EVOLUTION OF AIS MODELING

Stage 1
Manual Systems

- Resources:
  - Manual Process
  - Accounting Cycle
  - Data Stores (Files):
    - Journals & Ledgers

- Bias:
  - Generate financial statements

Stage 2
Automated Systems

- Resources:
  - Information Technology Process
  - Accounting Cycle
  - Data Stores (Files):
    - Journals & Ledgers

- Bias:
  - Generate financial statements

Stage 3
Event Driven IT Applications

- Resources:
  - Information Technology Process
  - Record, Maintain, Report
  - Business Activity Data
  - Data Store:
    - Business Activity Data
    - Integrated Stores

- Bias:
  - Support Planning, Control & Evaluation Activities of Various Information Customers

Entity-Relationship Modeling

- Entity

- Relationship

E-R Examples

[Diagram of E-R Examples]
### Sample E-R Diagrams

<table>
<thead>
<tr>
<th>Employees</th>
<th>Manages</th>
<th>Supervisors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part of</td>
<td></td>
<td>Departments</td>
</tr>
<tr>
<td></td>
<td>Manages</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Manager</td>
</tr>
<tr>
<td>Customer</td>
<td>Lead to</td>
<td>Sales</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lead to</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cash Receipts</td>
</tr>
<tr>
<td>Players</td>
<td>Part of</td>
<td>Teams</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Part of</td>
</tr>
<tr>
<td></td>
<td></td>
<td>League</td>
</tr>
</tbody>
</table>

### Hospital Modeling Example

- Hospital operating room environment
- Operations are performed on patients.
  - Usually one doctor performs the operation but is assisted with several nurses

### Hospital Example
Entity-Relationship Diagram

Resources
- Inventory
- Cash

Events
- Line items
- Sales
- Pays for
- Increases
- Cash collections

An Example from your Youth

Elmo has a cookie

Cookie Monster has a dollar

Entity-Relationship Diagram

Resources
- Cookie
- Cash

Events
- Sales
- Pays for
- Cash collections
REA

- Resources
- Events
  - types
    - economic exchanges
    - commitments
- Agents

REA Analysis

- Business process approach
- Database approach
- Information (vs. financial) approach

Sample REA Diagram
Developing A Model: Step One

Review the Business Process and Identify the Business Events of Interest

What strategically significant activities do decision makers want to plan, control the execution of, and/or evaluate?

McKell’s Retail Sale Store
REAL Model

• McKell’s Retail Store has hired you to analyze their revenue process and build an application to support the sale event. Each sale takes place at a specific register. Each sale involves only one customer (external agent); one salesperson (internal agent); and one or more items of merchandise. Individual items of merchandise are not uniquely identified at McKell’s. Each instance of merchandise refers to a type of class of Merchandise (e.g., size 12 blue t-shirt, size 9 white tennis shoes, or size 5 leather gloves). The salesperson and customer do not have a direct relationship, because McKell’s does not have a policy of assigning customers to specific salespersons. The customer and salesperson are only related through the sale.
Developing A Model: Step Two

Analyze Each Event Listed in Step 1 to Identify the Entities of interest.
What are the:
- Events,
- Commitments,
- Resources,
- Agents?

McKell’s Retail Sale Store REAL Model
Step 2

Identify the Direct Relationships Between Objects
- Event Resources and Agents
- Event to Event
- Resources and Agents independent of any event occurring
Define Cardinalities: Step Three

• Include commitment events

Define Cardinalities: Step Four

• object 1(min, max) --- object 2(min, max)
• How many instances of one entity can be linked to one specific instance of another entity?
  • How many sales transactions can be linked to a particular customer?
  • How many customers can be linked to a particular sales transaction?
  • How many rows in one table can be linked to a row in another table?

• MINIMUMS denote ______________
  • represents required activity
  • activities that require control procedures
  • Number of rows in related table that ____ be affected

• MAXIMUMS help ______________
  • data storage needed
  • Number of rows in related table that ____ be affected
  • both help structure your audit trail
McKell’s Retail Sale REA Model With Cardinalities

Merchandise ——— Sale ——— Customer

McKell’s Retail Sale REA Model With Cardinalities

Sale

Salesperson

Does each transaction that impacts the salesperson table update a row in the sales table?

McKell’s Retail Sale REA Model With Cardinalities

Sale

Salesperson

The salesperson table can be updated without requiring a sales transaction (cardinality =0).
How many rows (records) in the sales table can be related to a particular salesperson? How many sales transactions can a salesperson be involved in?

Maximum cardinality is many (N).

Each sale must be linked with one row of the salesperson table, but each sales transaction is only linked to one salesperson (row in the salesperson table).
Each sale must be linked with one row of the salesperson table, but each sales transaction is only linked to one salesperson. Cardinality (1,1).

Each sale must have 1, but can have many items of merchandise, i.e., an item of merchandise must be related to each sales record, but many items of merchandise can be related to one sales record. (Wal-mart receipt).

Each sale must have 1, but can have many items of merchandise, i.e., an item of merchandise must be related to each sale table record, but many items of merchandise can be related to one sales record. (Wal-mart receipt).
McKell’s Retail Sale REA Model With Cardinalities

The merchandise table can be updated without a sales transaction (min = ?). The merchandise tables can be updated with multiple sales transactions (max = ?)

McKell’s Retail Sale REA Model With Cardinalities

• Each sale record must have _ but can only have _ customer

• Can the customer record be updated without a sale? How many sales transactions can relate to a specific customer?

McKell’s Retail Sale REA Model With Cardinalities

Salesperson

Merchandise

Sale

Customer

(1,N)

(0..1)

(0..N)

(0..1)

(0..N)
Additional Model Development Steps:

✓ Step 5: Design the data repository structure.
  • tables or objects
  • primary keys
  • posted keys
  • nonkey attributes

Design the Data Repository Structure:
  • Each entity (resource, event, agent) in the REA Model becomes a table.

Design the Data Repository Structure:
  • Each object (resource, event, agent) in the REA Model becomes a table.

  • For McKell’s
    •
    •
    •

  KEY attribute
  The attribute that will uniquely identify each row in a table
McKell’s Retail Sale Store - Tables

Merchandise (Merchandise#)
Sale (Sale#)
Customer (Customer#)
Salesperson (Employee#)

Linking Objects with Many to Many (M:N) Relationships

CREATE a separate table that includes the key attributes from both object tables.

McKell’s Retail Sale REA Model With Cardinalities
McKell’s Retail Sale Store - Tables

Merchandise (Merchandise#)
Sale (Sale#)
Customer (Customer#)
Salesperson (Employee#)
Sale-Merchandise ([Sale#], [Merchandise#])

Linking Objects with One to One (1:1) Relationships

CREATE a separate table that includes the key attributes from both objects

OR

Put the key attribute of either object in the table of the other

When you are linking two events with a 1:1 relationship, either put the key of the prior event table into the subsequent event table or CREATE a third table.

McKell’s Retail Sale REA Model With Cardinalities

No (1,1) relationships

Merchandise [0..N], Customer [0..1], Sale [1..1], Salesperson [0..1]
Linking Entities with One to Many (1:N) or Many to One (N:1) Relationships

Post the key attribute of the entity with the many (N) side of the cardinality into the table of the 1 side of the cardinality. Becomes a foreign key.

McKell’s Retail Sale REA Model With Cardinalities

McKell’s Retail Sale Store - Tables

Merchandise (Merchandise#),
Sale (Sale# [Customer#], [Employee#]),
Customer (Customer#),
Salesperson (Employee#),
Sale-Merchandise ([Sale#] [Merchandise#]).
McKell’s Retail Sale Store - Tables

Merchandise (Merchandise#)
Sale (Sale#, Customer#, Employee#)
Customer (Customer#)
Salesperson (Employee#)
Sale-Merchandise ([Sale#], [Merchandise#])

Defining Non-Key Attributes:
• Additional attributes needed to produce the views of business events desired. Base this selection on the output views needed based on the conceptual framework defined earlier.

Business Processes and Business Events

Event 1: Marketing
Event 2: Take Customer Order
Event 3: Ship the Goods
Event 4: Collect Payment

Business Process: Delivering Goods and Collecting Payment

E-R Example

Operating Room
Operation
Doctor
Nurse
Patient
E-R Example

- Doctor - Operation:
  - An operation is performed by at least one doctor
  - A doctor may perform many operations over time

  OR

An operation event record must have a doctor and can have more than one doctor
Doctors may update multiple operation records.

E-R Example

- Nurse - Operation
  - A nurse is required at every operation.
  - An operation may assisted by many nurses
  - A nurse may assist in many operations

E-R Example

- Patient - Operation:
  - A patient can undergo many operations?
  - An operation is performed on one patient?

- Location - Operation
  - An operating room can be used for many operations
  - Each operation requires one operating room
What can we learn about a company’s business activities and policies by reviewing an E-R / REA diagram?

They assist in documentation

- REA diagrams are especially useful for documenting an advanced AIS built using databases.
- REA diagrams provide two important types of information about a database:
  1. Information about the relationships among data items
  2. Information about the organization’s business practices
- REA diagrams explicitly depict the relationships among the various data items that are stored in the accounting database.
Information About Business Practices

- The cardinalities in REA diagrams provide useful information about the nature of the company being modeled and the business policies that it follows.

- Due to the fact that McKell’s sells mass-produced goods, its REA diagram models the relationship between sales and inventory as being many-to-many.
- An REA diagram for a rare art dealer would depict the relationship between sales and inventory as being one-to-many.

Extracting Information From the AIS

- A complete REA diagram serves as a useful guide for querying an AIS database.
- Queries can be used to generate journals and ledgers from a relational database built on the REA model.