Chapter 1

Preamble

1.1 Preamble.

Database system made its first appearance in the early 1960's and there after it had undergone major changes in concepts and technology both. The rapid growth of hardware, software, connectivity and reduced cost augmented the development and upgradation of Database Management System software. Each database system represents an abstract model of data that helps the user to view information, not as a mere collection of bit-strings but in more understandable terms. Data manipulation in such models involves navigation through records and links. The record oriented viewpoint enables the user to choose an efficient storage organization for the data and also to implement retrieval/update operations in such a way so as to optimize disk access. This, however, substantially increases the burden on the user, who has to subsequently keep track of the navigational information in terms of the physical links followed to access a record. The translation of the user's logical view of the data to the physical record level view is often quite difficult and error prone. This also increases the cost of the database design. In fact, for large applications involving modeling a system model consisting of a large number of entities and their inter-relationships, the task becomes formidable. The introduction of the relational model by Codd\textsuperscript{4} revolutionized the field by replacing this navigational view of the database with a simpler view of relations. The relational model attracted the database community because of its simplicity and in-depth mathematical base. Keeping in view the pioneering work of Codd\textsuperscript{4}, a galaxy of researchers had enriched the relational database theory with appropriate implementation.\textsuperscript{6, 7} Today, relational database systems such as ORACLE, INGRES\textsuperscript{5, 8} etc. are proved to be the strong support in the increasingly wide range of platforms and have received large-scale acceptance among the database users.
Cehn\textsuperscript{2} proposed the entity-relationship (E-R) model in 1976 with a view to model the conceptual world more accurately than the record based models. He proposed a modeling schema based on two fundamental concepts \textit{entities of the world} and the \textit{relationships among the entities}. These relationships could be constrained on the basis of cardinality restrictions. Thus one may have either 1:1, 1: N or M: N relationships. The E-R model supports derived data types, modeled as weak entities. An entity consists of several simple attributes. Later, a variety of extensions of the E-R model\textsuperscript{1, 2, 3} were proposed in order to capture more complex data semantics. It may thus be seen that within a few years starting from the middle of the last decade, a large variety of models and implementations of object oriented databases were emerged. Even though all of them are ‘object oriented’, but at the same time they were ‘objective’ oriented. Different systems have come up to satisfy different application requirements. They, however, share some common properties which mark them as object-oriented. Necessity is felt to develop formal models of these different features of object oriented databases to integrate all in-house operation through library management software.

1.2 Genesis of Library Management Software in India.

The genesis of Library Management Software in India could be found with the introduction of CDS/ISIS. Being a menu driven storage and retrieval system, it could handle the non-numerical databases.

Module based system could be found in the first generation Library Management Software. No indignity between modules was possible. The second generation tried to solve portability between various operating system like UNIX and DOS. Third generation deals with the relational database structures and the forth generation Library Management Software cramped with Client Server architecture. Thus maturity of Library Management Software facilitated with a user interface which confirms access to multiple resources and services from one interface.

The features and functions of Library Management Software in four different generations (GEN*\textsuperscript{*}) are as follow:
<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Features</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; (Gen)*</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; (Gen)*</th>
<th>3&lt;sup&gt;rd&lt;/sup&gt; (Gen)*</th>
<th>4&lt;sup&gt;th&lt;/sup&gt; (Gen)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Programming Language</td>
<td>Low level</td>
<td>COBOL, PASCAL, C</td>
<td>4GL</td>
<td>OOPS</td>
</tr>
<tr>
<td>2</td>
<td>Operating System</td>
<td>In house</td>
<td>Vendor Specific</td>
<td>UNIX, DOS</td>
<td>UNIX, Windows</td>
</tr>
<tr>
<td>3</td>
<td>DBMS</td>
<td>Non-Standard</td>
<td>Hierarchical and Network model</td>
<td>Entity Relation model</td>
<td>Object Oriented model</td>
</tr>
<tr>
<td>4</td>
<td>Portability</td>
<td>Machine dependent and hardware specific</td>
<td>Machine independent but platform dependent</td>
<td>Multi platform</td>
<td>Multi platform</td>
</tr>
</tbody>
</table>

Table 1.1- Features and functions of LMS.

Library Management Software development activities take its spin in India with the adaptation of CDS/ISIS by NISSAT. Some non profit making organization took the initiative to develop some more Bibliographic Database Management System (BDMS) for library e.g. DLMS of DESIDOC, CATMAN by INSDOC and SANJAY by DESIDOC. Currently some more BDMS are available of Indian origin including some commercial BDMS.

<table>
<thead>
<tr>
<th>Origin of Library Management Software</th>
<th>Application Domain</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Large System</td>
</tr>
<tr>
<td>Foreign</td>
<td>Alice for Windows</td>
</tr>
<tr>
<td></td>
<td>BASISplus &amp; Techlibplu, TLMS</td>
</tr>
<tr>
<td>Develop with the help of some other software</td>
<td>DELISIS (BASISplus)</td>
</tr>
</tbody>
</table>
Table 1.2- Development of LMS.

1.3 Features of some leading Library Management Software in India.

A. LibSys:

Features:

- Provides ANSI Z39.50 complaint.
- Barcode technology.
- Offers SDI, CAS, email alert.
- Based on Client-Server model and SIP protocol.

Problems:

- Costly.
- Lack of functional proficiency.
- Lack of customization to individual library level.
- Lack of any Database structure.
- Based on COBOL type of instruction.
- Client software is to be installed in the client machine and the executable program will try to contact the database server through a port. It is also observed
that in several occasions the database server facing the problems to interact through the port with the client. Problems prone with network resulting a permanent display “Sorry link to database server is not working, inconvenience is regretted” as using Client/server through a port.

➢ The client software has to be reinstalled in the client machine with the upgradation of new version of the software at the server end.

B. Soul:

Features:
Windows based.
Based on Client–server architecture model.

Problems:
Separate SQL server requires.
Lack of customization to individual library level.
Problems prone to network.
Handling a huge number of records caused problems.

C. MECSYS

Feature:
MECSYS had been developed by MECON a Ranchi based company. This software had been developed on the top of UNIFY and work in the UNIX and XENIX environment.

D. NewGenLib

Feature:

Minimum requirements of the Server
➢ Hardware: Pentium 4 or equivalent, 1GB RAM and 40GB Hard disk.

**Minimum requirements of the Client:**
- Hardware: Pentium 3 or equivalent, 128MB RAM, and minimum 1 GB hard disk.

**NewGenLib Server Installation requirement:**
- J2SDK1.4.2 (Sun).
- Postgresql database.

**Application server:**
- Jboss Application server 3.2.1 (Basically it is tomcat application)

**Client (Librarian's interface):**
- Client machine must have J2SE Java (Sun) and client will access the application server through port 8080.

**Problems:**
The software is meant for small collection and tested with only 5000 document when tested with collection of more than one lakh the system becomes slow.

Client machine must support J2SE. The entire machine in the range of P2 and P3 is not supporting J2SE. As the client machine is sending request through HTTP protocol and the java environment is requesting Tomcat (Jboss) to collect data from postgresql. For small collection this duel transportation is working normally but with huge collection the system becomes very slow.

Library had been working with commercial package for several years but the existing system is found to have inadequate functionality to incorporate many of the requirements of the library. Similarly in the cases most of available packages which had been developed with out a particular library in mind. So visualizing the local functionalities required by a particular library are missing. It is vary difficult to implement
and run an efficient system with such generic packages. Some of the problems experienced by library with the package are briefed as a justification of my study.

1.4 Statement of the Problems.

Draw backs of presently available commercial Library Management Software in India:

Costly: Since the packages are developed and maintained by private commercial firms, they insist to update the package with modified version from time to time resulting provision of recurring financial involvement.

Customization: The modules of the package also require quite a good amount of customization at the user site for its full utilization. Even after considerable effort, library had been able to reach the desire level of customization for the book acquisition and circulation modules. In the case of dealing with the yearly subscription of more than over 1100 journal titles, it was found that the software is not competent enough to generate order documents, monitoring the loose issues, reminding about missing issues, mergers/splitting of journal titles, lacunas in the data entry module, no uniform code to search the titles, poor subject indexing etc.

False promises: The assurance in respect to system coverage is not being fulfilled by the developing firm and most of the time; the response for queries, transactions etc were extremely slows. The temporary files created consume space and these files are not deleted automatically. The situation has not improved considerable even after changing the server from a 486 processor to Pentium processor with higher RAM.

No DBMS: Apart from these problems the system is lacking the presence of a DBMS which is essential in a functional database application.

Not so User-friendly: Even for simple task the user have to move from one application to other and the transaction which was at the earlier face is carried forward and creating a wrong function.
Problems in generating report: The package provides some options to generate report other than the reports included in the option if the user wants to generate a report as per his desire, it is not supported by the software.

Module wise problems:

Circulation:
- No Customization options are set for generating reports concerning user transactions, fine etc,

Acquisition:
- In online order processing, during approval process, desired fields from the database could not be manipulated as per the local needs.
- Problems in handling decimals of exchange rates of foreign currency, while converting foreign currency into Indian Rupees in the purchase order.
- No provision for entering separate titles for multi-volume books.
- Difficult to modify the record of a gift book or to get a list of such books.
- Automatic generation of accession numbers.
- Vendor wise expenditure/fund booking for a particular period.
- No option to calculate the percentage of orders/titles supplied.
- No option for number and percentage of duplicate titles for which order placed.
- No option for number of text/general books ordered for a particular period.

Serials control:
- To initiate the approval process, there are problems in increasing the string length to search and select a title for approval from the existing database.
• There are rigid mandatory steps made in the approval process forcing all libraries to adopt that process which may be treated as unnecessary and time killing/time consuming.
• Difficult to generate vendor, publisher or department wise report about total expenditure, amount adjusted, amount due, etc.
• There are problems with entering information for journals which are re-subscribed after discontinuing for few years.

Technical Processing:

• Difficult to generate barcode data for a range of accession numbers.
• In multiple copies, different copy numbers are not accepted along with call number/difficulty in printing bold spine labels.

Without mentioning much about a particular software to generalize the total situation in India, this discussion may be concluded with an opinion that,

➢ Most of such packages had been developed with a particular library in mind.
➢ The local functionalities required by a meticulous library are missing.
➢ Most of the time every upgrade versions with added financial burden.
➢ Huge amount of customizations are required for every sub modules.
➢ Software is to be deficient of DBMS.

It also observed during the last 10 years that the needs of a very functional and specialized library are not served by readymade LMS packages available in the market.

1.5 Need for the study.

Library Database Management System: a case study of the Central Library, IIT Kharagpur:
An enormous compilation of over 3 lakhs specialized volumes in Science, Technology and Social Science, primarily composed of 1.8 lakhs books, 42000 text books, 1 lakhs bound volumes of 2400 unique journals and around 4000 other items of theses, standards patents, etc. The library is currently subscribing about 1100 journals and 5000 books are added annually. The annual issue/return transactions of books are approximately 1 lakh. To inform user about latest books and journals added to the library collection, fortnightly bulletins of latest addition of books and current arrival list of journals are being brought out in print as well as electronic form through website and email alert. It was felt the need for a specialized facility of Electronic Library to cater electronic database services and to facilitate use of floppies or CD's accompanying certain books, to view educational video cassettes brought out by the Centre for Educational Technology of the Institute and for internet services. Library website (http://www.library.iitkgp.ernet.in) enables users to browse detailed information about its activities to search library catalogue via web browser, and for accessing full text of around 800 e-journals.

State of Art of Library automation at IIT Kharagpur:

The first computer entered the Central Library in 1987 and the field of information relevant to library collection was converted from time to time using different database tools like UniBase and UniRec. Now the entire database and house keeping operations are handled using a commercial package supplied by a Delhi based vendor.

Automated Operations:

The existing computer based library operations are as follows:

- **Circulation:** Barcode-based issue/return of books, control of fines/ reminders/reservations, database of users and usage statistics generations etc.
➢ **Acquisition:** Database of books on order, monitoring of vendors, payment control and accessioning etc.

➢ **Technical Processing:** updations of OPAC, generation of catalogue cards and alert for new arrivals.

➢ **Serial control:** Control & Manage the subscription of Journals, Generation of binding list of journals etc.

### 1.6 Motivation.

The proposed Bibliographical database Management System, consisting of the following features:

**System:**
There will be no additional requirement of

- Client application program from client machine.
- sql server.
- Server side Java handler.

**Acquisition Subsystem:** The typical functions of this automated acquisition system include:

- ✓ Preorder searching to avoid duplication.
  - Creating purchase order.
  - Request for fund booking and invoice.
  - Sending order letter.

- ✓ Receiving materials
  - Making payments through cheques.
  - Compilations of accession register.
  - Alerting the latest books received via E-mail.
  - Completion of database entry.
Claims (for damaged materials).
Cancellation.
✓ Providing information to the management on orders outstanding.
✓ Maintain statistics on vendor evaluation.
✓ Support for order such as Firm, approval, standing, prepayment, gifts.
✓ Incorporation of RBI conversion rates for foreign currencies.
✓ Options to handle variable discount rates.
✓ Fund monitoring before placing orders.

Technical Processing Subsystem:
✓ Completion of database entry including classification.
✓ Generation of catalogue cards books labels etc.
✓ Transferring the book details to barcode system for generation barcode labels.
✓ Preparation of new arrivals list and its messaging through e-mail alert.

Circulation subsystem:
The circulation system designing was suggested by Majumdar and Singh\textsuperscript{10} to record and manipulate the information about the borrower, document and transaction. In addition to the primary function of the circulation system, issue and return of books, it performs the following functions.

➢ Provision of information on the location of the items (status issued/under bindary/reserve etc).
➢ Identification of items issued to a particular borrower class.
➢ Recording of holds or personal reserves for items issued but desired by another borrower, often with additional provision for callback or overdue books reserved by another user and automatic alerts about the availability to the requestor when returned by the former.
➢ Removing a member from the reservation queue after accepting or after a particular waiting period.
Facility for more than one member reserve the same document.
Issuing recall notices for items on long-term issue, when required by others.
Renewal of issued books, when not reserved by anyone for another issue period.
Notification to the library staff of overdue items and printing of overdue notices.
Notification to the library staff about delinquent borrowers (i.e. those with unpaid fines/over due books) either at the time of an attempted issue or at the time of a borrower is leaving the institution or on demand.
Calculation of fines, printing the fine notices, recording receipt of fines and sometimes printing details of fine receipt.
Calculation and printing various types of statistics.
Analysis of both summary statistics and statistics for the circulation of particular items for use in collection development, planning of services and for other administrative purposes.
Provision for printing due data slips, automatically generating orders for lost books or additional copies and printing mailing labels for remote borrowers.
Provision for fine to be collected in parts.
Varying fine possibilities for different category of users and different types of books.
PAC search indicating the status of books.
Keeping track of missing lost damaged written-off withdrawn documents.

Serial control:

In order to automated the serial control, the system has to perform the functions of
Inputting serial data.
Ordering new serials.
Renewals of presently subscribed serials.
Cancellation of presently subscribed serials, if necessary.
Accessioning the individual issues as the when the issues are received.
- Monitoring receipt of multiple issues of journals.
- Combined issue management.
- Sending reminders.
- Grace period for reminders.
- Claiming the issue.
- Selective follow-up of missing issue.
- Preparation of various lists (serials received / subscribe / holding status on the shelf.
- Keeping track of amount spent on serials subscription.
- Estimation of the budget for the next academic/financial year.
- Provision for renewal alerts.
- Handling supplementary invoices and partial changes in the processed invoices.
- Accepting refunds from the suppliers and adjustment in the budget database.

**Back issue:**

- Binder selection.
- Preparation of binding list.
- Processing of back issue.
- Accounts management including fund booking and payment for binding.
- Back volume database completion including classification, generation of catalogue cards and accusation register.

**PAC (Public Access Catalogue):**

- Online access catalogue with search facility by author, title publisher, subject key word, accession number etc.
- Searching multiple databases of books, serials and other database if available.
- Maintaining the log of PAC use.
Option for Boolean, right and left truncation, proximity search, free text search, wild cards, etc.

Display formats of retrieved records/Details of books on or in PAC.

**System Management subsystem:**

- Execute various privileges and permissions.
- Take care of system operations like backup routine checks needed during booting up.
- Security control operations/ Database maintenance etc.

### 1.7 Objectives.

Information is an essential ingredient of decision making. Information flow in library is complex and varied. Books, equipments and users are basic inputs to the system. There is many other stakeholder of the library i.e. vendor and the varied type of users. Library materials are organized in such a way that users get their required information quickly and easily. The main objectives of the study titled “Designing of Bibliographical Database Management System: An Object Oriented Approach” is to satisfy the following objectives

- To design and develop a vigorous and steadfast, user-friendly BDM model with ODS approach utilizing the principles and strategies for library
- To retrieve details of the catalogue to satisfy user requests through web enabled application with hyper media engine essence.
- To enhance the electronic communication and work in a web enabled environment.

### 1.8 Data Source.

A huge amount of information is required to be stored in such a way so that fast and efficient retrieval may be possible to cater the needs of the stakeholder effectively. The
Central Library of IIT Kharagpur is considered as a typical example. Central Library has a collection of 1.8 lakhs books. It has a large number of varied types of users of varied borrowing privileges. Average daily circulation exceeds 600 and about Rs. 1,000 is collected daily as delay fines. Similarly in the Acquisition section about 1000 purchase orders are released annually with a budget exceeding Rs.2 cores. A BDM model for library has to fulfill the functions of acquisition, circulation and information retrieval OPAC (Online Public Access Catalogue) routines. It has to fulfill the functions of acquisition, cataloguing, serial control, circulation control, information processing and service, documentation, information retrieval and processing and office routines, An effective BDM model should have able to mechanize all of the works in the library. Thus it helps the library staff to find more time for the vital functions of the information collection, organization and services. The requirements assessed for the BMD model was suggested by Majumdar and Singh9 as LIPS: Library Information Processing System at CLIK (Central Library, IIT, Kharagpur).

1.9 Software used in the study.

During the study Windows 2000 (with Window NT flavor) is used to integrate with Oracle8i as the database engine which provides significant features for online transaction processing (OLTP) and data warehouse applications and WebDB used for building, deploying, and proactively monitoring database applications with content-driven GUI tool to access data from the database engine.

1.10 Methodology.

The methodology for the purpose of the study consists of:

- Identification of the basis for the database requirement.
- Identification of the functions or facial appearance the library would like to routine.

The first indispensable is to congregate a full understanding of the real needs of the user of a new automated system.
Determination of the function the library would like to automate.

Identification of those repetitive tasks which occupied of a large amount of man hours. So, priority has to be given for routine works.

Identification of the capabilities which are required to support each specific function.

Development of a written checklist of specific functions that are essential and those which are desirable.

Preparing of Data Flow Diagrams (DFD) to represent the input data to the system.

Developing the Database Management System with the adoption of database engine and the front end utilities.

Creation of various tables in the database, in the line of the formal object model.

Developing of the various functions/sub systems/procedures to create required functions.

Defining the formal specification of the hypermedia engine.

Processing various function on the stored data to generate output data.

Reviewing the behavioral aspect of Object Oriented Database Schema based on the procedure.

1.11 Layout of the Thesis.

The thesis is organized as follows; Chapter 1 is an introduction and deals with genesis of Database Management System. The broad elements of BDMs had been discussed. It further highlighted the problems, objectives and methodology. The OODBMS and the procedural language for BDMS and the fundamental concepts of object oriented paradigm and some of the existing contributions in the field has been discussed in Chapter 2. An informal presentation of an ODS schema is given in chapter 3. A formal model of ODS schema is covered in chapter 4. Chapter 5 deals with Block Diagram for the proposed system. Chapter 6 deals with the E R model of the system. Chapter 7 highlights system integration. Chapter 8 deals with the web enable application. The concluding chapter, Chapter 9 summaries the contribution of the present works and identifies some open problems.
1.12 Reference.


