* Chapter 2(Hoffer, Ramesh, & Topi)
  + Problems and Exercises 1 (a, b,c,d,e,f), 2,4,5,6,11 (a,b,c,)

**Answers to Problems and Exercises**

1. Each answer refers to Figure 2-22 found in the chapter text.
   1. Where is a unary relationship, what does it mean, and for what reasons might the cardinalities on it be different in other organizations?

A unary relationship is shown with the EMPLOYEE entity; An EMPLOYEE Supervises 0:M EMPLOYEEs, An EMPLOYEE Is Supervised By 0:1 EMPLOYEE. This relationship tells us that we can determine what employees are supervised by another employee, as well as determine which employees are supervisors in this company.

In other organizations, there may be different policies regarding employee supervision that could cause the data relationships among EMPLOYEE instances to be different. For instance, another company might allow an employee to have multiple supervisors (e.g., in an organization with a matrix structure).

* 1. Why is Includes a one-to-many relationship and why might this ever be different in some other organization?

Includes is a one-to-many (1:M) relationship because of the business rules that PVFC has in place: “a product line may group any number of products but *must group at least one product*; and each product *must belong to exactly one product line*.” Another organization may have other business rules that could permit a product being assigned to more than one product line (changing Includes to a M:N relationship). Alternatively, another organization might also show Includes as a (1:M) overall relationship but might permit the establishment of a PRODUCT LINE without identifying PRODUCTs that belong to this group (e.g., thus permitting an optional minimum cardinality on the PRODUCT side of the Includes relationship).

* 1. Does Includes allow for a product to be represented in the database before it is assigned to a product line (e.g., while the product is in research and development)?

No, Figure 2-22 shows that the PRODUCT must be Included in at least 1 PRODUCT LINE by the mandatory 1 and only 1 cardinality notation near the PRODUCT LINE portion of the Includes relationship line. The cardinality notation would have to be changed to show optional 1 cardinality in order to represent the research and development situation.

* 1. Suppose there is a rating of the competency for each skill an employee possesses, where in the data model would we place this rating?

The Has Skill associative entity, that associates a single instance of a SKILL with a single instance of an EMPLOYEE, would permit the tracking of a competency rating for each skill in which an employee has competence.

* 1. What is the meaning of the Does Business In associative entity and why does each Does Business In instance have to be associated with exactly one TERRITORY and CUSTOMER?

The Does Business In associative entity associates a single instance of a TERRITORY with a single instance of a CUSTOMER for the overriding M:N Does Business In relationship between TERRITORY and CUSTOMER. Each Does Business In instance must be related to exactly one TERRITORY and one CUSTOMER because the business rules of PVFC indicate that sales territories have been established for its customers. In particular, the rules are: *a TERRITORY has one-to-many CUSTOMERs; and a CUSTOMER may do business in 0:M TERRITORIES.* When converting this M:N relationship on the ERD, the cardinalities near the originating entities will always be mandatory 1, indicating the exactly one relationship with each entity’s instances and the associative entity’s instance.

* 1. In what way might Pine Valley change the way it does business that would cause the Supplies associative entity to be eliminated and the relationships around it change?

According to current business practice at PVFC, each RAW MATERIAL is provided by 1 or more VENDORs and a VENDOR supplies 0, 1, or many RAW MATERIALs and this is represented by the Supplies associative entity. The PVFC could consider entering into exclusive supplier arrangements with particular vendors such that an instance of RAW MATERIAL is supplied by only 1 VENDOR. If that situation should occur, then the overall relationship between RAW MATERIAL and VENDOR would change to 1:M (instead of M:N) and the Supply Unit Price attribute could become part of the RAW MATERIAL entity instance; the Supplies associative entity would no longer need to be on the ERD.

1. Analysis of Figure 2-22:
   1. Entities PRODUCT, PRODUCT LINE; relationship Includes
   2. Entities CUSTOMER, ORDER; relationship Submits
   3. Entities ORDER, PRODUCT; associative entity ORDER LINE
   4. Entities CUSTOMER, TERRITORY; associative entity Does Business In
   5. Entities SALESPERSON, TERRITORY; relationship Serves
   6. Entities PRODUCT, RAW MATERIAL; relationship Uses
   7. Entities RAW MATERIAL, VENDOR; relationship Supplies
   8. Entities WORK CENTER, PRODUCT; associative entity Produced In
   9. Entities EMPLOYEE, WORK CENTER; associative entity Works In
   10. Entity EMPLOYEE; relationship Supervises, Is Supervised By
2. Problem 4

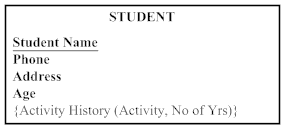
4a) The ERD for City B does not (nor does any ERD) tell us why the cardinality is 1:M. The more restrictive cardinality for City B could be due to a business rule that they want to maintain only current volunteers but it could also be due to only tracking the agency for which the volunteer works the most hours of assistance. More detailed discussions would need to be held with the end users to properly document this business rule; notes should be added to the diagram to depict the appropriate business rule.

4b) The ERD for City A shows that a volunteer may assist one, none, or several agencies.

4c) The native notation used in ERDs does not show whether membership in a relationship can change (i.e., whether a volunteer can change agencies or whether an agency can change its volunteers). Some DBMSs can be told whether membership can change or not, and special notation or textual notes can be added to an ERD to state such business rules. The minimum cardinality next to Agency does address whether a Volunteer must always be associated with an Agency to exist in the database, but none of the cardinalities control whether linkages between specific agencies and volunteers can change. More detailed discussions would need to be held with the end users to properly document this business rule; notes should be added to the diagram to depict the appropriate business rule.

|  |  |  |  |
| --- | --- | --- | --- |
|  | City A | City B | Can’t Tell |
| a. Which city maintains data about only those volunteers who currently assist agencies? |  |  | **X** |
| b. In which city would it be possible for a volunteer to assist more than one agency? | **X** |  |  |
| c. In which city would it be possible for a volunteer to change which agency or agencies she assists. |  |  | **X** |

1. Note: Assume Student Name is unique and available to be used as the identifier.



1. Are associative entities also weak entities? Why or why not? If yes, is there anything special about their “weakness”?

A weak entity requires the presence of another entity type; the weak entity does not exist independently from the other entity type and has no business meaning in the ERD without the other entity type. A weak entity will not have its own identifier, but will have a partial identifier attribute that will later be combined with the identifier of its strong entity owner to create a full identifier.

An associative entity is an entity type that associates the instances of one or more entity types and contains attributes specific to the relationship between those entity instances. An associative entity generally has independent business meaning to end users and can be identified with a single-attribute identifier. If an associative entity meets these conditions, then it would not be considered a weak entity.

