CHAPTER 9

DATABASE MANAGEMENT SYSTEMS

This chapter reintroduces the term database in a more technical sense than it has been used up to now. Data is one of the most valuable assets held by most organizations. The first section addresses the need for data management.

The traditional data management techniques are discussed, with attention paid to the problems that led to a new approach. Then the database approach is introduced. Section four examines the elements of the database method. This is followed by information on the different ways to view a database. The chapter concludes with a discussion of control issues.

The objectives of this chapter are:

- to understand the operational problems inherent in the traditional data management environment which gave rise to the database concept;
- to understand the relationships among the defining elements of the database environment;
- to understand the anomalies caused by unnormalized databases and the need for data normalization;
- to be familiar with the stages in database design including entity identification, data modeling, constructing the physical database, and preparing user views; and
- to be familiar with the operational features of distributed databases and recognize the issues that need to be considered in deciding on a particular database configuration.

The chapter Appendix considers two alternatives to the relational database model: the network and hierarchical models and the normalization process.
I. Overview of Flat-File versus Database Approach

The only reason for saving information is to be able to use it in the future. This chapter introduces the basics of data management. There are three basic tasks implied when data is collected: storage, retrieval, and deletion. There are two basic approaches discussed: the flat-file method, and the newer, and increasingly popular, database approach.

Traditional data management is best thought of as “possessive.” Each user group “owns” its data and it is not usually available to others, even within the organization. The text discusses the most important resulting problem: data redundancy. There are several related issues.

A. Data Storage

Store something 10 times and you use ten times the space, whether paper or magnetic.

B. Data Updating

If data is stored in multiple places, it must be updated in multiple places. The more places it is stored, the better the chance that some occurrences will be missed, leading to data inconsistency.

C. Currency of Information

All occurrences of a data item may not be up to date, i.e., the data is inconsistent.

D. Task-Data Dependency

Users can only access the information predetermined as part of their tasks. Therefore, one part of an organization may again collect data already held elsewhere in the organization, wasting time, effort, and money!

II. The Database Approach

Fig. 9-1, on page 467, represents traditional data management with individual users “owning” their own data. Fig. 9-2(a) and (b), on pages 469 and 470, are used to explain what is different in a database system. Note in particular the manner in which a database systems handles the four problems just discussed. (Data is stored once, can be updated in one step, and is thus correct.) In Fig. 9-2(a), the database is shared but there is no easy way to control access to individual data elements. There are new issues when a shared database is
used: controlling **access** and the need to **manage** the database. Fig. 9-2(b) inserts the database management system (DBMS) between the data and the programs that use it.

### III. Elements of the Database Environment

The four elements of the database environment are discussed thoroughly: users, the DBMS, the database administrator, and the physical database. See [Fig. 9-3, on page 471](#).

#### A. Users

Data is stored so that people (decision makers) can use it. The text mentions the two key ways that people can use a database—through routine data processing and through direct queries of the database. This corresponds to receiving your checking account monthly statement (routine) and checking your balance at an ATM (a query).

#### B. Database Management System

The role of the database management system, the software that pulls the pieces together, is important.

Four objectives are discussed: program development, backup and recovery, usage reporting, and database access.

This latter issue, access, is discussed in terms of the data definition language, data manipulation language, and the data query language. If you have used the online catalog at your college or university library, you have used a data query language.

Focus your attention on what the purpose of each is.

#### C. The Database Administrator

The role of the database administrator (DBA) is outlined in [Table 9-1, on page 476](#). The DBA can be more than one person. There are important administrative control issues here. From an accounting standpoint you should be aware of the important issues.
D. The Physical Database

Read the discussion of the physical database carefully. Try to grasp the basic difference in data structures. The criteria for selection of a data structure will be very helpful when you work with databases.

IV. The Relational Database Model

There are three views or models of databases. The most common model in use today is the relational model. [There are two others: the hierarchical model and the network model. These last two are called navigational models because their structure influences how the database must be navigated in order to retrieve data. These are covered in the chapter appendix.] Primary focus in the chapter is on the relational model. A system is relational if it represents data in the form of two dimensional tables and supports the relational algebra functions of restrict, project, and join. See the text related to Fig. 9-8 on page 479. Read the narrative carefully to understand these terms. Fig. 9-9, on page 480 helps.

A. Relational Database Concepts

This section presents a good review of concepts. For students who have not been exposed to database theory this material will be rather heavy—but worth the trouble. Many of the terms may be new, but the ideas will make sense. These concepts are grouped as follows:

- entity, occurrence, and attributes;
- associations and cardinality;
- physical database tables;
- linkages between relational tables; and
- user views.

B. The Data Normalization Process

Data normalization is a very important but difficult topic. It is a process of determining the correct location for each attribute to avoid redundant, inconsistent, and anomalous data items being stored in the tables. [The anomalies prevented should make the point: update, insertion, and deletion.] The discussion in this part of the chapter, together with the accompanying Figs. 9-13 to 9-17, on pages 485-490, will guide you through:

- the importance of normalization;
database anomalies: the *update, insertion, and deletion* anomalies;
- data normalization rules;
- splitting unnormalized tables;
- linking normalized tables; and
- accountants and data normalization.

For students with little exposure to database structure, this will be difficult. But if you have ever tried to extract information from a database and had problems you will appreciate the benefits to users.

V. **Designing Relational Databases**

Designing databases is not a simple process. The text will discuss the process in three phases: *conceptual, logical, and physical* database design. The process will be discussed as one of six primary phases. This example will design a new purchasing system introduced in the prior section of the chapter. The narrative is explained using Fig. 9-18 to 9-23 on pages 492-498.

A. **Identify Entities**

Think of the elements of the purchasing system. [If necessary, review the meaning of “entity” as introduced in Chapter 2 and discussed earlier in the current chapter.]

B. **Construct Data Model Showing Entity Associations**

The associations between entities will be reflected in an Entity Relationship diagram.

C. **Add Primary Keys and Attributes**

Primary keys must uniquely identify records. Think of the way the university uses your SS# as a key to all records about you. It is unique. Your name may or may not be. Attributes are used to describe the entity. Your name is an attribute attached to your SS#.

D. **Normalize the Data Model and Add Foreign Keys**

Read carefully. This is important but difficult.

E. **Construct the Physical Database**

This step involves the creation of the physical tables and filling them with data from older flat files or legacy database. It can be very lengthy.
F. Prepare User Views

Different users have need for different data. The user views will support all system users. See Fig. 9-23 on page 498.

VI. Databases in a Distributed Environment

When a database is planned, its location is a key decision. This section of the chapter looks at the two key options: a centralized database or a distributed database. If distributed, two options exist – that it be centralized or that it be broken-up or partitioned. Read carefully the pluses and minuses of each approach.

APPENDIX

The appendix presents a discussion of commercial navigational and relational database management systems. Also, the topic of normalization is presented in greater detail.

Review Questions for Chapter 9: 1-13, 16-25

Discussion Questions for Chapter 9: 1-6, 8, 9, 11-18, 20