Modeling Time-Dependent Data

Database contents vary over time. With renewed interest today in traceability and reconstruction of a historical picture of the organization for various regulatory requirements. For example, in a database that contains product information, the unit price for each product may be changed as material and labor costs and market conditions change. If only the current price is required, Price can be modeled as a single-valued attribute. However, for accounting, billing, financial reporting, and other purposes, we are likely to need to preserve a history of the prices and the time period during which each was in effect. As Figure 2-19 shows, we can conceptualize this requirement as a series of prices and the effective date for each price. This results in the (composite) multivalued attribute named Price History, with components Price and Effective Date.

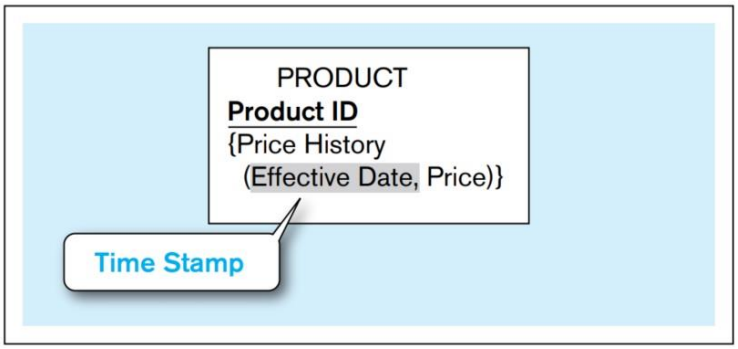

Figure 2-19 Simple example of time stamping

In Figure 2-19, each value of the attribute Price is time stamped with its effective date. A **time stamp** is simply a time value, such as date and time, that is associated with a data value. A time stamp may be associated with any data value that changes over time when we need to maintain a history of those data values.

Modeling Multiple Relationships between Entity Types

There may be more than one relationship between the same entity types in a given organization. An example is shown in Figure 2-21. Figure 2-21 shows two relationships between the entity types EMPLOYEE and DEPARTMENT. In this figure, we use the notation with names for the relationship in each direction; this notation makes explicit what the cardinality is for each direction of the relationship. One relationship associates employees with the department in which they work. This relationship is one-to-many in the Has Workers direction and is mandatory in both directions. That is, a department must have at least one employee who works there (perhaps the department manager), and each employee must be assigned to exactly one department.

The second relationship between EMPLOYEE and DEPARTMENT associates each department with the employee who manages that department. The relationship from DEPARTMENT to EMPLOYEE (called Is Managed By in that direction) is a mandatory one, indicating that a department must have exactly one manager. From EMPLOYEE to DEPARTMENT, the relationship (Manages) is optional because a given employee either is or is not a department manager.

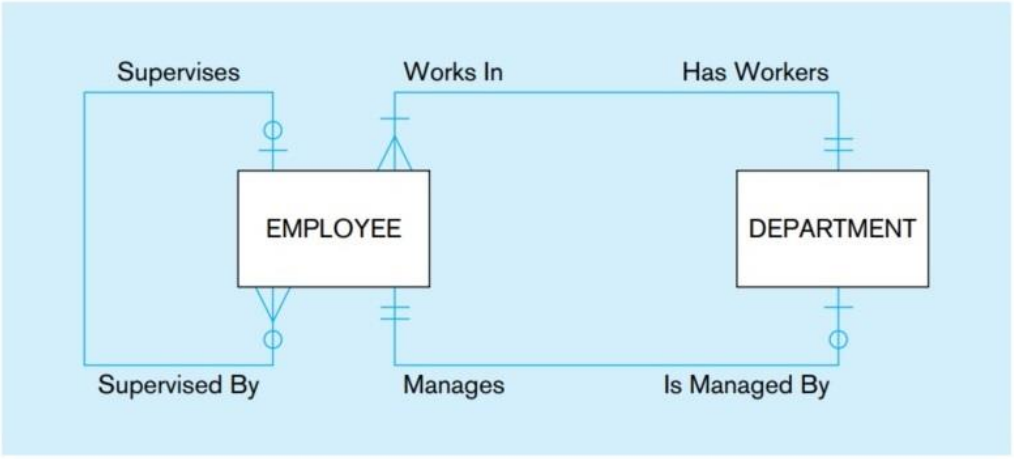

Figure 2-21 Example of multiple relationships

Figure 2-21 also shows the unary relationship that associates each employee with his or her supervisor, and vice versa. This relationship records the business rule that each employee may have exactly one supervisor (Supervised By).

Conversely, each employee may supervise any number of employees or may not be a supervisor.

Naming and Defining Relationships

In addition to the general guidelines for naming data objects, there are a few special guidelines for naming relationships, which follow:

• A relationship name is a *verb phrase* (such as Assigned To, Supplies, or Teaches). Relationships represent actions being taken, usually in the present tense.

• You should *avoid vague names*, such as Has or Is Related To. Use descriptive, powerful verb phrases, often taken from the action verbs found in the definition of the relationship.