Database Management Systems

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Points to Cover

- Database Design
- The Information System
- Database Requirements and Design
- Systems Development Life Cycle
- Phase 1: Database Initial Study
- Phase 2: Database Design
- II. DBMS Software Selection
- III. Logical Design
- IV. Physical Design
- Phase 3: Implementation and Loading
- Phase 4: Testing and Evaluation
- Phase 5: Operation
- Phase 6: Maintenance and Evaluation
- Decentralized Design

what is database design process

Database design is the **process** of producing a detailed data model of a **database**.

With a database design process you can quickly and effectively create a well-designed database that provides you with appropriate access to the information you want.

Steps in Database Design Process

The process of database design is divided into different parts. It consists of a series of steps. They are

- Requirement Analysis
- Conceptual Database Design (ER-Diagram)
- Logical Database Design (Tables, Normalization etc)
- Physical Database design (Table Indexing, Clustering etc)

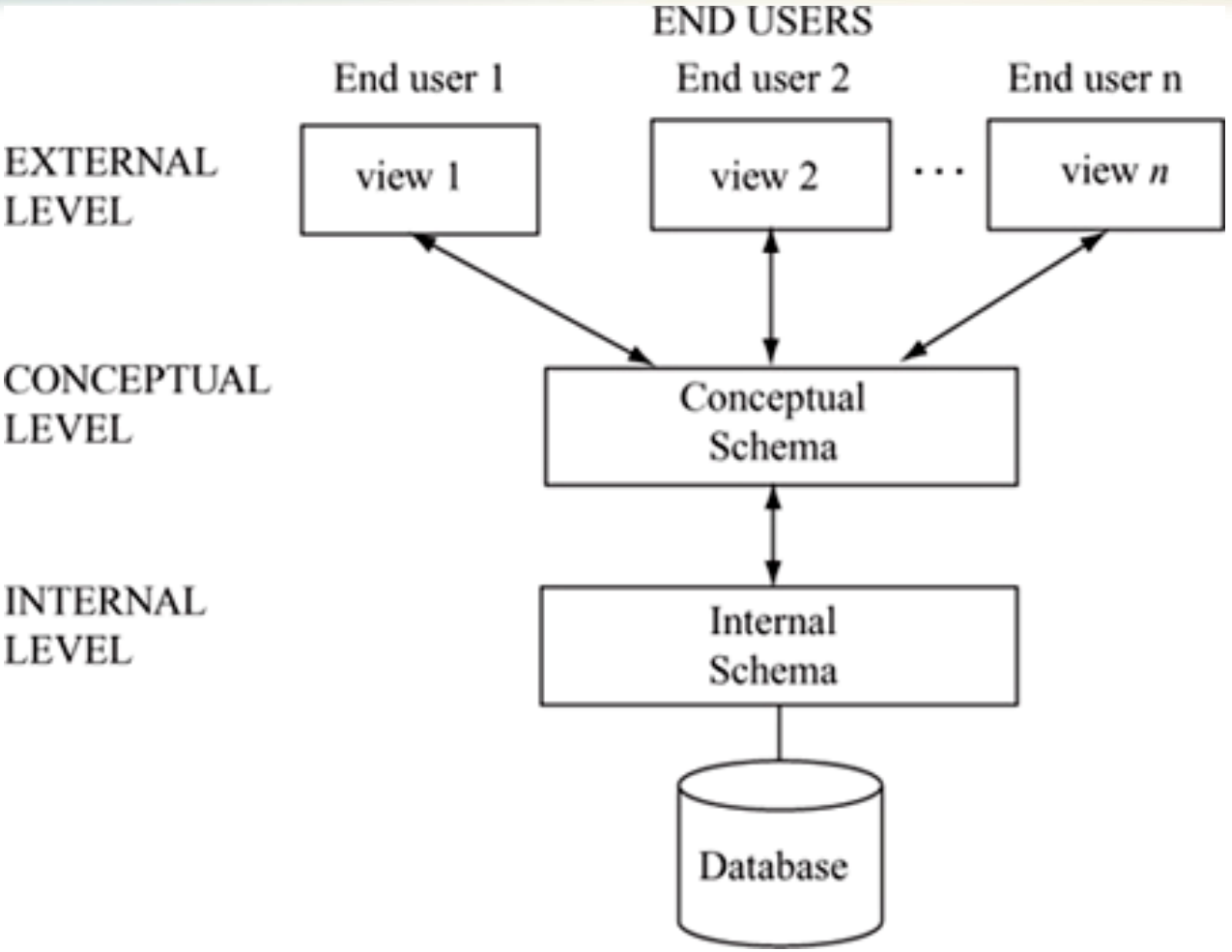
Differentiate between logical database design and physical database design. Show how this separation leads to data independence.

Basis	Logical Database Design	Physical Database Design
Task	Maps or transforms the conceptual schema (or an ER schema) from the high-level data model into a relational database schema.	The specifications for the stored database in terms of physical storage structures, record placement, and indexes are designed.
Choice of criteria	The mapping can proceed in two stages: ▪ System-independent mapping but data model-dependent ▪ Tailoring the schemas to a specific DBMS	The following criteria are often used to guide the choice of physical database design options: ▪ Response Time ▪ Space Utilization ▪ Transaction Throughput
Result	DDL statements in the language of the chosen DBMS that specify the conceptual and external level schemas of the database system. But if the DDL statements include some physical design parameters, a complete DDL specification must wait until after the physical database design phase is completed.	An initial determination of storage structures and the access paths for the database files. This corresponds to defining the internal schema in terms of Data Storage Definition Language.

Differentiate between logical database design and physical database design. Show how this separation leads to data independence. (**Cont**.)

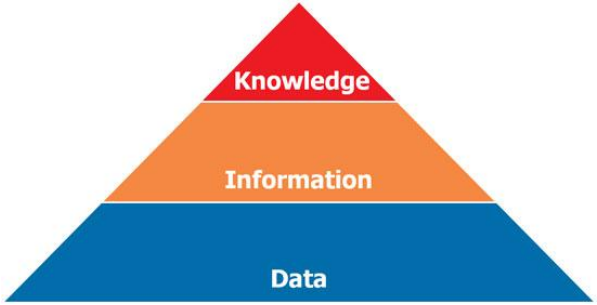
The database design is divided into several phases. The logical database design and physical database design are two of them. This separation is generally based on the concept of three-level architecture of DBMS, which provides the data independence.
Therefore, we can say thatoutput of the logical database design this separation leads to data independence because the is the conceptual and external level schemas of the database system which is independent from the output of the physical database design that is internal schema.

Three Level Database Architecture



Changing Data into Information

- Data
  - Raw facts stored in databases
  - Need additional processing to become useful
- Information
  - Required by decision maker
  - Data processed and presented in a meaningful form
  - Transformation

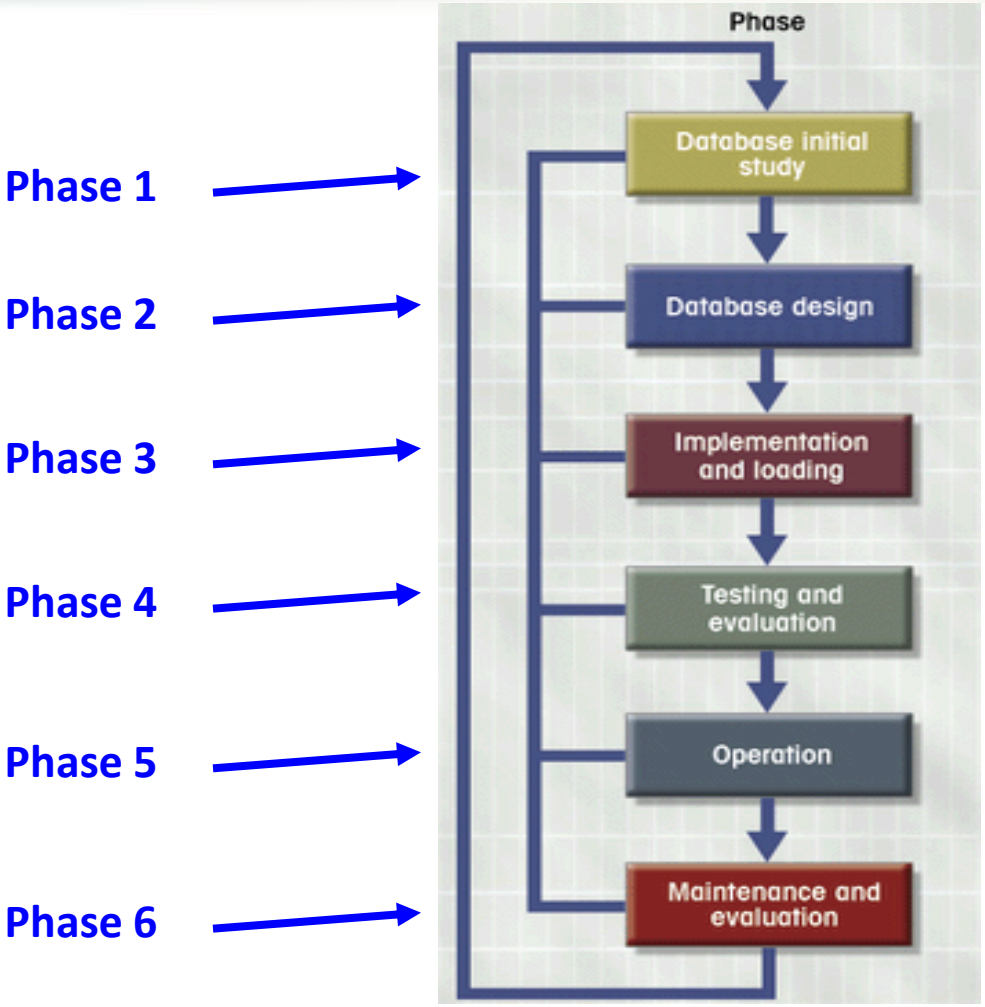


What is the difference between database system and information system

- Database system
  - Carefully designed and constructed repository of facts
  - Part of an information system

- Information System
  - Provides data collection, storage, and retrieval
  - Facilitates data transformation
  - Includes people, hardware, and software

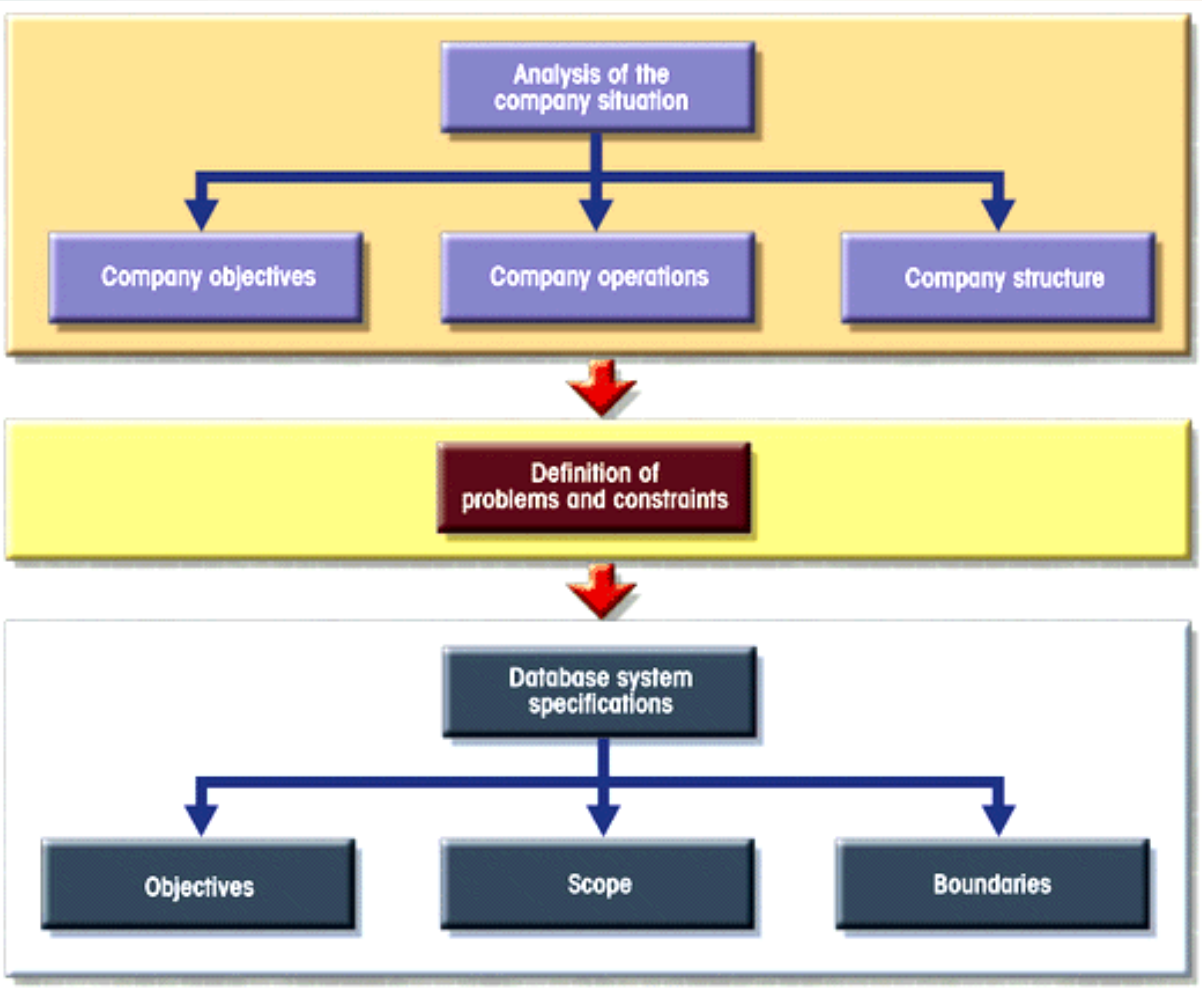
Database Lifecycle (DBLC)



Phase 1: Database Initial Study

- Purposes
  - Analyze company situation
    - Operating environment
    - Organizational structure
  - Define problems and constraints
  - Define objectives
  - Define scope and boundaries

Initial Study Activities



Phase 2: Database Design

- Most Critical DBLC phase
- Makes sure final product meets requirements
- Focus on data requirements
- Subphases
  - I. Create conceptual design
  - II. DBMS software selection
  - III. Create logical design
  - IV. Create physical design

I. Conceptual Design

- Data modeling creates abstract data structure to represent real-world items
- Data analysis and requirements
- Entity relationship modeling and normalization
- Data model verification

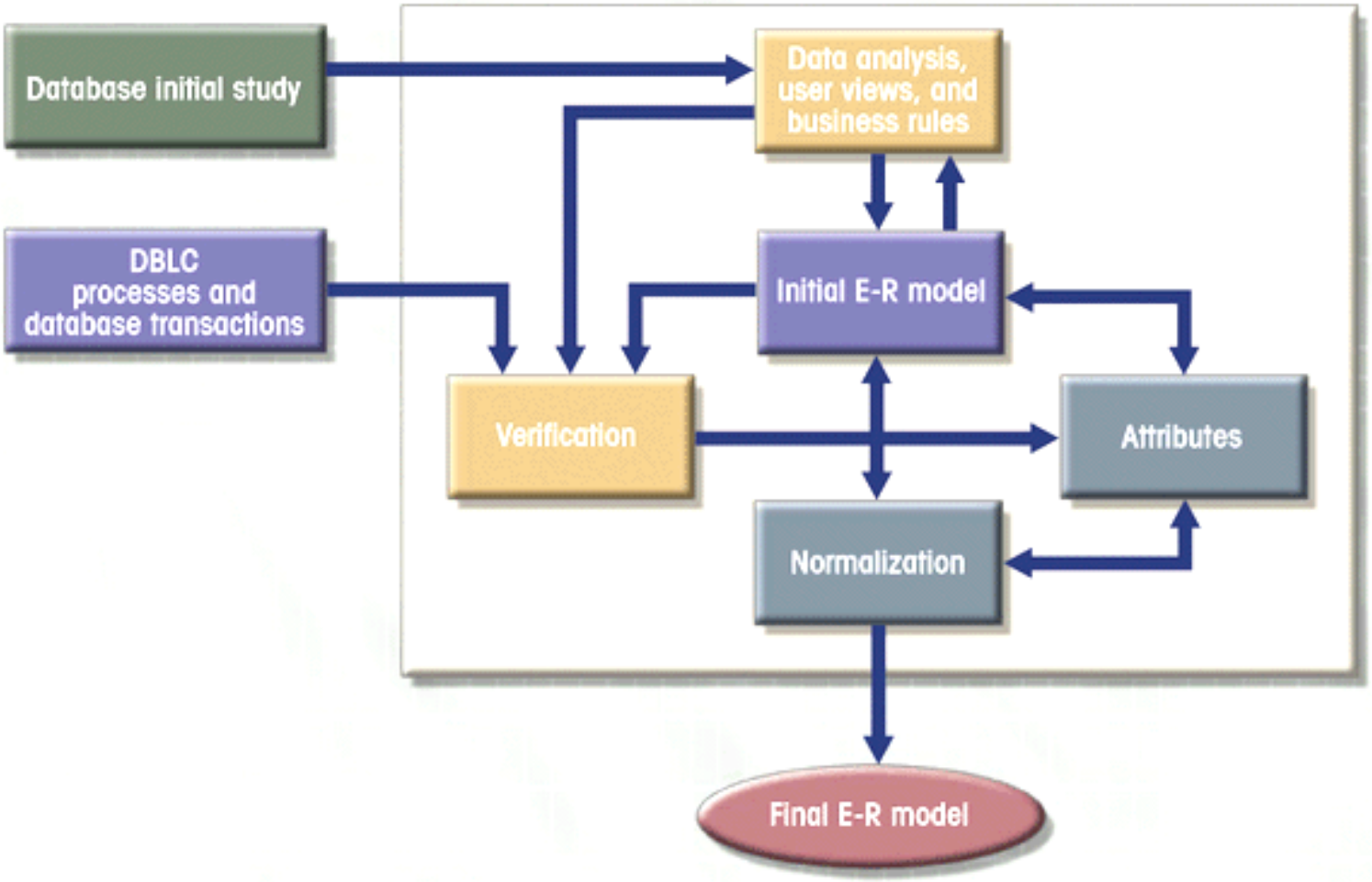
Data analysis and Requirements

- Focus on:
  - Information needs
  - Information users
  - Information sources
- Data sources
  - Developing and gathering end-user data views
  - Direct observation of current system
  - Interfacing with systems design group

Entity Relationship Modeling and Normalization

STEP	ACTIVITY
1	Identify, analyze, and refine the business rules.
2	Identify the main entities, using the results of Step 1.
3	Define the relationships among the entities, using the results of Steps 1 and 2.
4	Define the attributes, primary keys, and foreign keys for each of the entities.
5	Normalize the entities.
6	Complete the initial E-R diagram.
7	Have the main end users verify the model in Step 6 against the data, information, and processing requirements.
8	Modify the E-R diagram, using the results of Step 7.

E-R Modeling is Iterative



Data Model Verification

- E-R model is verified against proposed system processes
  - End user views and required transactions
  - Access paths, security, concurrency control
  - Business- enforced data requirements and constraints
- Discover additional entity and attribute details

E-R Model Verification Process

STEP	ACTIVITY
1	Identify the E-R model's central entity.
2	Identify each module and its components.
3	Identify each module's transaction requirements: Internal: Updates/Inserts/Deletes/Queries/Reports External: Module interfaces
4	Verify all processes against the E-R model.
5	Make all necessary changes suggested in Step 4.
6	Repeat Steps 2 through 5 for all modules.

III. Logical Design

- Translates conceptual design into internal model
- Maps objects in model to specific DBMS constructs
- Design components
  - Tables
  - Indexes
  - Views
  - Transactions
  - Access authorities
  - Others

IV. Physical Design

- Selection of data storage and access characteristics
- Becomes more complex for distributed systems
- Designers favor software that hides physical details

Phase 3: Implementation and Loading

- Creation or constructs of special related tables
- Data loaded into tables
- Other issues
  - **Performance**
  - **Security**
  - **Backup and recovery**
  - **Integrity**
  - **Company standards**
  - **Concurrency controls**

Phase 4: Testing and Evaluation

- Database is tested and fine-tuned for performance, integrity, concurrent access, and security constraints
- Done in parallel with application programming
- Actions taken if tests fail
  - Modification of physical design
  - Modification of logical design
  - Upgrade or change DBMS software or hardware

Phase 5: Operation

- Database considered operational
- Starts process of system evaluation
- Unexpected problems may surface
- Demand for change is constant

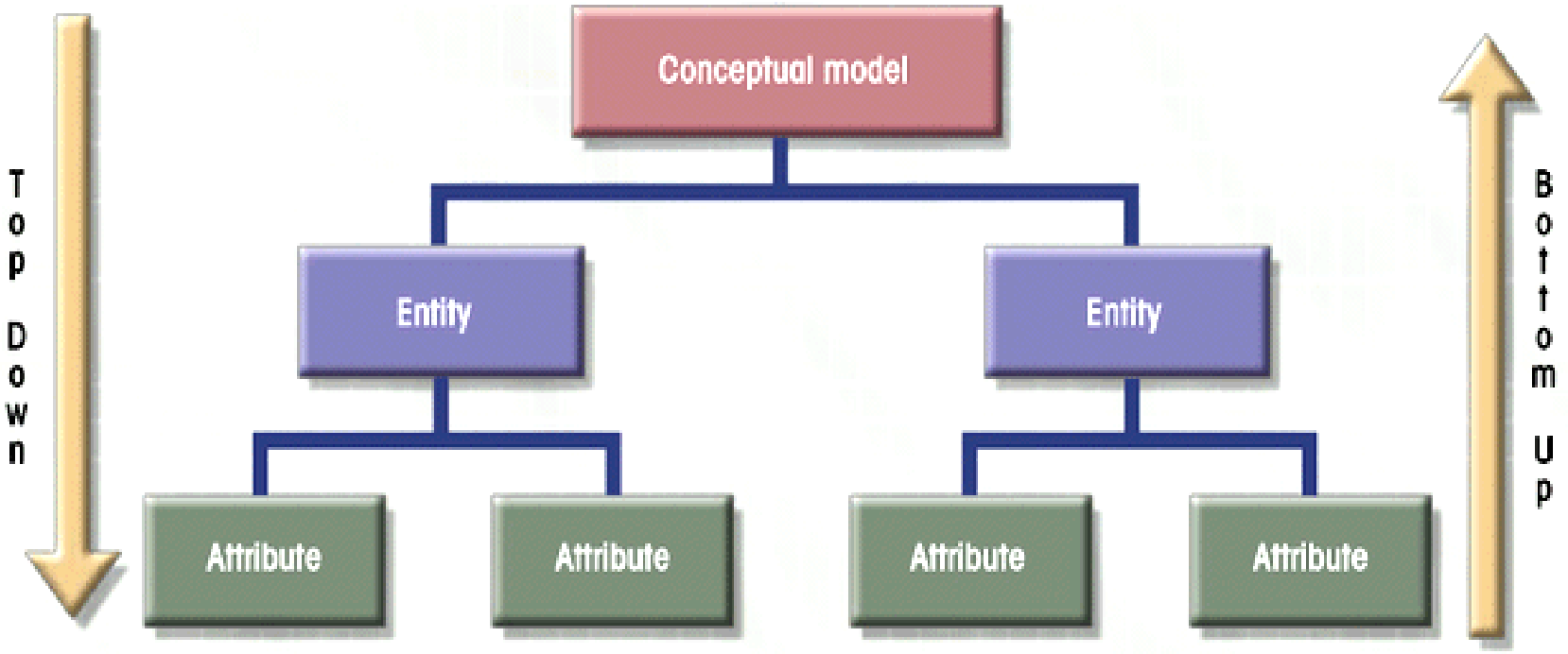
Phase 6: Maintenance and Evaluation

- Defensive maintenance
- Corrective maintenance
- Adaptive maintenance
- Assignment of access permissions
- Statistics method to monitor performance
- Periodic security revisions based on system-generated statistics
- Periodic system usage-summaries

DB Design Strategy Notes

- Top-down
  - 1) Identify data sets
  - 2) Define data elements
- Bottom-up
  - 1) Identify data elements
  - 2) Group them into data sets

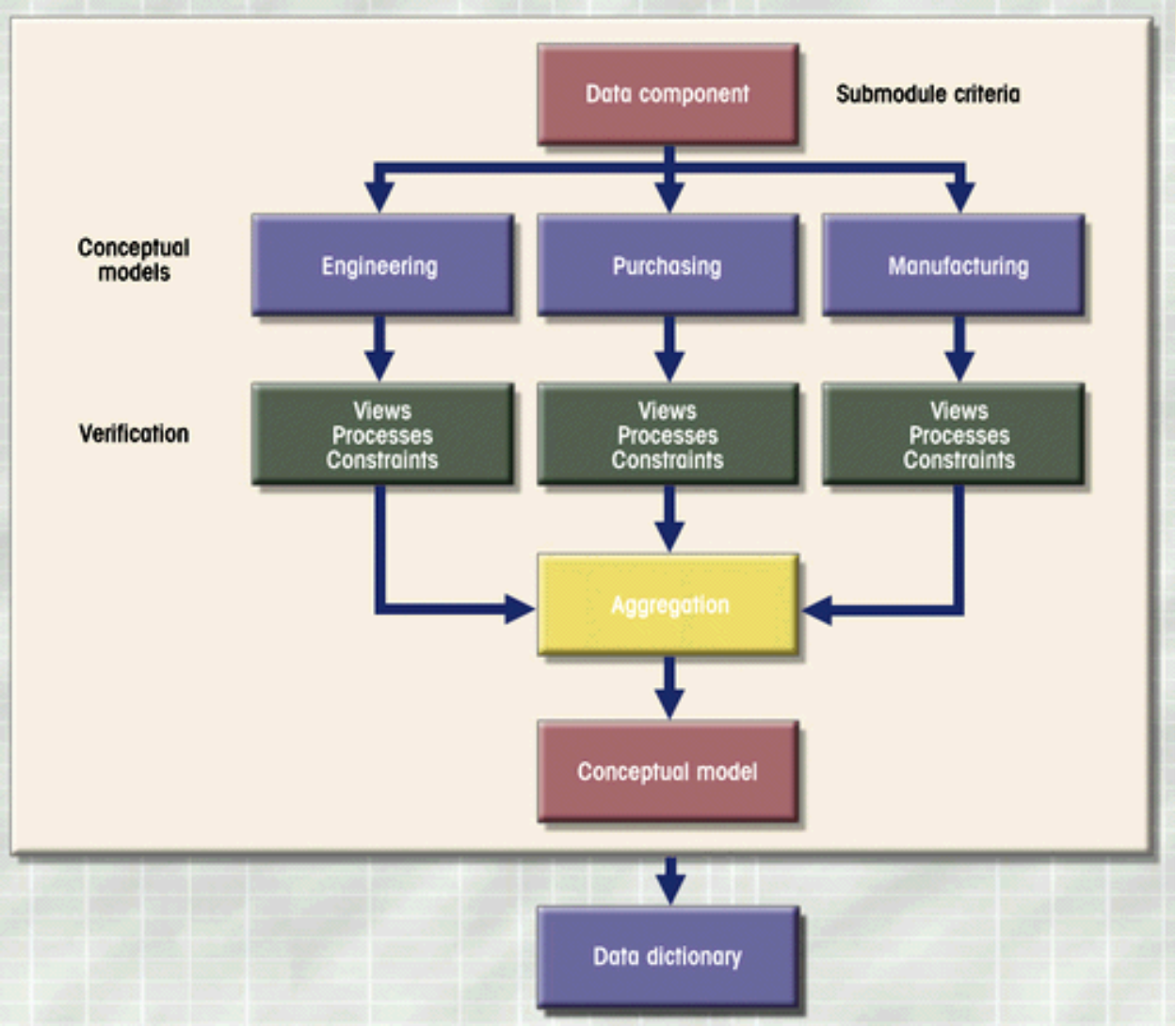
Top-Down vs. Bottom-Up



Centralized vs. Decentralized Design

- Centralized design
  - Typical of simple databases
  - Conducted by single person or small team
- Decentralized design
  - Larger numbers of entities and complex relations
  - Spread across multiple sites
  - Developed by teams

Decentralized Design



Thank you

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