THE DATABASE APPROACH

So, how do we overcome the flaws of file processing? We follow the database approach. We first begin by defining some core concepts that are fundamental in understanding the database approach to managing data. We then describe how the database approach can overcome the limitations of the file processing approach.

Data Models

Designing a database properly is fundamental to establishing a database that meets the needs of the users. Data models capture the nature of and relationships among data and are used at different levels of abstraction as a database is conceptualized and designed. The effectiveness and efficiency of a database is directly associated with the structure of the database. Various graphical systems exist that convey this structure and are used to produce data models that can be understood by end users, systems analysts, and database designers.

Database Management systems

A **database management system (DBMS)** is a software system that enables the use of a database approach. The primary purpose of a DBMS is to provide a systematic method of creating, updating, storing, and retrieving the data stored in a database. It enables end users and application programmers to share data, and it enables data to be shared among multiple applications rather than propagated and stored in new files for every new application. A DBMS also provides facilities for controlling data access, enforcing data integrity, managing concurrency control, and restoring a database.

Advantages of the Database Approach

The primary advantages of a database approach, enabled by DBMSs, are:

1. Program-Data Independence

The separation of data descriptions (metadata) from the application programs that use the data is called **data independence**. With the database approach, data descriptions are stored in a central location called the *repository*. This property of database systems allows an organization's data to change and evolve (within limits) without changing the application programs that process the data

2. Planned Data Redundancy

Good database design attempts to integrate previously separate (and redundant) data files into a single, logical structure. Ideally, each primary fact is recorded in only one place in the database. The database approach does not eliminate redundancy entirely, but it enables the designer to control the type and amount of redundancy. At other times, it may be desirable to include some limited redundancy to improve database performance.

3. Improved Data Consistency

By eliminating or controlling data redundancy, we greatly reduce the opportunities for inconsistency.

4. Improved Data Sharing

A database is designed as a shared corporate resource. Authorized internal and external users are granted permission to use the database, and each user (or group of users) is provided one or more user views into the database to facilitate this use.

5. Increased Productivity of Application Development

A major advantage of the database approach is that it greatly reduces the cost and time for developing new business applications.

6. Enforcement of Standards

When the database approach is implemented with full management support, the database administration function should be granted single-point authority and responsibility for establishing and enforcing data standards. These standards will include naming conventions, data quality standards, and uniform procedures for accessing, updating, and protecting data.

7. Improved Data Quality

The database approach provides a number of tools and processes to improve data quality.

8. Improved Data Accessibility and Responsiveness

With a relational database, end users without programming experience can often retrieve and display data. For example, an employee can display information about computer desks at Pine Valley Furniture Company with the following query:

```
SELECT *
FROM Product_T
WHERE ProductDescription = “Computer Desk”;
```

The language used in this query is called Structured Query Language, or SQL. The basic structure of the query is easy for even novice, nonprogrammers to grasp.

9. Reduced Program Maintenance

In a database environment, data are more independent of the application programs that use them. Within limits, we can change either the data or the application programs that use the data without necessitating a change in the other factor. As a result, program maintenance can be significantly reduced in a modern database environment.

10. Improved Decision Support

Some Databases Are Designed Expressly For Decision Support Applications. For Example, Some Databases Are Designed To Support Customer Relationship Management, Whereas Others Are Designed To Support Financial Analysis Or Supply Chain Management.

Cautions about Database Benefits

The previous section identified 10 major potential benefits of the database approach. However, we must caution you that many organizations have been frustrated in attempting to realize some of these benefits. Reason for failure to achieve the intended benefits is poor organizational planning and database implementation; even the best data management software cannot overcome such deficiencies. For this reason, we stress database planning and design.

COSTS AND RISKS OF THE DATABASE APPROACH

The database approach entails some additional costs and risks that must be recognized and managed when it is implemented

1. New, Specialized Personnel

Frequently, organizations that adopt the database approach need to hire or train individuals to design and implement databases, provide database administration services, and manage a staff of new people.

2. Installation and Management Cost and Complexity

A multiuser database management system is a large suite of software that has a high initial cost, requires a staff of trained personnel to install and operate, and has substantial annual maintenance and support costs. Additional or more sophisticated and costly database software may be needed to provide security and to ensure proper concurrent updating of shared data.

3. Conversion Costs

The cost of converting the older systems to modern database technology measured in terms of dollars, time, and organizational commitment—may often seem prohibitive to an organization.

4. Need for Explicit Backup and Recovery

A shared corporate database must be accurate and available at all times. This requires that comprehensive procedures be developed and used for providing backup copies of data and for restoring a database when damage occurs.

5. Organizational Conflict

A shared database requires a consensus on data definitions and ownership, as well as responsibilities for accurate data maintenance.

COMPONENTS OF THE DATABASE ENVIRONMENT

Now that you have seen the advantages and risks of using the database approach to managing data, let us examine the major components of a typical database environment and their relationships (see Figure 1-5).

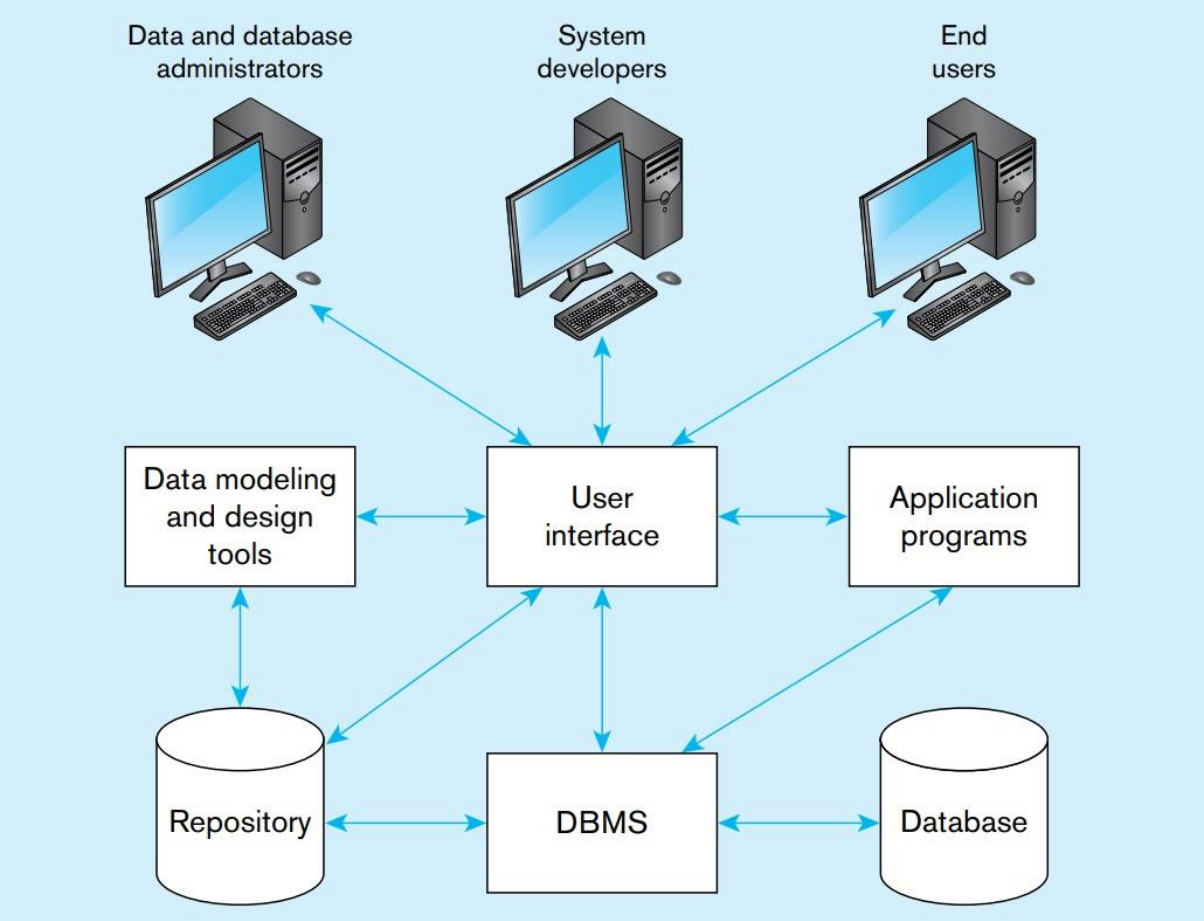

Figure 1-5 Components of the database environment

Following is a brief description of the nine components shown in Figure 1-5:

1. *Data modeling and design tools*

Data modeling and design tools are automated tools used to design databases and application programs. These tools help with creation of data models and in

some cases can also help automatically generate the “code” needed to create the database.

2. *Repository*

A repository is a centralized knowledge base for all data definitions, data relationships, screen and report formats, and other system components.

3. *DBMS*

A DBMS is a software system that is used to create, maintain, and provide controlled access to user databases.

4. *Database*

A database is an organized collection of logically related data, usually designed to meet the information needs of multiple users in an organization. It is important to distinguish between the database and the repository. The repository contains definitions of data, whereas the database contains occurrences of data.

5. *Application programs*

Computer-based application programs are used to create and maintain the database and provide information to users.

6. *User interface*

The user interface includes languages, menus, and other facilities by which users interact with various system components, such as data modeling and design tools, application programs, the DBMS, and the repository.

7. *Data and database administrators*

Data administrators are persons who are responsible for the overall management of data resources in an organization.

8. ***System developers***

System developers are persons such as systems analysts and programmers who design new application programs.

9. ***End users***

End users are persons throughout the organization who add, delete, and modify data in the database and who request or receive information from it. All user interactions with the database must be routed through the DBMS.

In summary, the database operational environment shown in Figure 1-5 is an integrated system of hardware, software, and people, designed to facilitate the storage, retrieval, and control of the information resource and to improve the productivity of the organization.