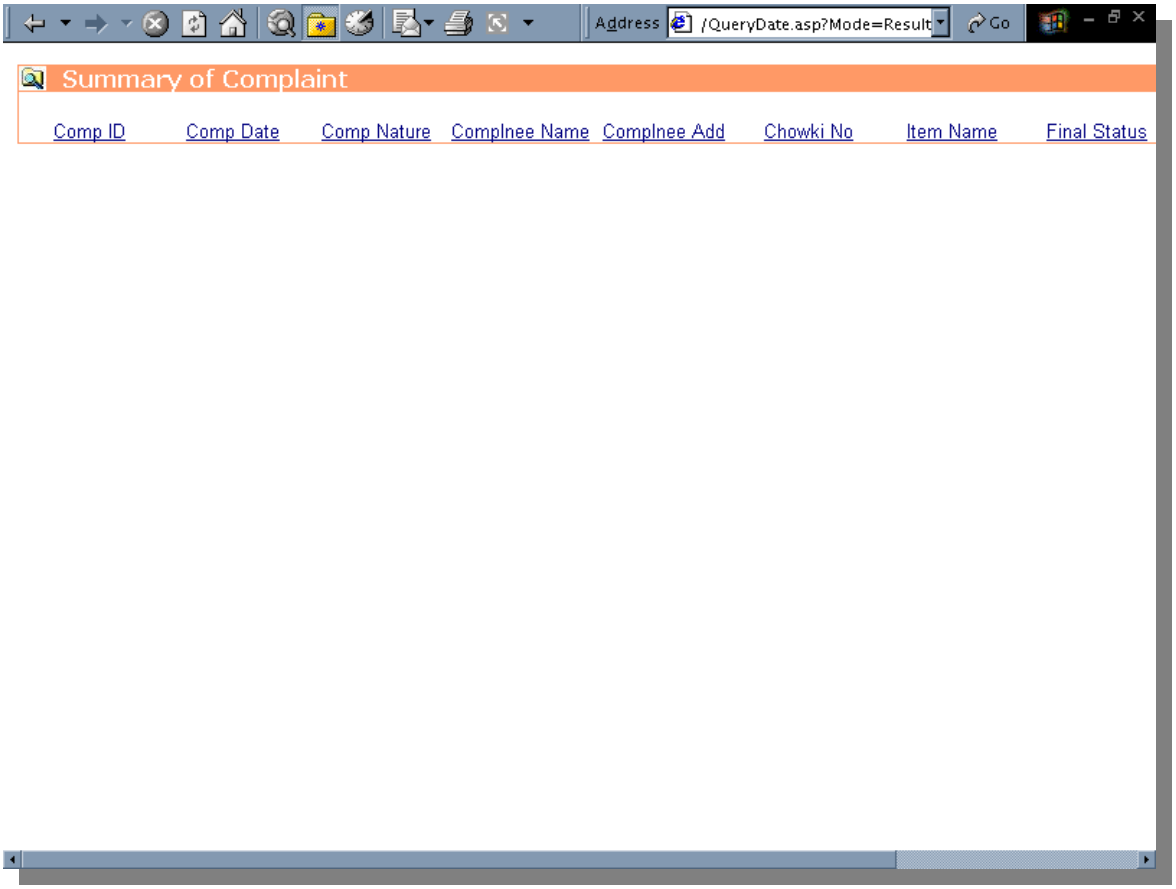


Fig 4.25 Query On Date Screen

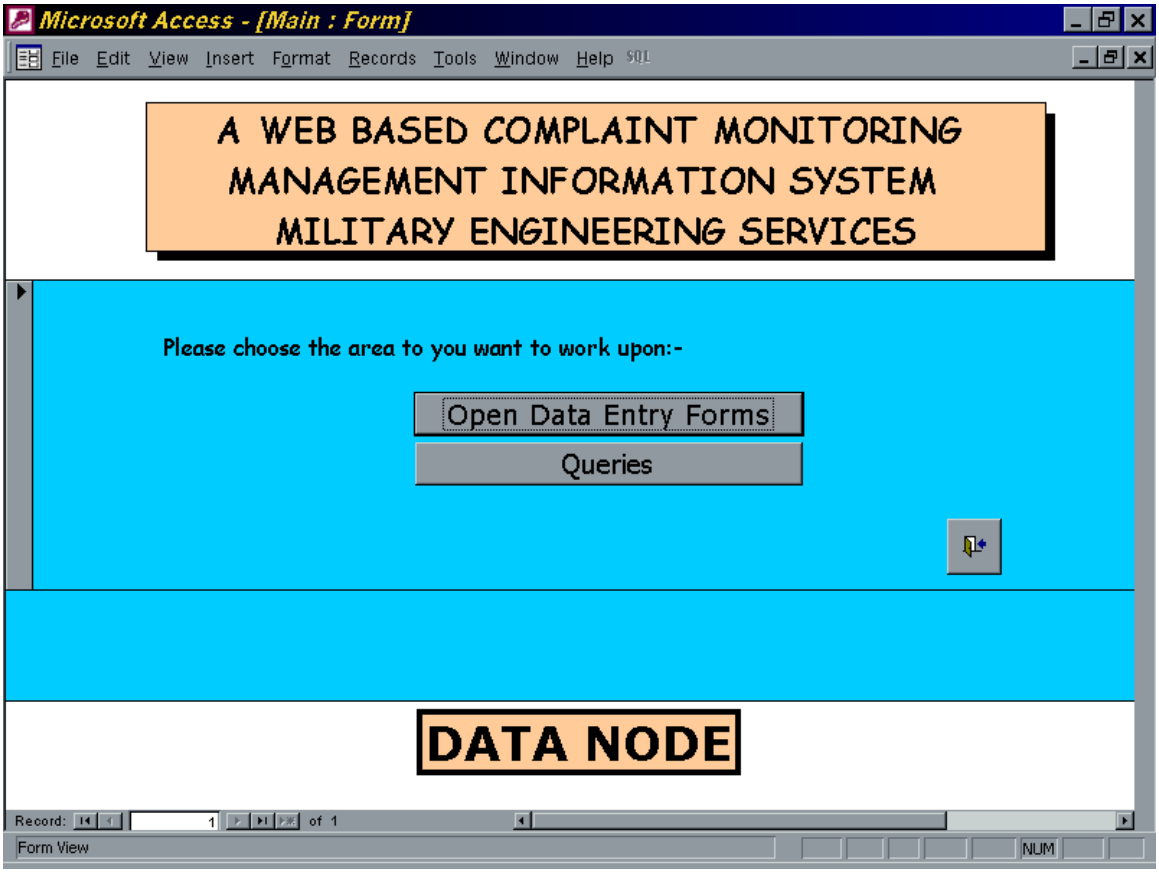
It is the query that displays complete record of a complaint on a particular date. This query has been specifically designed for the management to check the progress of a particular complaint. If user rings the GE and specifies that he has made a complaint No 123 on date 12 Mar 2001 but no action has been taken so far. GE can immediately see the latest progress report on this complaint by seeing its status through this complaint query. Search on following fields have also been provided to search on different fields whichever is given by the user:

- Complaint ID
- Chowki Number
- Date

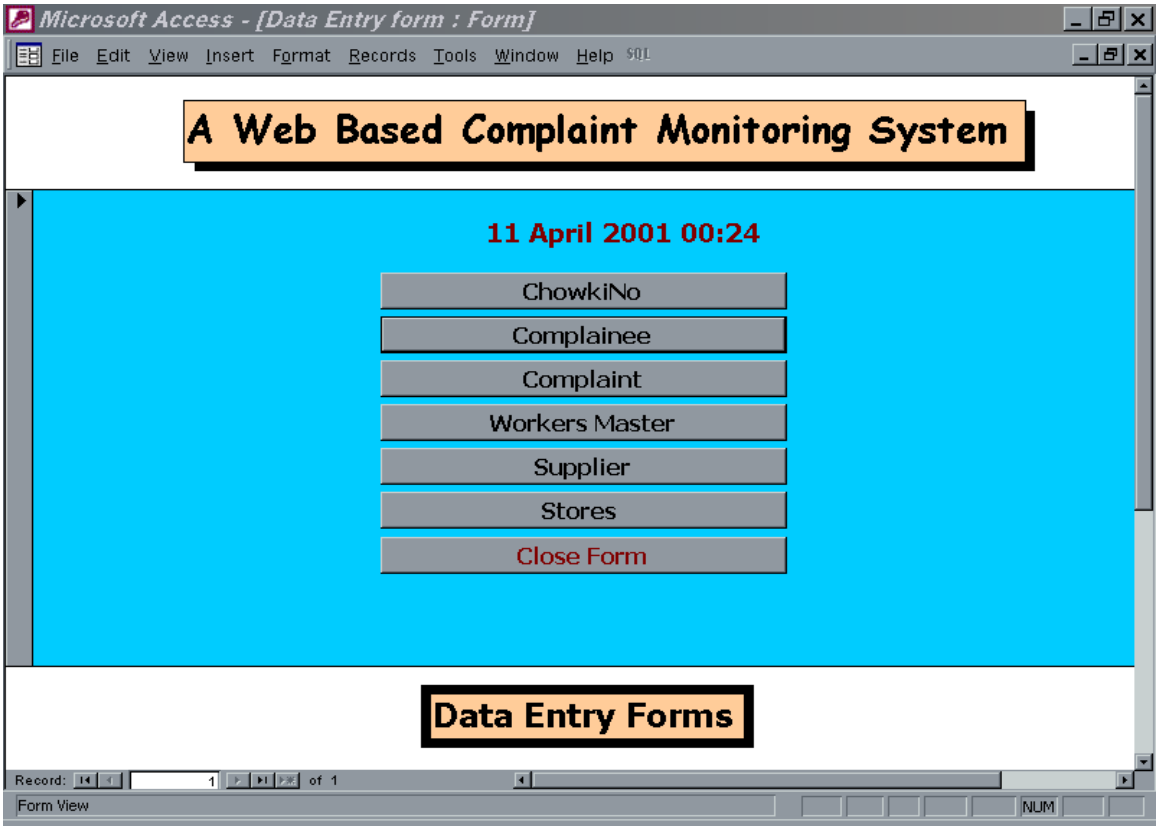
4.6.2 Data Node Implementation

Data node as already explained is a node that represents the Chowki in MES organization. At this node user registers their complaints and appropriate action is taken on each complaint by detailing the workers and issuing the stores. Data node has been developed in Microsoft Access. Data Node uses the partial replica of MIS node. Data entry forms has been designed for this node and once data entry is made it uses synchronization tool of Microsoft Access for updating the database at MIS node. The forms designed are shown in following sections.

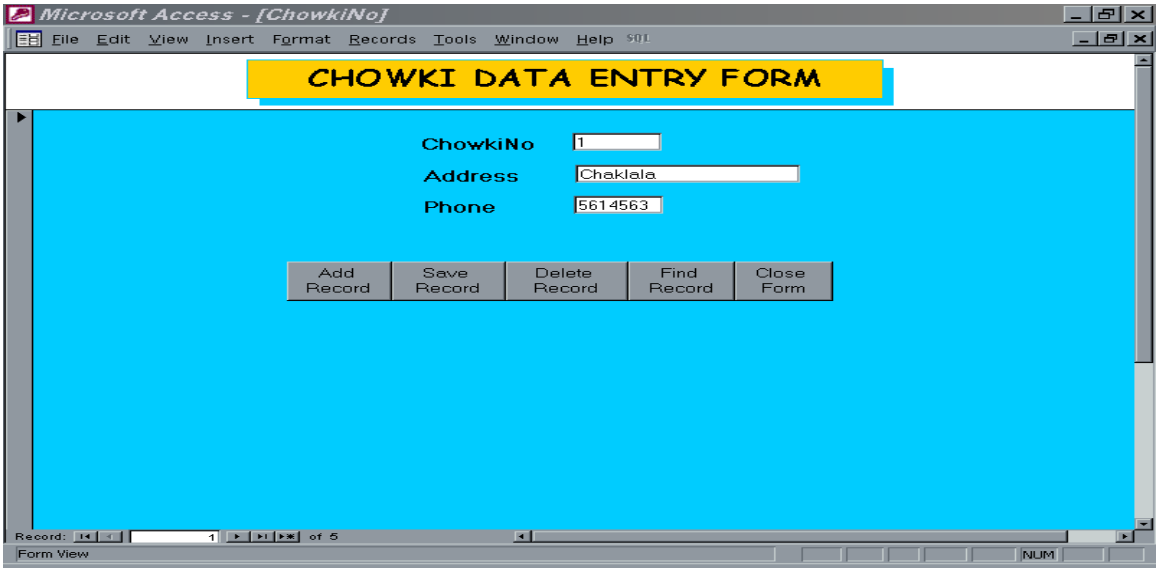
4.6.2.1 Main Form



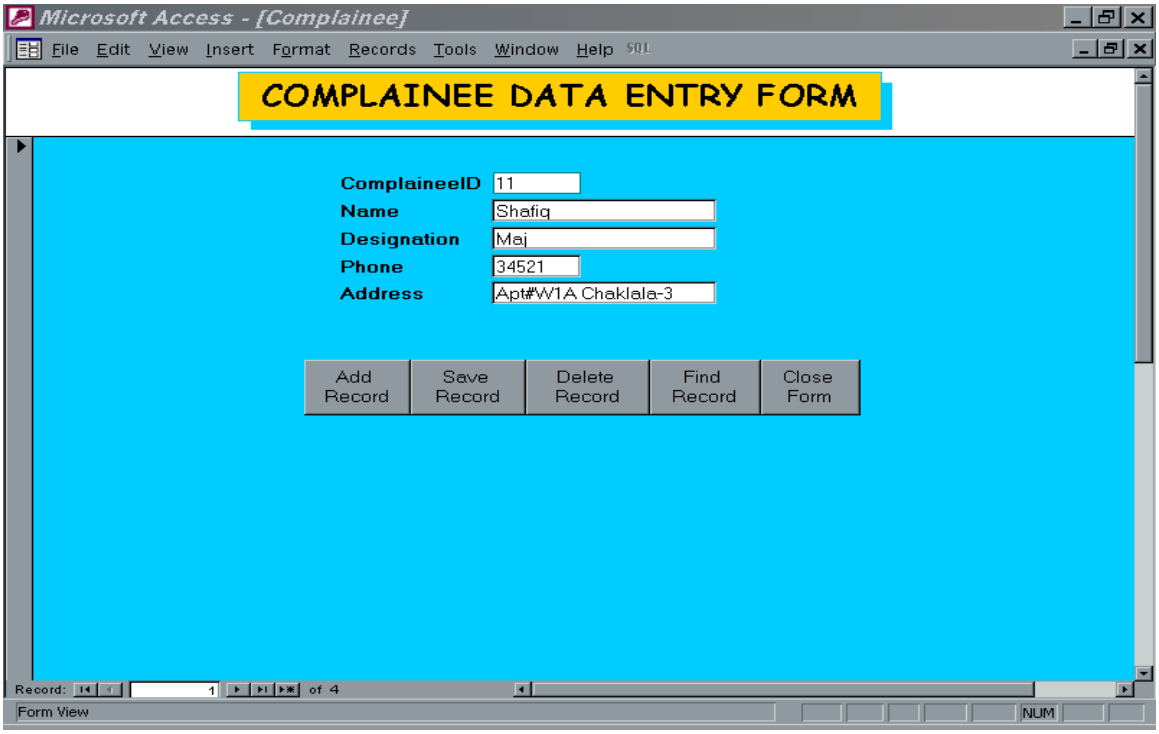
4.6.2.2 Data Entry Form



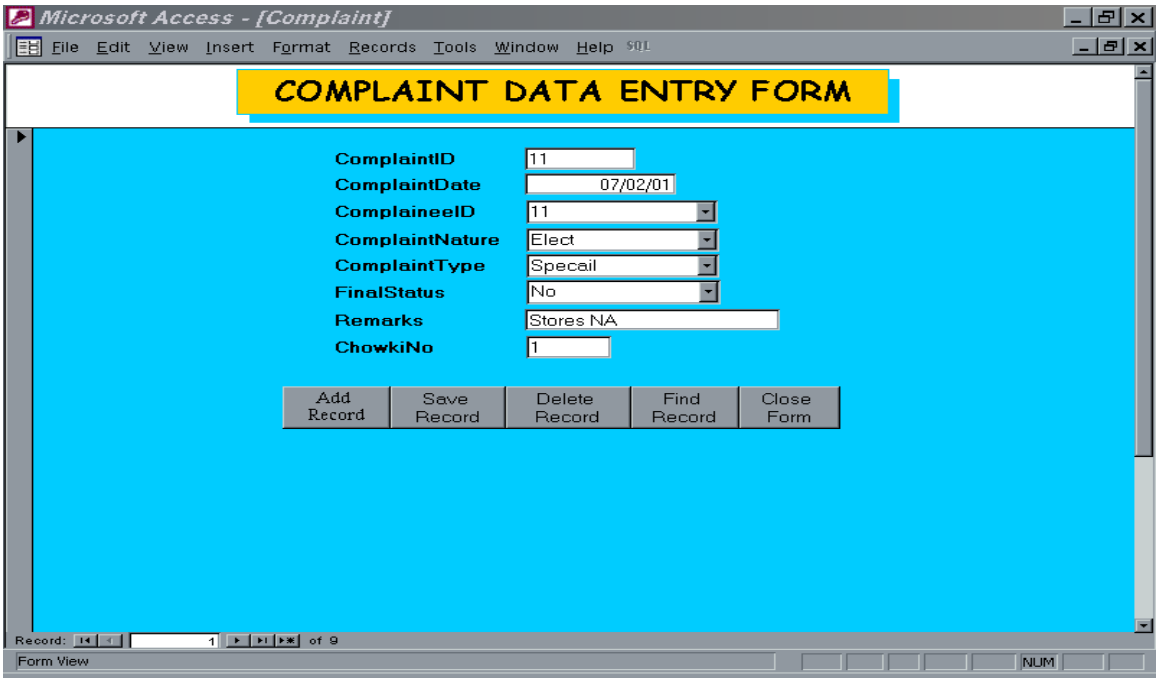
4.6.2.2.1 Data Entry Form : ChowkiNo



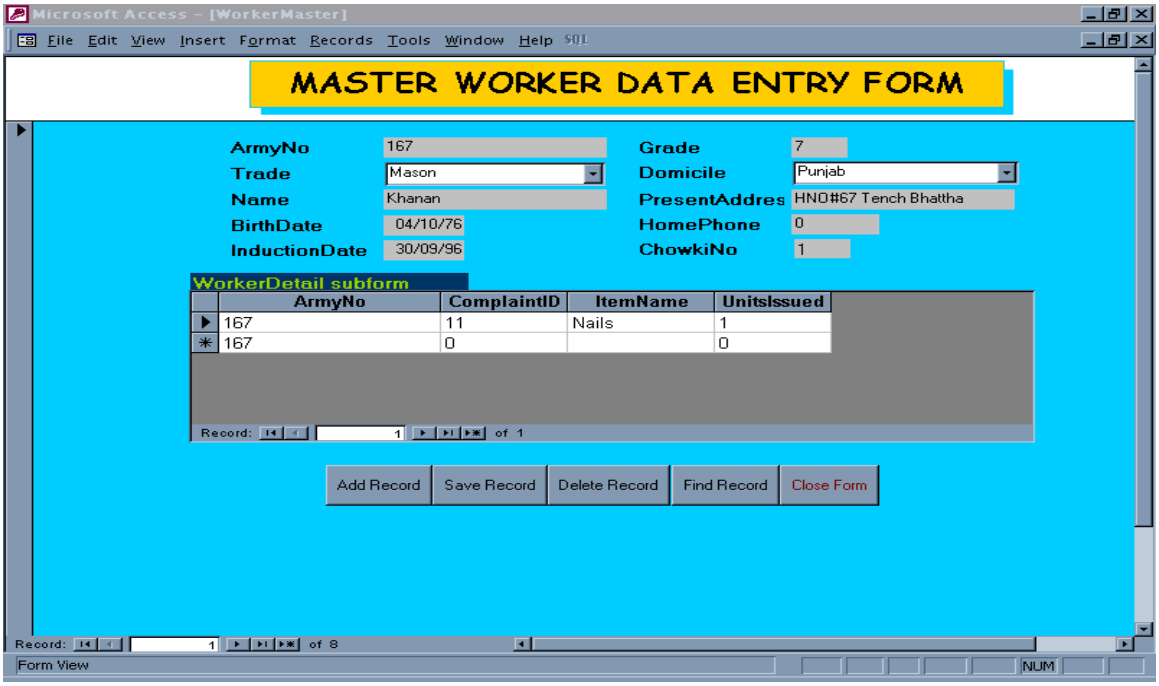
4.6.2.2.2 Data Entry Form :Complainee



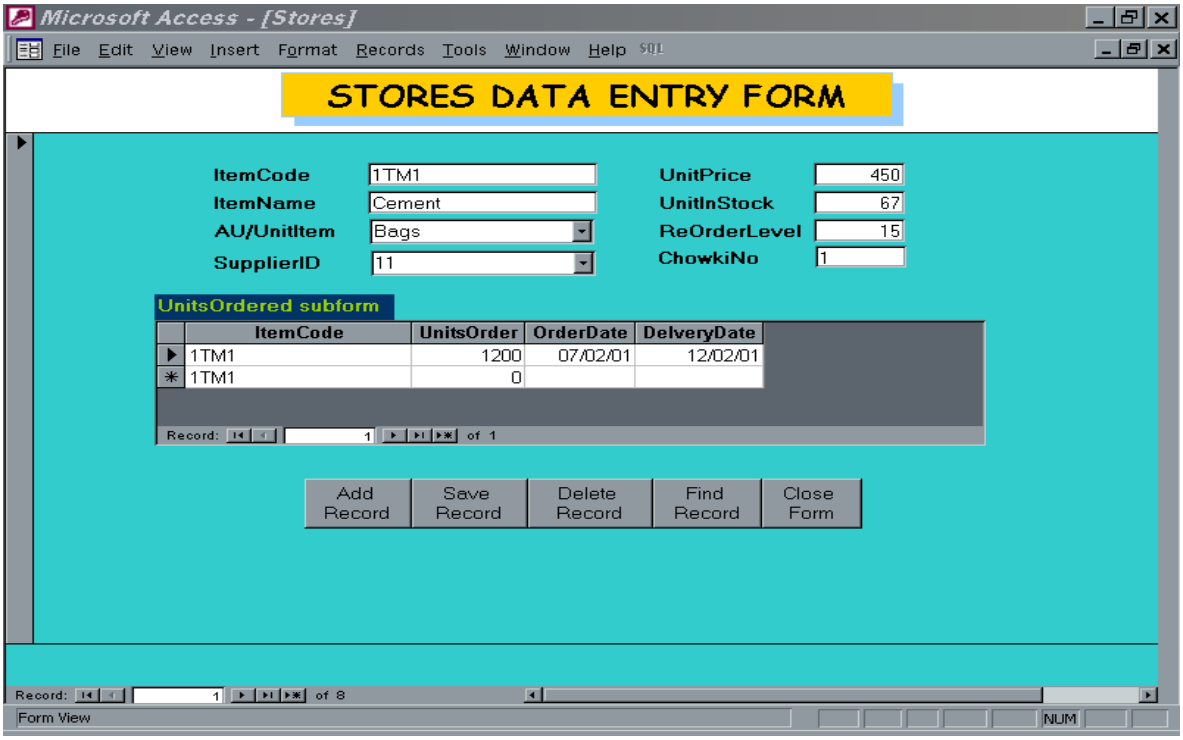
4.6.2.2.3 Data Entry Form: Complaint



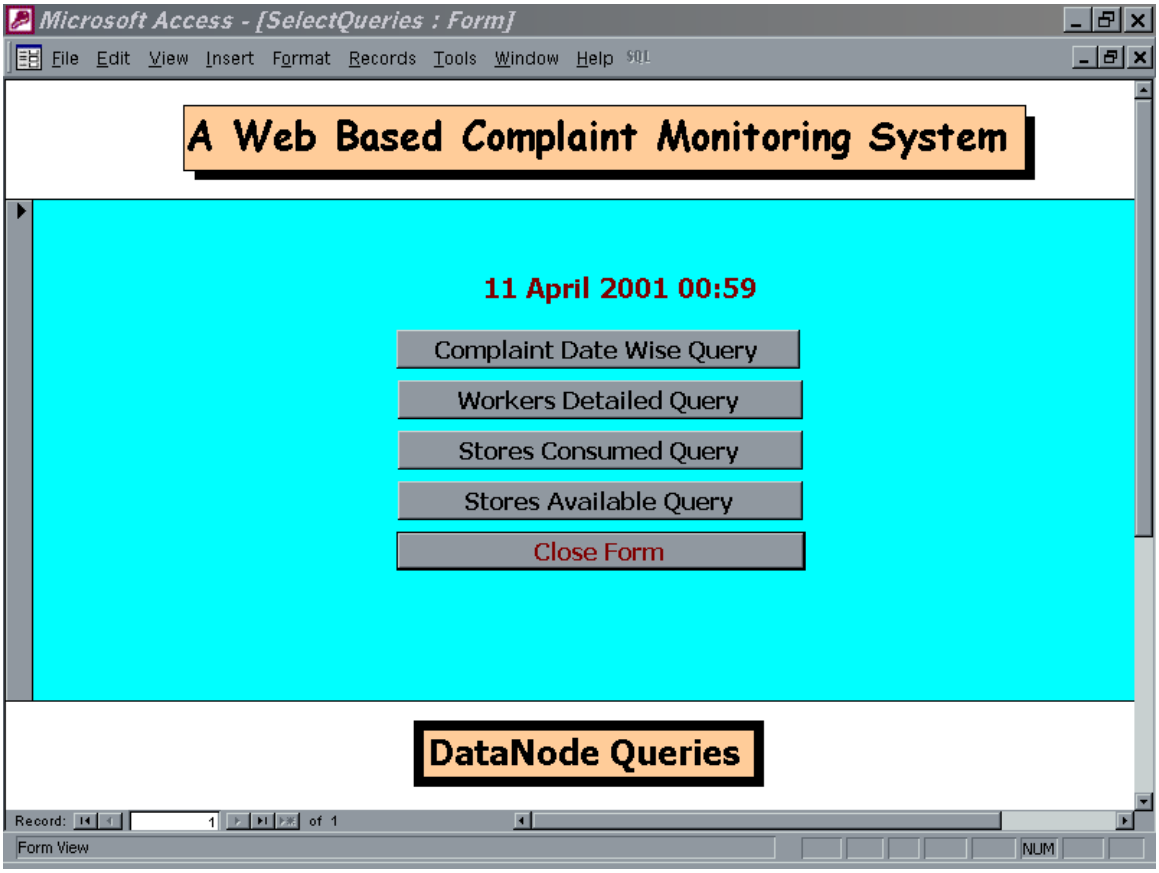
4.6.2.2.4 Data Entry Form: Master Workers



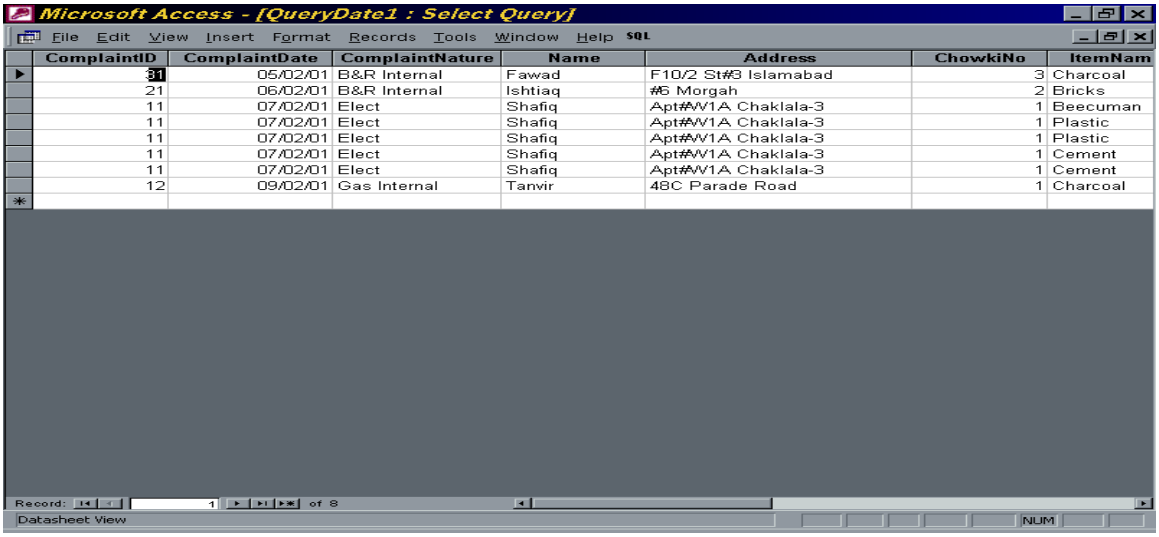
4.6.2.2.5 Data Entry Form: Stores



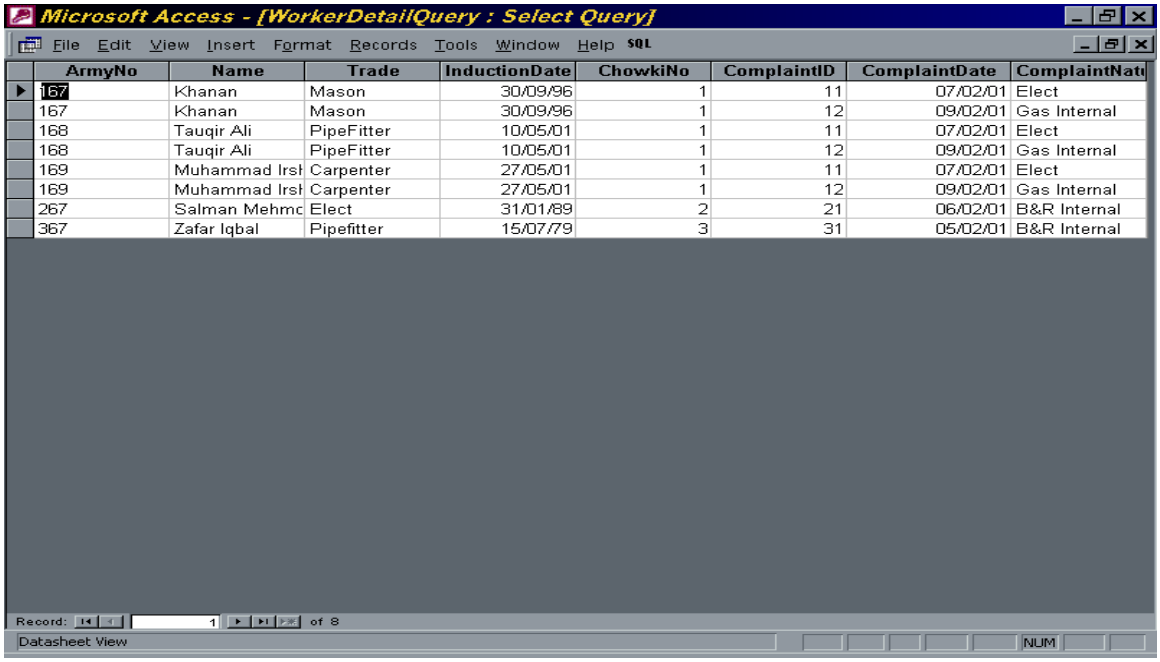
4.6.2.3 Queries Main Form



4.6.2.3.1 Complaint: Query

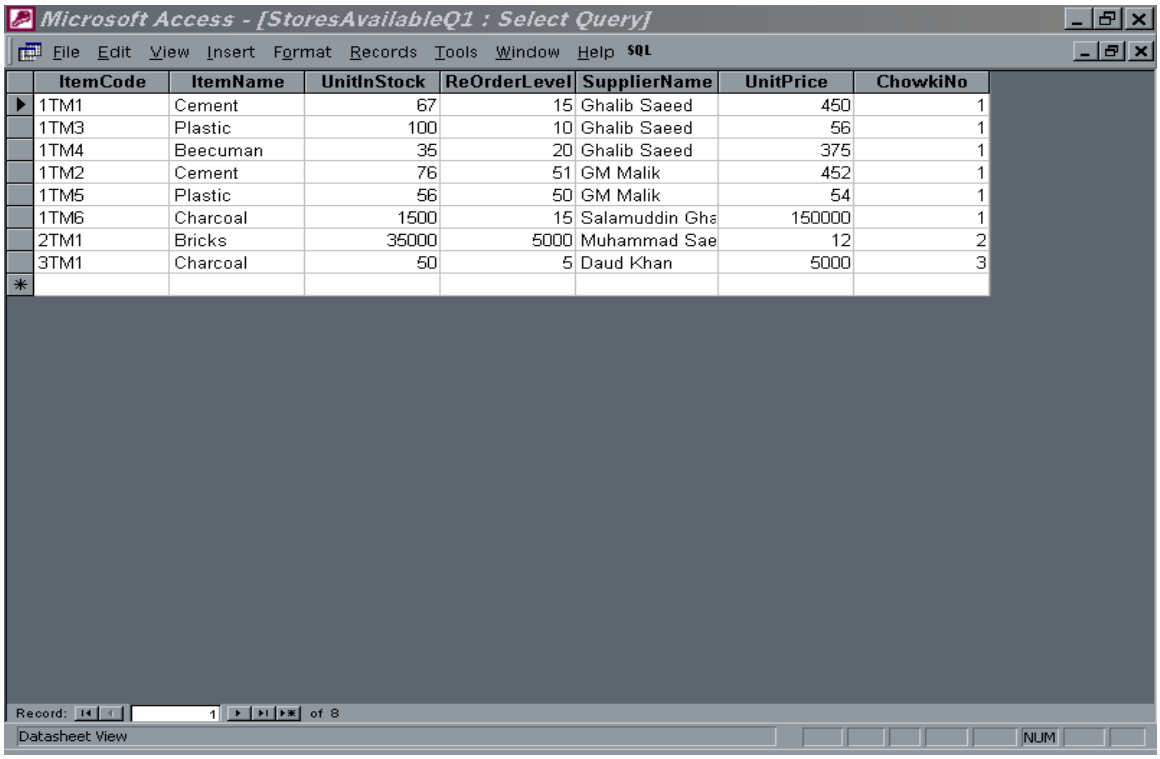


4.6.2.3.2 Complaint: Worker Detail



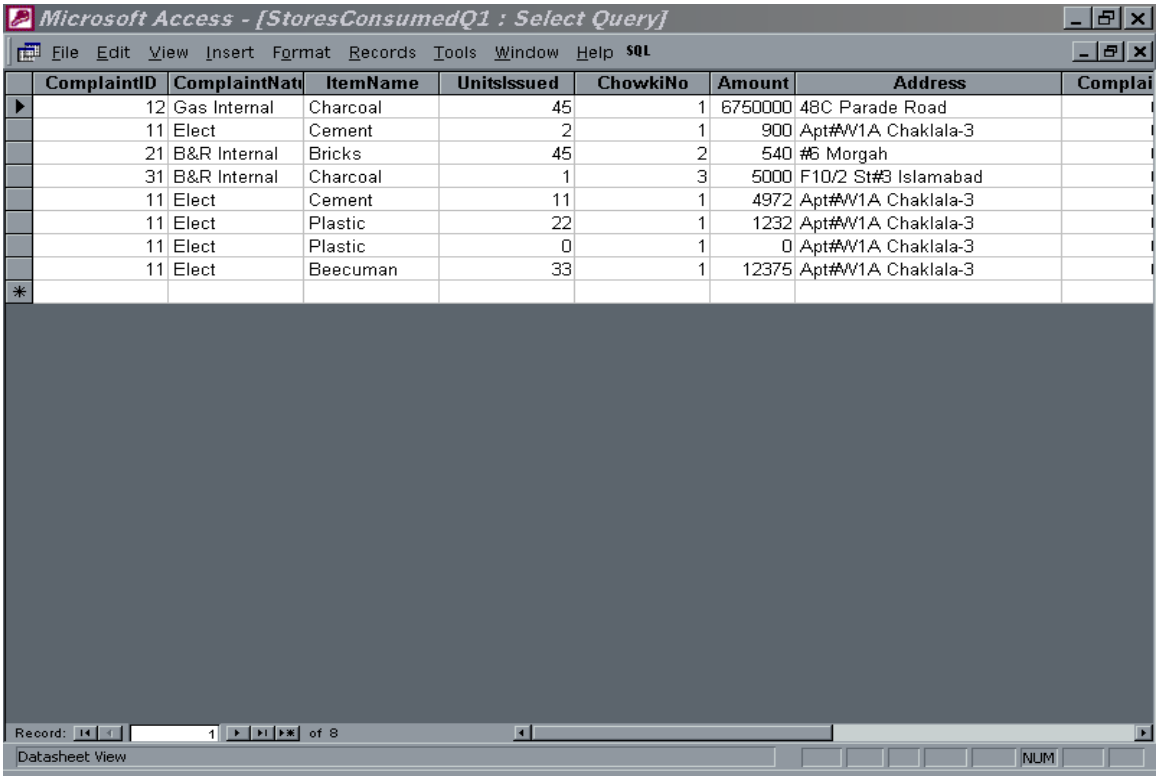
ArmyNo	Name	Trade	InductionDate	ChowkiNo	ComplaintID	ComplaintDate	ComplaintNatu
167	Khanan	Mason	30/09/96	1	11	07/02/01	Elect
167	Khanan	Mason	30/09/96	1	12	09/02/01	Gas Internal
168	Tauqir Ali	PipeFitter	10/05/01	1	11	07/02/01	Elect
168	Tauqir Ali	PipeFitter	10/05/01	1	12	09/02/01	Gas Internal
169	Muhammad Irsh	Carpenter	27/05/01	1	11	07/02/01	Elect
169	Muhammad Irsh	Carpenter	27/05/01	1	12	09/02/01	Gas Internal
267	Salman Mehmc	Elect	31/01/89	2	21	06/02/01	B&R Internal
367	Zafar Iqbal	Pipefitter	15/07/79	3	31	05/02/01	B&R Internal

4.6.2.3.3 Complaint: Stores available



ItemCode	ItemName	UnitInStock	ReOrderLevel	SupplierName	UnitPrice	ChowkiNo
1TM1	Cement	67	15	Ghalib Saeed	450	1
1TM3	Plastic	100	10	Ghalib Saeed	56	1
1TM4	Beecuman	35	20	Ghalib Saeed	375	1
1TM2	Cement	76	51	GM Malik	452	1
1TM5	Plastic	56	50	GM Malik	54	1
1TM6	Charcoal	1500	15	Salamuddin Gha	150000	1
2TM1	Bricks	35000	5000	Muhammad Sae	12	2
3TM1	Charcoal	50	5	Daud Khan	5000	3

4.6.2.3.4 Complaint: Stores Consumed



4.6.3 DSS Node Implementation

Commander MES is the head of MES department at any cantonment. CMES commands over several GE's. All policies regarding the organization and decision-making are done at CMES level. In regard to this important portfolio summaries of Complaints, Workers and Stores were designed and coded for this node, which are explained later in this section.

4.6.3.1 Proposed System

In the proposed system, a database has been designed in Microsoft Access 2000 and summaries have been created by using ASP, VB scripting and ADO. Also search has been provided to filter records according to user choice. The main database will be kept at DSS node whereas; its partial replica will be kept with all GE's. Data entry in the partial replicas will be done at MIS Node. MIS node will update the database of DSS node by synchronizing its data with DSS node.

4.6.3.2 Summaries at DSS Node

Three summaries have been created for DSS Node. These summaries can be accessed only after giving the correct User ID and Password in the following Screen

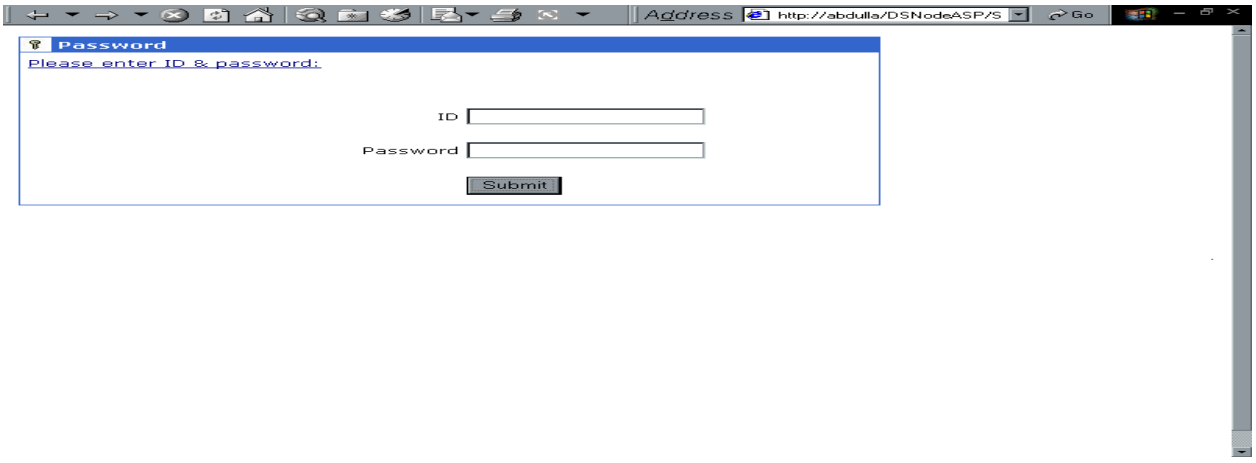


Fig 4.26 User Authentication Screen DSS Node

4.6.3.2.1 Option Screen

Fig 4.27 Option Screen DSS Node

4.6.3.2.2 Complaint Summary

Complaint summary displays: complaint nature, total complaints registered with each GE, total number of complaints completed, number of complaints left uncompleted, and GE army ID. It has the interface as under.

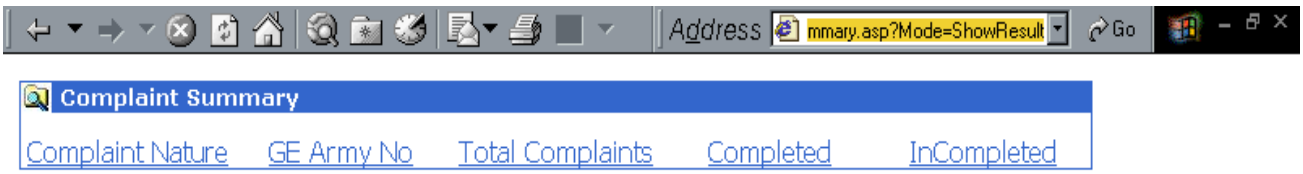


Fig 4.28 Complaint Summary DSS Node

Search has been provided on following data items:

- GEArmyID
- Complaint Nature

4.6.3.2.3 Workers Summary

Worker summary displays: GEArmyID, Complaint Nature, Trade, Total number of personals of that particular trade, and number of times personals of each trade are detailed. It has the interface as under:

Fig 4.29 Worker Summary DSS Node

Search has been provided on following data items:

- GEArmyID
- Trade

4.6.3.2.4 Stores Consumed Summary

Stores Consumed summary displays: GEArmyID, Item Name, Quantity Issued, and Accounting Units used for the item. It has the interface as under.

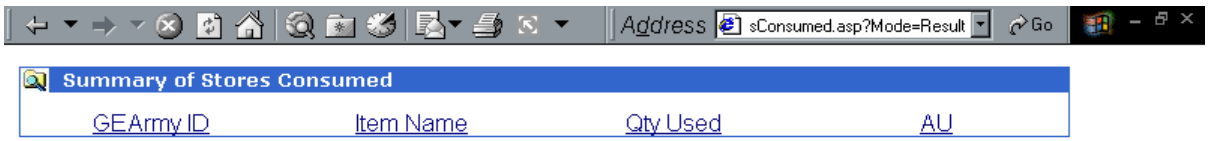


Fig 4.30 Stores Consumed Summary DSS Node

Search has been provided on following data items:

- GEArmyID
- Item Name

Chapter 5

System Implementation

5.1 Coding Details

This section describes various commands that are commonly used in the SQL, ASP and VB Script, ADO, HTML, and DHTML as under:

5.1.1 SQL Commands

a. **Select**

This statement is used to retrieve data from the database

Syntax: SELECT [DISTINCT] column-name [,column-name]… From table-name, table-name] WHERE predicate] Group By Column name [, Column-name]…[Having predicate]] ORDER By Column-name [, Column-name [, Column-name]…];

Select command has been used in all the queries.

b. **Update**

This statement is used to change the values in records already stored in a table.

Syntax: UPDATE table-name SET column-name = expression [column-name=expression]…. [WHERE Predicate];

c. **Insert**

This statement is used to put a new record into a table3

Syntax: INSERT table. Name [9Column-name[, column-name]…]] Values (constant [, constant[…];

d. **Delete**

This statement is used to erase stored records from a table.

Syntax: DELETE from table-name WHERE predicate;

e. **Create Table**

This command is used to create tables.

Syntax Create Table table-name (Column-name data type]…., [Primary Key] column-name [FOREIGN Key] [column-name [,Column-name] ….)

Delete Command has been used to remove data from temporary tables created for the Complaint Summary as shown in coding given at Appendix A.

f. **Alter Table**

This command allows modifying the existing table by adding a new column on the right side

syntax: ALTER TABLE table-name

ADD Column-name data type;

g. **Drop Table**

This command is used to drop (delete) on an existing table from the database

Syntax. DROP TABLE table-name;

5.1.2 HTML Tags

HTML Tags are used to create a basic HTML page. These are as under:

a. Structure Tags

TAG	ATRRIBUTE	FUNCTION
<HTML…</HTML>		Encloses the entire HTML document
<HEAD>…</HEAD>		Encloses the head of the HTML document
<BODY>…</BODY>		Encloses the body (text and tags) of the HTML document
	BACAKGROUND= …"	The name of URL of the image to tile on the page background
	BGCOLOR="…"	The color of the page background
	TEXT "…"	The color of the page's text
	HREF="…"	The full URL of this document
	TITLE="…"	The title of the linked-to do document

b. Heading and Title Tags

TAG	ATTRIBUTE	FUNCTION
<H1>…</H1>		A first level team
<TITLE>…</TITLE>		Indicates the title of the document used

		with in <HEAD>
<A>…</A>		With the HREP attribute creates a link to another document or another with the NAME attribute, creates an another that can be linked to
	HREF	For Using Hyper Reference
<B>…</B>		Boldface text
<I>…</I>		Italic text
<IMG>		Inserts an inline image into the document
	SRC =”…”	The URL of the image
	ALT=”…”	A text string that will be displayed in browsers that cannot support images
	ALIGN=”…”	Determines the alignment of the given image
<SCRIPT>		An interpreted script program
	LANGUAGE=”…”	We can specify VB Script or another languages like Java etc.
<FORM>…</FORM>		Indicates an input form

	ACTION="..."	The URL of the script to produces this form input
	METHOD="..."	How the form input will be sent to the gateway on the server side. Possible values are GET and POST
<TABLE>...</TABLE>		Creates a table that can contain a caption (<CAPTION> and any number of rows (<TR>).
	BORDER="..."	Indicates whether the table should be draws with or without a border. In Netscape, BORDER can also have a value indicating the width of the border.
	CELLSPACING="..."	The amount of space between the cells in the table
	CELLPADDING="..."	The amount of space between the edges of the cell and its contents
	WIDTH="..."	The width of the table on the page, in either

		exact pixel values or as a percentage of page width
	ALIGN="..."	Alignment of (works like IMG ALIGN). Values are LEFT or RIGHT
	BACKGROUND="..."	Background image to tile within all cells in the table
	BORDERCOLOR="..."	Border color (used with BORDER="...")
	Attribute	Function
<TR>...</TR>		Defines a table row
<TD>...</TD>		Define a table data cell

5.1.3 DHTML Tags

In order to create special effects and animations DHTML Tags are used to create the page. Some of the tags are as under:

EVENT	EFFECT	SETTINGS	FUNCTION
Mouse over	Formatting	Font	To start
Mouse out	Fly out	Border	The animation when a site
Click	Drop in	Form top	Site
Double Click	Spiral	From Left	Visitor's
Page Load	Elastic	From Right	Points to an element on a page

			or loads a page

For using DHTML Java script functions are defined as under

<Script Language= “Java Script” fptype = “dynamicanimation”

<!--

Function type dynamicanimation ( )

Function type click swap Img ( )

//…>

In a Paragraph Tag <P> animation is created as

<P align =”Center” dynamic animation = “fpAniformatRolloverFPI”

Fproll over style = “border-style: ridge;

Border-color: # FFOOFF;

Padding-top: O” Onmouse over = rollin(this)”

On mouse out = “rollout(this) language = Java script 1.2”>

The above script is to create a ridge type border once a site browser points a mouse to an element. DHTML tags are used in The development of home page to create animation.

5.1.4 ASP

ASP statements contain the structures of more ‘traditional’ programming languages, such as Visual Basic and Java , as they have features such as variables, decision trees, cyclic repetitions. Any thing that is contained between <%” and %>” marker is ASP script, and will be processed on the web server by the ASP script engine. In an editor ASP code is shown by red color font whereas HTML & HTM Tags are shown in blue and black fonts. Microsoft InterDev is an editor that use yellow color for the ASP markers ”<%….%> ”. In this project VB Scripting language has been used with the ASP because it is the

default language for server-side scripting with ASP. ASP uses VB scripting to create variables, to assign values to them, to perform arithmetic calculations and operations, logical ops, VB Script Constants, control structures, looping controls and functions etc.

Following is an example of ASP Script

```
<HTML>
<Head>
<Title> Example ASP <Title>
<Body>
<H1> Complaints for this month </H1> <BR>
<%
        Dim VarRowCount, VarTodayDate
        VarRowCount=1
        VarTodayDate= day (now ())
        Do while VarRowCount <= VarTodayDate
        Response.write “for ___”
        Response.write “number of complaints registered was:___ BR>”
        VarRowCount= VarRowCount+1
%>
</Body>
</HTML>
```

In this project all the summaries have been created using ASP.

In the ASP programming the functionality that is accessible to the programmer is grouped into a set of objects, which is known as an object Model. These objects make the core of ASP. These are also called built in objects. Following are the types of objects:

a. Server Object
b. Application object
c. Session object

d. Request object

e. Response object

f. ASP error object

5.1.4.1 Server Object

The server objects convert a virtual path to a physical on a server and take a user supplied string and encode it into proper format for a URL string. It provides a series of methods and properties that are useful in scripting with Asp. The most obvious is the Server. Create Object method, which properly instantiates other COM objects within the context of the current page or session. There are also methods to translate strings into the correct format for use in URLs and in HTML, by converting non-legal characters to the correct legal equivalent.

In this project Server.CreateObject has been used for creating ADO connection and Record objects as given in the coding.

5.1.4.2 Application Object

The Application object is created when the ASP DLL is loaded in response to the first request for an ASP page. It provides a repository for storing variables and object references that are available to all the pages that all visitors open it. Application object allows us to tie together all of the pages into a single web site of a consistent web application. Following are few Application objects:

a. OnStart event: Occurs with the first instance of a user requesting one of the web pages in the application, before the page that the user request is executed.

b. OnEnd event: Occurs when the ASP application ends.

5.1.4.3 Session Object

The Session object is created for each visitor when they request an ASP page from the site, and remains available until the default time period (or the timeout period determined by the script) expires. It provides a repository for storing variables and object references that are available just to the pages that is visitor opens during the lifetime of this session. Session object allows us to treat user's interaction with the web site within specified period of time, as a set of saved variables, rather than just a disconnected series of page requests.

e.g.

a. StaticObject: A collection of all the variables and their values that are stored in a particular session object by using an <OBJECT> element.
b. Timeout (property): Defines the timeout period in minutes for this session object.

5.1.4.4 Request and Response Object

These two objects handle communications between the browser and the web server. The request object makes available to the script all the information that the client provides when requesting a page or submitting a form. It allows ASP to deal with information that is sent to it from the client. Response object is a way to send the information about the contents of the page back to the User's browser.

e.g.

a. Request.Form: It is used to get a variable value from a form, where the value of the METHOD attributes is POST.
b. Request.QueryString: A collection of all the name/values pairs appended to the URL in the user's request, where the value of the METHOD attribute is GET or POST.
c. Response.Write: Write the specified string to the current HTTP response stream and IIS or PWS buffer so that it becomes part of the returned page.

In this project Request.Form and Reqest.QueryString has been used for getting values from the forms interfacing with the users.

5.1.4.5 ASPErrorObject

The ASPError Object contains details of any errors generated by an ASP script or by the asp.dll it self. ASPErrorobject uses Server.Get LastError method for handling of error messages.

5.2 ADO Object Model

Following are the objects that are used in the project:

a. ADODB.Connection: The connection object represents an open connection to a data store. Basically it is the object that enables us in creating the connection with database by using it with “Server.CreateObject” of ASP. Once connection is established using “Connection.Open” method opens it. ODBC connection path name is also given with “Open” method. Example is given as under:

   Set Connection = Server.CreateObject (“ADODB.Connection”)

   Con.Open “GEArmyData” : Here GEArmyData is System DSN.

b. ADODB.RecordSet: The RecordSet object represents the entire set of records from a base table, or the results of an executed command. At any time, the RecordSet object only refers to a single record within the set as the current record. Once connection is created than data can be accessed by using RecordSet object. Following shows the example of creating RecordSet object.

   Set RecordSet = Server.CreateObject(“ADODB.RecordSet”)

   RecordSet.Open “Complaint”, Connection

d. MoveNext: It is RecordSet property to move the position of the cursor from current record to the next record in the RecordSet. It is used for cursor control in the RecordSet.

e. Fields: It returns the fields in a RecordSet. It is also a RecordSet property that contains all of the field objects for the current RecordSet object. It displays read-only data of a field.

f. End-Of-File (EOF): It returns Boolean value. It indicates whether the current record is after the last record in a RecordSet object. It is a read only property of the RecordSet.

Following is the example for above three properties of the RecordSet:

```
<% Do While Not RS.EOF
IntCompID = RS.Fields (“ComplaintID”)
strCompNature = RS.Fields (“ComplaintNature”)
strItemName = RS.Fields (“Itemname”)
intChowkiNo = RS.Fields (“ChowkiNo”)
RS.MoveNext
Loop
RS.Close
Con.close
Set RS = Nothing
Set Con = Nothing      %>
```

g. RecordSet and Connection uses “Close” property. It closes the RecordSet object and Connection object from an existing RecordSet and Connection.

h. “Nothing” is another property used with connection and RecordSet in ASP coding to clean up after closing the RecordSet and Connection.

ASP object model and ADO object model are collection of variety of properties that can be used for different purposes according to the need of the system. In this project all the ADO objects and properties explained in this section have been repeatedly used in creating the summaries.

5.3 VB Scripting

VB script is default language used by ASP. ASP coding done in this project use different VBScript controls and functions. It can be seen from coding given with this dessertation. Some of the VBScript controls and functions used are as under:

IF-ELSE-ENDIF
DO WHILE NOT-LOOP
ISDATE()
ISNUMERIC()
LEN()
INCLUDE FILE
LIKE
Logical Operators such as “ <” and “>” and append sign like “&”.

5.4 Demo Results

Following are the different outputs for the MIS Node and DSS Node that are achieved after entering the sample data.

5.4.1 Complaint Summary (MIS Node)

Complaint Summary

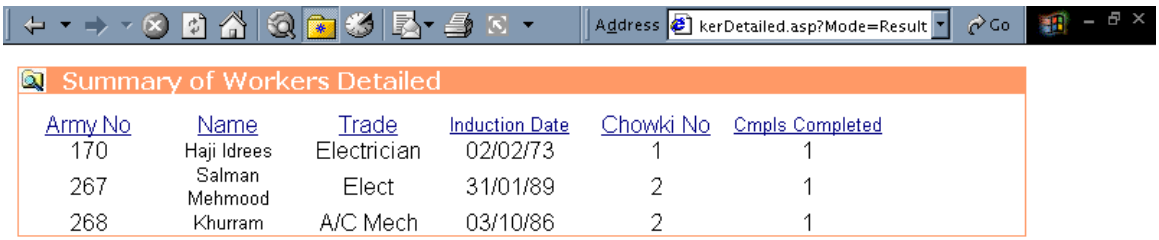
Complaint Nature	Chowki No	Total Complaints	Completed	InCompleted
A/C Refrigeration	1	1	0	1
A/C Refrigeration	2	1	1	0
B&R External	2	1	1	0
B&R Internal	2	2	2	0
B&R Internal	3	1	0	1
Elect	1	3	1	2
Elect	3	1	1	0
Elect Internal	1	1	1	0
Elect Internal	2	1	1	0
Elect Internal	3	1	1	0
Gas Internal	1	1	0	1
Gas Internal	3	2	2	0

5.4.2 Summary of Uncompleted Complaints with Reasons (MIS Node)

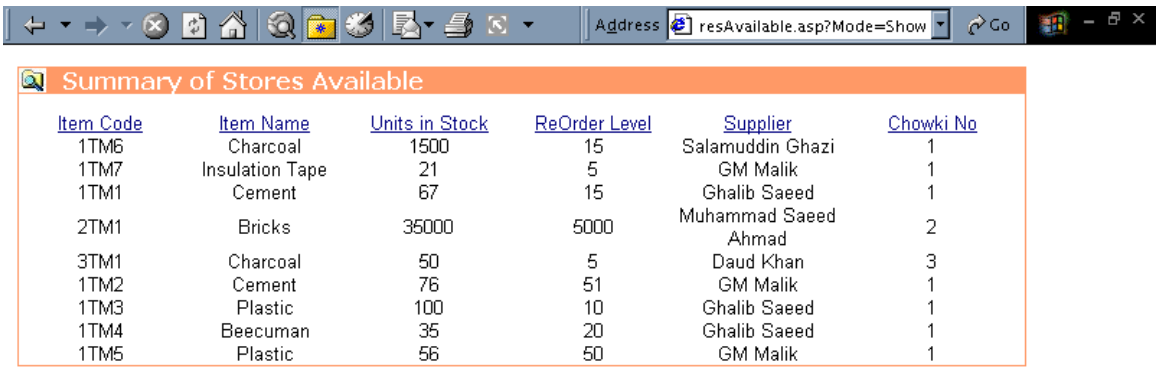
Summary of UnCompleted Complaints with Reasons

Complaint ID	Complaint Nature	Chowki No	Reasons
11	Elect	1	Stores NA
12	Gas Internal	1	Stores LP in Progress
13	Elect	1	Stores Issued
15	A/C Refrigeration	1	Stores NA
31	B&R Internal	3	Labour Detailed

5.4.3 Summary of Workers Detailed (MIS Node)

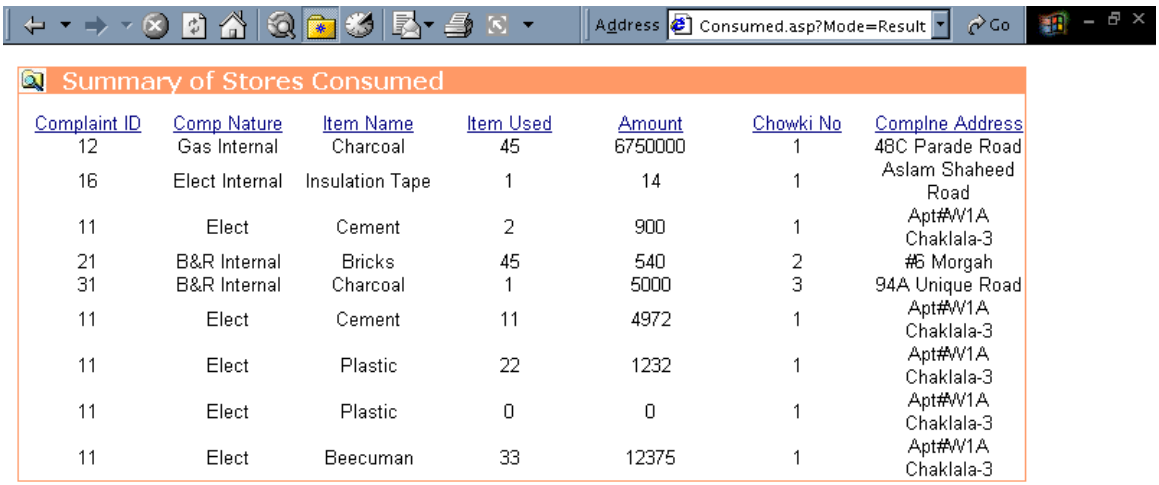


5.4.4 Summary of Stores Available (MIS Node)



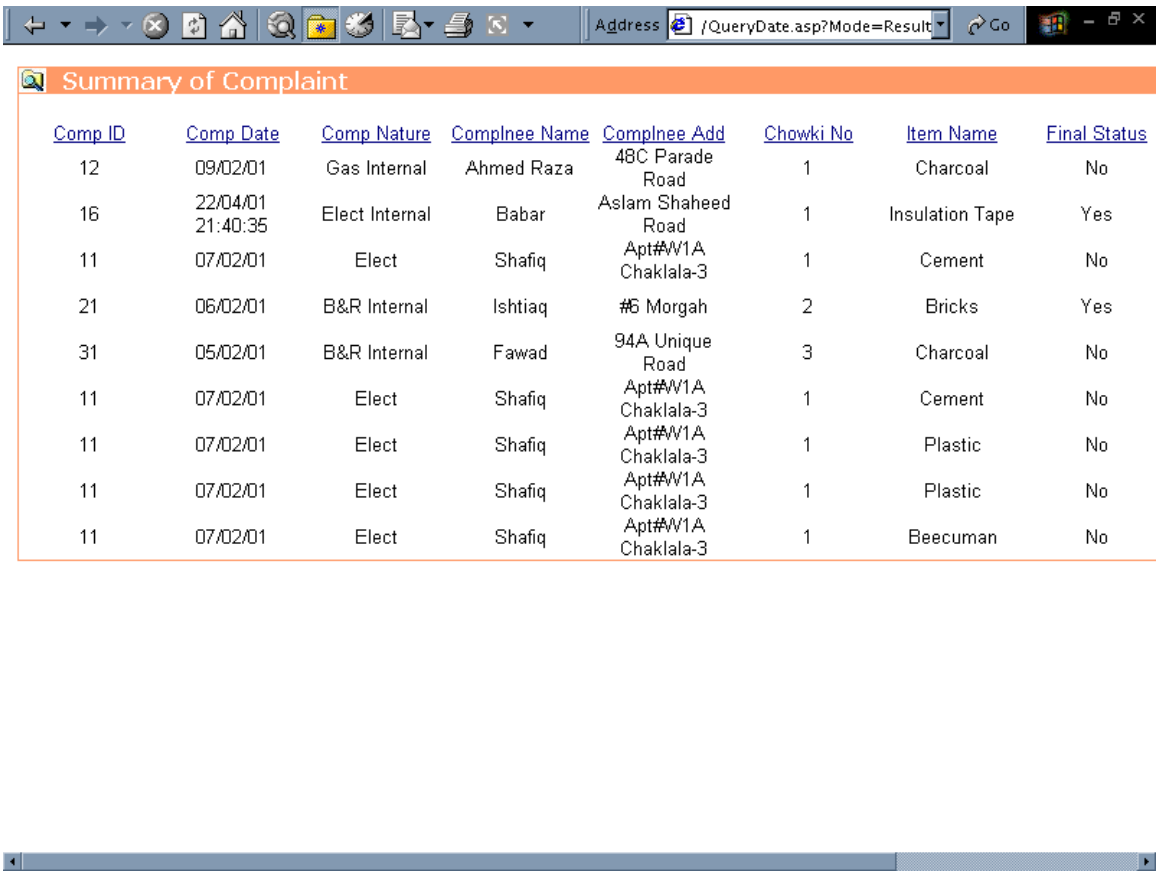
Item Code	Item Name	Units in Stock	ReOrder Level	Supplier	Chowki No
1TM6	Charcoal	1500	15	Salamuddin Ghazi	1
1TM7	Insulation Tape	21	5	GM Malik	1
1TM1	Cement	67	15	Ghalib Saeed	1
2TM1	Bricks	35000	5000	Muhammad Saeed Ahmad	2
3TM1	Charcoal	50	5	Daud Khan	3
1TM2	Cement	76	51	GM Malik	1
1TM3	Plastic	100	10	Ghalib Saeed	1
1TM4	Beecuman	35	20	Ghalib Saeed	1
1TM5	Plastic	56	50	GM Malik	1

5.4.5 Summary of Stores Consumed (MIS Node)



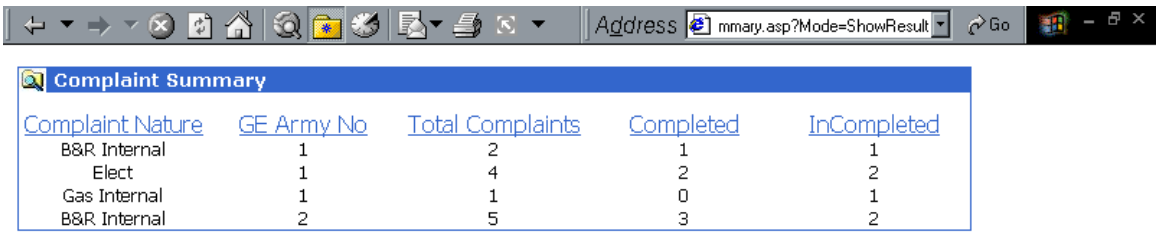
Complaint ID	Comp Nature	Item Name	Item Used	Amount	Chowki No	Complne Address
12	Gas Internal	Charcoal	45	6750000	1	48C Parade Road
16	Elect Internal	Insulation Tape	1	14	1	Aslam Shaheed Road
11	Elect	Cement	2	900	1	Apt#W1A Chaklala-3
21	B&R Internal	Bricks	45	540	2	#6 Morgah
31	B&R Internal	Charcoal	1	5000	3	94A Unique Road
11	Elect	Cement	11	4972	1	Apt#W1A Chaklala-3
11	Elect	Plastic	22	1232	1	Apt#W1A Chaklala-3
11	Elect	Plastic	0	0	1	Apt#W1A Chaklala-3
11	Elect	Beecuman	33	12375	1	Apt#W1A Chaklala-3

5.4.6 Complaints Detailed Query on Date (MIS Node)

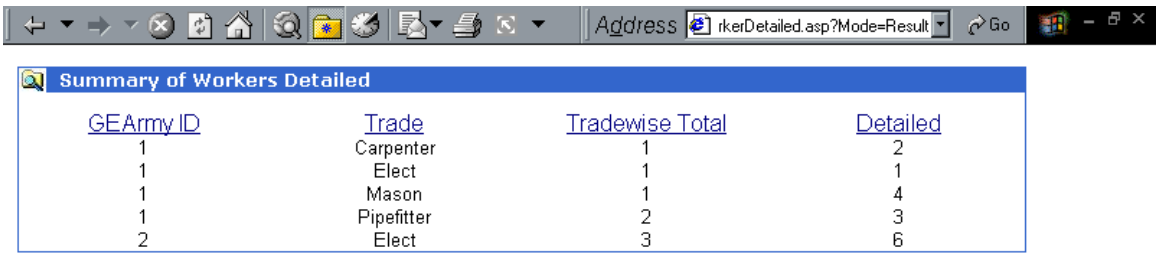


Comp ID	Comp Date	Comp Nature	Complnee Name	Complnee Add	Chowki No	Item Name	Final Status
12	09/02/01	Gas Internal	Ahmed Raza	48C Parade Road	1	Charcoal	No
16	22/04/01 21:40:35	Elect Internal	Babar	Aslam Shaheed Road	1	Insulation Tape	Yes
11	07/02/01	Elect	Shafiq	Apt#W1A Chaklala-3	1	Cement	No
21	06/02/01	B&R Internal	Ishtiaq	#6 Morgah	2	Bricks	Yes
31	05/02/01	B&R Internal	Fawad	94A Unique Road	3	Charcoal	No
11	07/02/01	Elect	Shafiq	Apt#W1A Chaklala-3	1	Cement	No
11	07/02/01	Elect	Shafiq	Apt#W1A Chaklala-3	1	Plastic	No
11	07/02/01	Elect	Shafiq	Apt#W1A Chaklala-3	1	Plastic	No
11	07/02/01	Elect	Shafiq	Apt#W1A Chaklala-3	1	Beecuman	No

5.4.7 Summary of Stores Consumed (DSS Node)



5.4.8 Summary of Workers Detailed (DSS Node)



5.4.9 Summary of Stores Consumed (DSS Node)

Summary of Stores Consumed

GEArmy ID	Item Name	Qty Used	AU
1	Beecuman	33	KGs
1	Bricks	45	Nos
1	Cement	13	Bags
1	Charcoal	46	KGS
1	Plastic	22	Mtr
2	Bricks	12000	Nos
3	Cement	14	Bags

Chapter 6
Conclusion And Future Work

6.1 Introduction

This chapter provides the summary of the project and assesses its accomplishments. Later the achievements are discussed alongwith the problems faced during this project. Finally recommendations are made that must be in corporated in order to make this project more beneficial for the MES

6.2 Project Summary

This is an era of modern computing. Internet and Intranet has made the world a global village. All the public service organizations like Banks, Universities, and Libraries etc are providing Internet based solutions to their users. Now-a-days E-Commerce is a hot topic. Sales and purchases are done globally round the clock on Internet. Internet technology is the futures technology. A variety of application softwares and tools are available in the market to execute any system on Internet.

With Internet working, distributed processing is another important aspect that is gaining momentum. By using distributed systems optimum efficiency can be achieved for any system.

A web based compliant monitoring and management information system has been developed using Internet and distributed database systems tools. The main objective of this system is to reduce the organizational slack. Organizational slack usually results in excess time consumption and delays, excess labour costs, leakages of material and a lack of responsiveness. The main advantage of this project is to identify and minimize the organizational slack, and to achieve a good

degree of coherence between different works area (chowkis). It can be measured in terms of improved output per man-hour, improved inventory control and better response to the Users. It will assist the top management of the organization in optimizing and using the available resources to meet the requirements projected by complaint monitoring system.

A web based complaint monitoring system has been built using three different areas of the present day technology these are:-

- Database
- Distributed systems
- Web techniques

Users of the system have also been categorized into three kinds. They are:

- Data Node
- MIS Node
- DSS Node

Data Nodes are 5 to 15 Chowkis. These are the nodes at which the consumers register complaints. Workers are detailed and stores requirements are fulfilled. This is the node at which main data entry is made. Therefore the data entry forms have been made available at this node. On the other end, MIS Node is the manager's node. ASP, VB Script, HTML and ADO has been used to develop summaries that display different calculated fields. OBDC has been used for establishing database connectivity. Similarly DSS Node, which is used by CMES, has been created with above said web techniques. The modules that have been computerize for complaint monitoring are:

- Complaints
- Workers

- Stores

The complaint module serves information about the total number of complaints registered, number of complaints completed and uncompleted complaint with reasons for complaints left uncompleted. It also provides detailed information about each complaint. Search has been programmed to further strengthen the data manipulation by the user. The user at MIS Node can select any record of information according to his choice. By giving “Start Date” and “End Date” the user can generate weekly, monthly quarterly or yearly reports according to his need.

By computerizing the worker data, management can efficiently plan uniform and balanced distribution of the workers between different Chowkis. With this system, management can keep an eye on the performance of each worker. It can measure the workload on each trade.

Store module has been developed with an objective to assist top management to monitor the stores held with all the under command chowkis. It helps the management in timely replenishment of stores by periodically checking the “Reorder level” of each item at each chowki. Timely availability of stores will ensure timely execution of the complaints. Which in turn will build greater user confidence on this organization.

All the above modules have been designed by providing an efficient and user-friendly interface with the system. The interface has been designed by using HTML, DHTML and ASP software.

Finally distributed processing has been designed by using built-in Replica and Partial Replica functions of Microsoft Access. Using synchronization property provides data updates. Using Dialup Networking software for Wide Area Network does all these activities.

The system has been made capable to be managed locally at Chowkis thus reducing the communication costs.

Once this project is completed and is made operative it will have following merits:

- Users will get prompt reply for the services they have asked from chowkis in their respective areas. Operator at chowki will immediately enter the data of the users; a complaint number will be given after entering user data. In case of any delay in reply to his complaint user can get lastest progress on his complaint from garrison engineer as well as from the chowki. This system will ensure that user complaints are honored and timely action is taken upon them, by ensuing better response time MES will gain more user confidence.
- At Chowkis level, this system ensures availability of correct and updated dated of the complaints lodged, workers held and stores in stock. By having this current information available Chowki Incharge can utilize his manpower much effectively and efficiently. Detailing of tradesmen and laborers will become easy, fast and more transparent. Similarly availability of stores will ensure prompt execution of the task. This transparency of the system will help the Chowki In charge in checking the slippages of duties by the workers and leakages of stores.
- Garrison Engineer is the most committed and most important appointment in the execution of the works and policies. He is a field officer who manages activities of all the chowkis under his command. There are about 1000 to 1800 personals under his command, and there are huge amount of stores and expensive machines and materials at his disposal. Obviously he entertains a large number of users who are at his maintenance load. There is a

large bulk of staff that includes Sub Divisional Officers (SDOs), Overseers, and clerical staff etc that helps him in his planning and working. But the system analyst carried out a small survey by asking the users about their satisfaction with the MES work. Around 90 percent of the surveyed people showed their dissatisfaction with the way the MES provides services to them. Mostly the reasons were that worker did not reported the sight, or has reported to a wrong place, or wrong type of worker detailed for the work, or stores requirement were taken from the spot and non of the MES staff reported again, or non availability of stores etc. By providing this system to the GE who is the backbone of the whole department the monitoring of complaints will become extremely easy and transparent. GE has been provided with all the possible summaries, which he can use according to his requirements as extensive search has been integrated on all most all data items. GE has to just switch on his commuter, click the Internet explorer and get the latest information on even one particular complaint on any of the chowkis, or get summary of complaints by nature/chowki/date, or he can get summary of complaints that were left uncompleted with reasons, or he can monitor the stores and workers. With these capabilities inbuilt in this system GE can get actively involved in the complaint monitoring and manage his man and material to their fullest capabilities in the best interest of his users.

- Finally the Commanders Military Engineering Services is another important field officer who is commanding several GE's. It is he who has to formulate the policies for his GE's and give decisions on important services matters in a cantonment. A system that has been designed for the CMES will provide up-to-date status of complaints, stores and workers of all the GE's in the cantonment.

By monitoring these activities of the GE's he can easily pin point weaker areas and give his decisions promptly to augment that area by pushing more resources in that direction. There is a proverb that "Stitch in time saves nine", so this prompt Decision making support system will ensure overall boost in the working of the garrison's repair and maintenance works.

6.3 Achievements

The main achievement of this research is to provide a flexible system equipped with required tools to solve the day-to-day problems of the management staff. Salient achievement during the design, development and implementation are given below.

a. Determining the end user's requirements by interviewing system study, if the same is not well defined in the existing system.

b. The development of this project in Microsoft Access provided chance to evaluate the relational data base system and its implementation by using Access objects such as tables, forms, queries, macros, SQL, Replicas, Partial Replica, Filter, Synchronization etc and exploring many other aspects of windows.

c. The use of Web Technology which includes internet working tools, web server techniques and development of static pages in HTML, DHTML, Java Script, VB Script, ASP and ADO. Using OBDC connectivity is another aspect that has been explored in this project.

d. Establish Wide Area Network (WAN) by using Dialup Networking and Dialup Server is another area, which has been used and evaluated.

e. Provision of flexibility to various staff of the organization.

f. Efficient collection and processing of data.

g. Structured design has been kept very simple so that DBA with a little skill can handle the system efficiently,

h. The job of data entry has been made easier by providing the “Item list” and “Combo Boxes” at every required stage.

i. Provision of maximum control over the database for generating the different structured queries efficiently.

j. Maximum possible queries, with search capabilities on nearly all-possible fields, have been generated and implemented as standard format.

k. The resultant packages application software, which can easily be modified to suit any new requirements and any public service organization like MES.

6.4 Performance Evaluation

This project under no circumstances can be termed as the final product to solve all the problems of MES, but at present it has provided as a take off point for the computerization of this organization. This project can be built into a larger database system in future. Use of ODBC and OLEDB has the advantage that database connectivity can be done with any kind of software i.e. Oracle, SQL Server etc. Every effort has been made to remove all possible errors and different checks have also integrated to avoid entering invalid data or any damage to the system application. Security has been

provided on database and also on accessing the data through web applications. The system performance has been tested in the following sequence.

a. All the forms have been validated.
b. Carrying out data entry in them has tested tables and its relation with referential integrity imposed.
c. Partial Replicas have been created for three Chowkis. Data has been tested for the filter applied on its database.
d. Testing synchronization of partial replicas with main database has been carried out on telephone lines.
e. Testing of all the modules created in web page including search fields.
f. Testing of data flow and module-to-module communication within the system.
g. Testing all the summaries and reports of each module.
h. All the facilities provided on Home Page of the system have been tested.
i. System as a whole has been tested.

6.5 Future Research

The project/thesis work that has been designed and developed covers just some modules that are complaint monitoring and related things to complaints like workers and stores, but this project is going to be the base line to start with automation of MES department. As said earlier this project has full capabilities to incorporate future changes/additions. Following are the recommendations for future expandability in order to make the organization fully computerized.

a. **Works**: Works is another area, which deals with new projects. It consists of cost estimation, sanctions,

execution, and finalization of account and payment of bills. Some of the work has already been done on it, which can be easily incorporated with this system.

b. **Accommodations**: MES is dealing with maintenance of large number of residential, non-residential and hired accommodations in cantonments areas. Subsystems with which accommodation deals are: buildings with locations, formations/Units on whose pool the accommodation is held, design of building, occupation/vacation of the buildings, handing/taking over record, deficiencies in the building, and complete inventories of the buildings. This area is complex and requires due attention for automation because a large data flow is involve in it.

c. **Utility Bills**: Bills for electricity, Gas and furniture are charged to every occupant and non-residential buildings. Keeping record of meter reading, payments, rebates and deductions are another areas to be kept in mind during future computerization processes.

MES is an Organization that is spread all over the Pakistan. So any system that has to be designed must be capable to run over Wide Area Network because distances involved between the chowkis, garrison engineers, commanders MES, and DW&CE (Army) are large. Due to involvement of WAN the system becomes complex, but using Web Technology on an Intranet is the best solution to distributed processing.

It is recommended that in future hardware capabilities may be enhanced so that garrison engineer computers are installed with Windows NT server. The web site of MES is available to all consumers and they may be given option to send their complaints via e-mail and

browse the progress of their complaints on the same site. It is further suggested that MES management must educate its staff by arranging computer-training courses periodically.

The designing concepts of proposed system can equally be useful for big organizations whose different working units are located at large distances. A similar complaint monitoring system can be developed for any public service organization like PIA, PTCL, and WAPDA, PAKISTAN Railways etc. where it can be used effectively.

6.6 Conclusion

MES is a public service organization, its efficiency and effectiveness depends upon smooth and fast flow of information for decision making. Success of MES lies with utmost satisfaction of its consumer, which can be achieved by prompt delivery of the services at their doorsteps. By computerization of entire organization this goal can be achieved with less time and efforts. A web Based Complaint Monitoring And Management System is a platform to start with computerization, with the addition of proposed future recommendations it will become a real time support system for the decision makers and the executors.

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