CHAPTER 15

Database Design Using the REA Data Model

INTRODUCTION

Questions to be addressed in this chapter include:
– What steps are followed to design and implement a database system?
– How is the REA data model used to design an AIS database?
– How is an entity-relationship REA diagram of an AIS database drawn?
– How are REA diagrams read, and what do they reveal about the business activities and policies of the organization being modeled?

INTRODUCTION

Steps in database design include the following:
– Planning
– Requirements analysis
– Design
– Coding
– Implementation
– Operation and maintenance

Eventually, changes in business strategy and practices or new IT developments lead to the need for a new system and the process starts over.

INTRODUCTION

Accountants can and should participate in all stages of the database design process, although participation varies between stages.
– Planning stage
– Requirements analysis and design stages
– Coding stage
– Implementation stage
– Operation and maintenance stage

Accountants use the database system to process transactions.
Sometimes help manage it.

INTRODUCTION

Accountants may provide the greatest value by taking responsibility for data modeling—the process of defining a database to faithfully represent all aspects of the organization, including interactions with the external environment.
– Occurs during both requirements analysis and design stage.
– Two important tools to facilitate data modeling:
  • Entity-relationship diagramming
  • REA data model

ENTITY-RELATIONSHIP DIAGRAMS

An entity-relationship (E-R) diagram is a graphical technique for portraying a database schema.
– Shows the various entities being modeled and the important relationships among them.
ENTITY-RELATIONSHIP DIAGRAMS

- In this book, we will create E-R diagrams with a large number of entities and relationships.
- To reduce clutter and improve readability, we omit diamonds and list attributes in a separate table.

<table>
<thead>
<tr>
<th>Entity Name</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enrollment</td>
<td>Enrollment No., Enrollment Date, Enrollment Time</td>
</tr>
<tr>
<td>Student</td>
<td>Student ID No., Student Name, Student Address</td>
</tr>
</tbody>
</table>

THE REA DATA MODEL

- The REA data model was developed specifically for use in designing accounting information systems.
  - Focuses on business semantics underlying an organization’s value chain activities.
  - Provides guidance for:
    - Identifying the entities to be included in a database.
    - Structuring the relationships among the entities.
- REA data models are usually depicted in the form of E-R diagrams.
- Therefore, we refer to E-R diagrams developed with the REA model as **REA diagrams**.

THE REA DATA MODEL

- Three basic types of entities
  - The REA data model is so named because it classifies entities into three distinct categories:
    - **Resources** that the organization acquires and uses.
    - **Events** in which the organization engages
    - **Agents** participating in these events.

  - Includes people and organizations who participate in events and about whom information is desired for planning, control, and evaluation purposes.

THE REA DATA MODEL

- Structuring relationships: The basic REA template
  - The REA data model prescribes a basic pattern for how the three types of entities (resources, events, and agents) should relate to one another.
    - Rule 1: Each event is linked to at least one resource that it affects.
    - Rule 2: Each event is linked to at least one other event.
    - Rule 3: Each event is linked to at least two agents.
The revenue cycle involves interactions with your customers. You sell goods or services and get cash.

The expenditure cycle involves interactions with your suppliers. You buy goods or services and pay cash.

In the production cycle, raw materials, labor, and machinery and equipment time are transformed into finished goods.

The human resources cycle involves interactions with your employees. Employees are hired, trained, paid, evaluated, promoted, and terminated.

The financing cycle involves interactions with investors and creditors. You raise capital (through stock or debt), repay the capital, and pay a return on it (interest or dividends).

Not every relationship between two events represents a give-to-get economic duality. Commitment events are linked to other events to reflect sequential cause-effect relationships.

Example:
- Take customer order (commitment), which leads to:
- Deliver inventory (give event) and receive cash (get event).
DEVELOPING AN REA DIAGRAM

- Developing an REA diagram for a specific transaction cycle consists of three steps:
  - STEP ONE: Identify the events about which management wants to collect information.
  - STEP TWO: Identify the resources affected by the events and the agents who participated.
  - STEP THREE: Determine the cardinalities between the relationships.
- Let’s walk through an example.

STEP ONE: IDENTIFY RELEVANT EVENTS

- Example: Typical activities in the revenue cycle include:
  - Take customer order
  - Fill customer order
  - Bill customer
  - Collect payment

  - The give-to-get, then, is:
    - Fill customer order (often referred to as “sale”);
    - Collect cash (often referred to as “cash receipt”).

STEP ONE: IDENTIFY RELEVANT EVENTS

- Printing and mailing invoices does not directly affect an economic resource.
- It does not represent a commitment on the part of the company to a future exchange.
- It is an information retrieval event and should not alter the contents of the database.
- Does not need to be included in the model.

STEP ONE: IDENTIFY RELEVANT EVENTS

- Although accounts receivable is an asset in financial reporting, it is not represented as a resource in an REA model.
- It represents the difference between total sales to a customer and total cash collections from the customer.
- The information to calculate an accounts receivable balance is already there because the sales and cash receipt information is captured.

STEP ONE: IDENTIFY RELEVANT EVENTS

- Events that pertain to “entering” data or “re-packaging” data in some way do not appear on the REA model.
- They are not primarily value-chain activities.
- What is modeled is the business event and the facts management wants to collect about the event, not the data entry process.

Take Order

Sale

Receive Cash
STEP TWO: IDENTIFY RESOURCES AND AGENTS

Take Order
  • What is the give event?
  Sale
  Receive Cash

STEP TWO: IDENTIFY RESOURCES AND AGENTS

Take Order
  Inventory
  • What resource is reduced by the give event?
  Sale
  Receive Cash

STEP TWO: IDENTIFY RESOURCES AND AGENTS

Take Order
  • What is the get event?
  Inventory
  Sale
  Receive Cash

STEP TWO: IDENTIFY RESOURCES AND AGENTS

Take Order
  Inventory
  • What resource is increased by the get event?
  Sale
  Cash
  Receive Cash

STEP TWO: IDENTIFY RESOURCES AND AGENTS

Take Order
  Inventory
  • What resource is affected by the commitment event?
  Sale
  Cash
  Receive Cash

• The agents who participate in each event should also be identified.
  – There will always be at least one internal agent (employee).
  – In most cases, there will also be an external agent (e.g., customer or supplier) who participates.
STEP TWO: IDENTIFY RESOURCES AND AGENTS

- What agents are involved in the sale?
  - Inventory
  - Sale
  - Cash
  - Take Order

- What agents are involved in the receipt of cash?
  - Inventory
  - Cash
  - Customer
  - Employee

- What agents are involved in taking the order?
  - Inventory
  - Sale
  - Cash
  - Employee

STEP THREE: DETERMINE CARDINALITIES OF RELATIONSHIPS

- The final step in an REA diagram for a transaction cycle is to add information about the relationship cardinalities.
- A cardinality describes the nature of the relationship between two entities.
  - It indicates how many instances of one entity can be linked to a specific instance of another entity.
  - For example, the cardinality between the event Sales and the agent Customer answers the question:
    • For each sale a company makes, how many customers are associated with that sale?

- Three types of relationships
  - Three types of relationships are possible between entities.
    - Relationships depend on the maximum cardinality on each side of a relationship.
      • A one-to-one relationship (1:1) exists when the maximum cardinality for each entity in the relationship is one.
      • A one-to-many (1:N) relationship exists when the maximum cardinality on one side is one and the maximum on the other side is many.
      • A many-to-many (M:N) relationship exists when the maximum on both sides is many.
STEP THREE: DETERMINE CARDINALITIES OF RELATIONSHIPS

- The maximum number of inventory items that can be sold in one sale is many.
- The maximum number of sales that can occur for a particular inventory item is many.
- This is a many-to-many (M:N) relationship.

For each agent the cardinality between agent and event is typically (0:N).
- Example: For a particular salesperson:
  - There is typically a minimum of zero sales (allows for inclusion of a new salesperson who has not yet made any sales).
  - A salesperson can have a maximum of many sales.
- Or: For a particular customer:
  - There is typically a minimum of zero sales (to allow for the inclusion of prospective customers who haven’t bought anything yet) and a maximum of many sales.

Let’s now look at the relationship between events and resources.
- In the cardinality between event and resource, the minimum cardinality is typically one, because an event can’t occur without affecting at least one resource.
- The maximum could be one or zero.
  - In this particular story, each sale can involve many items of inventory, so the maximum is many.
  - However, every receipt of cash is deposited to one and only one cash account, so the maximum there is one.
STEP THREE: DETERMINE CARDINALITIES OF RELATIONSHIPS

• In the cardinality between event and resource, the minimum is typically zero.
  – A company can have an inventory item for which there has never been a sale.
  – When the company's cash account is new, there has never been a cash receipt deposited in it.

• In the cardinality between event and resource, the maximum is typically many.
  – Most inventory items can be sold many times. (An exception might occur if each inventory item is one unique item, such as a piece of real estate.)
  – The company's cash account can have many cash receipts.

• Finally, let's look at the relationships between events.
  • When events occur in a sequence, the minimum cardinality between the first event and the second event is always zero, because there is a span of time (although possibly quite short) when the first event has occurred but there are zero occurrences of the second event.
  • Examples:
    – When an order is first taken, there have been no deliveries of goods (sale event) to the customer.
    – When goods are delivered to the customer, there is a span of time, however brief, in which there is no cash receipt from the customer.
STEP THREE: DETERMINE CARDINALITIES OF RELATIONSHIPS

- The minimum cardinality between the second event and the first event is typically one, because the second event can’t occur without the first event having occurred.

- An exception could occur if the first event is not required for the second event to occur.
  - Example: If a sale can be made without first taking an order, then the minimum cardinality between sale and take order could be zero.

- The maximums in the cardinalities between events can be either one or many, and these maximums vary based on business practices.
  - We saw this when we looked at the four different possibilities for the relationships between sales and cash receipts previously.
  - On the following slides, see if you can explain the maximums between the three events.