Chapter 3   The Enhanced E-R Model

Chapter Overview

The purpose of this chapter is to present some important extensions to the E-R model (described in Chapter 2) that are useful in capturing additional business meaning. In particular, we describe two types of extensions to the E-R model. First, the enhanced entity-relationship (EER) model includes constructs for supertype/subtype relationships. Second, the inclusion of new notation for business rules allows the designer to capture a broader range of constraints on the data model than were previously available.

Chapter Objectives

Specific student objectives are included in the beginning of the chapter. From an instructor’s point of view, the objectives of this chapter are to:

1. Introduce the concept of supertype/subtype relationships, and prepare the students to recognize when to use these relationships in data modeling.
2. Describe the use of specialization (top-down perspective) and generalization (bottom-up perspective) as complementary techniques for defining supertype/subtype relationships.
3. Introduce a notation for specifying both completeness constraints and disjointness constraints when modeling supertype/subtype relationships.
4. Help students gain sufficient perspective so that they recognize when to use (and when not to use) supertype/subtype relationships in realistic business situations.
5. Describe the basic premises of a business rules paradigm.
6. Discuss the concept of a universal data model and its use in packaged data models.

Key Terms

<table>
<thead>
<tr>
<th>Attribute inheritance</th>
<th>Generalization</th>
<th>Subtype discriminator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completeness constraint</td>
<td>Overlap rule</td>
<td>Supertype</td>
</tr>
<tr>
<td>Disjoint rule</td>
<td>Partial specialization rule</td>
<td>Supertype/subtype hierarchy</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>-----------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Disjointness constraint</td>
<td>Specialization</td>
<td>Total specialization rule</td>
</tr>
<tr>
<td>Enhanced entity-relationship (EER) model</td>
<td>Subtype</td>
<td>Universal data model</td>
</tr>
<tr>
<td>Entity cluster</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Classroom Ideas

1. Introduce the concept of supertypes and subtypes with a familiar example, such as VEHICLE (subtypes are CAR, TRUCK, SUV, etc.).
2. Introduce the basic notation for supertype/subtype relationships (Figure 3-1). Use this notation to represent the example you introduced in (1). Introduce your students to all three notation types.
3. Discuss the EMPLOYEE example with subtypes (Figure 3-2). Use this figure to introduce the concept of attribute inheritance.
4. Use Figure 3-3 to discuss the two major reasons for introducing supertype/subtype relationships: unique attributes among subtypes, and unique subtype relationships.
5. Contrast generalization and specialization using Figures 3-4 and 3-5. Have your students suggest other examples that use each of these approaches.
6. Introduce the completeness constraint using Figure 3-6. Give other examples where either the total specialization rule or the partial specialization rule is more appropriate.
7. Discuss the disjointness constraint and related notation using Figure 3-7. For reinforcement, have the students work Problem 3-25 or 3-26 (Problems and Exercises) in class.
8. Introduce notation for a subtype discriminator (Figures 3-8 and 3-9). Discuss why a different notation is required for the two cases shown in these figures.
9. Discuss entity clustering and illustrate with Figures 3-13 and 3-14.
10. Review the extended example of a supertype/subtype hierarchy shown in Figure 3-10. For reinforcement, ask the students to work Problem 3-19 (Problems and Exercises) in class.
11. Review universal data models and discuss how these are being used more widely today. Consider inviting an industry guest speaker to discuss how these universal data models are utilized in his/her company.
12. Ask your students for examples of other business situations they have encountered recently in their work, school, or home experience that could be modeled with supertype/subtype hierarchies. See if they can diagram these rules using the notation provided in this chapter.
Answers to Review Questions

3-1. Define each of the following terms:

a. Supertype. A generic entity type that has a relationship with one or more subtypes
b. Subtype. A subgrouping of the entity instances in an entity type that is meaningful to
   the organization
c. Specialization. The process of defining one or more subtypes of the supertype, and
   forming supertype/subtype relationships
d. Entity cluster. A set of one or more entity types and associated relationships grouped
   into a single abstract entity type
e. Completeness constraint. A type of constraint that addresses the question whether an
   instance of a supertype must also be a member of at least one subtype. The
   completeness constraint has two possible rules: total specialization and partial
   specialization
f. Enhanced entity-relationship (EER) model. The model that has resulted from
   extending the original E-R model with new modeling constructs such as supertypes
   and subtypes
g. Subtype discriminator. An attribute of the supertype whose values determine the
   target subtype (or subtypes)
h. Total specialization rule. Specifies that each entity instance of the supertype must be
   a member of some subtype in the relationship
i. Generalization. The process of defining a generalized entity type from a set of more
   specialized entity types
j. Disjoint rule. Specifies that if an entity instance (of the supertype) is a member of
   one subtype, it cannot simultaneously be a member of two (or more) subtypes
k. Overlap rule. Specifies that an entity instance can simultaneously be a member of
   two (or more) subtypes
l. Partial specialization rule. Specifies that an entity instance of the supertype is
   allowed not to belong to any subtype
m. Universal data model. A generic or template data model that can be reused as a
   starting point for a data modeling project

3-2. Match the following terms and definitions:

d supertype
f entity cluster
a subtype
e specialization
g subtype discriminator
c attribute inheritance
b overlap rule
3-3. Contrast the following terms:

a. **Supertype; subtype.** A supertype is a generalized entity type that has one or more subtypes, while a subtype is a subgrouping of the entity instances in a supertype.

b. **Generalization; specialization.** Generalization is the process of defining a generalized entity type from a set of more specialized entity types, while specialization is the process of defining one or more subtypes of the supertype.

c. **Disjoint rule; overlap rule.** With the disjoint rule an instance of a supertype must be a member of only one subtype at a given time. With the overlap rule an instance of a supertype may simultaneously be a member of two or more subtypes.

d. **Total specialization rule; partial specialization rule.** With the total specialization rule, each instance of the supertype must be a member of some subtype in the relationship. With the partial specialization rule, an instance of the supertype is allowed not to belong to any subtype.

e. **PARTY; PARTY ROLE.** In a universal data model, PARTY represents persons and organizations independent of the roles they play whereas PARTY ROLE contains information about a party for an associated role.

f. **Entity; entity cluster.** An entity is a person, place, object, event, or concept in the user environment about which the organization wishes to maintain data. An entity cluster is a set of one or more entity types and associated relationships grouped into a single abstract entity type.

3-4. Two conditions for using supertype/subtype relationships:

a. There are attributes that apply to some (but not all) of the instances of an entity type.

b. There are relationships that apply to some (but not all) of the instances of an entity type.

3-5. Reasons for using an entity clustering approach:

a. Simplifying the presentation of a complex enterprise-wide E-R diagram.

b. Enabling a hierarchical decomposition of a macro-level data model into finer and finer views of the data.

c. Desiring to focus part of the model on an area of interest to a community of users.

d. Creating several different entity cluster segments each with a different focus, such as departments, information system applications, business processes, or corporate divisions.

3-6. An example of a supertype/subtype relationship:

The supertype PERSON has many possible subtypes: MALE, FEMALE, INFANT, TEENAGER, etc., assuming these different types of persons have somewhat different attributes or participate in different relationships. In an organizational context, PERSON may have subtypes of EMPLOYEE, CONTRACTOR, CUSTOMER, VENDOR, MANAGER, etc.
3-7. **Attribute inheritance explanation:**

Attribute inheritance is a property of the enhanced ER diagram that ensures subtype entity instances inherit the values of all attributes of their supertype. This property is important because it makes it unnecessary to include supertype attributes redundantly with subtypes.

3-8. **Examples of supertype/subtype relationship where:**

a. the disjoint rule applies: PERSON has subtypes MALE and FEMALE.

b. the overlap rule applies: PERSON has subtypes INSTRUCTOR and STUDENT.

3-9. **Types of business rules in EER:**

The types of business rules that are normally captured in an EER diagram include terms, relationship constraints, and supertype/subtype relationships (see Figure 3-11).

3-10. **Subtype discriminator purpose:**

The purpose of a subtype discriminator is to determine the target subtype (or subtypes) for each instance of a supertype.

3-11. **Usefulness of packaged data model:**

A packaged data model is most useful when one can easily customize it to the specific business (that is, the organization is very similar to other organizations for the same industry or purpose or the functional area is roughly the same as that functional area in other organizations). As long as the packaged data model is for the type of business or functional area, then it can generally be customized. The amount of customization depends upon the types of specialized business rules in place for the organization.

3-12. **Starting project with packaged data model vs. from scratch:**

A packaged data model provides the metadata of a standardized, industry-vetted data model usually built with a structured data modeling tool (i.e., ERWin from Computer Associates or Oracle Designer from Oracle Corporation). A data modeling project that starts with a packaged data model is different from one using a model developed from scratch along the following dimensions:

a. The project would begin by identifying the parts of the packaged data model that apply to your specific project’s data modeling situation, rather than beginning to draw model elements.

b. The identified data elements from the packaged data model would be renamed to terms local to the organization.

c. Data in the packaged data model would be mapped to data in current organization databases, with the intent of developing migration plans for converting organizational data.

i. Some of the data cannot be mapped (e.g., data elements in the package won’t be in the current systems, and likewise). Determine whether each
non-mapped item is essential and unique, as well as if these requirements are necessary now or in the future.

ii. A purchased data model will have business rules to cover all possible circumstances whereas your specific local situation may need less flexibility and complexity.

iii. The purchased data model can be used to “seed” questions for coverage with the end users of the new system and database, allowing for earlier and more in-depth participation of system users and managers in the data modeling project.

iv. The comprehensive nature of the purchased data model will likely force the project to prioritize the staging of systems requirements related to customization of the overall data model.

3-13. **Data profiling usage:**

Data profiling is a way to statistically analyze data to uncover hidden patterns and flaws. Profiling can find outliers, see shifts in data distribution over time, and identify other phenomenon. Each perturbation of the distribution of data may tell a story, such as showing when major application system changes occurred, or when business rules changed. Often these patterns suggest poorly designed databases (e.g., data for separate entities combined to improve processing speed for a special set of queries but the better structure was never restored). Data profiling can also be used to assess how accurate current data are and anticipate the clean-up effort that will be needed to populate the purchased data model with high-quality data.

3-14. **Skill needed for packaged data model vs. without:**

A data modeling project using a packaged data model requires at least the same amount of skill as a project not using a packaged data model. In some cases, it may require more skill. The primary reason is that when a data modeling project uses a packaged data model, the data modeler must customize the packaged data model to meet local organizational needs and constraints. Thus, a successful data modeler using a packaged data model needs advanced skills and knowledge about the organization’s business rules, complex data modeling formalisms, and the structured data modeling tool used to specify the packaged data model.

3-15. **Benefit of packaged data model:**

A packaged data model provides the metadata of a standardized, industry-vetted data model usually built with a structured data modeling tool (such as ERWin from Computer Associates or Oracle Designer from Oracle Corporation). The packaged data model contains a fully populated description of the data model and the structured data modeling tool that permits customization of the data model and printing of several reports from the model. The structured data modeling tool often includes the ability to produce SQL commands for database definition in a variety of database management systems.
3-16. Usefulness of supertype/subtype hierarchy:

A supertype/subtype hierarchy is useful when you have several subtypes that are also supertypes. An example would be for bank accounts. At the first level (supertype), you can have savings, checking and loans. Underneath loans, there are several subtypes, including personal, auto, home, etc.

3-17. Supertype/subtype membership:

3-18.

A member of a supertype is always a member of at least one subtype when the rule of total specialization applies to an EERD.

Solutions to Problems and Exercises

3-19. A supertype/subtype example listing follows for a GRADUATE STUDENT:

<table>
<thead>
<tr>
<th>Attribute Name</th>
<th>Data Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSN</td>
<td>736-94-1802</td>
</tr>
<tr>
<td>Name</td>
<td>Jessica James</td>
</tr>
<tr>
<td>Address</td>
<td>25 Lake Dr. Medford OR 95106</td>
</tr>
<tr>
<td>Gender</td>
<td>female</td>
</tr>
<tr>
<td>Date_of_Birth</td>
<td>Oct. 23, 1967</td>
</tr>
<tr>
<td>Major_Dept</td>
<td>Computer Science</td>
</tr>
<tr>
<td>Test_Score</td>
<td>986</td>
</tr>
</tbody>
</table>
3-20. Figure 3-10 with subtype discriminators
3-21. Adding subtype discriminators

a. Figure 3-2, revised

b. Figure 3-3, revised
c. **Figure 3-4b, revised**

![Vehicle Diagram](image)

- **VEHICLE**
  - **Vehicle ID**
  - Price
  - Engine Displacement
  - Vehicle Name
  - (Make, Model)
  - Vehicle Type

  Vehicle Type =

  ![Tree Diagram](image)

  "C"
  - **CAR**
    - No Of Passengers

  "T"
  - **TRUCK**
    - Capacity
    - Cab Type

---

d. **Figure 3-7a, revised**

![Patient Diagram](image)

- **PATIENT**
  - **Patient ID**
  - Admit Date
  - Patient Type

  Patient Type =

  ![Tree Diagram](image)

  "O"
  - **OUTPATIENT**
    - Checkback Date

  "I"
  - **RESIDENT PATIENT**
    - Date Discharged

- **RESPONSIBLE PHYSICIAN**
  - **Physician ID**

  Is Cared For

- **BED**
  - **Bed ID**

  Is Assigned
e. Figure 3-7b, revised

![Database diagram](image)

3-22. Sample definitions for Figure 3-2:

EMPLOYEE: a person who has signed an employment agreement or contract with the company

HOURLY EMPLOYEE: an employee whose pay is based on number of hours worked

SALARIED EMPLOYEE: an employee who receives a fixed salary each pay period

CONSULTANT: an employee who has signed a contract to perform certain tasks and whose pay is based on an agreed billing rate

Employee Number: an employee’s identification number

Employee Name: an employee’s name consisting of first name, middle initial, and last name

Address: an employee’s home address, consisting of street address, city, state, and zip code

Date Hired: the date when an employee signed an employment agreement or contract

Hourly Rate: the pay rate ($/hour) for an hourly employee

Annual Salary: the base annual salary for a salaried employee

Stock Option: the annual compensation (shares/year) of company stock for a salaried employee

Contract Number: the number of the contract signed by a consultant

Billing Rate: the compensation ($/hour or other stated period) on the employment contract signed by a consultant

3-23. Sample definitions for Figure 3-3:

PATIENT: a person who has been admitted to the hospital, or to a treatment program administered by the hospital

OUTPATIENT: a person who has been admitted to a program of treatment administered by the hospital
RESIDENT PATIENT: a person who has been admitted for a stay in the hospital and assigned to a bed location

RESPONSIBLE PHYSICIAN: a physician who has formally admitted patient to the hospital

BED: a hospital bed located within a room in the hospital

Is Cared For: the relationship between a physician and a patient admitted to the hospital by that physician

Is Assigned: the relationship between a resident patient and the hospital bed to which that patient is assigned

Patient ID: a patient’s identification number

Patient Name: a patient’s first and last name

Admit Date: the date when a patient was most recently admitted to the hospital or to a treatment program

Checkback Date: the date when an outpatient is scheduled for a return visit

Date Discharged: the date when a resident patient was discharged following the most recent stay in the hospital

Physician ID: a unique identification number for an admitting physician

Bed ID: a unique identification number for each hospital bed

3-24. **Explanation of Figure 3-13b questions**

a. Because only regular customers (as opposed to national customers) do business in a sales territory, not all instances of the customer entity cluster do business in a selling unit. However, because all sales territories do business with at least one regular customer, then all sales territories do business with at least one instance of a customer entity cluster.

b. The attributes of item would be the attributes of PRODUCT and PRODUCT LINE from Figure 2-22: Product ID, Product Description, Product Finish, Product Standard Price, Product Line ID, and Product Line Name.

c. The attributes of material would be the attributes of RAW MATERIAL, SUPPLIES, SUPPLIER, and VENDOR from Figure 2-22: Vendor ID, Vendor Name, Vendor Address, Supply Unit Price, Material ID, Unit Of Measure, Material Name, and Material Standard Cost.
3-25. **Virtual Campus:**
3-26. *Library situation analyses and EERD segments*

*a. A holding is exactly one subtype*

![Diagram of HOLDING with subtypes]

*b. A holding may or may not be a subtype; but only one subtype at a time*

![Diagram of HOLDING with multiple subtypes]
c. A holding may or may not be a subtype; but can be more than 1 at a time.

d. A holding must be a subtype; but can be more than 1 at a time.
3-27. **Bank situation, standard EER Notation:**

![Diagram showing Account Type and subtypes](image)

**Bank situation, Visio Notation:**

![Diagram showing Account Type and subtypes](image)
Bank situation, Subtype in Supertype Notation:

```
<table>
<thead>
<tr>
<th>ACCOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acct No</td>
</tr>
<tr>
<td>Date Opened</td>
</tr>
<tr>
<td>Balance</td>
</tr>
<tr>
<td>Account Type</td>
</tr>
</tbody>
</table>

  | CHECKING         |
  | Service Charge   |

  | SAVINGS          |
  | Interest Rate Sav|

  | LOAN             |
  | Interest Rate Loan Payment |
```
There are three entity clusters: Project Detail, Employee Detail, and Dept Detail. Project Detail contains the set of entities that would be used by one interested in the project without concern for the specific employees on the project. An assumption is that the only concern from the project side is to track employee skills and location, not individual employees.

The Employee Detail cluster would be of most value to the user who was interested in what skills specific employees have as well as location. Other details are available in this cluster, such as marriage. This cluster was chosen since one can then isolate employee information without looking at project information.

The Dept Detail cluster was chosen since one might not be concerned about vendors; however one might want to know for what department a given employee works. In the same way, one might want specifics about vendors without needing information about employees or projects.

See diagram on next page.
E-R Diagram from Chapter 2, Problem 23 with Entity Clusters

- **VENDOR**
  - Vendor ID
  - Vendor Name
  - Vendor Address

- **DEPARTMENT**
  - Dept Name
  - Dept Phone

- **EMPLOYEE**
  - Emp No
  - Emp Name
  - Emp Title
  - Emp Date Of Birth

- **EMPLOYEE**
  - Belongs To

- **SKILL**
  - Skill No
  - Skill Description

- **EMP SKILL**

- **PROJECT**
  - Proj No
  - Proj Est Cost

- **PROJECT**
  - Assigned To

- **LOCATION**
  - Loc ID
  - Loc City
  - Loc State
  - Loc Population

- **LOCATION**

- **Date Last Meeting**

- **Dept Phone**

- **Is Married To**

- **Date Married**
3-29.  E-R Diagram for P&E 3-24f with Entity Clusters:
3-30. Non-profit organization.

Please note that the problem does not explicitly state that Skill is a multivalued attribute. Given the fact that examples in the text have skill as a multivalued attribute, we have made this assumption here also.

Nonprofit situation, EER Notation:
Non-profit organization, Visio Notation:
Nonprofit organization, Subtypes inside Supertypes Notation
3-31. **Note:** Again, we have assumed that Skill is a multivalued attribute. Also, note that the reference in the P&E 3-30 specification is incorrect. It should have been 3-29 instead of 2-29.

Nonprofit organization, EER Notation, revised:
Nonprofit organization, Visio Notation, revised:

```
<table>
<thead>
<tr>
<th>PERSON</th>
</tr>
</thead>
<tbody>
<tr>
<td>PK</td>
</tr>
<tr>
<td>SSN</td>
</tr>
</tbody>
</table>

Name
Address
City
State
Zip Code
Telephone
Donor?
Employee?
Volunteer?

Person Type:

Donor? = "Y"  Employee? = "Y"  Volunteer? = "Y"

DONOR

EMPLOYEE

Date Hired

VOLUNTEER

HAS SKILL

ITEM

SKILL
```
Nonprofit organization, Subtypes inside Supertypes Notation, revised
3-32. Technology Company ERD

CUSTOMER
Customer ID
Name
Address
Phone Number

BILLING
Service Date
Bill Due Date
Amount Due

Purch Date
Cust Contact

Purchases

OFFERING
Offering ID
Description
Offering Type

Offering Type =

PRODUCT
Product Name
Std Price
First Release Date

SERVICE
Unit Resp Name
Service Conditions
Service Type

Service Type =

REPAIR
Cost

MAINTENANCE
Hourly Rate

"P"

"S"

"R"

"M"
Note to Instructor: This Problem & Exercise has a different written scenario than a similar one in Chapter 2. The plural “requested judgment characteristics” in Chapter 2 is semantically different from this exercise’s “requested judgment characteristic” which results in the alternate model solution shown below. This may be useful to point out to students regarding the importance of paying attention to subtle details while modeling data.

Diagram Notes for Problem and Exercise 3-32:

a. Person Or Org attribute denotes Person or Organization type of Legal Entity. There is no reason to show Person and Organization as subtypes of Legal Entity, as there are no special attributes or relationships identified in the scenario.

b. The same legal entity cannot be both a Plaintiff and Defendant in the same Case.

c. Although DEFENDANT has no other unique attributes, it is required as a subtype to show the parties involved in a CASE. Further, the DEFENDANT subtype is necessary to show the Brought Against role that is necessary to defining the parties in a CASE.
3-34. School of Technology, EERD notation:
School of Technology, Visio notation:
School of Technology, Subtype within Supertype notation:
3-35. Fin and Finicky Security Consultants.

EER Diagram Notes (for all notations):

a) A CONSULTANT is either a Business or Technical consultant, not both.

Consulting Firm, EER Notation:
Fin and Finicky Security Consultants, Visio notation:
Fin and Finicky Security Consultants, Subtype within Supertype Notation:
3-36. Consulting Firm, P&E 3-34, Selected Sample Definitions

CONSULTANT: a person who has signed an employment agreement or contract with the company, and who is on the company payroll

BUSINESS CONSULTANT: a consultant who provides an estimate to a customer

TECHNICAL CONSULTANT: a consultant who provides security services to a customer

CUSTOMER: a business that has a need for security services

LOCATION: a customer’s place of business

SERVICE: a security service that can be performed

ESTIMATE: A written estimate prepared by a business consultant for a location

SERVICE PERFORMED: actual services performed by a technical consultant for a location

Emp ID: a consultant’s employee identification number

Degree: a consultant’s academic degree

Business Experience: a business consultant’s business experience

Tech Skills: a technical consultant’s technical expertise

Coverage: how much of an area a service covers for a given location
3-37.  DocIT EERD
Diagram Notes for Problem and Exercise 3-37:

a. Owners wish to know the attendance and Price Charged for each TIMESLOT (i.e., there is a charge with an attendance to see everything shown on a SCREEN in the same TIMESLOT).

b. Movie Seq No tracks the sequence in which movies are shown in the TIMESLOT (e.g., in a timeslot there might be two trailers, followed by two commercials, followed by a feature film, and closed with a commercial).
3-39. Revision to Figure 3-16

Diagram Notes for Problem and Exercise 3-38:

a. A PERSON, in his/her EMPLOYMENT, may hold multiple POSITIONs or not yet have an assigned POSITION (this is shown with the 0:M cardinality near POSITION from EMPLOYMENT).

b. A POSITION might initially be unfilled, or over time, may be filled with multiple EMPLOYMENT instances of PERSONs (this is shown by the 0:M cardinality near EMPLOYMENT from POSITION).
Suggestions for Field Exercises

3-40.

Common examples of supertype/subtype constructs may be easy for student interviewees to identify. Ask your students to try to find an example of each of the rules described in the chapter: disjoint, overlapping, partial specialization, and total specialization. Also, for each example, have your students identify a candidate subtype discriminator. Ask your students to justify the use of supertype/subtype relationships for each of these examples, using the guidelines stated in the chapter.

3-41.

We suggest that you use this exercise as a continuation of Field Exercise 2 in Chapter 2. Ask your students to determine whether supertype/subtype relationships are formally modeled in the corporate E-R diagrams. Also, ask your students to determine how business rules are stated and enforced by each organization.

3-42.

We suggest you assign this exercise in conjunction with Field Exercise 4 in Chapter 2.

3-43.

Following are several questions that can be used to structure this report:

a. How are business rules defined?
b. Why are business rules important to an organization?
c. What are alternative methods for capturing and expressing business rules?
d. What advantages can an organization realize by formally capturing business rules?

3-44.

The availability of Web sites that provide information on this topic changes rapidly. This might be an excellent exercise to bring in an industry guest speaker to address your students. Possible sites that students may find information about this topic include:

- [www.universaldatamodels.com](http://www.universaldatamodels.com) (Note: site will point to Embarcadero ER/Win product for more information on what the models include, but the images may not be fully readable)
- [www.inmoncif.com](http://www.inmoncif.com) (Note: under the “Corporate Information Factory” section, there are sample models available to view, however, visitors must register an email address to access the materials)
Project Questions

3-45.  *EER model for FAME*

See the model on p. 42.

3-46.  *Description of the thought processes that you went through to create the model in 3-44.*

Two different types of modifications are included in the EER model in the response of 3-44: a) those that are based on the need to apply supertype/subtype relationships to the diagram developed in the context of Chapter 2 and b) those that are created based on the new information presented in Chapter 3.

a.  Subtype/supertype relationships in the existing diagram:

- The recognition that Prospective Artist and Artist are subtypes of a general Artist entity.
- The recognition that Artist Expenses and Manager Expenses can be separated into subtypes so that the accuracy of the cardinalities can be improved.

b.  New information from the case that requires changes to the diagram:

- Pat Smith identifies a number of possible sources for recommendations for prospective artists. It seems based on the case that identifying SOURCE as a separate entity is justifiable. There does not, however, be enough differentiation between the source types to justify a subtype/supertype structure.
- Pat Smith provides useful information regarding the attributes required for ARTIST and RECOMMENDATION. To keep the diagram readable, the solution above leaves the following ARTIST attributes out: Year of Birth, {Instrument}, {University Degree}, Address, Phone Number, E-mail, {Honor}.
- Other Pat Smith requirements have been taken care of in the existing diagram or by the changes specified above.
- Shannon Howard makes an important contribution to articulating better the various types of time commitments an artist can have: Actual performance events, rehearsal periods, travel time, and personal time off. At least the event related categories and personal time off should be separated from each other, as has been done in the answer to 3-44. Firmness attribute of PERSONAL tells whether or not the personal commitment can be broken if a good enough opportunity emerges, and Category in PERF RELATED separates Performance, Rehearsal, and Travel.
- Multivalued attribute {Samples} has been added to Contracted Artist based on Shannon Howard’s recommendation.
- Also based on Shannon Howard’s recommendation, an attribute for At Source Tax Withheld is added to AGREEMENT.
3-47. *Identify a revised set of outputs*

The following outputs can be identified based on Chapter 3 material (in addition to those identified in Chapter 2):

- List of recommendations categorized and filtered in a number of ways to support review of prospective artists.
- List of prospective artists filtered appropriately together with all artist recommendations from a specific time period.
- Travel expense report for artist managers (a subset of a report from Chapter 3).
- A more detailed availability report than specified in Chapter 2.
- Inclusion of the At Source Tax in the revenue reports.

These requirements are already taken into account in the model included in 3-44.

3-48. *Plan for reviewing deliverables with appropriate stakeholders*

Meeting individually with Mr. Forondo, Pat Smith, and Alex Martin (at the minimum) is recommended to verify the sufficiency of the conceptual data model and the appropriateness of the design decisions. If possible, a group meeting would be useful after the individual discussions in order to consolidate different points of view. In addition to Mr. Forondo’s sign-off (assuming that he has not delegated that responsibility to somebody else), it is important that those involved in the day-to-day operations of the business also approve the model before moving on.
Question 3-44 Figure 1
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