Chapter 1: The Database Environment and Development Process

Modern Database Management
12th Edition
Jeff Hoffer, Ramesh Venkataraman, Heikki Topi

Objectives/Self-study outline

- Definisi Terminologi (Slides #3-6)
  - Limitasi nama file processing konvensional
  - Penjelasan keuntungan dari database
  - Identifikasi biaya dan risiko database
- Elemen Pendekatan Basis Data (Slides #12-20)
- Daftar komponen lingkungan database (Slide #24)
- Model data Enterprise (Slides #25-26)
  - Identifikasi kategori aplikasi database
  - Penjelasan siklus hidup pengembangan sistem database
  - Penjelasan pendekatan prototipe dan pengembangan agile
  - Penjelasan peran individu
- Penjelasan arsitektur three-schema (Slides #40-41)
- Running example in the book (Slides #53-55)

Definisi

- Database: pengelolaan koleksi data yang terkait secara lojik
- Data: representasi tersimpan dari objek dan peristiwa yang bermakna
  - Structured: numbers, text, dates
  - Unstructured: images, video, documents
- Information: data diolah untuk menambah pengetahuan orang yang menggunakan data
- Metadata: data yang mendeskripsikan properti dan konteks data pengguna

Figure 1-1a Data in context

Class Roster

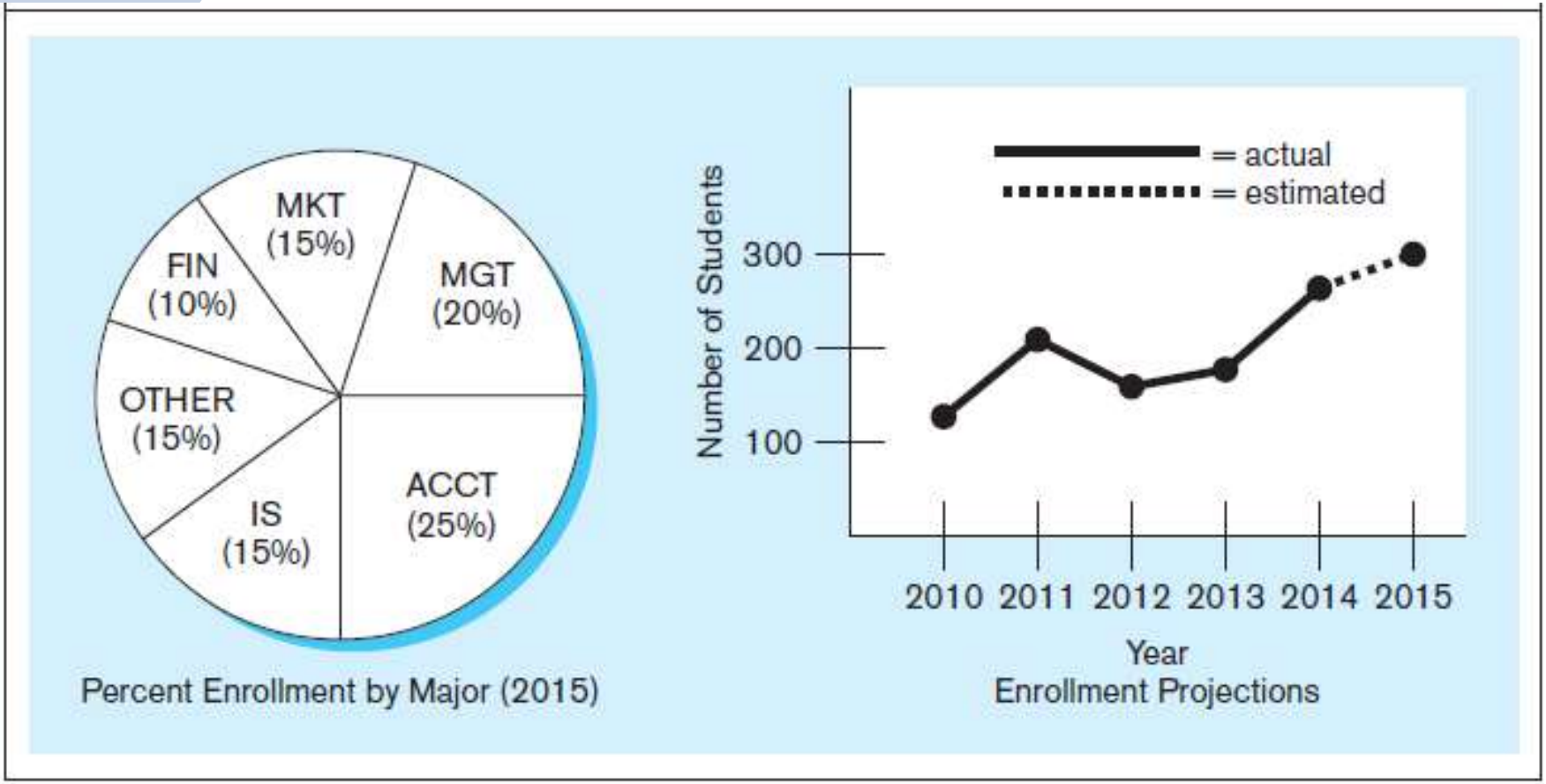
Course: MGT 500 Business Policy Semester: Spring 2015

Section: 2

Name	ID	Major	GPA
Baker, Kenneth D.	324917628	MGT	2.9
Doyle, Joan E.	476193248	MKT	3.4
Finkle, Clive R.	548429344	PRM	2.8
Lewis, John C.	551742186	MGT	3.7
McFerran, Debra R.	409723145	IS	2.9
Sisneros, Michael	392416582	ACCT	3.3

Context helps users understand data

Figure 1-1b Summarized data



Graphical displays turn data into useful information that managers can use for decision making and interpretation

TABLE 1-1 Example Metadata for Class Roster

Data Item		Metadata				
Name	**Type**	**Length**	**Min**	**Max**	**Description**	**Source**
Course	Alphanumeric	30			Course ID and name	Academic Unit
Section	Integer	1	1	9	Section number	Registrar
Semester	Alphanumeric	10			Semester and year	Registrar
Name	Alphanumeric	30			Student name	Student IS
ID	Integer	9			Student ID (SSN)	Student IS
Major	Alphanumeric	4			Student major	Student IS
GPA	Decimal	3	0.0	4.0	Student grade point average	Academic Unit

Descriptions of the properties or characteristics of the data, including data types, field sizes, allowable values, and data context

Disadvantages of File Processing

- Program-Data Dependence
  - All programs maintain metadata for each file they use
- Duplication of Data
  - Different systems/programs have separate copies of the same data
- Limited Data Sharing
  - No centralized control of data
- Lengthy Development Times
  - Programmers must design their own file formats
- Excessive Program Maintenance
  - 80% of information systems budget

Problems with Data Dependency

- Each application programmer must maintain his/her own data
- Each application program needs to include code for the metadata of each file
- Each application program must have its own processing routines for reading, inserting, updating, and deleting data
- Lack of coordination and central control
- Non-standard file formats

Duplicate Data

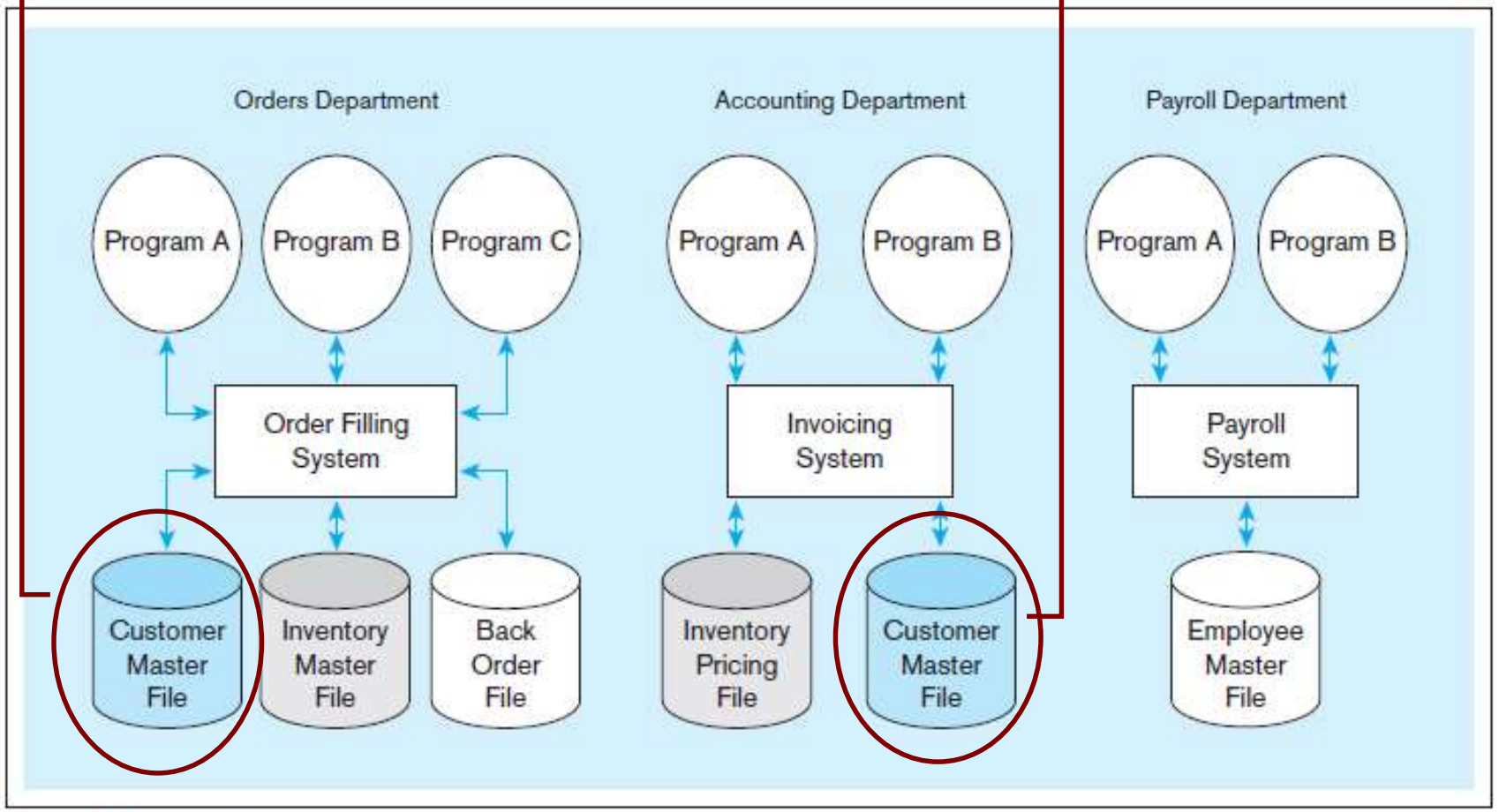


FIGURE 1-2 Old file processing systems at Pine Valley Furniture Company

Problems with Data Redundancy

- Waste of space to have duplicate data
- Causes more maintenance headaches
- The biggest problem:
  - Data changes in one file could cause inconsistencies
  - Compromises in *data integrity*

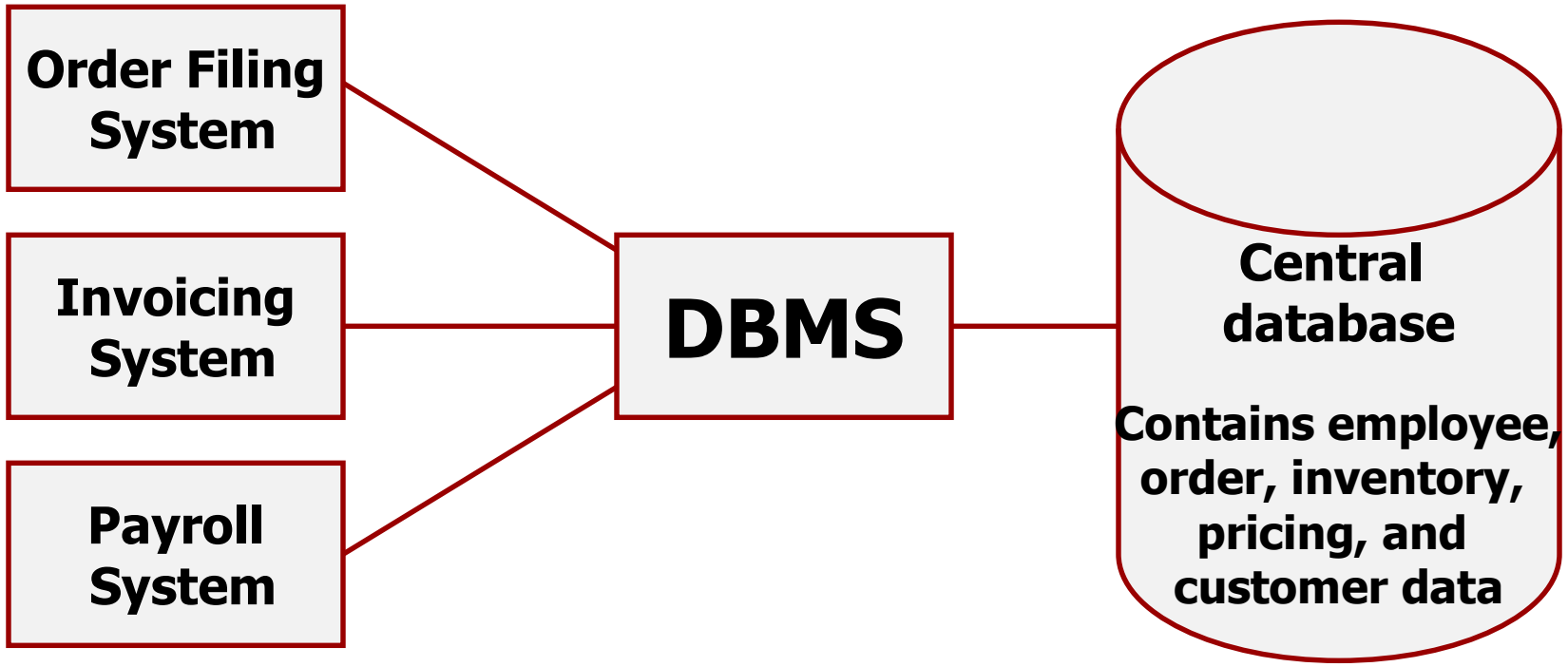
SOLUTION: The DATABASE Approach

- Central repository of shared data
- Data is managed by a controlling agent
- Stored in a standardized, convenient form

Requires a Database Management System (DBMS)

Database Management System

A software system that is used to create, maintain, and provide controlled access to user databases



DBMS manages data resources like an operating system manages hardware resources

Elements of the Database Approach (1)

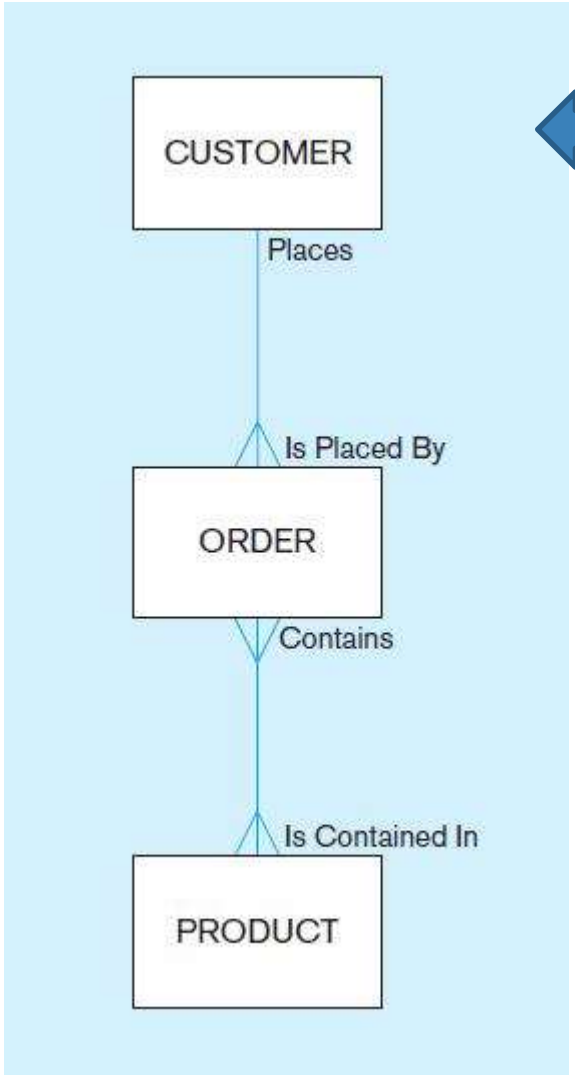
- DATA MODELS
  - Graphical system capturing nature and relationship of data
    1. Enterprise Data Model–high-level entities and relationships for the organization
    2. Project Data Model–more detailed view, matching data structure in database or data warehouse
- ENTITIES – we met these concepts Week 1
  - Noun form describing a person, place, object, event, or concept
  - Composed of attributes

Understand entity type vs entity instance

Elements of the Database Approach (2)

- Relationships
  - Between entities
  - Usually one-to-many (1:M) or many-to-many (M:N)
- Relational Databases
  - Database technology involving
    - tables (relations) representing entities, and
    - primary/foreign keys representing relationships

Fig 1-3 Comparison of enterprise and project level data models

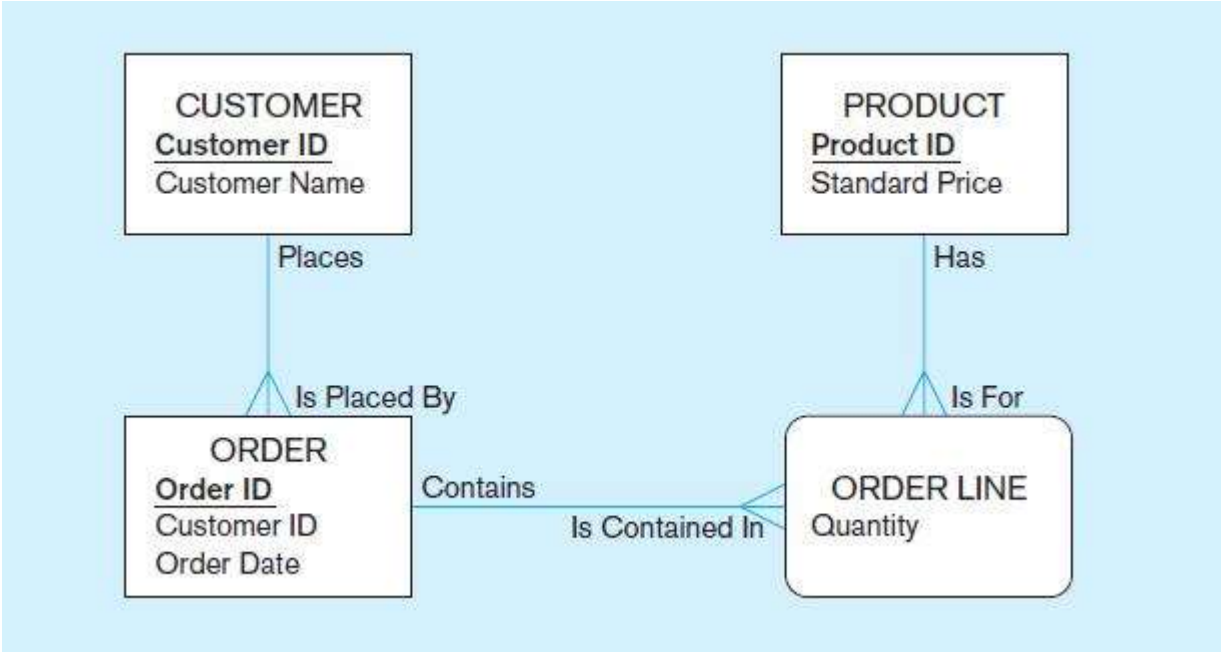


Segment of an **ENTERPRISE DATA MODEL**

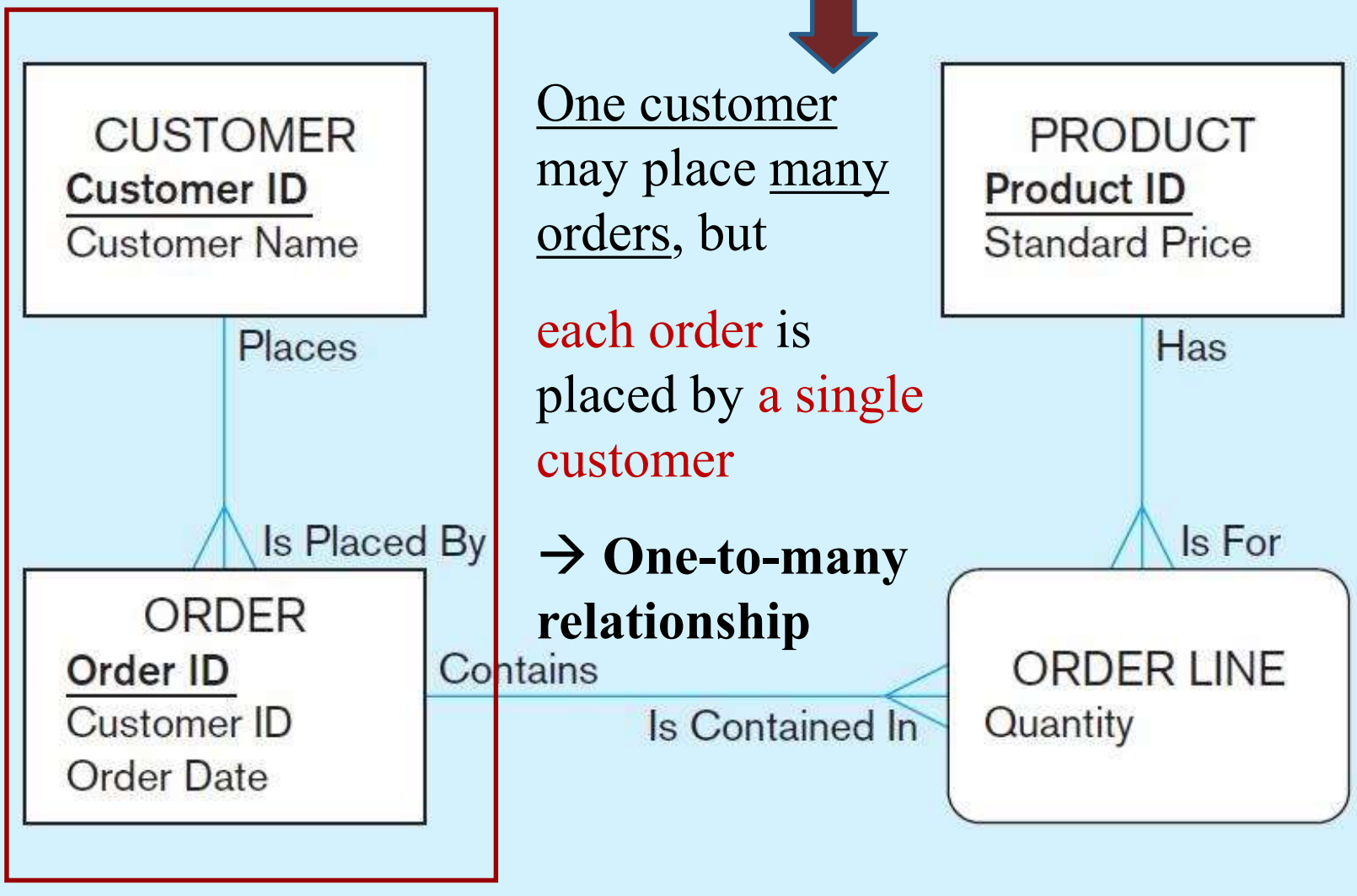
high-level entities and relationships

Segment of a **PROJECT-LEVEL DATA MODEL**

detailed view, matching data structure



Note the expression of the relationship

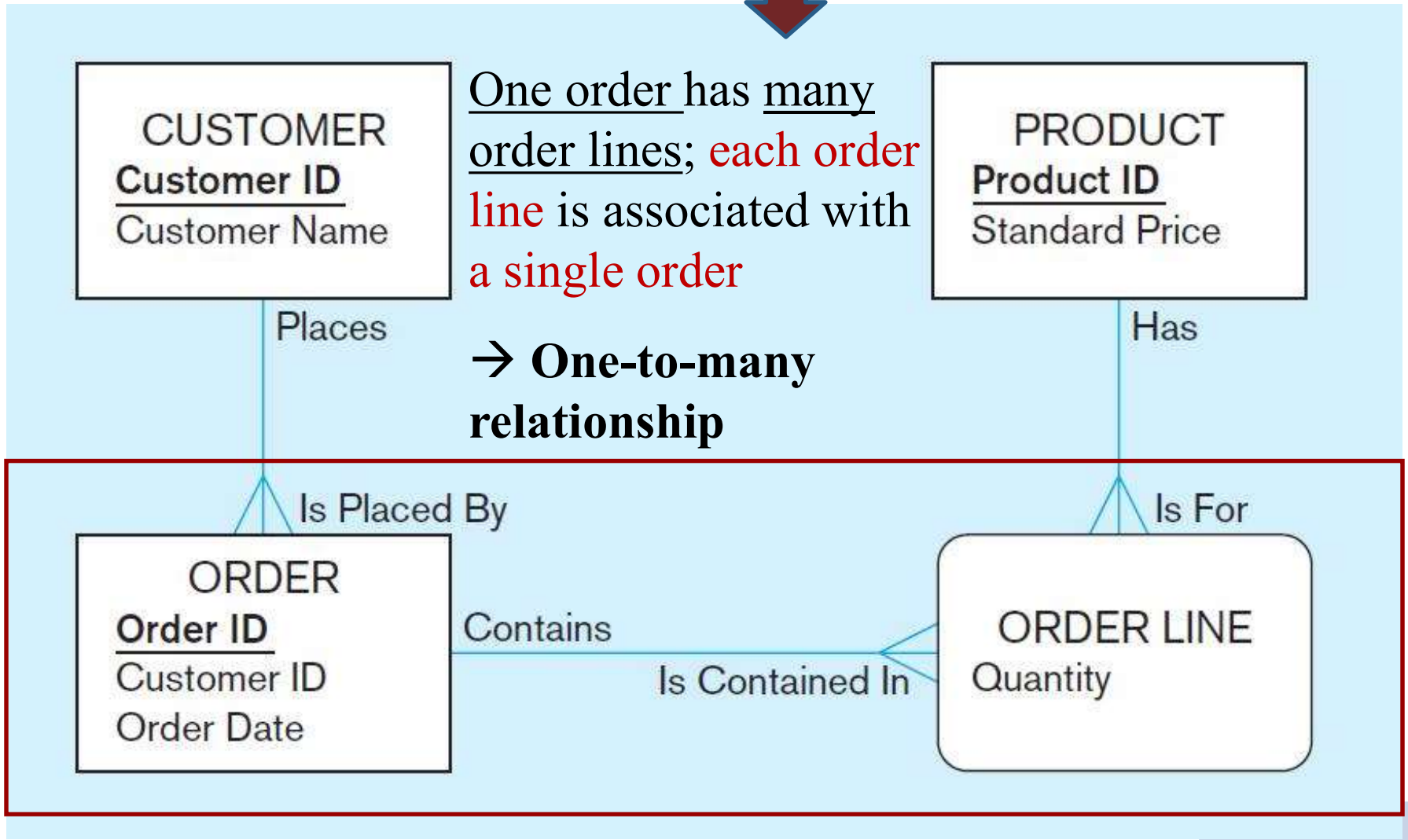


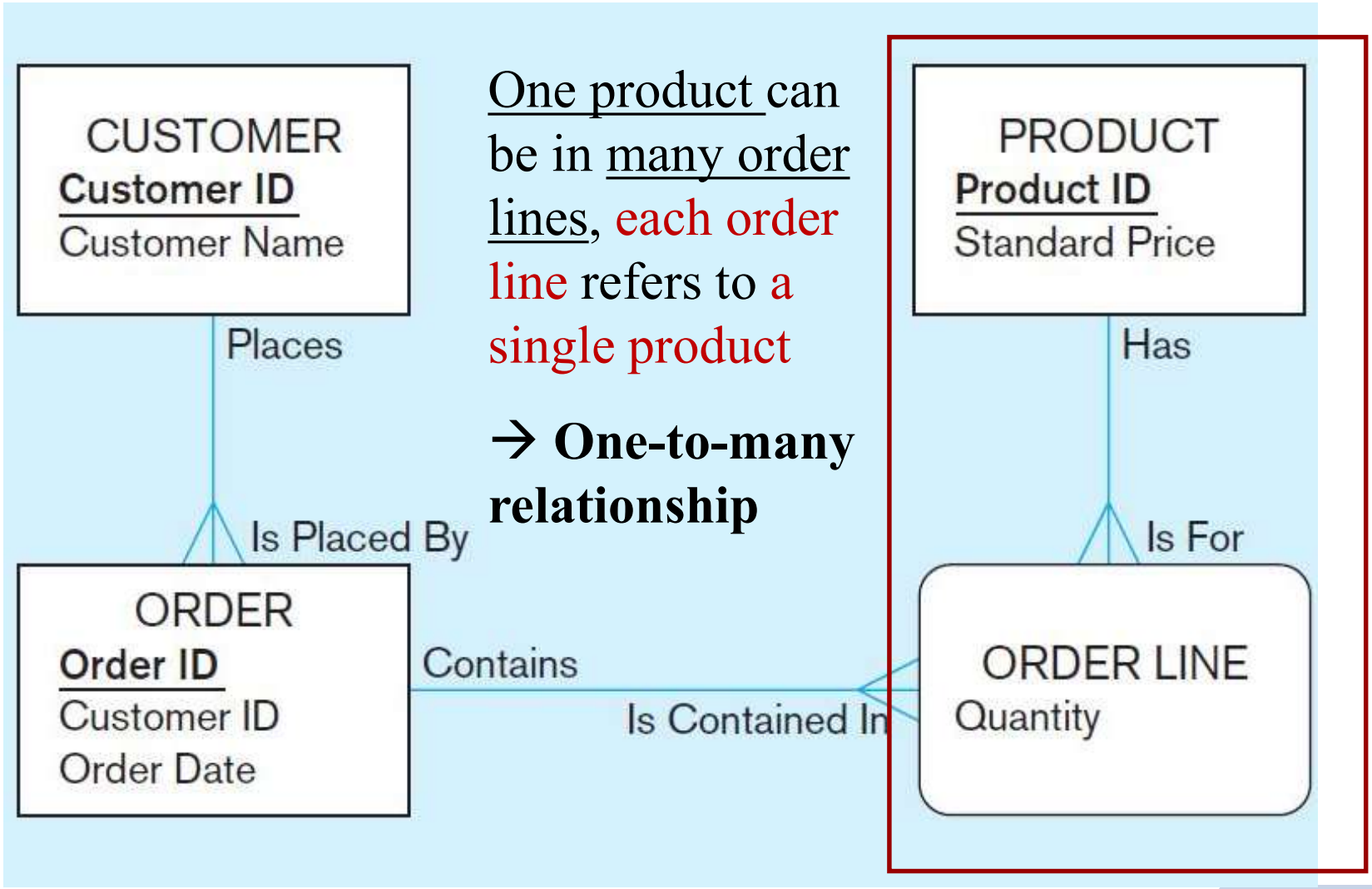
One customer may place many orders, but

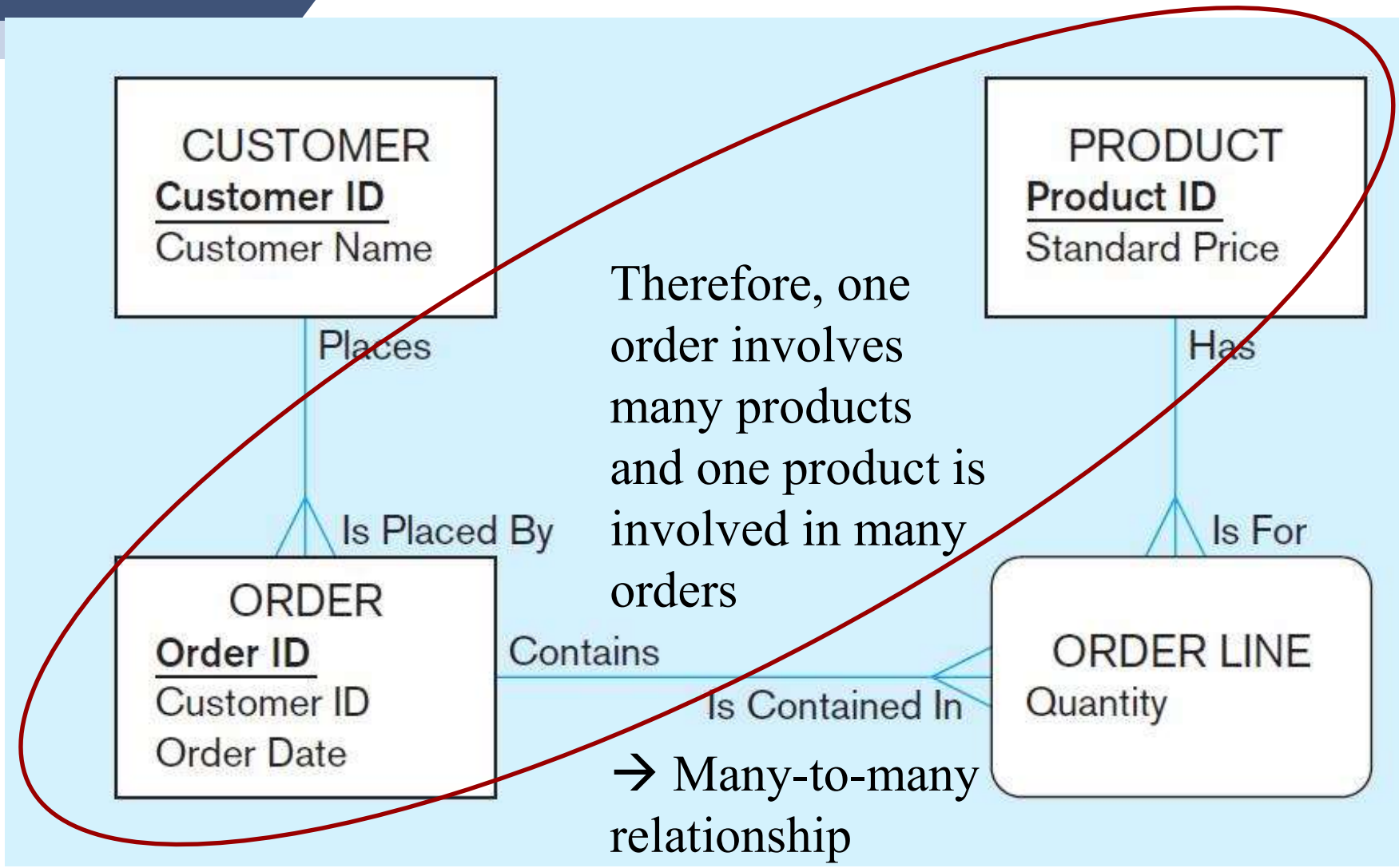
each order is placed by a single customer

→ **One-to-many relationship**

Note the expression of the relationship







A many-to-many relationship can be "decomposed" to two 1-M relationships

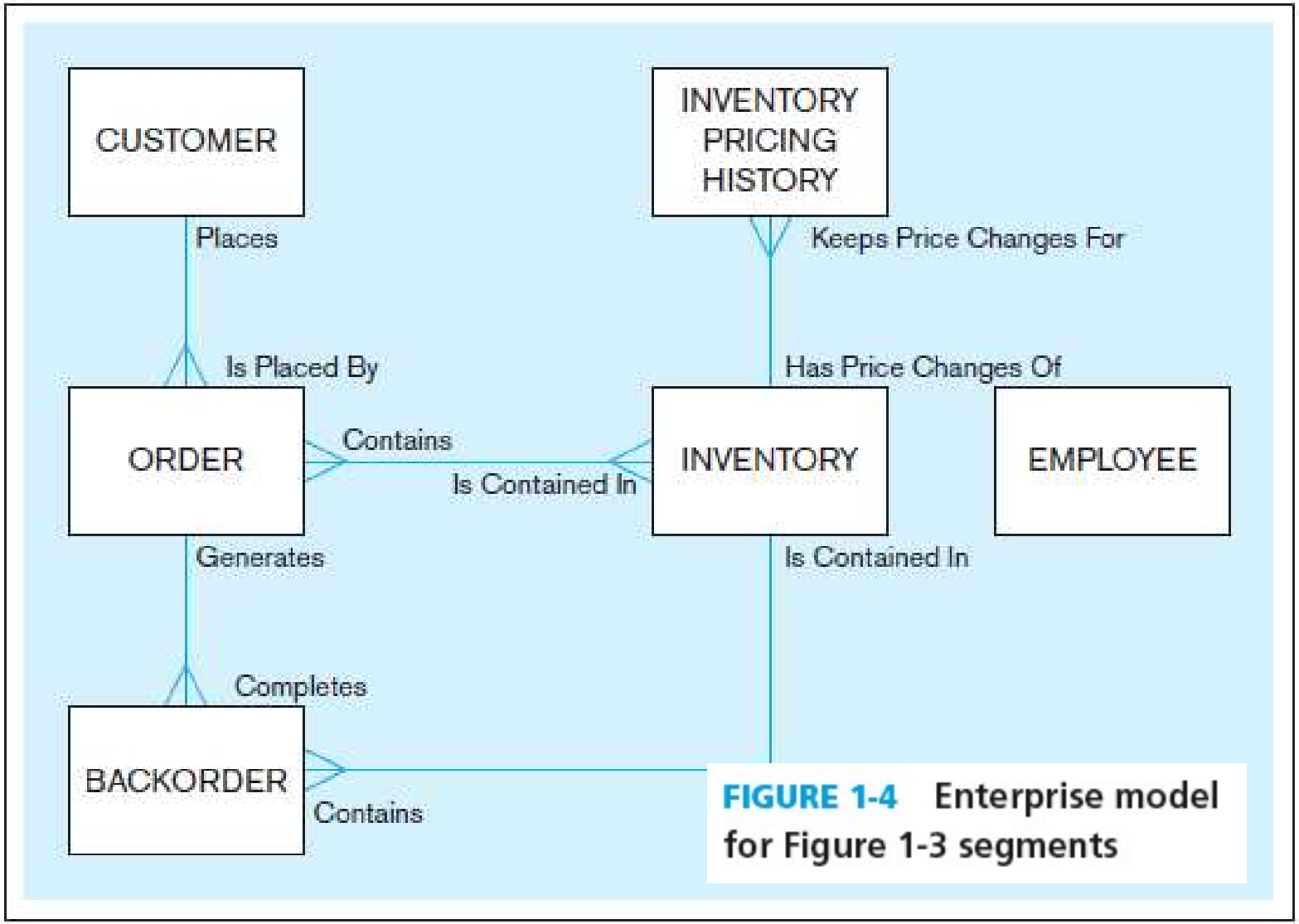


FIGURE 1-4 Enterprise model for Figure 1-3 segments

Advantages of THE DatabaSE APPROACH

- Program-data independence
- Planned data redundancy
- Improved data consistency
- Improved data sharing
- Increased application development productivity
- Enforcement of standards
- Improved data quality
- Improved data accessibility and responsiveness
- Reduced program maintenance
- Improved decision support

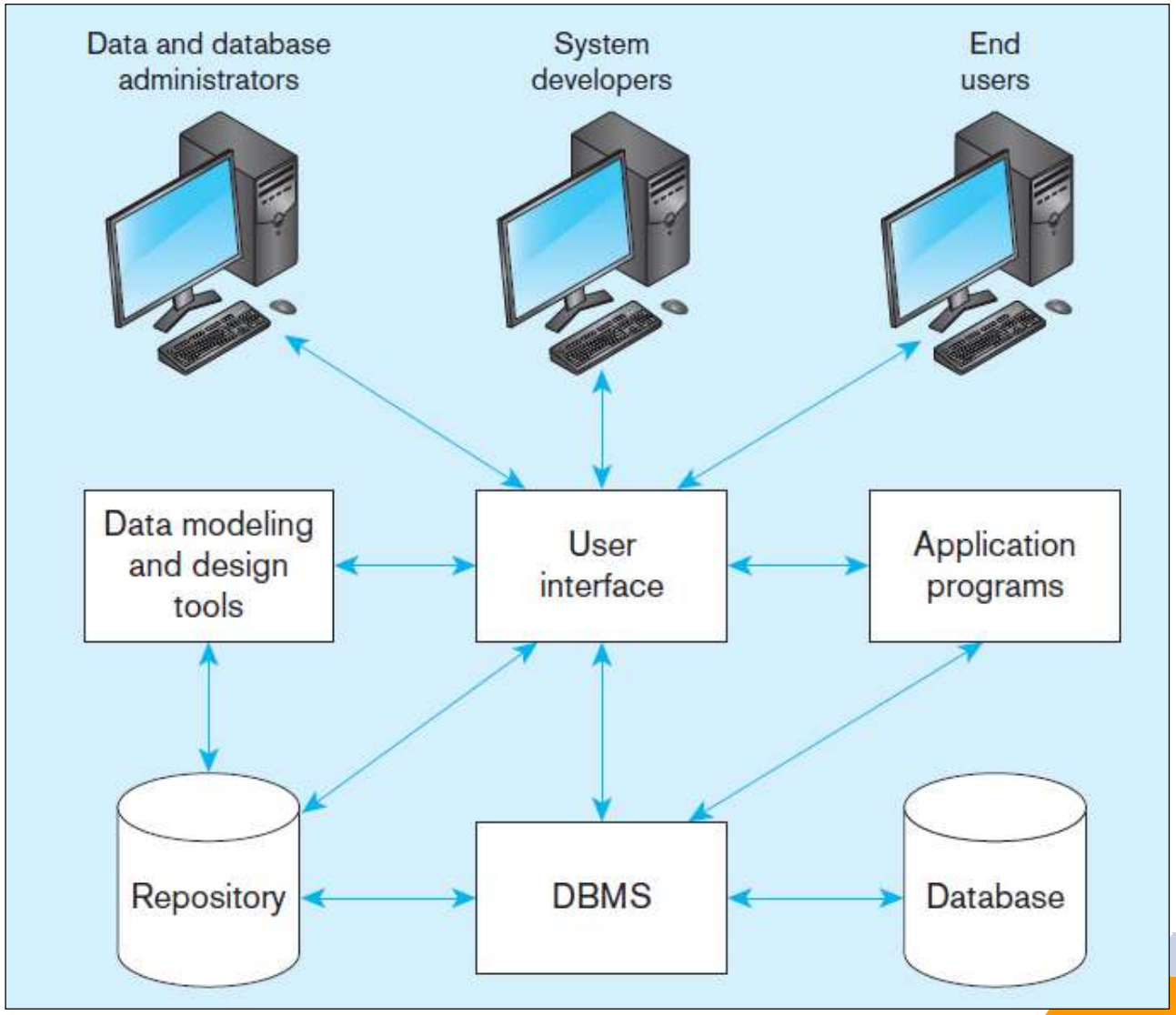
Costs and Risks of the Database Approach

- New, specialized personnel
- Installation and management cost and complexity
- Conversion costs
- Need for explicit backup and recovery
- Organizational conflict
  - on data definitions, formats and coding, rights to update…

Components of the Database Environment

1) DATA MODELING AND DESIGN TOOLS -- automated tools used to design databases and application programs
2) REPOSITORY–centralized storehouse of metadata
3) DATABASE MANAGEMENT SYSTEM (DBMS) –software for managing the database
4) DATABASE–storehouse of the data
5) APPLICATION PROGRAMS–software using the data
6) USER INTERFACE–text, graphical displays, menus, etc. for user
7) DATA/DATABASE ADMINISTRATORS–personnel responsible for maintaining the database
8) SYSTEM DEVELOPERS–personnel responsible for designing databases and software
9) END USERS–people who use the applications and databases

Figure 1-5 COMPONENTS OF THE DATABASE ENVIRONMENT



Enterprise Data Model

- First step in the database development process
- Specifies scope and general content
- OVERALL PICTURE OF ORGANIZATIONAL DATA AT HIGH LEVEL OF ABSTRACTION
  - ENTITY-RELATIONSHIP DIAGRAM (ERD)
  - DESCRIPTIONS OF ENTITY TYPES
  - RELATIONSHIPS BETWEEN ENTITIES
  - BUSINESS RULES

FIGURE 1-6 Example business function-to-data entity matrix

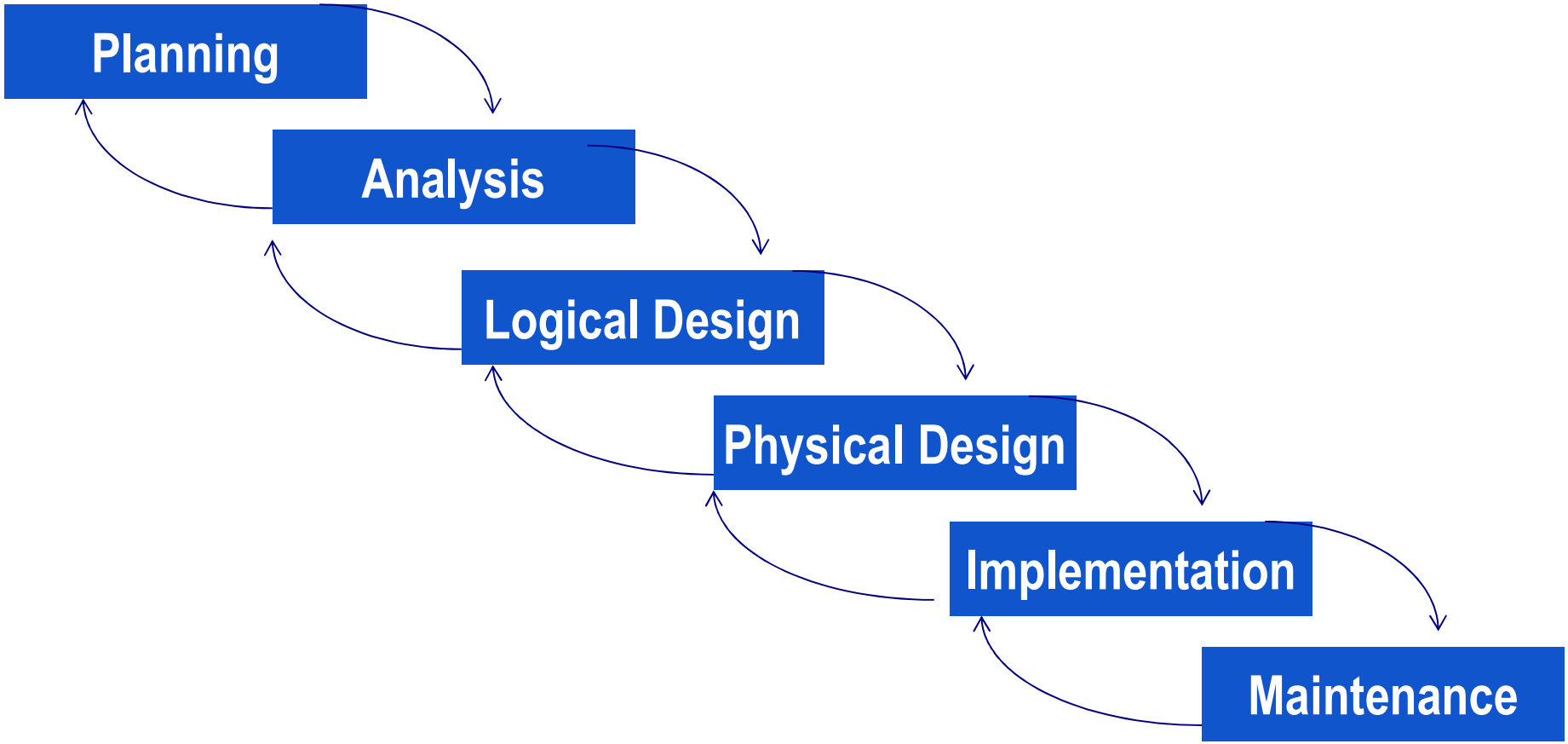
Business Functions \ Data Entity Types	Customer	Product	Raw Material	Order	Work Center	Work Order	Invoice	Equipment	Employee
Business Planning	X	X						X	X
Product Development		X	X		X			X	
Materials Management		X	X	X	X	X		X	
Order Fulfillment	X	X	X	X	X	X	X	X	X
Order Shipment	X	X		X	X		X		X
Sales Summarization	X	X		X			X		X
Production Operations		X	X	X	X	X		X	X
Finance and Accounting	X	X	X	X	X		X	X	X

X = data entity is used within business function

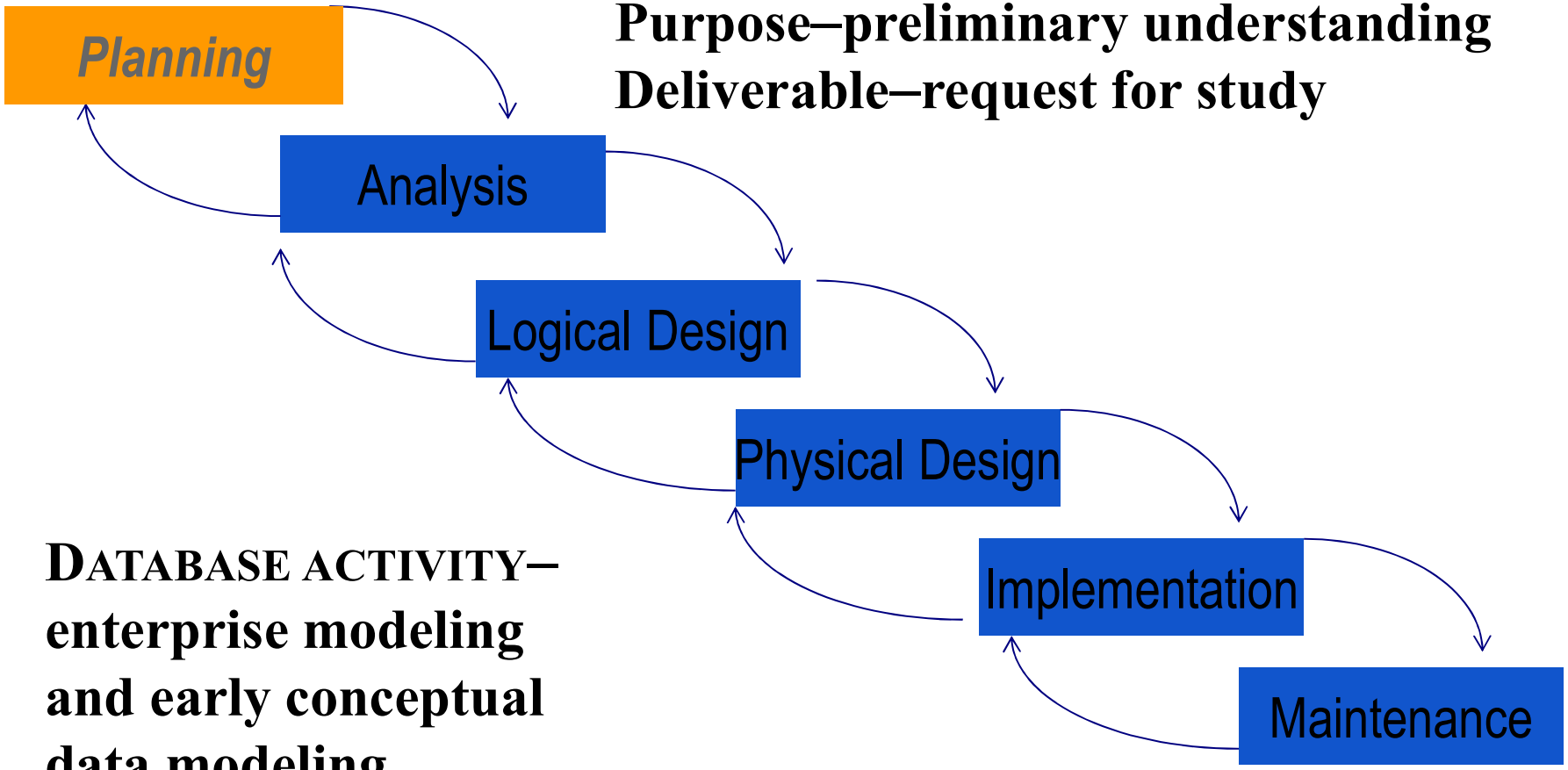
Two Approaches to Database and IS Development

- SDLC
  - System Development Life Cycle
  - Detailed, well-planned development process
  - Time-consuming, but comprehensive
  - Long development cycle
- Prototyping
  - Rapid application development (RAD)
  - Cursory attempt at conceptual data modeling
  - Define database during development of initial prototype
  - Repeat implementation and maintenance activities with new prototype versions

Systems Development Life Cycle (see also Figure 1-7)



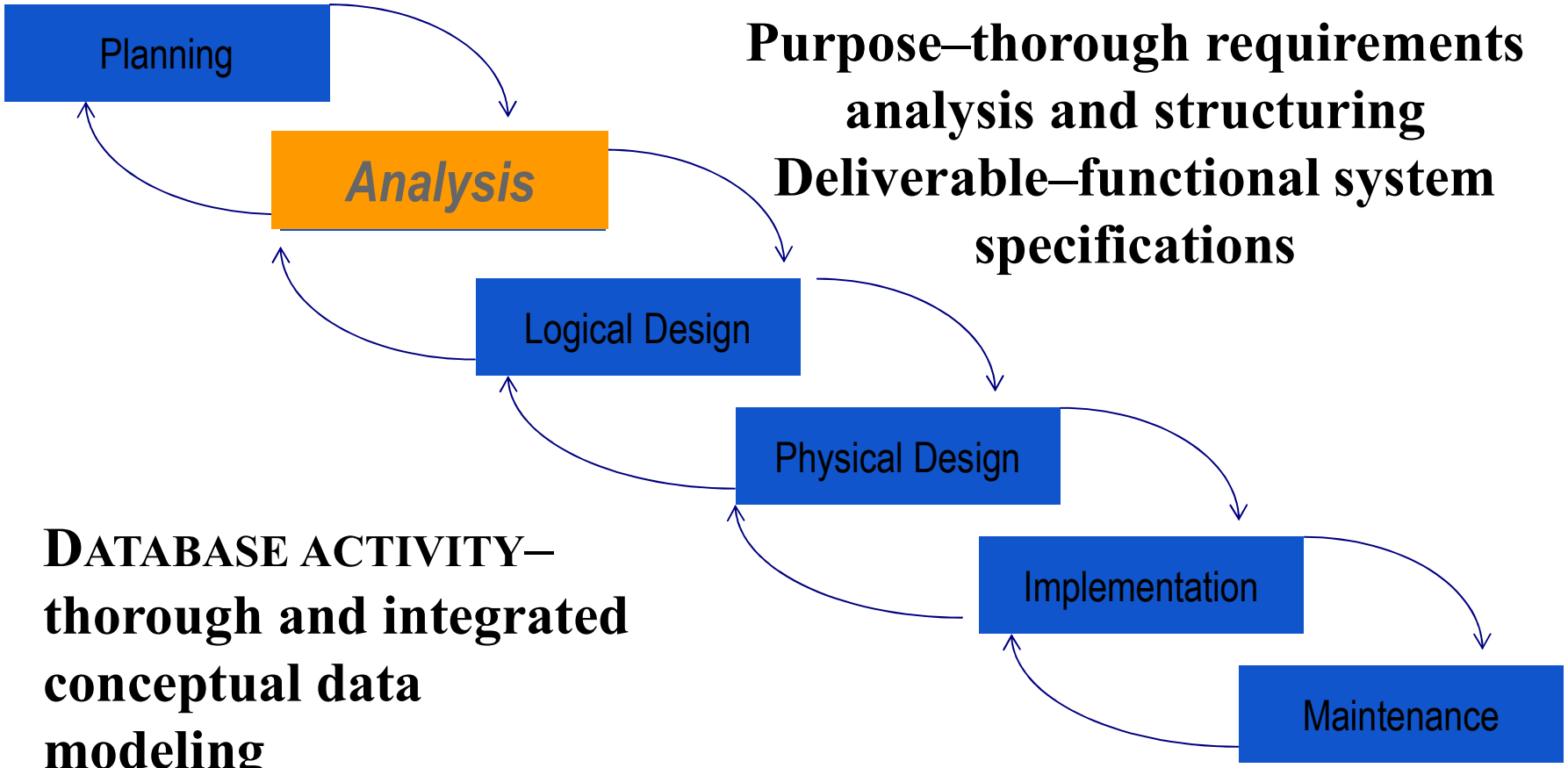
Systems Development Life Cycle (see also Figure 1-7) (cont.)



Purpose–preliminary understanding
Deliverable–request for study

DATABASE ACTIVITY–enterprise modeling and early conceptual data modeling

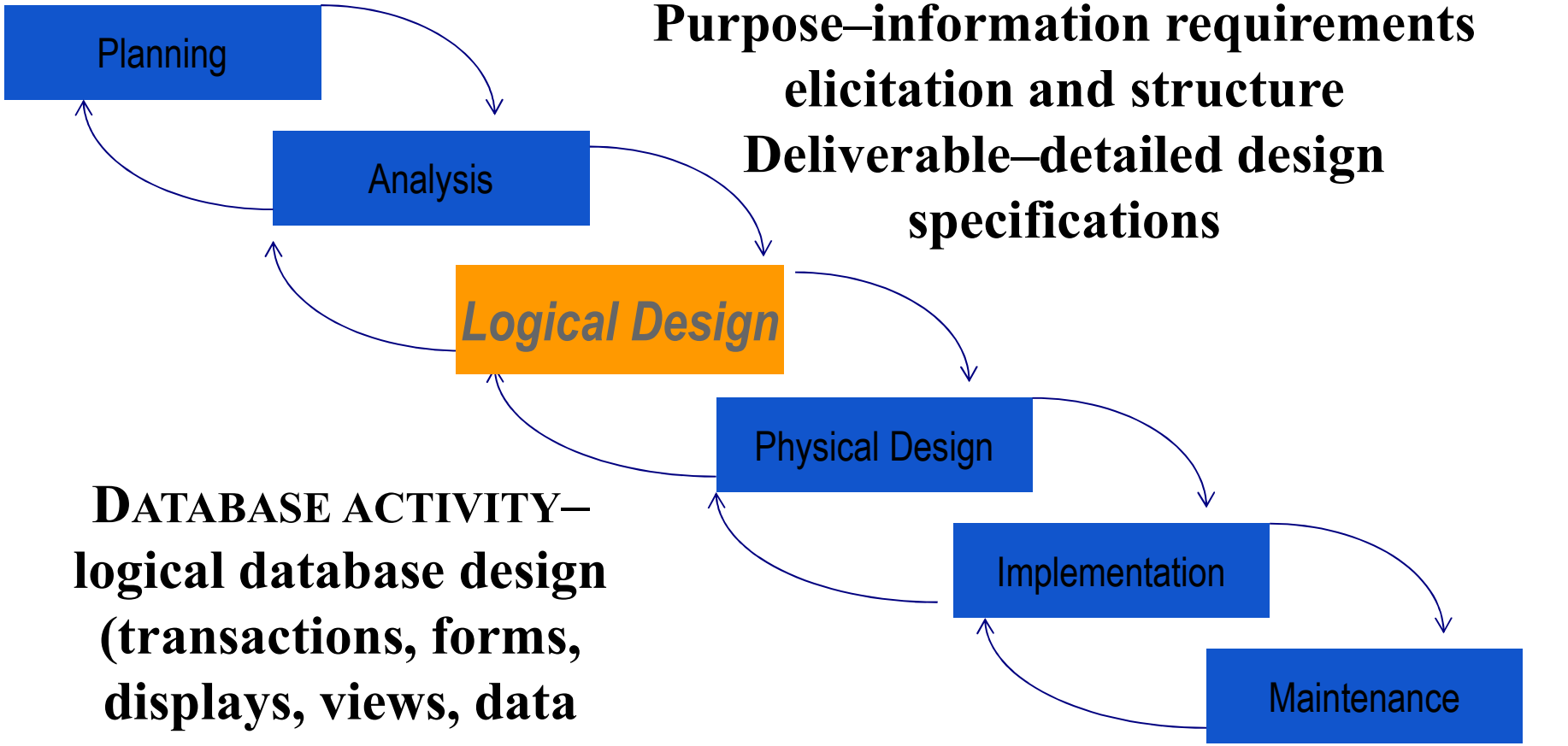
Systems Development Life Cycle (see also Figure 1-7) (cont.)



Purpose–thorough requirements analysis and structuring Deliverable–functional system specifications

DATABASE ACTIVITY– thorough and integrated conceptual data modeling

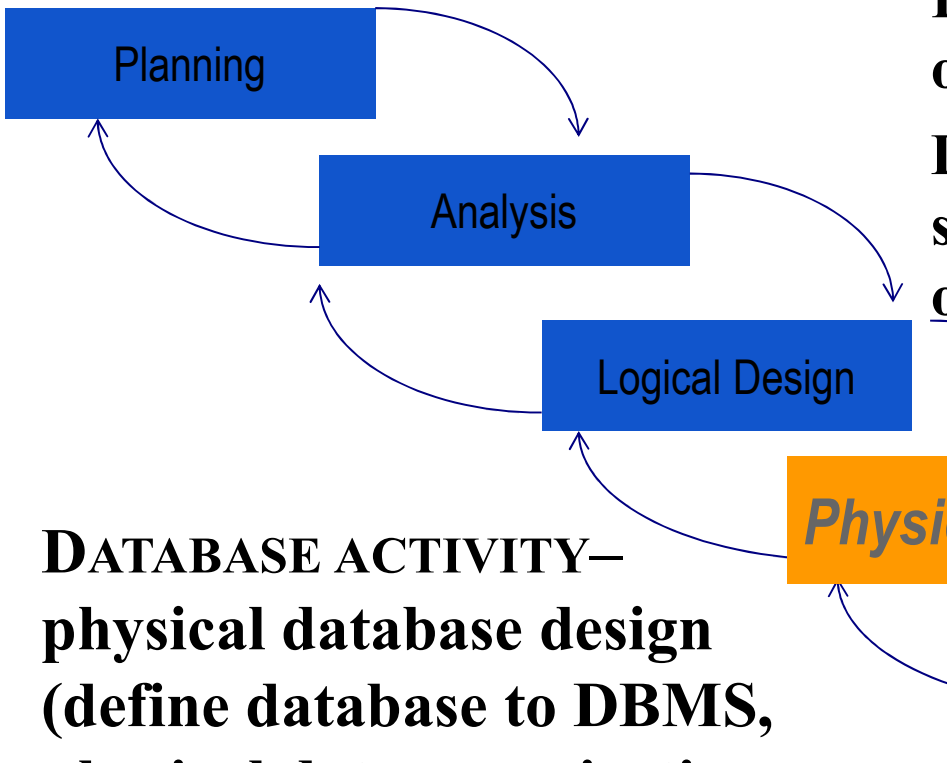
Systems Development Life Cycle (see also Figure 1-7) (cont.)



Purpose–information requirements elicitation and structure Deliverable–detailed design specifications

DATABASE ACTIVITY–logical database design (transactions, forms, displays, views, data integrity and security)

Systems Development Life Cycle (see also Figure 1-7) (cont.)

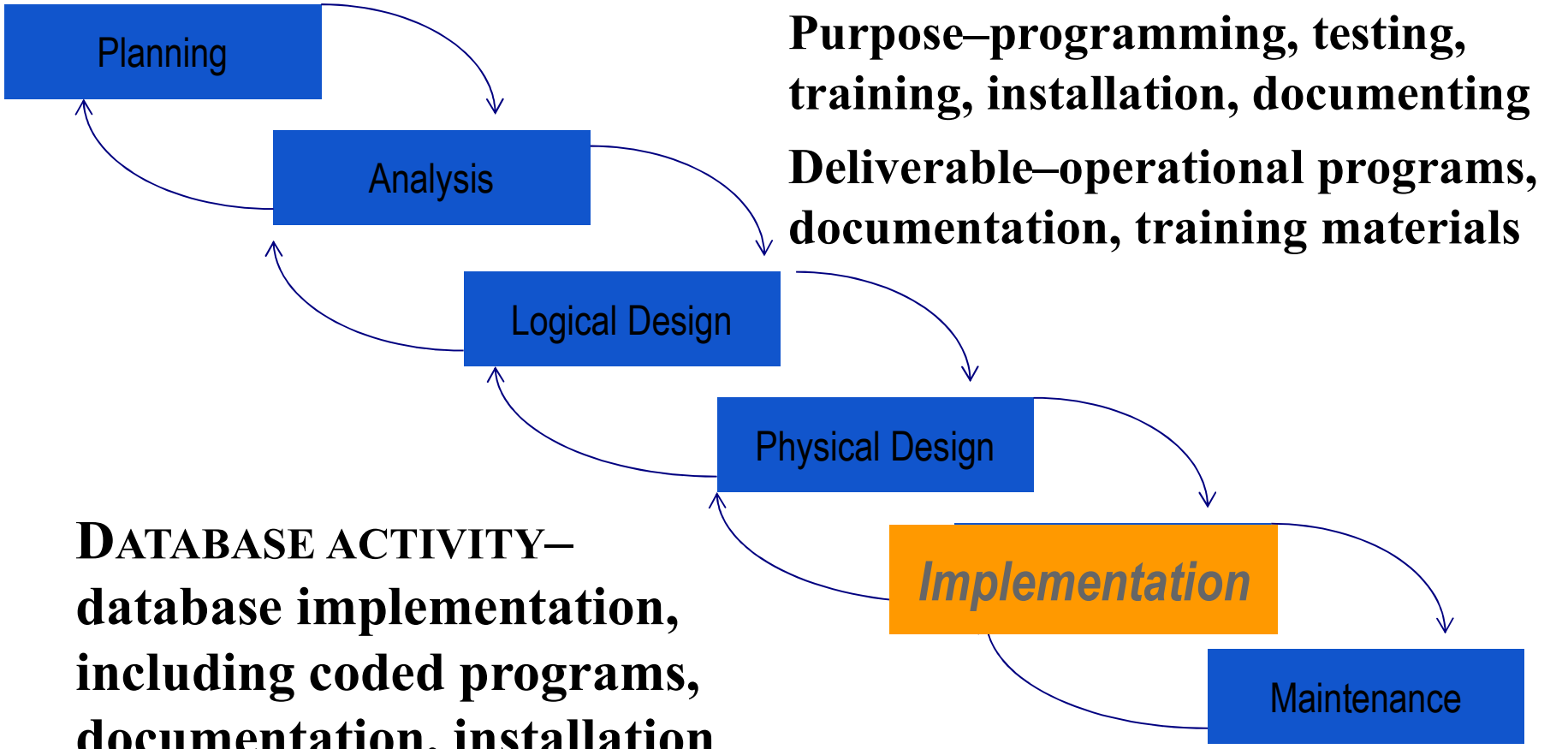


Purpose–develop technology and organizational specifications

Deliverable–program/data structures, technology purchases, organization redesigns

DATABASE ACTIVITY–physical database design (define database to DBMS, physical data organization, database processing programs)

Systems Development Life Cycle (see also Figure 1-7) (cont.)

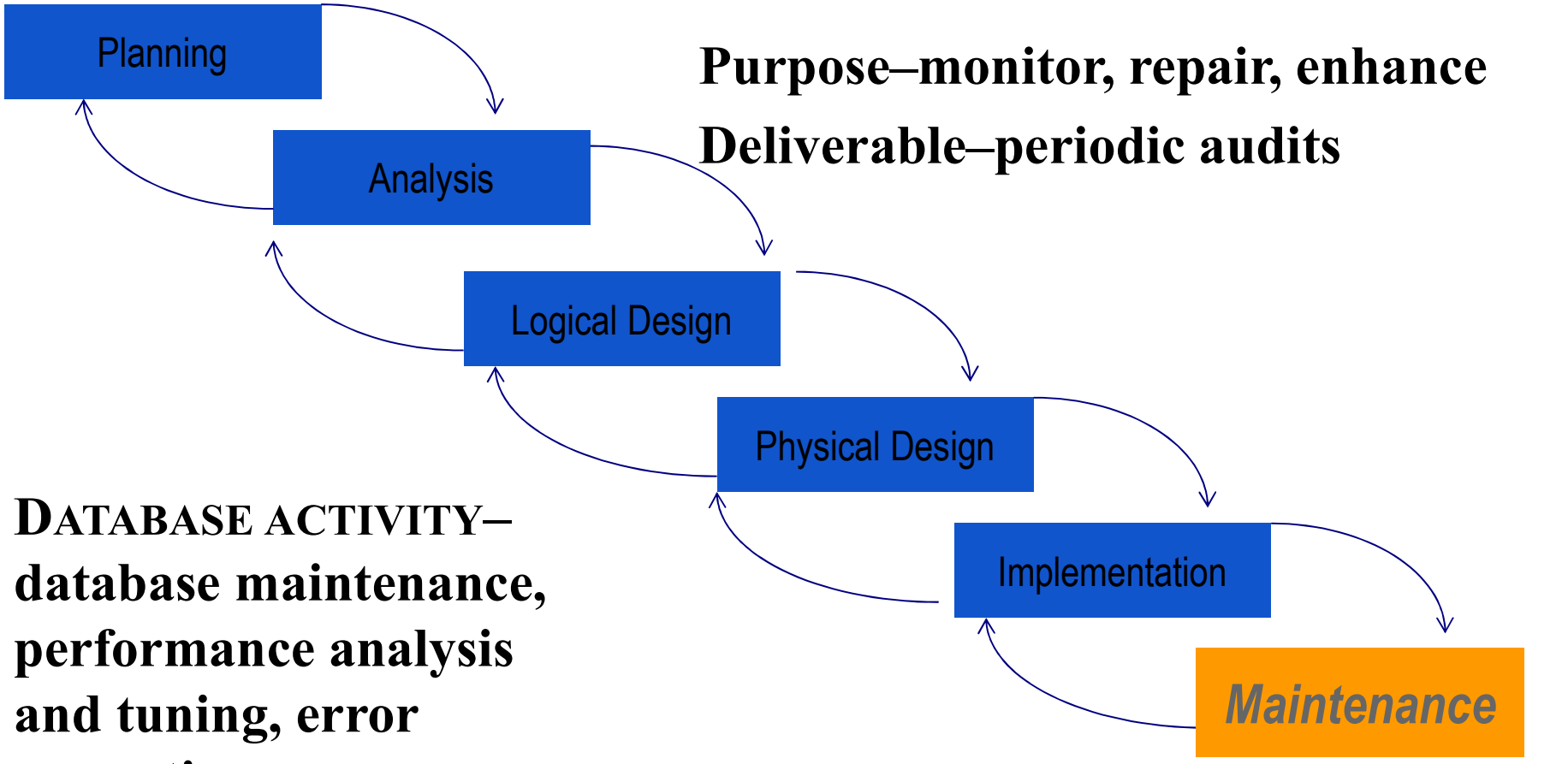


Purpose–programming, testing, training, installation, documenting

Deliverable–operational programs, documentation, training materials

DATABASE ACTIVITY–database implementation, including coded programs, documentation, installation and conversion

Systems Development Life Cycle (see also Figure 1-7) (cont.)

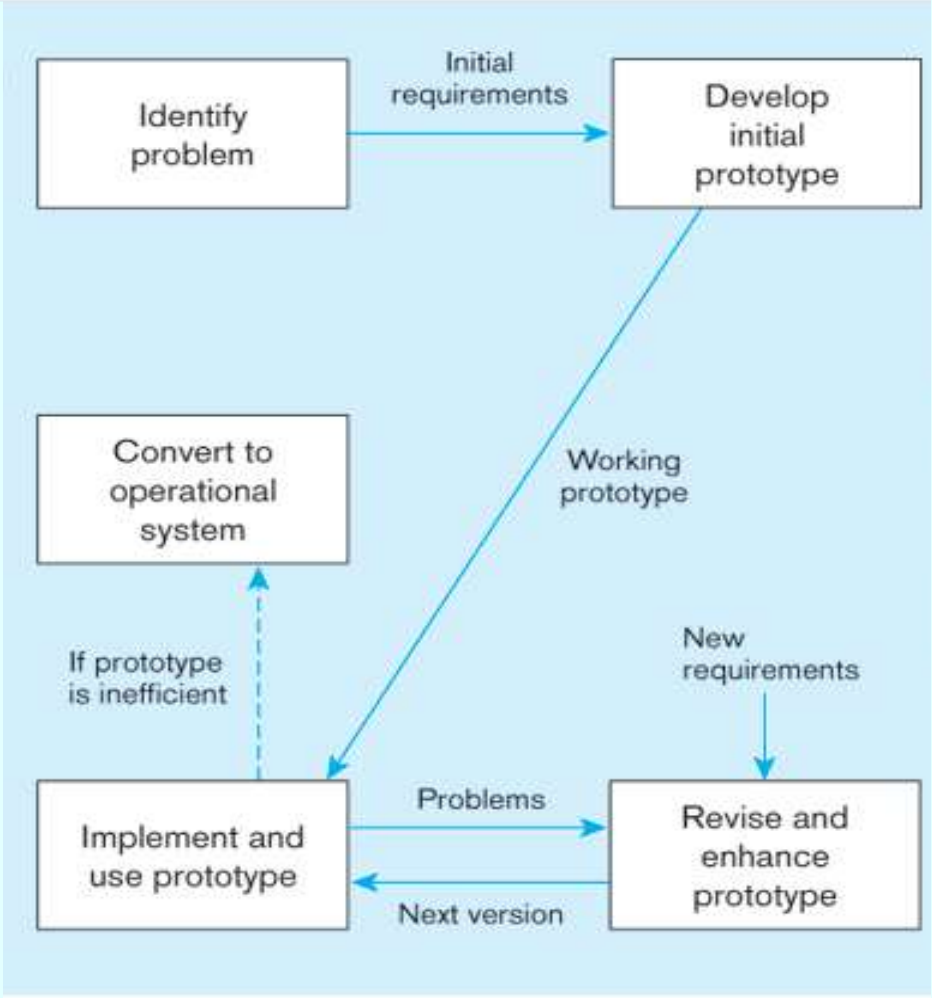


Purpose–monitor, repair, enhance

Deliverable–periodic audits

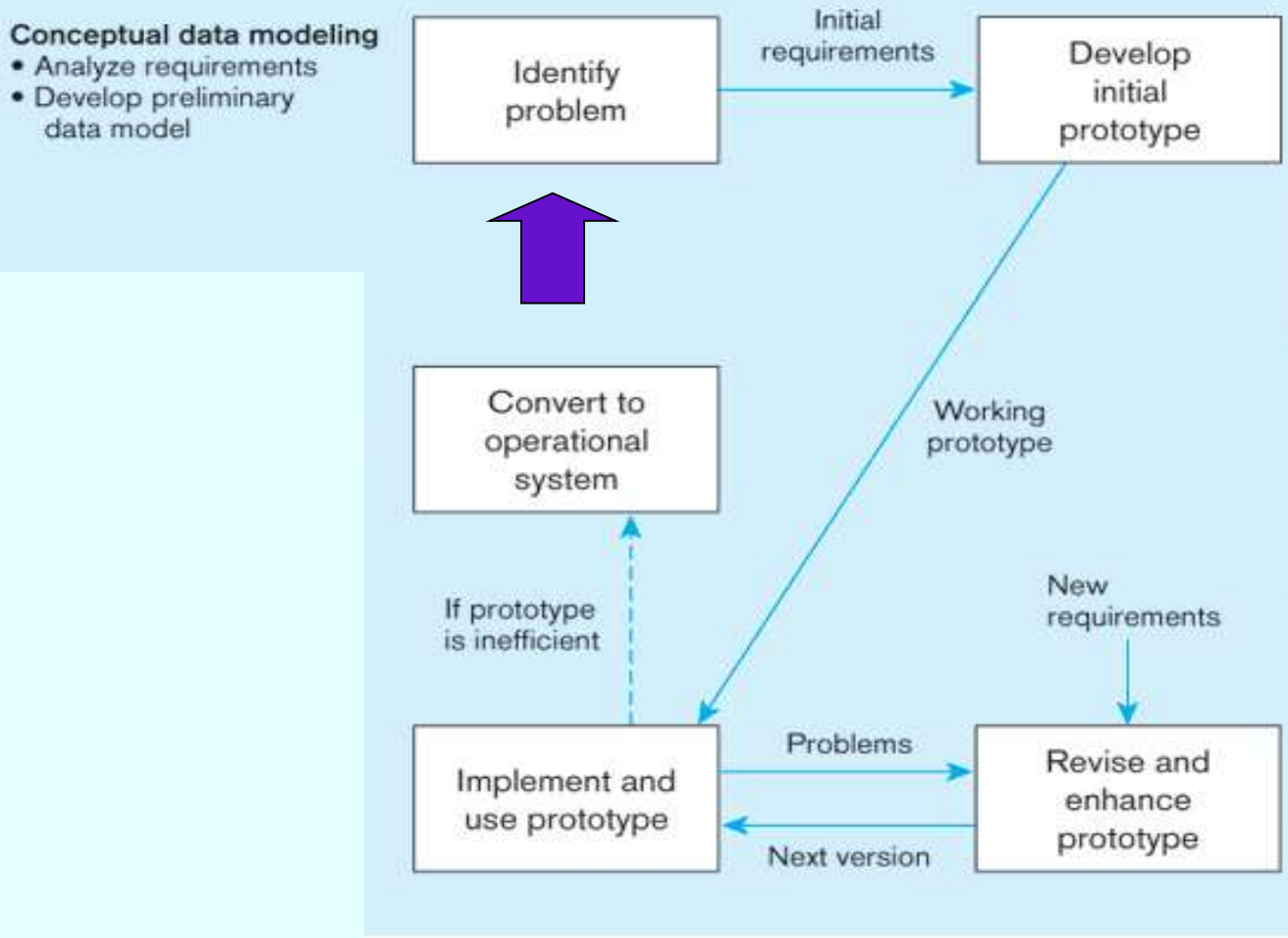
DATABASE ACTIVITY–database maintenance, performance analysis and tuning, error corrections

Prototyping Database Methodology (Figure 1-8)

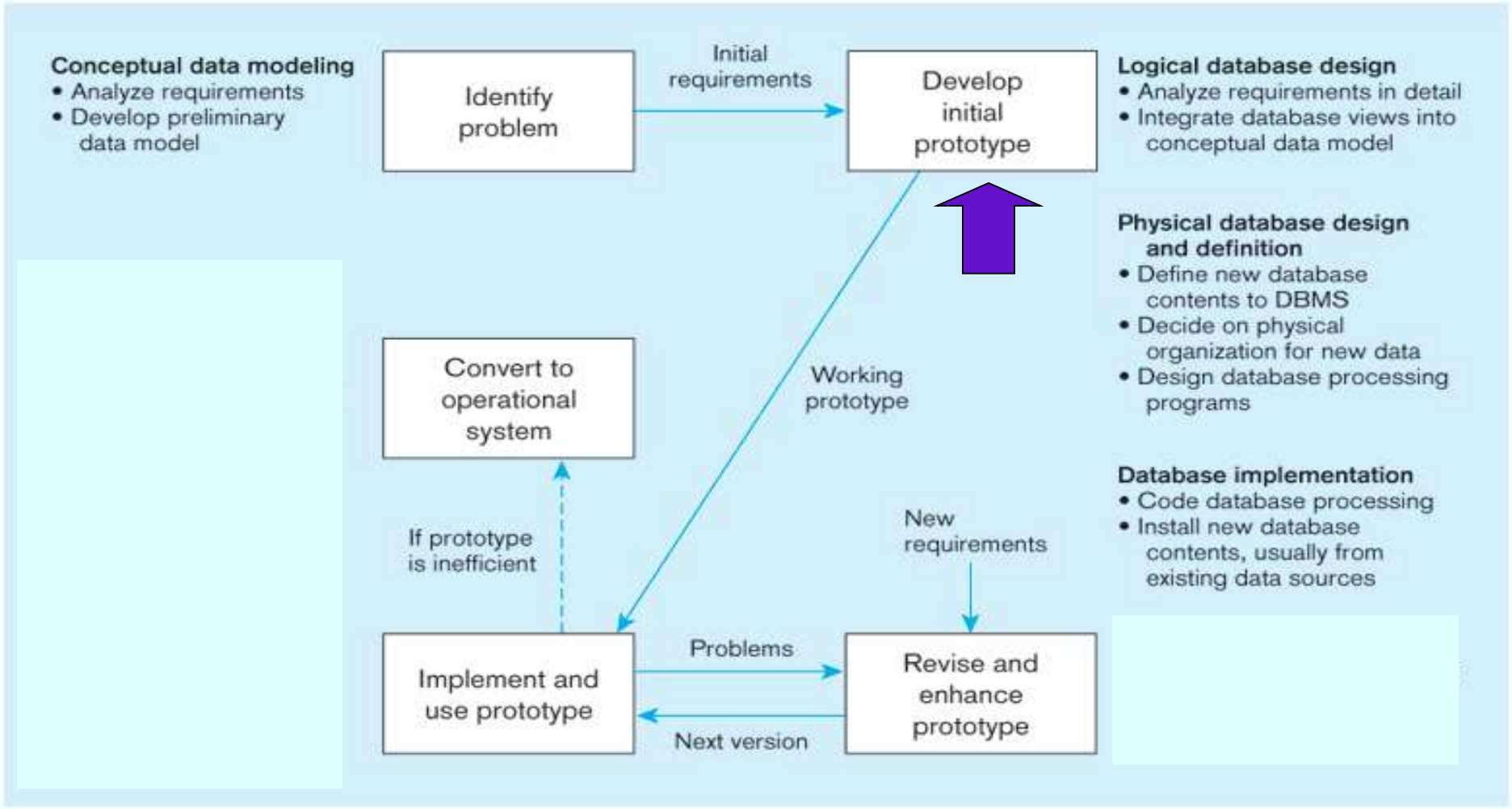


Prototyping is a classical Rapid Application Development (RAD) approach

Prototyping Database Methodology (Figure 1-8)



Prototyping Database Methodology (Figure 1-8)



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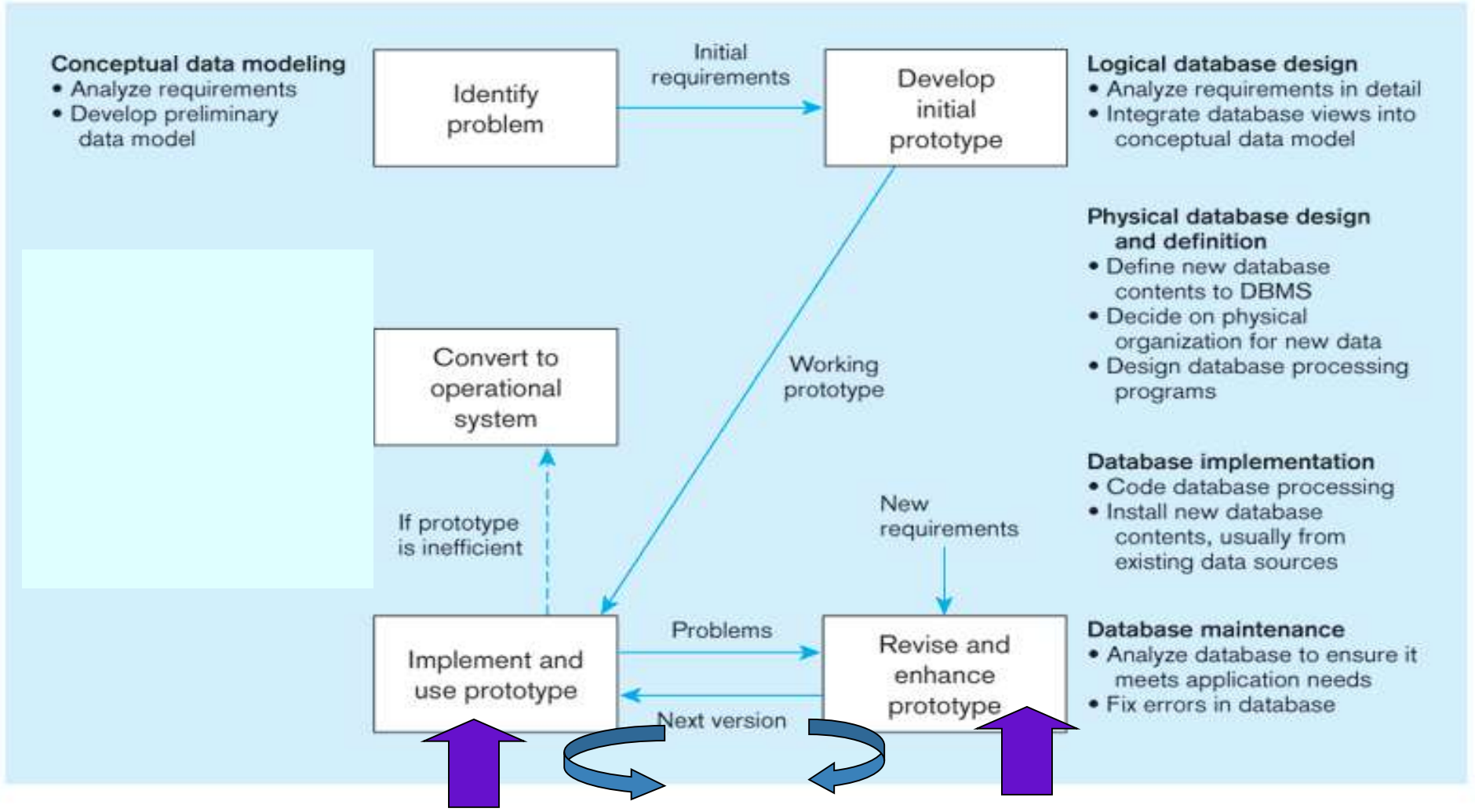

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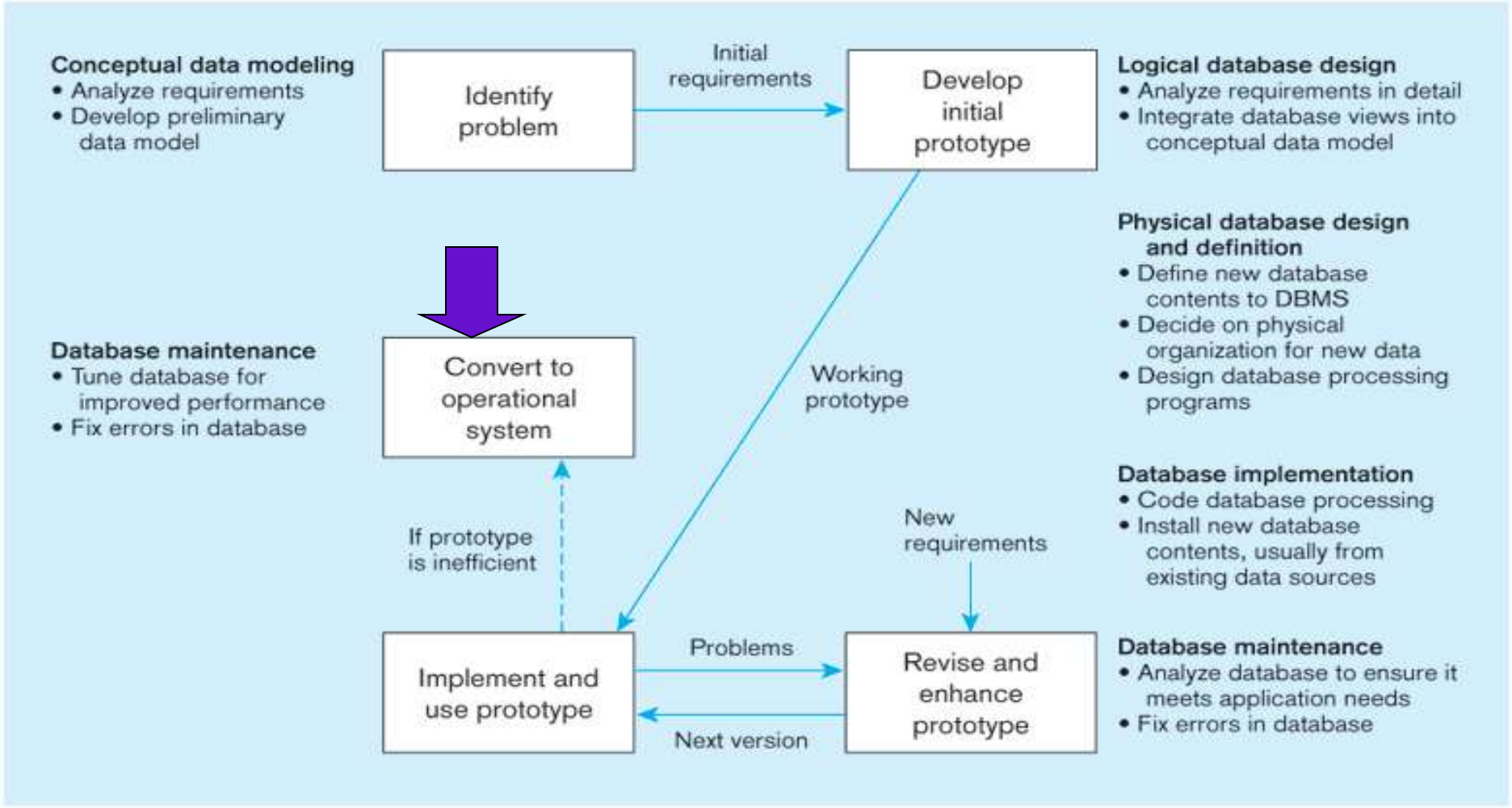


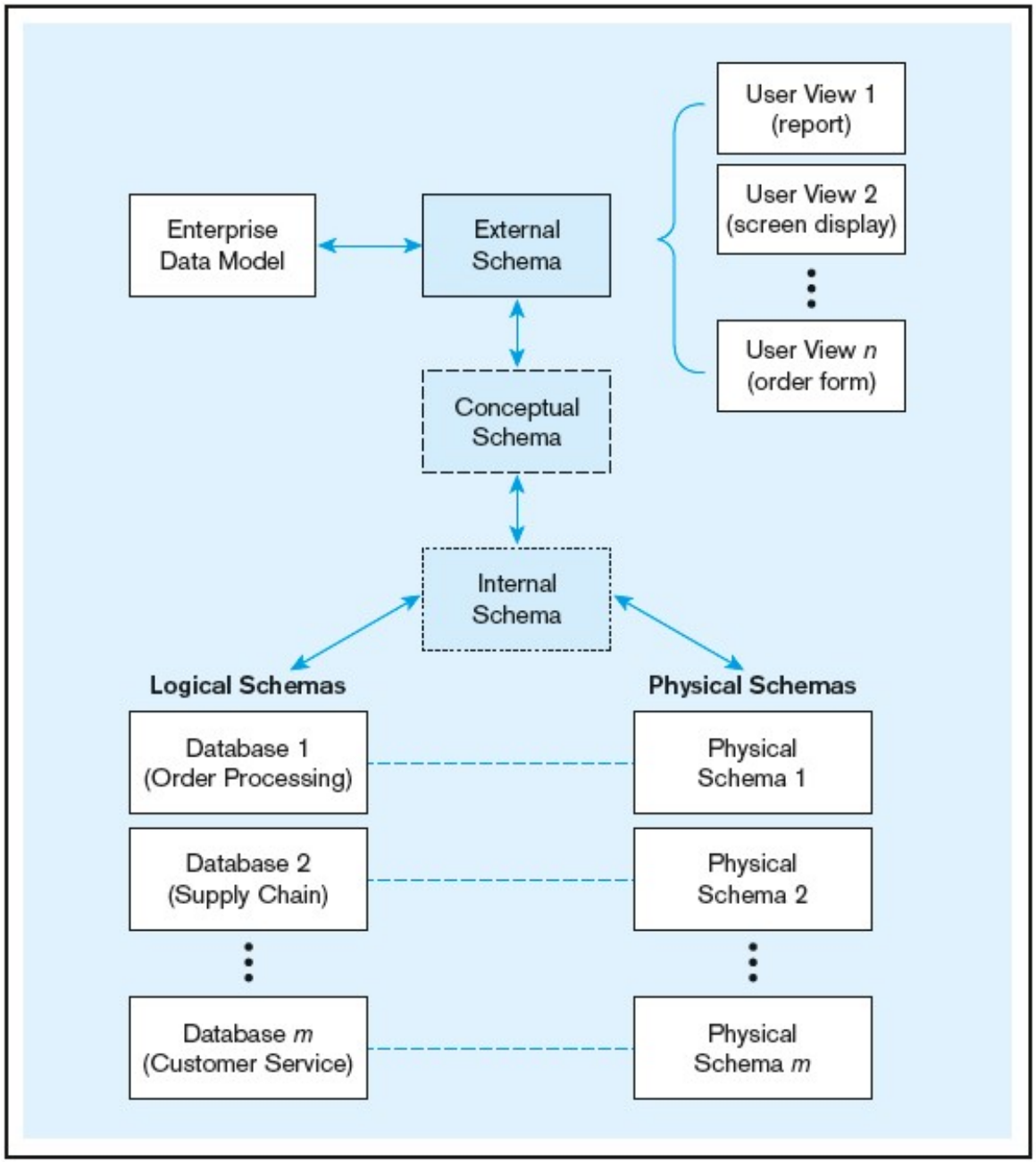
Database Schema

- External Schema
  - Can be determined from business-function/data entity matrices (Fig 1-6)
  - Enterprise model + User Views
  - During the Analysis and Logical Design phases
- Conceptual Schema
  - E-R models–covered in Chapters 2 and 3
  - A single, coherent definition of enterprise's data
  - The view of data architect or data admin
  - During the Analysis phase
- Internal Schema
  - Logical structures–covered in Chapter 4
  - Physical structures–covered in Chapter 5

Figure 1-9 Three-schema architecture

Different people have different views of the database…these are the external schema

The internal schema is the underlying design and implementation



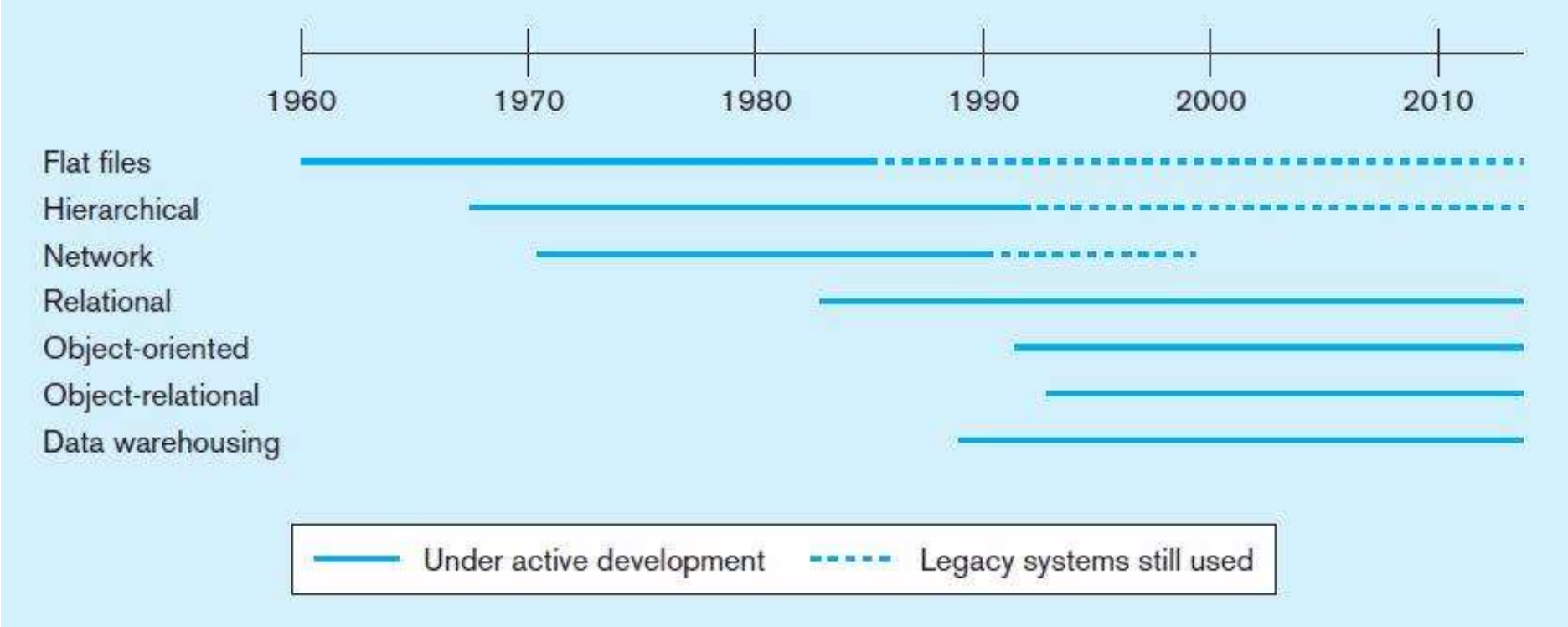
Managing People and Projects

- Project–a planned undertaking of related activities to reach an objective that has a beginning and an end
- Initiated and planned in planning stage of SDLC
- Executed during analysis, design, and implementation
- Closed at the end of implementation

Managing Projects: People Involved

- Business analysts
- Systems analysts
- Database analysts and data modelers
- Users
- Programmers
- Database architects
- Data administrators
- Project managers
- Other technical experts

Figure 1-10a Evolution of database technologies



Evolution of Database Systems

- Driven by four main objectives:
  - Need for program-data independence ➔ reduced maintenance
  - Desire to manage more complex data types and structures
  - Ease of data access for less technical personnel
  - Need for more powerful decision support platforms

Figure 1-10b Database architectures

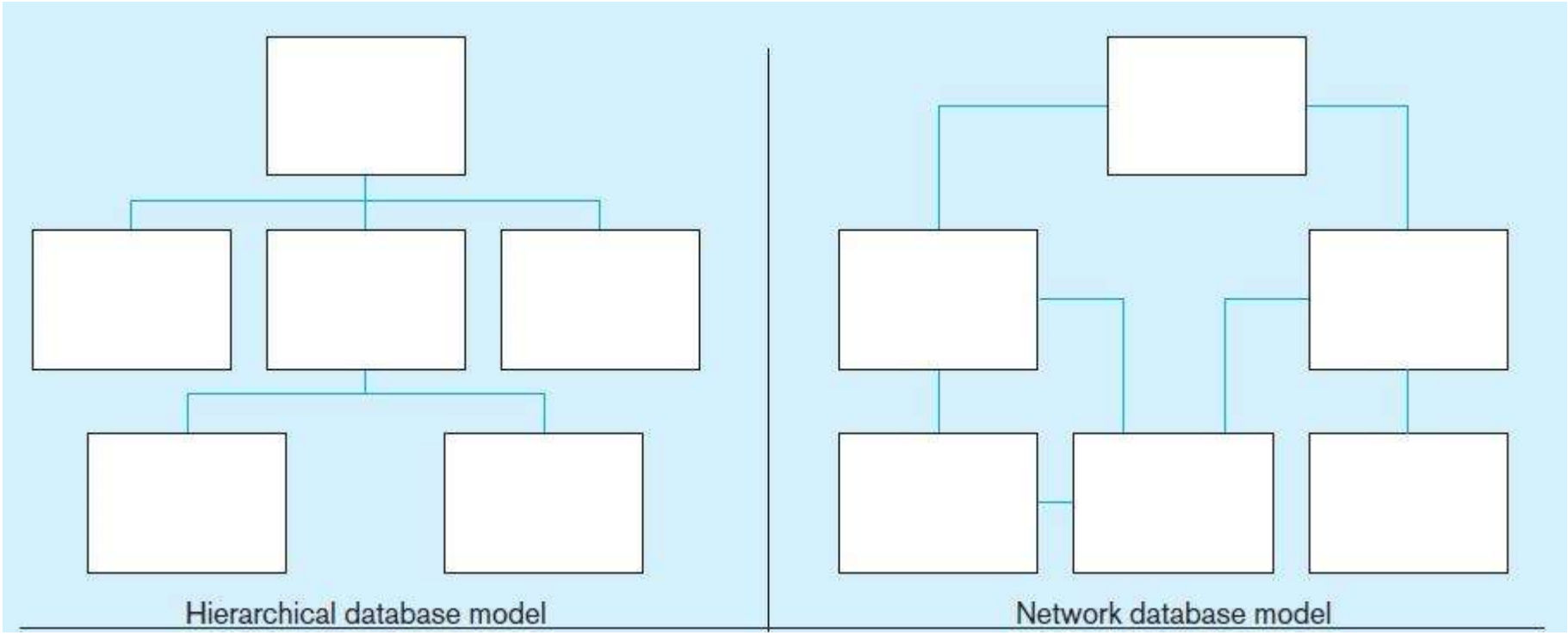


Figure 1-10b Database architectures (cont.)

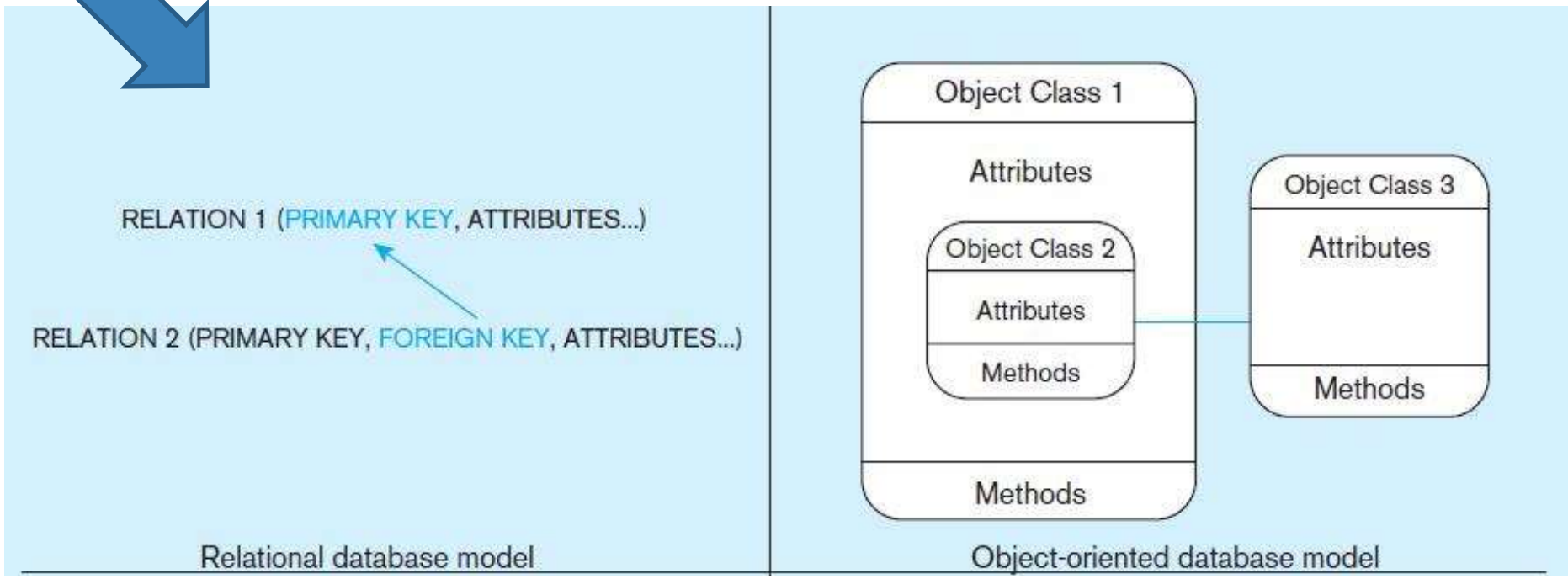
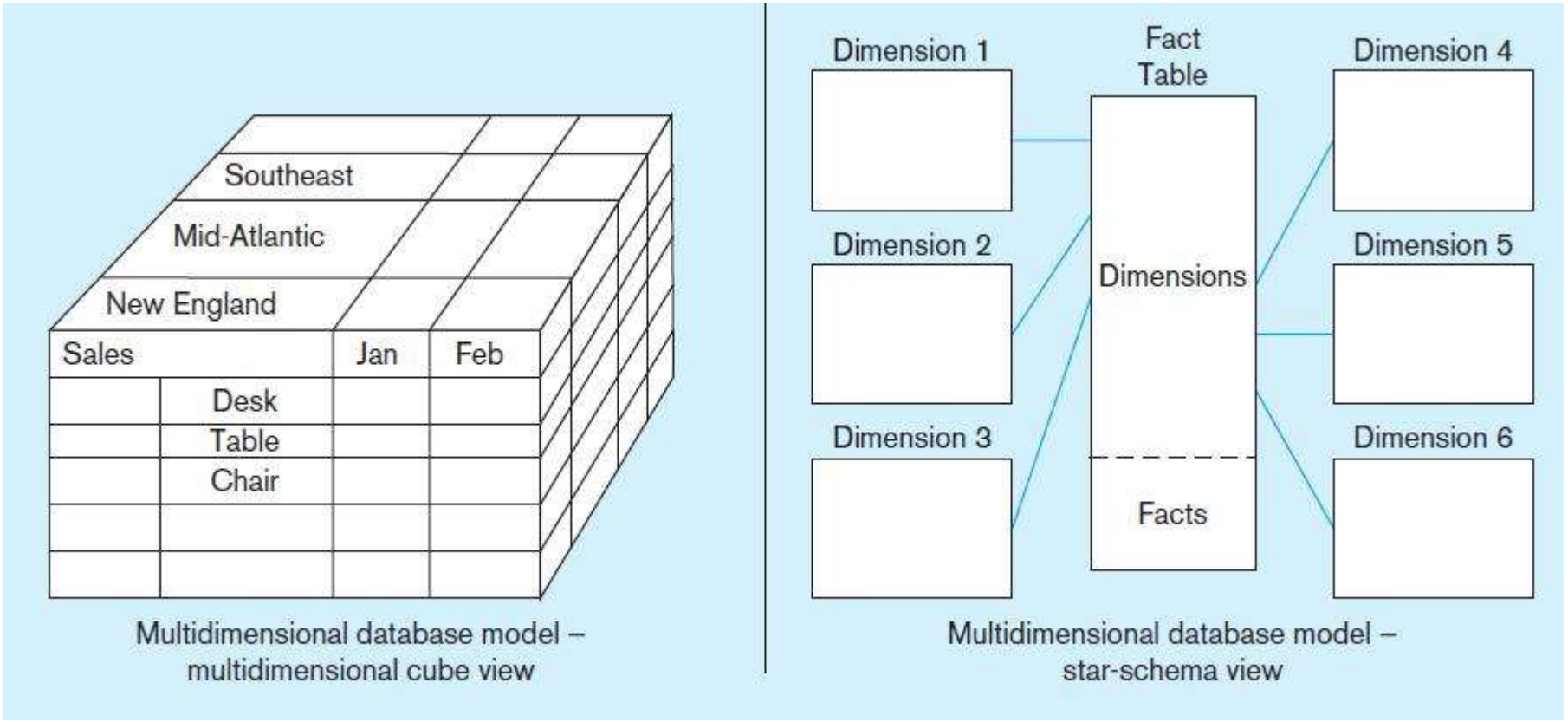


Figure 1-10b Database architectures (cont.)



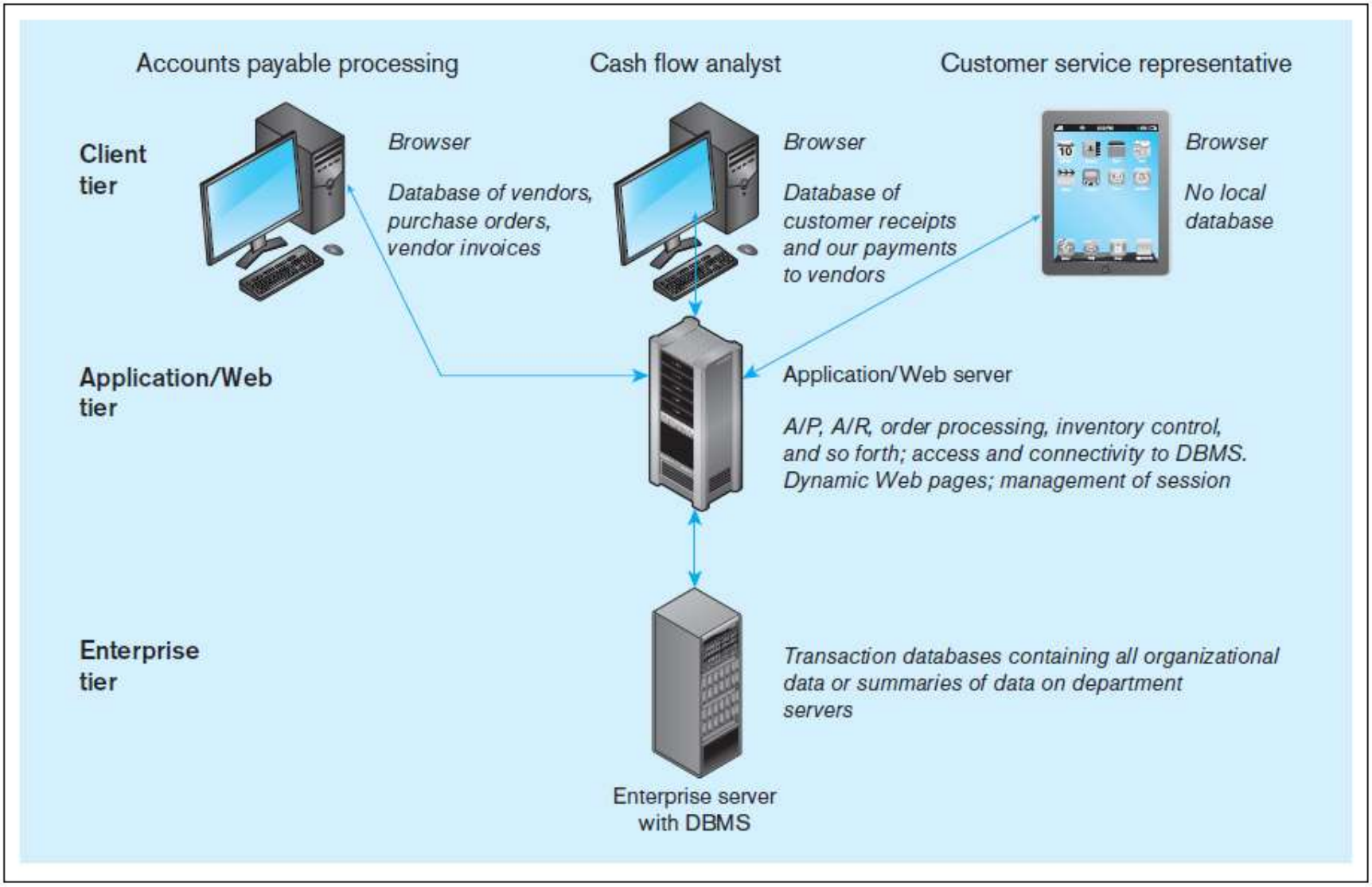
The Range of Database Applications

- Personal databases
- Two-tier and N-tier Client/Server databases
- Enterprise applications
  - Enterprise resource planning (ERP) systems
  - Data warehousing implementations

TABLE 1-5 Summary of Database Applications

Type of Database / Application	Typical Number of Users	Typical Size of Database
Personal	1	Megabytes
Multitier Client/Server	100–1000	Gigabytes
Enterprise resource planning	>100	Gigabytes–terabytes
Data warehousing	>100	Terabytes–petabytes

Figure 1-11 Multi-tiered client/server database architecture



Enterprise Database Applications

- Enterprise Resource Planning (ERP)
  - Integrate all enterprise functions (manufacturing, finance, sales, marketing, inventory, accounting, human resources)
- Data Warehouse
  - Integrated decision support system derived from various operational databases

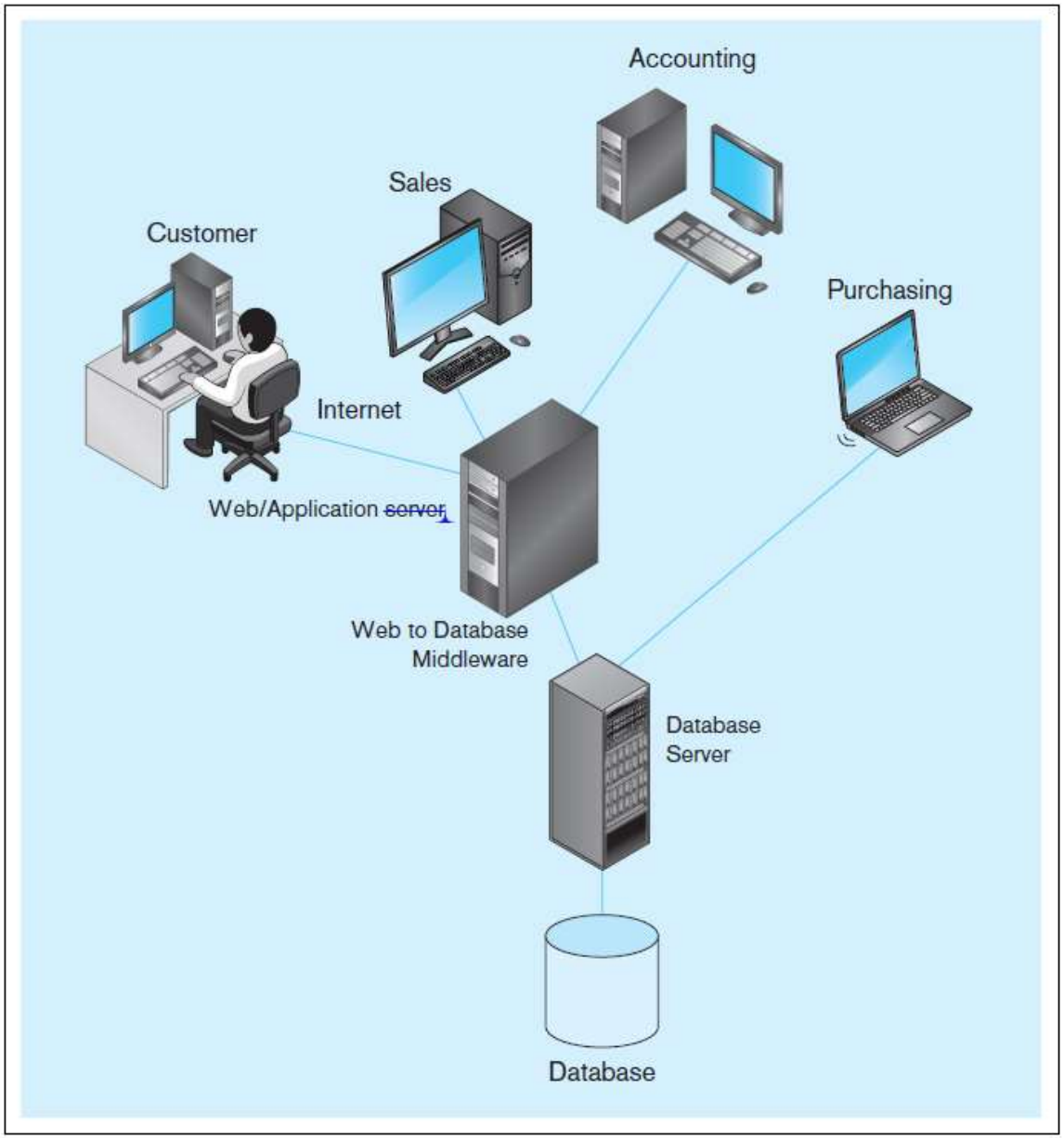


FIGURE 1-13 Computer System for Pine Valley Furniture Company

FIG 1-14 PRELIMINARY DATA MODEL

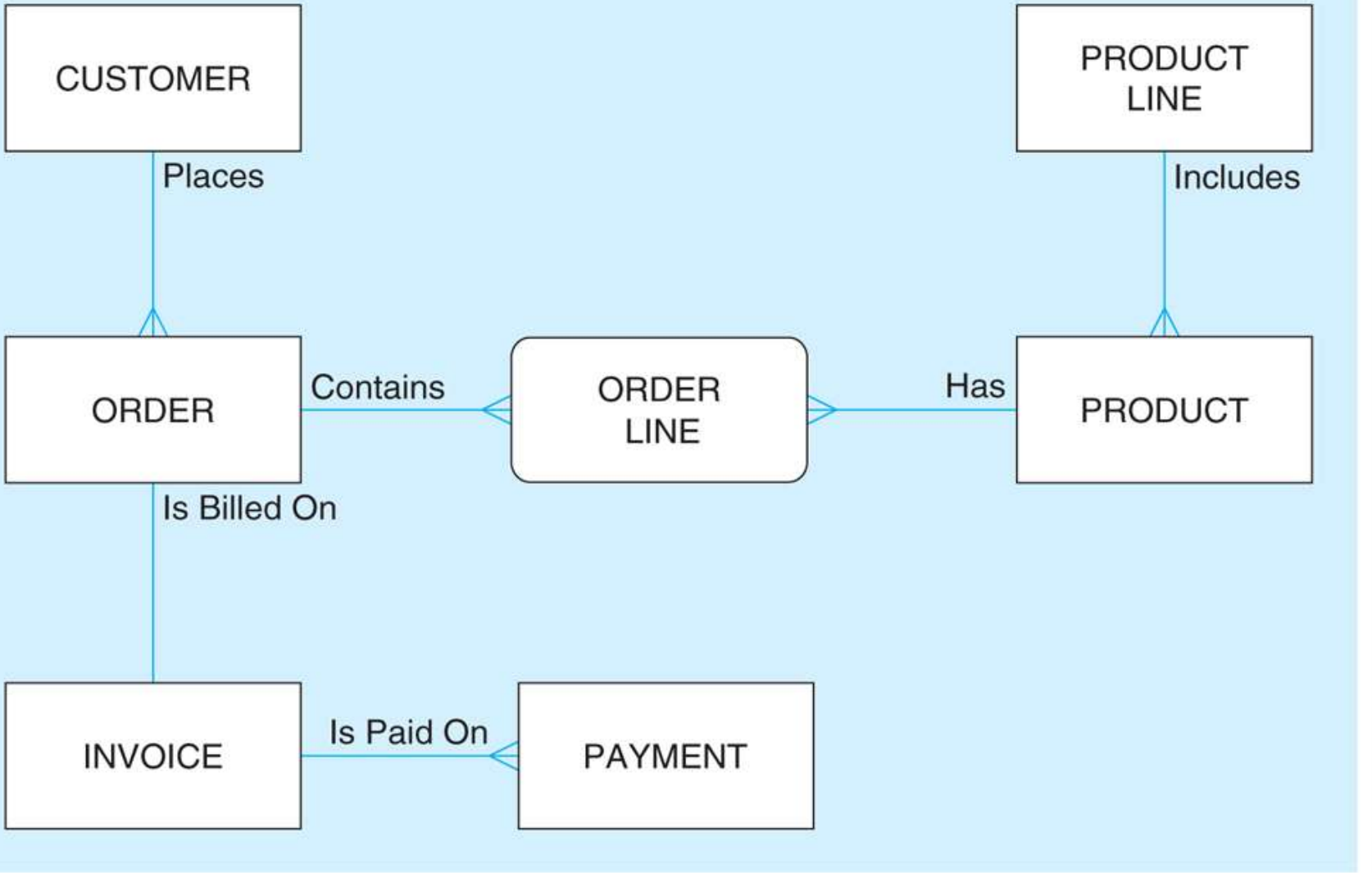
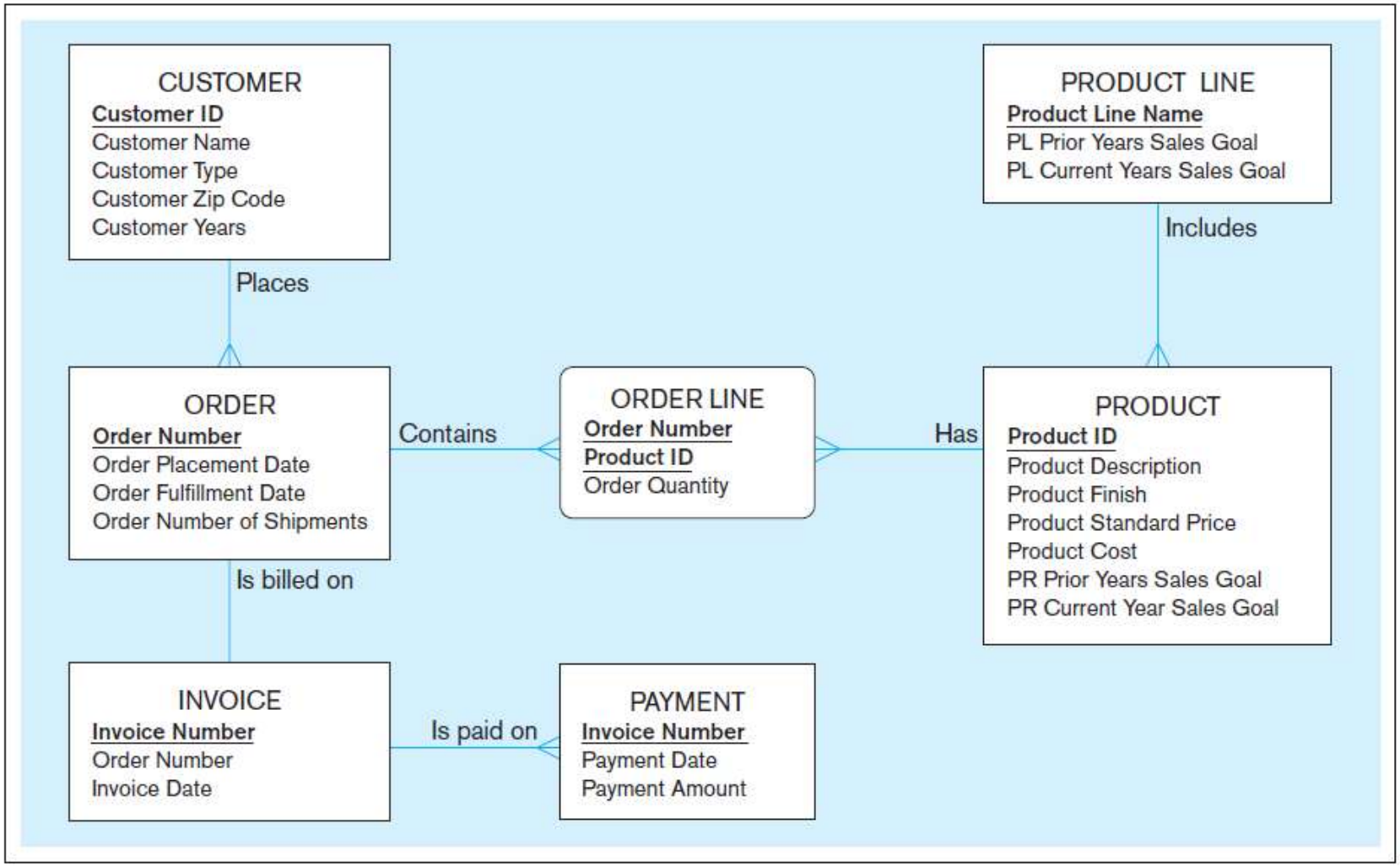


TABLE 1-6 Data Attributes for Entities in the Preliminary Data Model (Pine Valley Furniture Company)

Entity Type	Attribute
Customer	Customer Identifier
	Customer Name
	Customer Type
	Customer Zip Code
Product	Product Identifier
	Product Description
	Product Finish
	Product Price
	Product Cost
	Product Annual Sales Goal
	Product Line Name
Product Line	Product Line Name
	Product Line Annual Sales Goal
Order	Order Number
	Order Placement Date
	Order Fulfillment Date
	Customer Identifier
Ordered Product	Order Number
	Product Identifier
	Order Quantity
Invoice	Invoice Number
	Order Number
	Invoice Date
Payment	Invoice Number
	Payment Date
	Payment Amount

FIGURE 1-15 Project data model for Home Office product line marketing support system



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