CHAPTER V

DATA BASE MANAGEMENT SYSTEM

Overview

Objectives of data base management: The professional approach to application system development had a strong focus on application programmes and processes. When the primary focus is on process naturally application systems develop separately and operate independently. Data files are established as a by product of application development. As a consequence, if two applications require same items of data they are duplicated resulting in redundancy.

To retrieve data that is stored urgently, the user has to decide as to which application to use to obtain the necessary data. This necessitates the coordination of data updating as regards the application systems. This is necessary to ensure that the same data is updated in the same way at the same time irrespective of the fact in which file the data exists. To be able to obtain at all times information based on the latest version of data would involve using additional programming which would periodically be similar data in different files so that all the files have the latest version of the data. This would delay obtaining information at request as a great deal of processing is necessary before correct and latest information could be given. In the 1960s, usage of a magnetic tape as a computer medium was prevalent which imposed a sequential structure of the file. In the early 1970s in countries like USA and Australia, the concept of data base management systems emerged. In our own country only in the last two or three years, that is from the 1990s the concept of data
base management system has been catching on. Till recently, that is before 1990s the high cost of equipment and the non-availability of skilled personnel necessitated centralised execution and control of system development. This resulted in end-users maintaining privately data manually so that at any point of time they would have up to date information.

The emergence of micro computers has made end-users maintaining this information on the computers instead of manually.

Having micro-computers at the users end did not solve the problems but only ended up in the information problems being transferred also to the end-users.

The need for getting over these problems motivated organisations to seek for new solutions.

**MOTIVATION TOWARDS DATA BASE MANAGEMENT SYSTEM**

The major problems which motivate data base management are:

(i) Quick answers were not available for ‘simple’ adhoc questions

(ii) High development costs as the efforts were duplicated both at the central processing department as also the user department

(iii) Low responsiveness to change

Once an application is developed and handed over to the user many things happen. Application system may require change either due to the changes in
statutory requirements or users own views for a different approach - after the system has been in use for some time. Making changes to the system after the application has been developed requires great deal of costs and time by way of additional programming effort and computer time.

It is reported that maintenance of existing programmes consumes 75% of the time of Systems Analysts and Programmers. This leads naturally to the management to study ways of reducing people-intensive activities. Such reduction can be achieved only if a special effort is put in to develop a ... disciplined system.

LOW DATA INTEGRITY AND QUALITY

Incomplete and inaccurate data leads to lack of confidence in such data. However, should such data be used for making important decisions, it would be detrimental to the interests of the organisation. This leads to a situation when managers are constrained to maintain their own files and of good quality information and unquestionable integrity.

INADEQUATE DATA MODEL

Complex data and inter-file relationship make it difficult provide a formal definition to the system. There are limited tools for defining data structures importance being given to the programming in data structure being modified to suit the language. This necessitates a richer and better data structure writing capabilities.
While the problems discussed motivate a data base approach one should not lose sight of the fact that there are certain areas to be borne in mind which would restrain the introduction of a data base management system.

OBJECTIVES OF DATA BASE MANAGEMENT

The main objectives of the data base management are:

a) Sharability
b) Availability
c) Evolvability and integrity

a) Sharability

The concept of sharability means that the same data would be used at the same time not only by different people but also in different processes. Data belongs to the whole organisation and not to any single individual. When data base is shared by several people it is necessary to have a central body to control the collection and use of all data. When this is achieved the following would result:

a) Consistency of data
b) Reduce redundancy of data
c) Reduction in the effort needed
d) Capture and maintenance of data

Sharing of data has its own ramifications and it would become necessary to arrive at a compromise between conflicting needs of different users.
b) Availability

By the concept of availability we mean that data should be made available when and where it is needed and also in a form and manner in which it is needed. There are two dimensions to the concept of availability objective and they are:

i) Function and ii) Form

i. Function

The function of data base is to define and create a data base and getting the relevant data in and out of the data base as per the requirements of users.

ii. Form

The DBMS system should be in a position to economically and effectively.

a) Store diverse data
b) In an environment of diverse users
c) Operating in diverse modes
d) Using diverse language
e) Satisfying diverse patterns of usage.

If DBMS were to handle only a very narrow range of diversity users could feel disillusioned as it has fallen short of expectations or has not become as responsive as was anticipated.
c) Evolvability and integrity

The characteristic of evolvability of DBMS is its ability to change in response to the users needs as also the advancing technology. Evolvability is distinct from expandability or extensibility. Evolvability increases the possibility of the future availability of data resources.

PROBLEM AREAS

The technological developments in the Information Technology field have been growing very fast. The software and the hardware have been vying with each other in their growth. There has been the realisation that information is power. As the organisations grow larger the need to have an effective information system has been greatly appreciated.

The concepts of data base has been spoken of in many seminars and workshops. Hence it has become an "in thing" in larger organisations to try and implement a data base management system. There have been products like ORACLE, SYBASE, INGRESS etc. There have been tremendous marketing efforts with each vendor claiming that theirs is the product. Organisations have had to make a study of their user needs and the appropriate DBMS package. However, in view of the concept not being very old there has not been enough experience, the organisations have had to depend upon their senior data processing staff and outside consultants. In the present context, executive turnover is very high generally and more so in the information technology field. This has resulted in the organisations depending more on outside help from consultants. In most organisations there is no
individual specifically designated as a data base administrator or data administrator. It is absolutely necessary that one individual should be responsible for data base design, definition and maintenance. However, this aspect is not present in most of the organisations as a group of two or three people have to play this role of DBA. In the circumstances, determining proper access permissions for application programs and users and resulting in conflict among users of the data does create contradictions.

Creation of data dictionary in many instances is not comprehensive. Most importantly back-up and recovery procedures are not satisfactory. There are no well-settled policies and procedures. Each of the data base products like ORACLE, SYBASE and INGRESS have their own functions and security aspects. Unless the security aspects of each of the data base packages are completely understood and implemented, the possibility of the system being exposed to security violations is immense. Lack of knowledge to implement the concept without the associated administrative and organisational support is leading to a situation in many organisations spending the whole time in unravelling the mysteries of the data base management system package which they have implemented. The benefits that were expected to be reaped have not yet been completely achieved. In most of the cases, the cost benefit analysis after the project has been implemented would never have justified the implementation of the DBMS in the first place. The situation is not due to the fact that the concept is not implementable. The DBMS is an extremely useful and effective tool. Special efforts need to be put in, for the creation of a perfect data dictionary allocating specific responsibility for data base administration. In the absence of such a foundation, the data base system gets rocked. Users access needs
to be controlled which is achieved by granting them the privilege or by selecting commands that they can use. As these procedures are not streamlined the increased and important advantages of DBMS is not achieved.

Three large public limited companies were selected at random. A popular DBMS package was introduced. While the package was introduced no precautions have been taken about ensuring that a specific individual was designated as the database administrator who would take total responsibility for creating a data dictionary and ensure that discipline associated with the implementation of D.B.M.S. package is followed. The organisations concurred with me that they are not violating the required disciplines associated with implementing security considerations in a D.B.M.S. environment. The organisations were still struggling with problems of deadlock and relational integrity which was of greater concern. The data was not getting updated in all the files which is a basic principle in a D.B.M.S. environment.

PRESENT PRACTICES
AUDIT

As in all other areas of auditing in a computerised environment, the present day presence of the audit function is totally absent. Verifying the information technology control in a data base environment does not figure in the internal auditors audit programme of the organisation. Procedures associated with data access, passwords system and terminal security are never audited for the senior management of the organisation to know whether the controls are in place and effective.
STANDARD ACCEPTED PROCEDURES

Controls

There are three main database structures, viz. hierarchical network and relational. The figures given below represent the pictorial representation of the structure of the different databases. The more popular and useful database structure is the relational database. Relational databases are in the structure of a table. As mentioned earlier, relational databases are more popular because they are easier to set up and maintain. The database concept separates the data requirements from the application requirements. Both the requirements of data and application are a constantly evolving process. But these requirements need not necessarily be compatible. In a database approach integration is provided by sharing of common data among different programs. The data elements are stored with very little redundancy. The physical file structure may not have resemblance to logical records and files. Database system helps in gaining flexibility by creating independent data and application programs. A database management system satisfies the needs of an organisation by a shared collection of information. The database management system executes functions on behalf of application programs. Standard accepted procedures in a database management system include the following:

* Creation of a data dictionary
* Creation of a post of database administrator
* Laying down procedures
* File consistency
* Avoiding deadlock
* Error recovery and reliability
Data dictionary describes the various attributes of data element. In many database packages, information regarding physical location of the data is also included. The other details included would be the data name, the segment on which it occurs, the programs using the file. The main advantage of having a data dictionary is that data is defined uniformly. Information as to what data is available and in which database it is located is also furnished by the data dictionary. In an active database, data dictionaries are updated automatically when there is a change. In a passive database, it does not happen automatically.

Data base administrator as its very name indicates is the manager of the database. The main responsibilities of the database administrator are data base design, definition and maintenance. He is also responsible for setting up policies and procedures for back up and recovery. He determines appropriate access permissions for users as also applications programs. Whenever any conflict arises among the users of the data, the responsibility for resolving the conflict devolves on the data base administrator.

Laying down procedures

It is possible that an application may be updating at more than one node. Also it is possible that a file at one Node may be updated by more than one application. In the absence of procedures it is very likely that data consistency will be lost. There should be procedures to void inconsistencies. This could be done to locate a record when it is being updated. However, if the file action is to "read only", there is no possibility of an update and hence the record need not be located for
such purposes. Yet another method is to allow files to be updated only by processors located at the Node where the file rests.

Deadlock

A deadlock situation arises if two or more processes bid for the same resources in a mutually exclusive manner. In such a situation, the file may not be released as none of the processes would be completed. This would naturally cause an indefinite impasse. This situation is called deadlock. It is necessary to ensure that DBMS packages provided for such a situation be identified and controlled. There should be a well-established mechanism for the recovery of lost files and for continuation of operations even though certain nodes are unavailable. It is necessary to ensure that there is continuous availability of files. This can be achieved by duplicating such of the files that are critical to system operation.

AUDITING PROCEDURES

The auditor is to have a clear understanding of the situation, identify controls and design proper tests.

The auditor should review existing procedures and policy manuals. He should identify data elements which are significant from the auditing angle and determine their relationship within the data structure.

The auditor should refer to the audit dictionary and with support from data base administrator understand logically relationship between important data elements,
programs and transaction types. The auditor should understand the internal control system of the DBMS package with special reference to the following:

Who can access data elements?
Who can add, change or delete?
The auditor should establish as to who are identified as authorised users and as to what are their capabilities.
The auditor should have a detailed discussion with the data base administrator to gain the following information:

As to how the data base is used and what controls are employed for different purposes?
In a data base environment absence of an individual by whatever name he is called who performs the duties of a DBA would amount to a serious control weakness?

The auditor’s concern for access control should be under the following heads:

- Data element access
- Pass word systems
- Terminal security

The auditor should ensure that programs access only such data elements which they are authorised to access while executing their processing tasks. Unnecessary or uncontrolled access would expose sensitive data to exposure. He should ensure that there is a distinction between test data base and production data base.
While developing applications access may not be restricted to, but there should be built-in controls to avoid unauthorised access to production data base.

Password systems

Auditors should study the password system to evaluate its adequacy. The password system should be effective and should be monitored on an on-going basis. This involves maintenance of accurate and secure records of users and their associated problems. Deletion of passwords allocated to employees who have since left service is an important audit concern.

Terminal security

The terminal should not only be physically secure but also logically secure. Effective terminal security standards will ensure that only authorised transactions can be entered only through authorised terminals.

Testing

An audit should test the integrity of security aspects of databases by verifying and how concurrent update references are handled, how the DBMS is maintained, how the DBA functions and what are the disaster recovery and contingency procedures thought of.

ANALYSIS AND FINDINGS

The specimen audit program questionnaire which is enclosed was utilised for gathering information regarding audit procedures followed in a DBMS environment.
Neither the internal auditors nor the external auditors had a positive answer for any of the questions in the specimen audit programme. The auditors were not even aware of the name of the DBMS package being utilised in the organisation. The auditors in the organisation in the sample survey were blissfully ignorant of the audit concern in a DBMS environment, viz. security and integrity.

There were no well laid out policies and procedures regarding the file consistency, deadlock, error recovery or reliability. The documentation was unsatisfactory. The systems are functioning in the organisation, though not satisfactorily, only due to the dedication and integrity of a couple of members of the staff of the data processing team. Accidental and intentional access to unauthorised data, usage of commands associated with logical terminals were not in order. However, by a process of development and by trial and error procedures are being developed.

Audit

Information was gathered from a sample of 30 auditors regarding the procedures they adopt in organisations where End-User computing was in existence and utilised for important areas of operation.

The auditors either internal or external were aware of the risks associated with End-User computing environment. There was no audit being performed. The auditors in spite of being aware that Personal Computers were installed in all the functional departments, they were ignorant of the type of applications. The audit in that area
was totally absent. Counter-checking of this fact was made with the End-users who confirmed the same.

SUGGESTIONS

CONTROLS

Even though a data base management system package might have already been introduced in an organisation, it would be necessary to issue policies and guidelines for the following aspects:

* Creation of data dictionary
* Duties and responsibilities of data base administrator with a specific individual or individuals being held responsible.
* File consistency
* Deadlock
* Error recovery
* Control over access
* Password systems
* Terminal security.

AUDIT

Even though the internal auditor might not have been associated in the earlier stages, it would be advisable to have the internal auditor/audit department review the controls to satisfy themselves that they are adequate. The present state of knowledge of the auditors is not adequate to discharge his duty. However, lack of knowledge would not be an excuse for not performing a duty and discharging
their responsibilities. In the circumstances, it would be necessary for the auditor to set out the control objectives and have an independent authority (not part of the computer department) to help them. The auditors have to satisfy themselves regarding the data base, security and integrity. He should be able to assure himself:

The users can only access data that they are authorised to access on a need to know basis.

Log on IDs and password procedures should be evaluated.

Are the concurrent updates handled properly?

Are there proper procedures for the maintenance of DBMS?
QUESTIONNAIRE FOR AUDIT PROCEDURE

Do you identify data elements that are of particular significance to the data?

Do you find out whether there is a DBA?

Do you discuss with the DBA the following:

To satisfy yourself about adequacy of security - security integrity, Have you verified?

The segments where data of financial significance is located.

- The users who have access to identified transactions
- The specific terminals from which these transactions can be executed
- The users who have direct access to the segments and the type of access they have

II. Have you tested the controls for its effectiveness?

- Have you reviewed the maintenance controls for DBMS?
- Have you examined the procedures to ensure that any changes to DBMS are appropriate and functioning as expected?
- Have you checked whether logging facilities are in place to facilitate to DBA to recover lost or corrupted data?
- Do you analyse the results of testing and form your opinion regarding adequacy of controls?
- Have you ever presented a report to the Management regarding audit and controls?