Enterprise Data Model

- First step in database development
- Specifies scope and general content
- Overall picture of organizational data at high level of abstraction
- Entity-relationship diagram
- Descriptions of entity types
- Relationships between entities
- Business rules
Enterprise data model describes the high-level entities in an organization and the relationship between these entities.
Information Systems Architecture (ISA)

- Conceptual blueprint for organization’s desired information systems structure

- Consists of:
  - Data (e.g. Enterprise Data Model – simplified ER Diagram)
  - Processes – data flow diagrams, process decomposition, etc.
  - Data Network – topology diagram
  - People – people management using project management tools (Gantt charts, etc.)
  - Events and points in time (when processes are performed)
  - Reasons for events and rules (e.g. decision tables)
Information Engineering

• A data-oriented methodology to create and maintain information systems

• Top-down planning: a generic IS planning methodology for obtaining a broad understanding of the IS needed by the entire organization

• Four steps to Top-Down planning:
  – Planning
  – Analysis
  – Design
  – Implementation
Information Systems Planning

• Purpose: align information technology with organization’s business strategies

• Three steps:
  1. Identify strategic planning factors
     a. Goals
     b. Critical success factors
     c. Problem areas
  2. Identify corporate planning objects
     a. Organizational units
     b. Locations
     c. Business functions
     d. Entity types
  3. Develop enterprise model
     a. Functional decomposition
     b. Entity-relationship diagram
     c. Planning matrices
Identify Strategic Planning Factors

• Organization goals – what we hope to accomplish
• Critical success factors – what MUST work in order for us to survive
• Problem areas – weaknesses we now have
Identify Corporate Planning Objects

- Organizational units – departments
- Organizational locations
- Business functions – groups of business processes
- Entity types – the things we are trying to model for the database
- Information systems – application programs
Develop Enterprise Model

• Functional decomposition
  – The process of breaking down the functions of an organization into progressively greater levels of detail.

• Enterprise data model

• Planning matrixes
Example of process decomposition of an order fulfillment function (Pine Valley Furniture)

Decomposition -- breaking large tasks into smaller tasks in a hierarchical structure chart
Planning Matrixes

• Describe relationships between planning objects in the organization

• Types of matrixes:
  – Function-to-data entity: which data are useful to each function.
  – Location-to-function: which function is performed where.
  – Unit-to-function: which function is performed by which unit.
  – IS-to-data entity: how each IS interacts with each data entity.
  – IS-to-business objective: which IS supports each business objective.
## Example business function-to-data entity matrix

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<th>Business Function (users)</th>
<th>Customer</th>
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<th>Order</th>
<th>Work Center</th>
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<th>Invoice</th>
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Two Approaches to Database and IS Development

• SDLC
  – System Development Life Cycle
  – Detailed, well-planned development process
  – Time-consuming, but comprehensive
  – Long development cycle

• Rapid 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

Planning

**Purpose** To develop a preliminary understanding of a business situation and how information systems might help solve a problem or make an opportunity possible

**Deliverable** A written request to study the possible changes to an existing system or the development of a new system that address an information systems solution to the business problems or opportunities

Maintenance

**Purpose** To monitor the operation and usefulness of a system, and to repair and enhance the system

**Deliverables** Periodic audits of the system to demonstrate whether the system is accurate and still meets needs

Implementation

**Purpose** To write programs, build data files, test and install the new system, train users, and finalize documentation

**Deliverables** Programs that work accurately and to specifications, documentation, and training materials

Analysis

**Purpose** To analyze the business situation thoroughly to determine requirements, to structure those requirements, and to select among competing system features

**Deliverables** The functional specifications for a system that meets user requirements and is feasible to develop and implement

Design

**Purpose** To elicit and structure all information requirements; to develop all technology and organizational specifications

**Deliverables** Detailed functional specifications of all data, forms, reports, displays, and processing rules; program and database structures, technology purchases, physical site plans, and organizational redesigns
Database Development Activities During The Systems Development Life Cycle

Planning
- Enterprise modeling
  - Analyze current data processing
  - Analyze the general business functions and their database needs
  - Justify need for new data and databases in support of business
- Conceptual data modeling
  - Identify scope of database requirements for proposed information system
  - Analyze overall data requirements for business function(s) supported by database

Database maintenance
- Analyze database and database applications to ensure that evolving information requirements are met
- Tune database for improved performance
- Fix errors in database and database applications and recover database when it is contaminated

Database implementation
- Code and test database processing programs
- Complete database documentation and training materials
- Install database and convert data from prior systems

Analysis
- Conceptual data modeling, cont’d.
  - Develop preliminary conceptual data model, including entities and relationships
  - Compare preliminary conceptual data model with enterprise data model
  - Develop detailed conceptual data model, including all entities, relationships, attributes, and business rules
  - Make conceptual data model consistent with other models of information system
  - Populate repository with all conceptual database specifications

Logical database design
- Analyze in detail the transactions, forms, displays, and inquiries (database views) required by the business functions supported by the database
- Integrate database views into conceptual data model
- Identify data integrity and security requirements, and populate repository

Physical database design and definition
- Define database to DBMS (often generated from repository)
- Decide on physical organization of data
- Design database processing programs
1. Identify problem
2. Initial requirements
3. Develop initial prototype
4. Working prototype
5. Convert to operational system
6. If prototype is inefficient
7. Implement and use prototype
8. Problems
9. Next version
10. Revise and enhance prototype
11. New requirements
Packaged Data Models

• Model components that can be purchased, customized, and assembled into full-scale data models

• Advantages
  – Reduced development time
  – Higher model quality and reliability

• Two types:
  – Universal data models
  – Industry-specific data models
Database Design

- The database design process can be divided into six basic steps. Semantic data models are most relevant to only the first three of these steps.

1. *Requirements Analysis:* The first step in designing a database application is to understand what data is to be stored in the database, what applications must be built on top of it, and what operations are most frequent and subject to performance requirements. Often this is an informal process involving discussions with user groups and studying the current environment. Examining existing applications expected to be replaced or complemented by the database system.
Database Design (cont.)

2. **Conceptual Database Design:** The information gathered in the requirements analysis step is used to develop a high-level description of the data to be stored in the database, along with the constraints that are known to hold on this data.

3. **Logical Database Design:** A DBMS must be selected to implement the database and to convert the conceptual database design into a database schema within the data model of the chosen DBMS.
4. **Schema Refinement:** In this step the schemas developed in step 3 above are analyzed for potential problems. It is in this step that the database is *normalized*. Normalization of a database is based upon some elegant and powerful mathematical theory. We will discuss normalization later in the term.

5. **Physical Database Design:** At this stage in the design of a database, potential workloads and access patterns are simulated to identify potential weaknesses in the conceptual database. This will often cause the creation of additional indices and/or clustering relations. In critical situations, the entire conceptual model will need restructuring.
6. **Security Design**: Different user groups are identified and their different roles are analyzed so that access patterns to the data can be defined.

- There is often a seventh step in this process with the last step being a *tuning phase*, during which the database is made operational (although it may be through a simulation) and further refinements are made as the system is “tweaked” to provide the expected environment.

- The illustration on the following page summarizes the main phases of database design.
Database Design (cont.)

Miniworld

Requirements Collection and Analysis

Database Requirements

Conceptual Design

Conceptual Schema (high-level data model)

Logical Design – (data model mapping)

Logical Schema (data model of specific DBMS)

Physical Design

Internal Schema

DBMS-independent DBMS-specific

Functional Requirements

Database Requirements

Functional Analysis

High-level Transaction Specification

Conceptual Schema (high-level data model)

Logical Design – (data model mapping)

Logical Schema (data model of specific DBMS)

Physical Design

Internal Schema

Application Program Design

Transaction Implementation

Application Programs
CASE

• Computer-Aided Software Engineering (CASE) – software tools providing automated support for systems development

• Three database features:
  – Data modeling – entity-relationship diagrams
  – Code generation – SQL code for table creation
  – Repositories – knowledge base of enterprise information
Managing Projects

- Project – a planned undertaking of related activities to reach an objective that has a beginning and an end
- Involves use of review points for:
  - Validation of satisfactory progress
  - Step back from detail to overall view
  - Renew commitment of stakeholders
- Incremental commitment – review of systems development project after each development phase with re-justification after each phase
Managing Projects: People Involved

- Systems analysts
- Database analysts
- Users
- Programmers
- Database/data administrators
- Systems programmers, network administrators, testers, technical writers
Gantt Chart

Sales Promotion Tracking

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Date: 4/1/98 8:00am

Critical  Noncritical  Progress  Milestone  Summary  Rolled Up

Shows time estimates of tasks
PERT chart (Program Evaluation and Review Technique)

Sales Promotion Tracking

- Screen Design
  - Requirements Collection: 1, 5w, 4/16/01, 5/18/01
  - 2, 6w, 5/21/01, 6/29/01

- Database Design
  - 4, 2w, 7/2/01, 7/13/01

- User Documentation
  - 5, 5.5w, 7/16/01, 8/22/01
  - 9/10/01, 9/14/01

- Installation
  - 8, 5.5w, 9/10/01, 9/14/01

- Programming
  - 6, 5w, 7/16/01, 8/17/01

- Testing
  - 7, 3w, 8/20/01, 9/7/01

- Report Design
  - 3, 6w, 5/21/01, 6/29/01

Date: 4/2/01 6:00am

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