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Basic Definitions and Concepts

This chapter covers the following topics:

- Basic definitions and concepts in database technology
- The role of computers and network technology in helping run businesses and other organizations
- Common types of information processing systems in current use

Basic Terms and Definitions

There are some basic definitions and concepts that should provide useful context for understanding database design. Some of the terms we define are in common use but take on specific meaning in the information technology field.

Datum is a singular word, and *data* is its plural. A datum (sometimes called a "data item") is a "particle" of information like "12" or "Q."

Information refers to data that are structured and organized to be useful in making a decision or performing some task. Relational databases are currently the most common way data are organized into information; hence this book's focus on relational databases.

Knowledge denotes understanding or evaluating information. An example could be when Casleton Corporation analyzes its recruiting data and concludes that recruits from Driftwood College tend to have good performance evaluations only if their GPAs are at least 3.0. Based on this "knowledge," Casleton's managers might choose to screen applicants from Driftwood College by their GPAs, interviewing only those graduates with at least a 3.0 GPA.

For this book, we will focus on representing information within computer systems. Note, however, that knowledge can also be represented within computers. One common kind of knowledge representation (KR) within computers is part of the field of *artificial intelligence* (AI). One common business application of AI in business is in automated *business rules* systems. Another

Introductory Relational Database Design for Business, with Microsoft Access, First Edition.
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recently popularized AI application is the "Siri" personal assistant on iPhones and iPads, or the similar "Google Voice" app on Android devices. Although its business uses are substantial and gradually expanding, we will not discuss AI, as relational database systems are simpler and far more ubiquitous.

Information systems consist of the ways that organizations store, move, organize, and manipulate/process their information. The components that implement information systems – in other words, *information technology* – consist of the following:

- Hardware – physical tools: computer and network hardware, but also low-tech objects such as pens and paper
- Software – (changeable) instructions for the hardware (when applicable; the simplest hardware does not need software)
- People
- Procedures – instructions for people
- Data/databases

Information systems existed before computers and networks – they just used relatively simple hardware that usually did not need software (at least as we know it today). For example, filing all sales receipts alphabetically by customer in a filing cabinet is a form of information system, although it is not electronic. Tax records kept on clay tablets by ancient civilizations were also a form of information system. Strictly speaking, this book is about an aspect of CBISs (computer-based information systems). Because of the present ubiquity of computers in information systems, we usually leave out the "CB," treating it as implicit.

Present-day CBISs have the following advantages over older, manual information systems:

- They can perform numerical computations and other data processing much more quickly, accurately, and cheaply than people.
- They can communicate very quickly and accurately.
- They can store large amounts of information quickly and cheaply, and information retrieval can often be very rapid.
- They can, to varying degrees, automate tasks and processes that previously required human labor.
- Information no longer needs to be "stuck" with particular things, locations, or people.

However, increasingly, automated systems can have drawbacks, such as the following:

- Small errors can have a much wider impact than in a less automated system. For example, in March 2003, a minor software bug in some airport data collection code – which programmers were aware of but considered too small to cause operational problems – grounded all aircraft in Japan for two days.

- Fewer people in the organization understand exactly how information is processed.
- Sometimes, malfunctions may go unnoticed. For example, American Airlines once discovered a serious bug in its "yield management" software only after reporting quarterly results that were significantly lower than expected. ("Yield management" refers to the process of deciding how many aircraft seats to make available for sale at different fare levels.)

Information architecture is the particular way an organization has arranged its information systems: for example, a particular network of computers running particular software might support a firm's marketing organization, while another network of computers running different software might support its production facilities, and so forth.

Information infrastructure consists of the hardware and software that support an organization's information architecture, together with the personnel and services dedicated primarily to maintaining and developing that hardware and software.

Application and *application program* (nowadays sometimes simply "app") are somewhat ill-defined terms but typically denote computer software and databases supporting a particular task or group of tasks. For example, a firm's human resource department might use one application to analyze benefit costs and usage, and another to monitor employee turnover.

A classic business IT problem is that applications, especially those used by different parts of an organization, may not communicate with one another effectively – for example, a new hire or retirement might have to be separately entered into both of the human resources systems described above because they do not communicate or share a common database.

Types of Information Systems

Particular information systems may be intended for use at one or more *levels* of an organization, as follows (Figure 1.1):

- The operational level – day-to-day operations and routine decisions. In an airline, for example, an operational decision is whether to cancel a particular flight on a particular day, or what type of aircraft to schedule on a particular flight during the summer flying season. Operational events that that might need to be recorded could include a customer scanning her boarding pass as she boards a flight, or an aircraft arriving at its destination gate.
- The strategic level – the highest-level, "big picture" decisions. In the example of an airline, whether to serve the Asia–US market, or whether to emphasize cost over service quality.

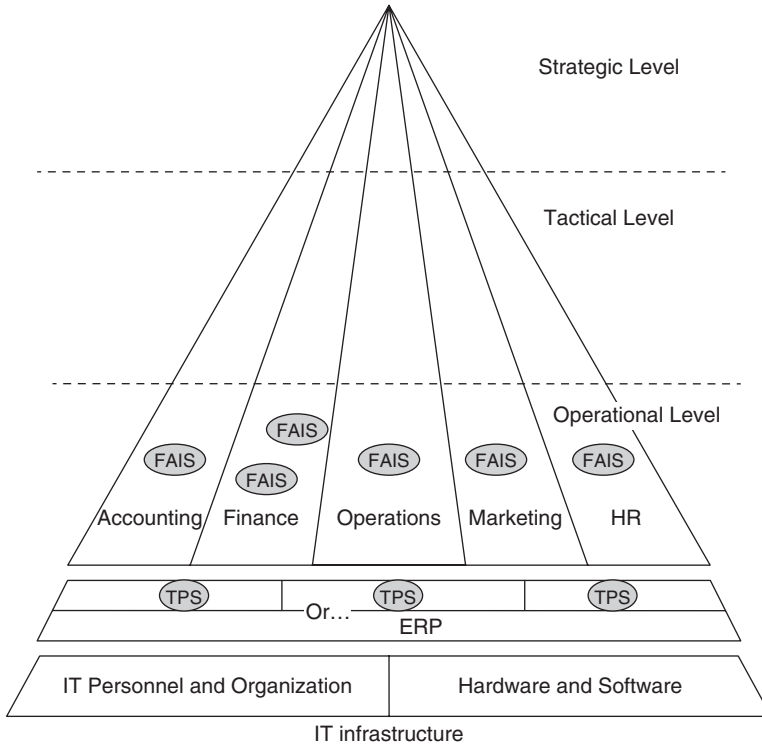

Figure 1.1 Information systems and the levels of an organization.

- The tactical level – decisions in between operational and strategic levels; for an airline, such a decision might be whether to increase or decrease service to a particular city.

In reality, the boundaries between these levels are typically somewhat indistinct: the levels form a continuous "spectrum." But labeling different segments of this spectrum as "levels" is useful conceptually.

Organizations are also typically divided into *functional areas*, meaning that different parts of the organization have different functions (that is, they do different things). These divisions vary by organization, but Figure 1.1 shows a fairly standard division into accounting, finance, operations, marketing, and human resources.

Transaction processing systems (TPSs) gather data about everyday business events in "real time" as they occur. Examples:

- You buy three items at a local store.
- A shipment of coffee beans arrives at a local distribution center.
- A passenger checks in for a flight.
- A package is unloaded from a FedEx or UPS aircraft.

Although only one of the above events is a transaction in the classical economic sense, from an information systems perspective all of these events are examples of *transactions* that may be immediately tracked by a TPS. Often, technology like barcodes and scanners makes tracking such transactions quicker, cheaper, and more detailed than if their associated data were to be keypunched manually. TPS systems are always operational-level systems, but they may also be used at other levels, or feed information to other systems at higher levels.

Functional area information systems (FAISs), also called *departmental information systems* (DISs), are designed to be operated within a single traditional functional department of an organization such as sales, human resources, or accounting. In the early days of CBIS, these were often the only kind of systems that were practical, because managing the data from more than one functional area would have required too much storage or computing power for a single system.

When an organization has multiple functional area systems, properly coordinating them becomes a potentially difficult issue. The systems may require overlapping data and can therefore become "out of sync" with one another. *ERP (enterprise resource planning) systems* are a relatively extreme reaction to the problem of poorly coordinated functional area systems, and are offered by vendors such as SAP and Oracle. They aim to support the entire organization's needs with essentially one single integrated system. They have enormous potential benefits but are also notoriously tricky and expensive to configure and install. Note that the only really meaningful word in the ERP acronym is "enterprise," denoting a system for the entire enterprise, and the reasons for "resource planning" in the acronym are historical. Such systems can perform resource planning but not particularly more than any other business function.

Some other common terms, some of which we will define in more detail later in the book, include the following:

- MIS – *management information system* – refers to a standard system that consolidates operational data into reports useful to managers.
- DSS – *decision support system* – refers to a system designed to help analyze and make specific kinds of decisions (at any level of the management hierarchy).
- ES – *expert system* – refers to a system that mimics the knowledge and behavior of human experts in particular domains, such as diagnosing problems with complicated equipment.
- EIS – *executive information system* – refers to a system that is designed to provide executives with information to assist them in making high-level (strategic or tactical) decisions.
- An *interorganizational system* (IOS) is a system that connects two organizations – for example, it may allow a company to automatically share inventory and backlog data with suppliers or customers.
- *Electronic commerce* or *e-commerce* refers to sales transactions in which at least one side of the transaction (buyer or seller), and perhaps both, is performed by a CBIS without direct human intervention.