

Chapter 3 Entity-Relationship Data Modeling: Process and Examples



DATABASE PROCESSING
Fundamentals, Design,
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A Data Modeling Process

- Steps in the data modeling process
 - Plan project
 - Determine requirements
 - Specify entities
 - Specify relationships
 - Determine identifiers
 - Specify attributes
 - Specify domains
 - Validate model

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Sources for DB Requirements

Figure 3.2 Sources for Database Requirements

- User Interviews
- User Activity Observations
- Existing Forms and Reports
- New Forms and Reports
- Existing Manual Files
- Existing Computer Files/Databases
- Formally Defined Interfaces (XML)
- Domain Expertise

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Planning the Project

- Obtaining project authorization and budget
- Building the project team
- Planning the team's activities
- Establishing tools, techniques, and standards for consistent results
- Defining the project's scope

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Determining System Requirements

- Sources for data modeling requirements
 - User interviews and user activity observations
 - Existing forms and reports
 - New forms and reports
 - Existing manual files
 - Existing computer files/databases
 - Formally defined interfaces (XML)
 - Domain expertise
- The result of the requirements determination will be a repository of notes, diagram, forms reports, files, etc., that can be used to develop the data model

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Specifying Entities

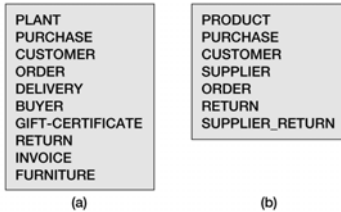
- An entity is something that the users want to track; something the users want to keep data about
- Entities
 - can be physical things or logical concepts
 - are identifiable; you can tell one from another
 - are things described by nouns, not characteristics described by adjectives

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Padden Creek Gardens

Figure 3.3 Entity Lists for Padden Creek Gardens;
(a) Initial Entity List and (b) Final Entity List



Padden Creek Gardens

Figure 3.4 Entity Descriptions

Entity	Description
PRODUCT	A product that is ordered from suppliers and purchased by customers. Products are identified by name of plant or product type, not by individual item. Thus, a product is "Poinsettia, Azalea," or "Festive Planter," not a particular potted plant or planter.
PURCHASE	A record of items purchased by a customer. Many purchases are written as cash sales and do not include identifying customer information. The record of credit card purchases has the credit card receipt stapled to it, but there is no goal to track customer credit card data. The identifying customer data is recorded for purchases over \$150 and for purchases by frequent buyers.
CUSTOMER	Someone who buys from Padden Creek. Identifying data is kept only for certain customers.
SUPPLIER	A vendor of plants, furniture, or other items to Padden Creek.
ORDER	An order of products from a supplier.
RETURN	A record of the return of a product to us by a customer.
SUPPLIER_RETURN	A record of the return of a product to a supplier by us.

Specifying Relationships

- Includes:
 - Identity of the parent and child entities
 - Relationship type
 - Minimum and maximum cardinalities
 - Name of the relationships
- Two techniques:
 - Examine whether a relationship exists between every combination of two entities
 - Locate relationships from requirement documents
- A combination of the two approaches may be used

Potential Relationship Diagram

Figure 3.5 Potential Relationship Diagram

	CUSTOMER	CUSTOMER_ORDER	PRODUCT	PURCHASE	RETURN	SUPPLIER	SUPPLIER_RETURN
CUSTOMER	X						
ORDER		X					
PRODUCT			X				
PURCHASE				X			
RETURN					X		
SUPPLIER						X	
SUPPLIER_RETURN							X

Y → Yes, there is a possible direct relationship
Blank → Relationship is unlikely

Determining Identifiers

Identifiers are keys

- Identifier is an attribute or group of attributes that uniquely identifies an entity instance
- If there is difficulty specifying an identifier, maybe:
 - it should be part of a different entity
 - it is a subtype or category of a common entity
 - it needs one or more identifying relationships

Specifying Attributes and Domains

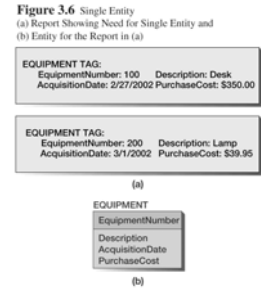
- Find attributes on forms, reports, existing files, etc., and add them to entities
- Determine whether the attribute has already defined a domain
 - If so, the attribute is based upon that domain
 - If not, a new domain is defined
- Review the domains and make adjustments as necessary
- Domain property inheritance: when the domain properties change, all the attribute properties change as well
- Domains may be used to enforce data standards promoting compatible data types and systems
- Once all attributes have been specified the model should be reviewed for missing entities

Validating Model

- Data model is a model of humans' models, not a model of reality
- A data model is wrong if it does not accurately reflect the ways the users think about their world
- Data models are validated through a series of reviews
 - Normally, a team review is followed by user reviews
- E-R model as well as prototypes of forms and reports may be used to communicate to users features of the data model

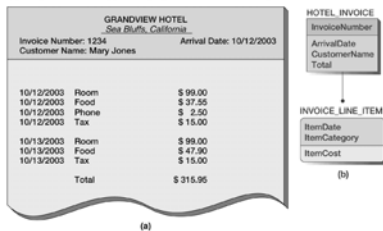
Creating Data Models From Forms and Reports

- Example: Single entities



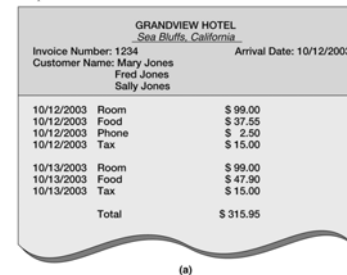
Example: Identifying Connection Relationships

Figure 3.7 Identifying Connection Relationships
(a) Sample Invoice and (b) Identifying Connection Relationship



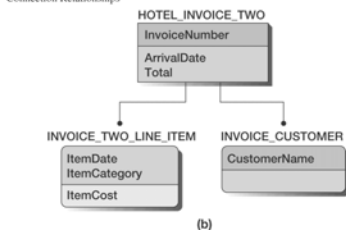
Example: Repeating Groups

Figure 3.8a Hotel Invoice with Two Repeating Groups — Sample Invoice



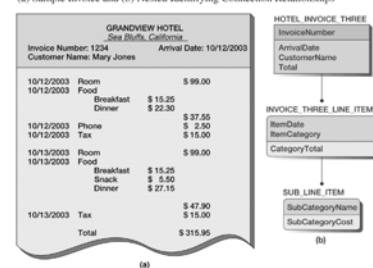
Example: Repeating Groups

Figure 3.8b Hotel Invoice with Two Repeating Groups — Two Identifying Connection Relationships



Example: Nested Groups

Figure 3.9 Hotel Invoice with Nested Groups
(a) Sample Invoice and (b) Nested Identifying Connection Relationships



Example: Non-Identifying Connection Relationships

- Example: 1:1

Figure 3.10a 1:1 Non-Identifying Connection Relationship — Sample Forms

VEHICLE DATA			
License number	Serial number		
Make	Type	Year	Color
Employee assignment			

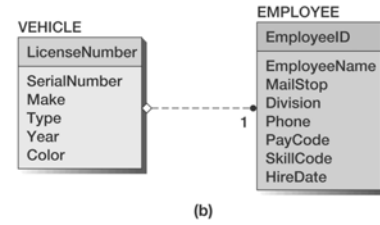
EMPLOYEE WORK DATA			
Employee name	Employee ID		
MailStop	Division	Phone	
Pay code	Skill code	Hire date	Auto assigned

(a)

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Example: Non-Identifying Connection Relationships

Figure 3.10b 1:1 Non-Identifying Connection Relationship — Non-identifying Relationship



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Example: 1:N

Figure 3.11a 1:N Non-identifying Connection Relationship — Sample Forms

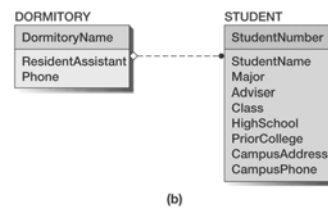
DORMITORY OCCUPANCY REPORT		
Dormitory	Resident Assistant	Phone
Ingersoll	Sarah and Allen French	3-5567

Student name	Student Number	Class
Adams, Elizabeth	710	SO
Baker, Rex	104	FR
Baker, Brydie	744	JN
Charles, Stewart	319	SO
Scott, Sally	447	SO
Taylor, Lynne	810	FR

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Example: 1:N

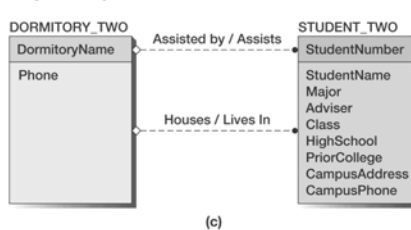
Figure 3.11b 1:N Non-identifying Connection Relationship — Non-identifying Relationship



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Example: 1:N

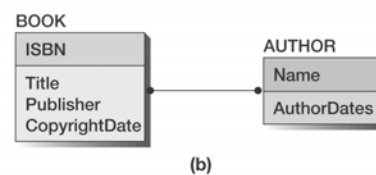
Figure 3.11c 1:N Non-identifying Connection Relationship — Using Relationship for Resident Assistant



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Example: N:M

Figure 3.12b N:M Relationship — Non-Specific Relationship



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Example: N:M Assignment Relationship

Figure 3.13a Assignment Relationship — Assignment Report

Project Assignment Report			
Project Name	Abernathy House	Architect Name	Jackson, B.
Project Manager	Smith, J	Phone	232-8878
Project Start	11/11/2003	Office Number	J-1133
Project End			
Assignment Starts	12/15/2003		
Assignment Ends	3/15/2004		
Maximum Budgeted Hours	345		
Maximum Labor Cost	\$27,500		
Maximum Material Cost	\$17,500		

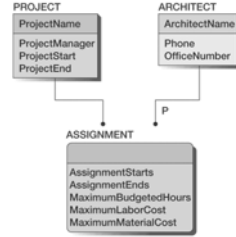
(a)

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Example: Assignment Relationship

Figure 3.13b Assignment Relationship —
Two Identifying Connection Relationships



(b)

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Natural Non-ID Conn. Rels.

Figure 3.14a Need for Strong FLIGHT Entity — Sample Documents

FLY CHEAP INTERNATIONAL Flight Planning Data Report			
FLIGHT NUMBER	FC-17	DATE	7/30/2003
ORIGINATING CITY	Seattle	DESTINATION	Hong Kong
FUEL ON TAKEOFF			
WEIGHT ON TAKEOFF			
AIRPLANE			
Tail Number	N1234FI		
Type	747-SP		
Capacity	148		
PILOT			
Name	Michael Nilson		
FC-ID	32887		
Flight Hours	18,348		

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Natural Non-ID Conn. Rels.

Figure 3.14b Need for Strong FLIGHT Entity —
Two Non-Identifying Relationships



(b)

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Example: Category Relationship

Figure 3.15a Example Category Relationship —
Form Suggesting Need for Categories (Subtypes)

Resident Fishing License		License No: 03-1123432
2003 Season State of xxxxxx		
Name:		
Street:		
City:	State:	Zip:
For Use by Commercial Fishers Only		For Use by Sport Fishers Only
Vessel Number:	Number Years at this Address:	
Vessel Name:	Prior Year License Number:	
Vessel Type:		
Tax ID:		

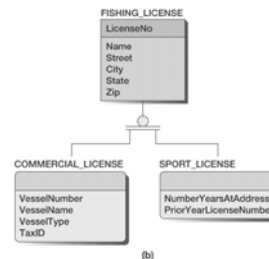
(a)

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Example: Category Relationship

Figure 3.15b Example Category Relationship —
Category Cluster with Two Categories



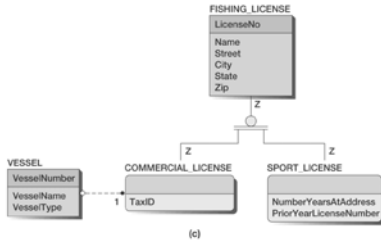
(b)

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Example: Category Relationship

Figure 3.15c Example Category Relationship — One Category Has Additional Relationship



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Sales-Order Model

Figure 3.16a Sales Order Example — Sample Document;

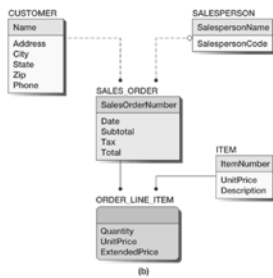
The screenshot shows a sales order form for Carbon River Furniture. The Sales Order Number is 10643 and the Date is 25-Sep-01. The Customer Name is Carbon River Bookshop, located at 1145 Elm Street, Carbon River, IL 62234. The Salesperson is Dodsworth, Anne, with Salesperson Code C21. The order contains three items: a Lectern Desk (1 unit, \$250.00), a Conference Table (1 unit, \$1,750.00), and a Side Chair (4 units, \$98.00). The subtotal is \$1,798.00, tax is \$23.46, and the total is \$1,821.46.

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Example: Sales Order

Figure 3.16b Sales Order Example — LINE_ITEM with Two Identifying Relationships



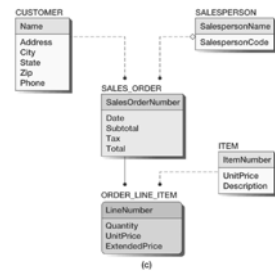
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Example: Sales Order

Figure 3.16c Sales Order Example — LINE_ITEM with One Identifying Relationship

- Figure 3-16(c) shows an alternative design that allows an item to appear more than once on a given order

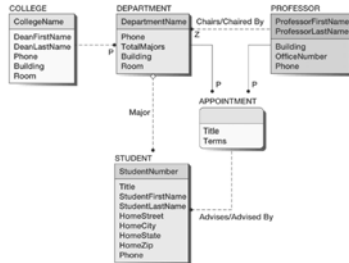


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Example: University System

Figure 3.25 Final Data Model

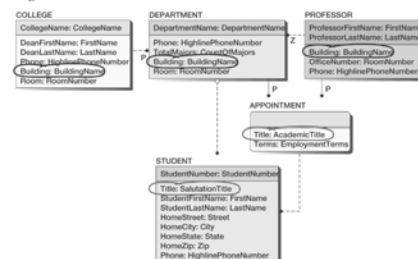


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University System With Domain Names

Figure 3.27 Model with Domain Names



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