THE E-R MODEL: AN OVERVIEW

An entity-relationship model (E-R model) is a detailed, logical representation of the data for an organization or for a business area.

The E-R model is expressed in terms of entities in the business environment, the relationships (or associations) among those entities, and the attributes (or properties) of both the entities and their relationships.

An E-R model is normally expressed as an entity-relationship diagram (E-R diagram, or ERD), which is a graphical representation of an E-R model.

Sample E-R Diagram

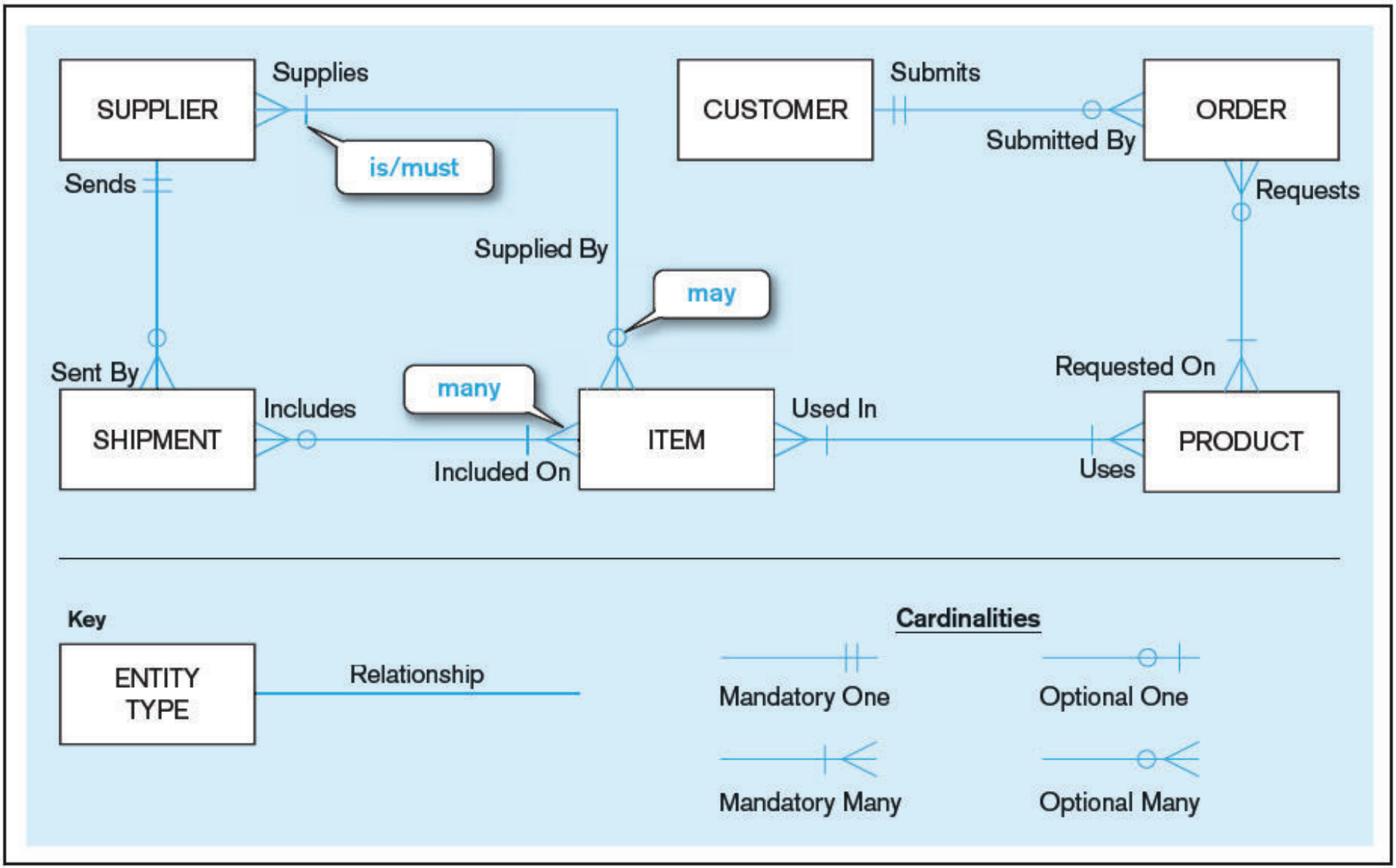
Figure in the next slide presents a simplified E-R diagram for a small furniture manufacturing company, Pine Valley Furniture Company.

A number of suppliers supply and ship different items to Pine Valley Furniture.

The items are assembled into products that are sold to customers who order the products.

Each customer order may include one or more lines corresponding to the products appearing on that order.

FIGURE 2-1 Sample E-R diagram



The diagram in Figure 2-1 shows the entities and relationships for this company. (Attributes are omitted to simplify the diagram for now.) Entities (the objects of the organization) are represented by the rectangle symbol, whereas relationships between entities are represented by lines connecting the related entities. The entities in Figure 2-1 are:

CUSTOMER	A person or an organization that has ordered or might order products. *Example*: L. L. Fish Furniture.
PRODUCT	A type of furniture made by Pine Valley Furniture that may be ordered by customers. Note that a product is not a specific bookcase, because individual bookcases do not need to be tracked. *Example*: A 6-foot, 5-shelf, oak bookcase called O600.
ORDER	The transaction associated with the sale of one or more products to a customer and identified by a transaction number from sales or accounting. *Example*: The event of L. L. Fish buying one product O600 and four products O623 on September 10, 2010.
ITEM	A type of component that goes into making one or more products and can be supplied by one or more suppliers. *Example*: A 4-inch ball-bearing caster called I-27–4375.
SUPPLIER	Another company that may provide items to Pine Valley Furniture. *Example*: Sure Fasteners, Inc.
SHIPMENT	The transaction associated with items received in the same package by Pine Valley Furniture from a supplier. All items in a shipment appear on one bill-of-lading document. *Example*: The receipt of 300 I-27-4375 and 200 I-27-4380 items from Sure Fasteners, Inc., on September 9, 2010.

The symbols at the end of each line on an ERD specify relationship cardinalities, which represent how many entities of one kind relate to how many entities of another kind.

The cardinality symbols express the following business rules:

1. A SUPPLIER may supply many ITEMs (by "may supply," we mean the supplier may not supply any items). Each ITEM is supplied by any number of SUPPLIERs (by "is supplied," we mean that the item must be supplied by at least one supplier). See annotations in Figure 2-1 that correspond to underlined words.
2. Each ITEM must be used in the assembly of at least one PRODUCT and may be used in many products. Conversely, each PRODUCT must use one or more ITEMs.
3. A SUPPLIER may send many SHIPMENTs. However, each shipment must be sent by exactly one SUPPLIER. sends and supplies are separate concepts. A SUPPLIER may be able to supply an item, but may not yet have sent any shipments of that item.
4. A SHIPMENT must include one (or more) ITEMs. An ITEM may be included on several SHIPMENTs.
5. A CUSTOMER may submit any number of ORDERs. However, each ORDER must be submitted by exactly one CUSTOMER. Given that a CUSTOMER may not have submitted any ORDERs, some CUSTOMERs must be potential, inactive, or some other customer possibly without any related ORDERs.
6. An ORDER must request one (or more) PRODUCTs. A given PRODUCT may not be requested on any ORDER, or may be requested on one or more orders.

There are actually two business rules for each relationship, one for each direction from one entity to the other. Note that each of these business rules roughly follows a certain grammar:

<entity> <minimum cardinality> <relationship> <maximum cardinality> <entity>

For example, rule 5 is:

<CUSTOMER> <may> <Submit> <any number> <ORDER>

This grammar gives you a standard way to put each relationship into a natural English business rule statement.

E-R Model Notation

The notation we use for E-R diagrams is shown in Figure 2-2. As indicated in the previous section, there is no industry-standard

The notation in Figure 2-2 combines most of the desirable features of the different notations that are commonly used in E-R drawing tools today and also allows us to model accurately most situations that are encountered in practice.

FIGURE 2-2 Basic E-R notation