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Current Topics in Accounting Research

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Overview

- Papers for Week 2
- Database Normalization
- Key Ideas from Class 1
- Homework 1
- Papers for Week 1
- Questions

Papers for Week 2

- Mattesich, Richard. 1964. "Accounting and Analytical Methods" Chapters 1-3. Richard D. Irwin: Homewood, IL.
- Sorter, George. 1969. "An 'Events' Approach to Basic Accounting Theory" *The Accounting Review*, pp. 12-19.
- Yu, S. C. 1976. "The Structure of Accounting Theory" Chapter 8. The University Presses of Florida: Gainesville, FL.
- Bubenko, Janis. 1977. "The Temporal Dimension in Information Modeling" Research Report RC 6187. IBM Research Laboratories: Yorktown Heights, NY. In *Architecture and Models in Data Base Management Systems*: pp. 93-118
- Everest, Gordon C. and Ron Weber. 1977. "A Relational Approach to Accounting Models" *The Accounting Review* (Vol. LII, No. 2): pp. 340-359.
- Smith, John Miles and Diane C. P. Smith. 1977. "Database Abstractions: Aggregation" *Communications of the ACM* (Vol. 20, No. 6): pp. 405-413
- Smith, John Miles and Diane C. P. Smith. 1977. "Database Abstractions: Aggregation and generalization" *ACM Transactions on Database* (Vol. 2, No. 2): pp. 105-133.

Mattessich

- Accounting and Analytical methods
  - Chrematistic
    - Of, pertaining to, or engaged in, the acquisition of wealth
  - Accounting theory has developed a body of knowledge which is of a dogmatic rather than scientific-hypothetical character . . . Legalistic
  - Need for a general theory of accounting
  - Accounting can be regarded as an applied, normative discipline
  - A service discipline:
    - in dependence with its master discipline, economics

Mattessich

- Accuracy had to be sacrificed to parsimony
- Versatility of application is a requirement
- AICPA definition: recording, classifying, and summarizing . . . and interpreting the results thereof

Mattessich

- Basic assumptions:
  - Monetary values
  - Time intervals
  - Structure
  - ***Duality***
  - Aggregation
  - ***Economic objects***
  - ***Inequity of monetary claims***
  - ***Economic agents***
  - ***Entities***
  - ***Economic transactions***
  - Valuation
  - Realization
  - Classification
  - Data input
  - Duration
  - Extension
  - Materiality
  - Allocation

Mattessich

- Duality principle
- Income . . . the flow of goods and services . . .
- Logico-mathematical principle
  - Any change can be quantified in two ways:
    - by measuring the sum total of all contributing increments and decrements (flows)
    - By measuring the difference between the two totals (stocks) connected by this change.

Sorter

- The purpose of accounting is to provide information about relevant economic events that might be useful in a variety of possible decision models
- Decisions as to what events are relevant (surely not all events can be recorded) must be made and can only be made with users' needs in mind

Sorter

- A balance sheet should be so constructed as to maximize the reconstructibility of the events being aggregated
- Each event should be described in a manner facilitating the forecasting of that same event in a future time period given exogenous changes

Yu

- Stocks and flows
  - Stocks: scarce resources measured at a point in time in terms of their economic potentials for a specific entity
  - Flows: occur over time, and are measured between two points in time; they cause the economic position of an entity to change
- Accounting entities
  - Basic economic decision-making units under which scarce resources are possessed and utilized

Yu

- Economic events and accounting transactions
  - Economic events are a class of phenomena which reflect changes in scarce means resulting from production, exchange, consumption, and distribution
  - Accounting events
    - Identifiable with specific entities
    - Socioeconomic, as well as legal, in nature
    - Meaningful primarily in terms of stock-flow relationships
    - Measurable in terms of not only certain well-defined measurement scales and units of measure but, most of all, of maximum likelihood
    - Exchange transactions, or the equivalent, including both internal and external entity activities
    - Neutral in nature and have a sufficient degree of verifiable content

Bubenko

- Discusses binary relational model from the point of view of a conceptual framework where time is treated in an unrestricted fashion
- ‘Conclusion materialization’

Everest & Weber

- DBMS deal with ‘real’ entities such as jobs, projects, departments, people, and parts
- The accountant deals with many ‘artifacts’
- Charts of accounts are useful taxonomies, classification schemes or naming conventions rather than real entities
- Paper applies relational model to accounting, integrating accounting and information theories

Smith & Smith 1977a

- Abstraction
- Aggregation
  - ‘Reifies’ a *relationship* between objects into a higher-level object, creating a new data type, called ‘aggregate’
- RDBMS do not have good programming construct to support real-world abstractions
- (This was 1977 – now OODBMS and ORDMS?)

Smith & Smith 1977b

- Distinguishes aggregation from generalization
- Generalization
  - An abstraction that ‘reifies’ *classes* of objects into generic objects, creating a new data type called ‘generic’
- Normal forms do not address abstraction
- Paper shows how to structure relational databases to support both aggregation and generalization

Database Normalization

- Relational databases and other data processing systems can suffer from a number of anomalies
- Proper application of REA modeling should avoid these problems by automatically generating 3NF data
- Problems may be encountered, though, with data designed in other ways

Database Normalization

- Data anomalies
  - Insertion anomalies
    - inability to add certain data
  - Deletion anomalies
    - deleting data in one place causes a loss of other data that needs to be retained
  - Update anomalies
    - changes must be made in multiple locations

Database Normalization

- Functional dependency
  - If in a table with two attributes, X and Y, there is only one possible value of Y for each possible value of X, Y is said to be functionally dependent on X
  - Thus secondary keys are functionally dependent on the primary key (although this is not the only kind of functional dependency)

Database Normalization

- Derived fields
  - Transitive dependencies
    - Functional dependencies not originating from the primary key
  - Calculated fields
    - Functionally dependent on values in other tables

Database Normalization

- Unnormalized tables
- First Normal Form (1NF)
- Second Normal Form (2NF)
- Third Normal Form (3NF)

- Boyce/Codd Normal Form (BCNF)
- Fourth Normal Form (4NF)
- Fifth Normal Form (5NF)
- Domain/Key Normal Form (DK/NF)

Database Normalization

- 1NF
  - No repeating groups
- 2NF
  - 1NF + Full dependence on the entire key
- 3NF
  - 2NF + No derived fields

Fabulous Furniture Forum

Fun Family Furniture

Sales Invoice

Customer:
Benjamin Sisko
Deep Space Nine
Alpha Quadrant

Customer ID: 9876

Invoice #: 12345

Date: 12/31/2350

Salesman: Jean-Luc Picard

1 x Executive Desk @ $30,000	30,000
2 x Office Chairs @ $500	1,000
Subtotal:	31,000
Intergalactic Shipping	14,000
Total:	$55,000

Database Normalization

- What data is on this invoice?
- (Customer#, Customer, Address, Invoice#, Date, Salesman, {Qty, Item, Price, Value}, Shipping, Total)
  - This is unnormalized data because of the recurring items
  - Value and Total should not be stored because they can be calculated from other data

Database Normalization

- (Invoice#, Customer#, Customer, Address, Date, Salesman, Shipping)
- ([Invoice#], Line#, Qty, Item, Price)
  - These tables are 1NF
  - The Invoice table is 2NF but not 3NF because Customer and Address depend on Customer# which depends on Invoice#
  - Salesman names and Item descriptions are repeated on these tables unnecessarily
  - On the Invoice-Line table Price is not determined by the key at all - we still need to know the Item number

Database Normalization

- (Invoice#, [Customer#], Date, [Salesman#], Shipping)
- (Customer#, Customer, Address, . . .)
- (Salesman#, Salesman, . . .)
- (Item#, Item, . . .)
- ([Invoice#], Line#, [Item#], Qty, Price)
  - But now the final table is not 2NF because Price depends only on [Item#] - and Line# is useless

Database Normalization

- (Invoice#, [Customer#], Date, [Salesman#], Shipping)
- (Customer#, Customer, . . .)
- (Salesman#, Salesman, . . .)
- (Item#, Item, Price, . . .)
- ([Invoice#], [Item#], Qty)
  - These tables are 3NF

Database Normalization

- BCNF
  - All determinants must be candidate keys
  - E.g., Interviews (Applicant#, Date, Time, InterviewStaff#, Room#)
    - Room# depends on Staff# and Date, but this is NOT a candidate key (does not determine Time, for example)
- 4NF and 5NF deal with multi-valued attributes
- DKNF
  - Free of anomalies – but not always achievable
- 6NF
  - Recently proposed to deal with temporal data

Database Normalization

- Storing Balances
  - Technically wrong
  - Sometimes still done for convenience
  - Imposes extra processing burden to ensure correct
- Recording agents: customers/vendors
  - Can you be certain who you shipped to and who you paid?
  - Omit if you can
  - For now assume not! . . .
- Inventory
  - Are items uniquely identified (like cars) or not (like books)
- Cash as a resource
  - Cash account numbers

Key Ideas from Class 1

- The Semantic Modeling Principle
  - Data in an information system should model the structure of the relevant categories of reality in its application domain

Key Ideas from Class 1

1. Identify the significant events
2. Identify the related resources
3. Identify the related internal and external agents
4. Identify relationships between entities
5. Specify the optionalities and cardinalities of the relationships
6. Identify the attributes of the REA entities

. . . . . .

7. Identify the information processes

- -

8. Design the data repository structure

- -

9. Implement the design

Key Ideas from Class 1

- Business Transaction
  - Predefined set of activities and/or processes of persons which is initiated by a person to accomplish an explicitly shared business goal and terminated upon recognition of one of the agreed conclusions by all the involved persons although some recognition may be implicit

Key Ideas from Class 1

- Extended REA Ontology (Gillett 2003/6):
  - Economic Resources (R)
  - Significant Events
    - Economic Events (E)
    - Commitments (C)
    - Business Events
      - Instigation (I)
      - Facilitation (F)
      - Terminal (T)
  - Economic Agents (A)
    - Internal Agents
    - External Agents
  - Business Location (L)

Facilitation and Terminal events are best thought of as the beginning or end of economic events or commitments that we choose to record separately

Key Ideas from Class 1

- Extended REA Ontology (Gillett 2003/6):
  - Relationships
    - Duality (E – E)
      - Transfer
      - Transformation
    - Resource-flow (E – R)
      - Inflow
        - Take
        - Production
      - Outflow
        - Use (entirely)
        - Consumption (in small parts)
        - Give
    - Participation (E – A)
      - Inside
        - Accountability
        - Authorization
      - Outside
    - Site (E – L)

Key Ideas from Class 1

- Extended REA Ontology (Gillett 2003/6):
  - Relationships
    - Linkage (R – R)
      - Composition: Shirts are composed of fabric, thread, buttons, labels, etc.
      - Substitution: White Packing Tissue substitutes for Ivory Packing Tissue
    - Association (A – A)
      - Responsibility: Managers are responsible for Secretaries
      - Assignment: Salespersons are assigned to Customers in their region
      - Cooperation: One Vendor cooperates with another Vendor
    - Custody (A – R)
      - Cashier has custody of Petty Cash
    - Designation (A – R)
      - Customer designates a new Ship
    - Certification (A – R)
      - Vendors certified to supply specific Inventory – Approved Vendors List

Key Ideas from Class 1

- Extended REA Ontology (Gillett 2003/6):
  - Relationships
    - Fulfills (C – E)
      - Contract: Shipment fulfills the Sales Order
      - Schedule: Production fulfills the Job Order
    - Reserves (C – R)
      - Sales Order reserves Finished Goods
    - Partners (C – A)
      - Customer partners the Sales Order
    - Reciprocal (C – C)
      - Materials Requisition is the reciprocal of the Production Order

We are recording the (mutual) commitment to the (non-cash) initial event in economic exchanges; strictly,commitment events are paired in reciprocal relationships.

Key Ideas from Class 1

- Extended REA Ontology (Gillett 2003/6):
  - Relationships
    - Instigates (I – C, I – E, I – F)
      - Requisition instigates Purchase Order
    - Facilitates (F – E, F – C)
      - Picking facilitates Shipping
    - Necessitates (E – T, C – T)
      - Receipt of goods necessitates Storage
    - Demands (I – R)
      - Requisition demands Inventory
    - Authorization (I – A)
      - Inventory Manager authorizes the Requisition
    - Involves (F – R), (T – R)
      - Marshals
        - Picking marshals Inventory
    - Participation (F – A), (T – A)
      - Inside
        - Accountability

Event-Oriented Modeling

- Economic Resource
  - Good, right, or service of value, under the control of a person
- Economic Event
  - Occurrence in time wherein ownership of an economic resource is transferred from one person to another
- Economic Agent
  - Persons and agencies who participate in the economic events of an enterprise or who are responsible for subordinates' participation

Event-Oriented Modeling

- Economic Exchange
  - Type of a business transaction where the goal is an exchange of economic resources between two persons where both parties derive higher utility after the completed business transaction
    - Usually involves two economic events each incrementing or decrementing a different resource in a *duality* relationship

Event-Oriented Modeling

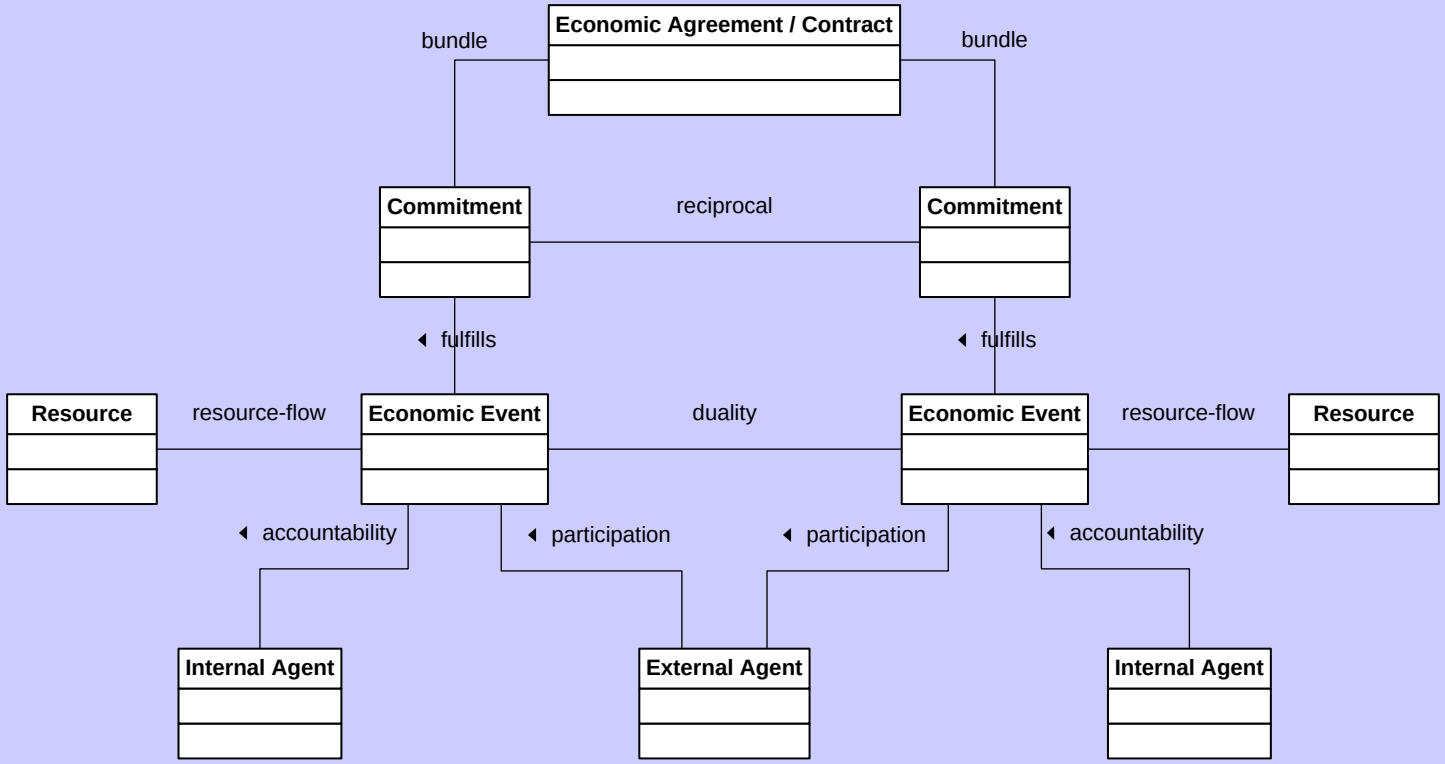
- Commitment
  - Making or accepting of a right, obligation, liability, or responsibility by a person that is capable of enforcement in the jurisdiction in which the commitment is made
- Economic commitment
  - Type of commitments by one person to transfer economic resources to another person at some specified point in the future
- Economic commitments may be *bundled* into
  - Economic agreements (incomplete, not subject to legal enforcement)
  - Economic contracts (complete, enforceable)
- We will often use informal *mutual commitments*

Event-Oriented Modeling

- Economic Claims
  - Expectation of one person to receive a future inflow of economic resources from another person because of an economic exchange which is presently incomplete
    - A claim is *materialized* by an event in an economic exchange
    - It is *settled* by a requiting event in the economic exchange
      - e.g. Accounts Receivable

Event-Oriented Modeling

- Economic Commitments



Event-Oriented Modeling

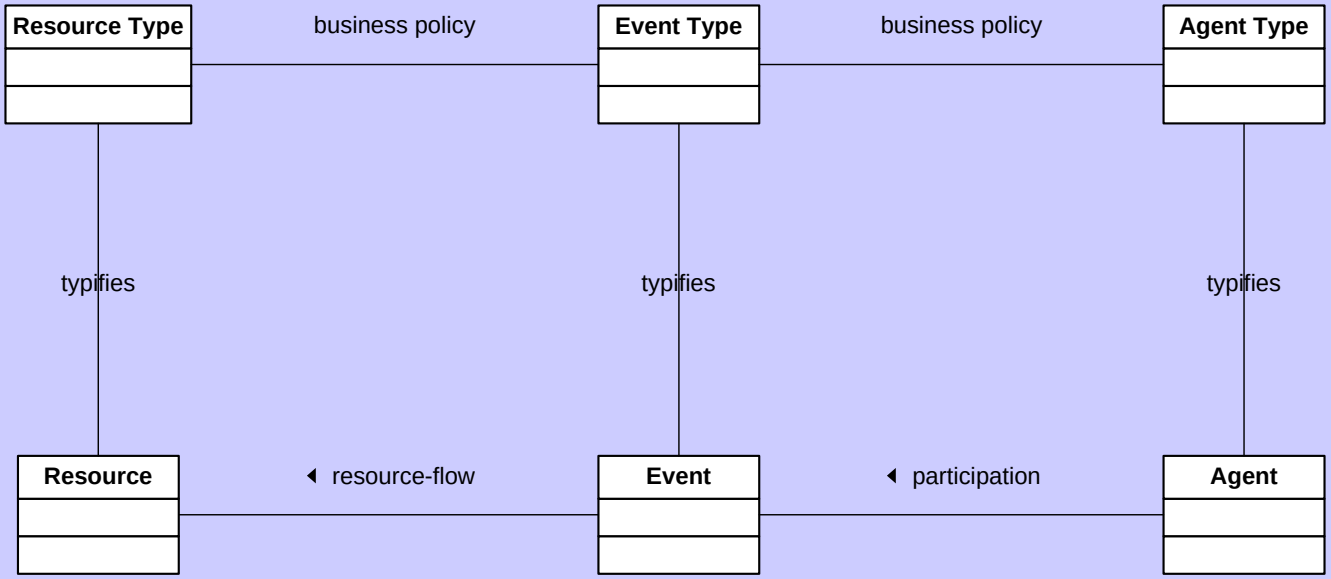
- For many kinds of resources, we want to monitor and control types, as we have discussed:
  - E.g., we may identify books by ISBN – this refers to books of a particular type (title, author, etc.), not to individual copies
- For other resources, we want to monitor and control individual items:
  - E.g., individual ships we are building for our customers
- Sometimes, we want a mixture of both approaches:
  - E.g., a customer orders an automobile of a particular type . . .
  - . . . but we deliver an specific automobile with a unique VIN
- These considerations lead us to add *typification*

Event-Oriented Modeling

- REA Ontology – Typification
  - Association between a concrete entity and the abstract specification of its grouped properties
  - The base classes of the REA Ontology are extended by the addition of related type classes, related to them by the relationship *typifies*
  - An entity type is a subset of all the possible instances of the entity:
    - Resource (R) – Automobile:
      Resource type (RT) – Automobile model
    - Event (E) – Order:
      Event type (ET) – Telephone Order
    - Agent (A) - Customer:
      Agent type (AT) – Business customer
  - Types may be useful to document *business policies* – i.e., what *should* happen rather than what *did* happen

Event-Oriented Modeling

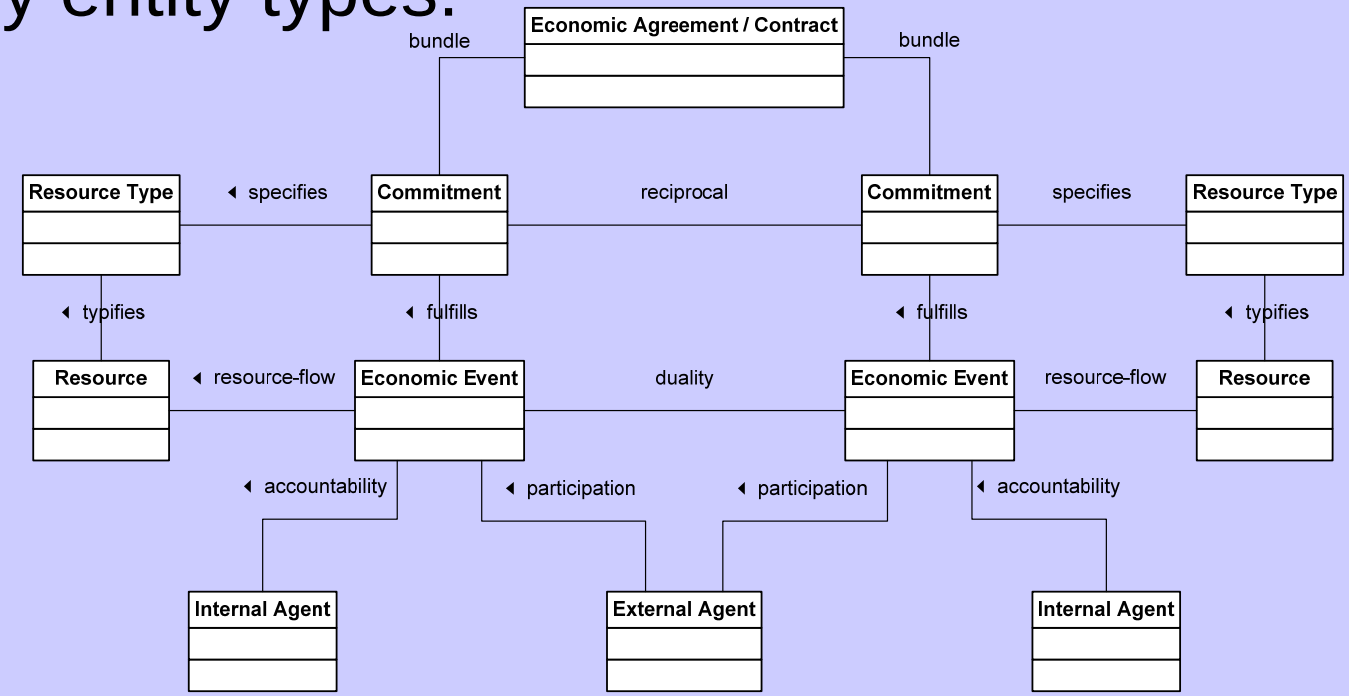
- Typification for Business Policies



- E.g., Only Business Customers may place telephone orders
- E.g., Telephone orders will not be accepted for sports cars

Event-Oriented Modeling

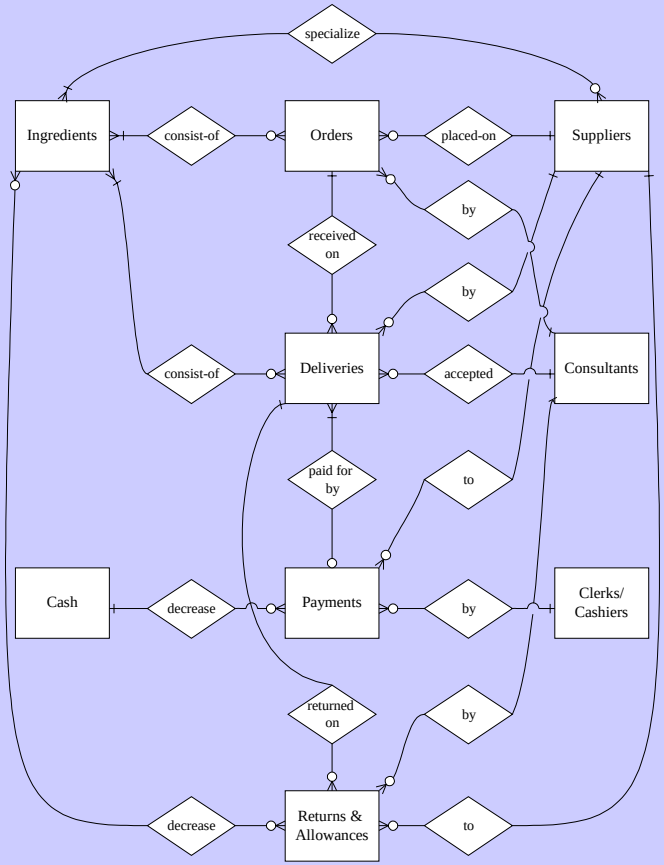
- Economic Commitments may, minimally, specify only entity types:



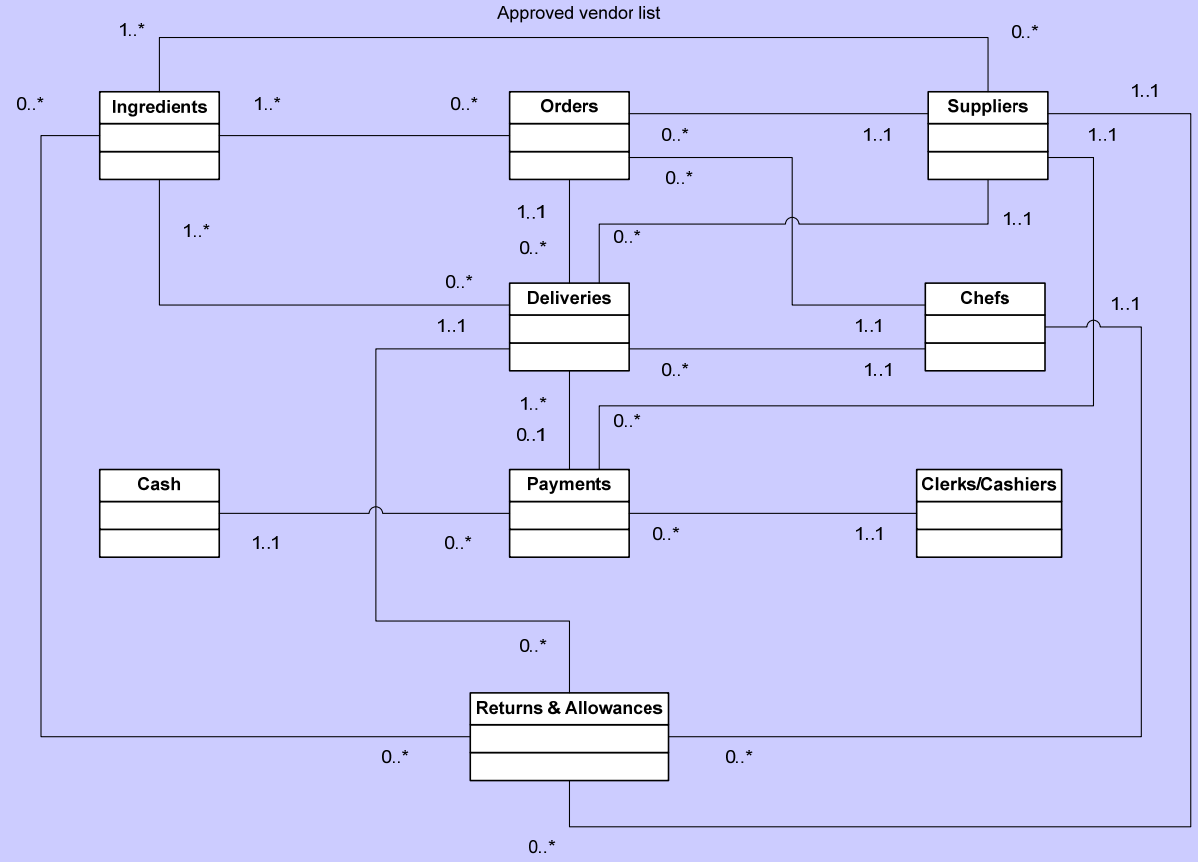
Homework 1

- Events
  - Economic Events
    - Deliveries – Payments
    - Deliveries – Returns & Allowances
  - Commitments
    - Orders
  - Business Events
    - None
- Resources
  - Ingredients
  - Cash
- Agents
  - Suppliers
  - Chefs
  - Clerks/Cashiers
- Relationships

Homework 1


specialize
Ingredients
consist-of
Orders
placed-on
Suppliers
by
received on
by
consist-of
Deliveries
accepted
Consultants
paid for by
to
Cash
decrease
Payments
by
Clerks/ Cashiers
returned on
by
decrease
Returns & Allowances
to

Homework 1


Approved vendor list
Ingredients
Orders
Suppliers
Deliveries
Chefs
Cash
Payments
Clerks/Cashiers
Returns & Allowances

Homework 1

- Orders (Order#, [Supplier#], [Chef#], Date)
- Deliveries (Delivery#, [Order#], [Supplier#], [Chef#], Date)
- Payments (Payment#, [Account#], [Supplier#], [Clerk#], Check#, Date)
- ReturnsAllowances (RA#, [Delivery#], [Supplier#], [Chef#], Type, Amount, Date)
- Ingredients (Ingredient#, Description, *QuantityOnHand*, ReorderLevel)
- Cash (Account#, AccountName, Bank, BankAccount#, *Balance*)
- Suppliers (Supplier#, Name, Address, Phone#, ContactName)
- Chefs (Chef#, Name, Address, Phone#, Salary, JobTitle, DateHired, DateLeft)
- Clerks/Cashiers (Clerk#, Name, Address, Phone#, Salary, DateHired, DateLeft)
- Deliveries-Payments ([Delivery#], [Payment#], Amount)
- Orders-Ingredients ([Order#], [Ingredient#], DeliveryDate, Quantity, OrderPrice)
- Deliveries-Ingredients ([Delivery#], [Ingredient#], Quantity, Price)
- ReturnsAllowances-Ingredients ([RA#], [Ingredient#], Quantity)
- Supplier-Ingredients ([Supplier#], [Ingredient#])

Papers for Week 1

- Chen, Peter P-S.1976. "The Entity-relationship Model – Toward a Unified Model of Data" *ACM Transactions on Database Systems* (Vol.1, No.1): pp. 9-36.
- McCarthy, William E. 1979. "An Entity-relationship View of Accounting Models" *The Accounting Review* (Vol. LIV, No. 4): pp. 667-696.
- McCarthy, William E. 1982. "The REA Accounting Model: A Generalized Framework for Accounting Systems in a Shared Data Environment" *The Accounting Review* (Vol. LVII, No. 3): pp. 554-578.
- McCarthy, William E. 2003. "The REA Modeling Approach to Teaching Accounting Information Systems" *Issues in Accounting Education* (Vol. 18, No. 4): pp. 427-441.

Chen

- A data model, called the entity-relationship model, is proposed. This model incorporates some of the important semantic information about the real world. A special diagrammatic technique is introduced as a tool for database design. An example of database design and description using the model and the diagrammatic technique is given. Some implications for data integrity, information retrieval, and data manipulation are discussed. The entity-relationship model can be used as a basis for unification of different views of data: the network model, the relational model, and the entity set model. Semantic ambiguities in these models are analyzed. Possible ways to derive their views of data from the entity-relationship model are presented.

McCarthy 1979

- This paper is an extension of previous work aimed at integrating ideas in the field of database systems with accounting theory. Unlike others, however, it does not propose use of a particular type of database system. Instead it concentrates on an overall design methodology—the entity-relationship model—which transcends specific database theoretical structures. A complete model is specified for a small retail enterprise, and some accounting uses for the derived system are shown. Finally, the use of an entity-relationship model in integrating aspects of measurement theory, casual double-entry, and “event” accounting with computerized information systems is discussed.

McCarthy 1982

- This paper proposes a generalized accounting framework designed to be used in a shared environment, where both accountants and non-accountants are interested in maintaining information about the same set of phenomena. This framework, called the REA accounting model, is developed using data modeling techniques, and its underlying structure is found to consist of sets representing economic resources, economic events, and economic agents plus relationship among those sets. Correspondence of REA elements with the accounting theories of Ijiri and Mattessich is discussed. Finally, practical use of the model in the database design phases of view modeling and view integration is presented, and some REA presentations of accounting objects are reconciled with those representations found in conventional double-entry systems.

McCarthy 2003

- The REA model was first conceptualized in a paper for the 1982 The Accounting Review as a framework for building accounting systems in a shared data environment, both within the enterprise and between enterprises. The model's core feature was an object pattern consisting of two mirror-image constellations that represented semantically the input and output components of a business process. The REA acronym derives from that pattern's structure, which consisted of economic Resources, economic Events and economic Agents. Simultaneous with it research publication, REA began to be used as a framework for teaching accounting information systems (AIS) originally at Michigan State University and then gradually at other colleges and universities. In its extended form, the REA model integrates the teaching of accounting transaction structures, commitment and business policy specification, business process engineering, and enterprise value chain construction. As of 2003, REA modeling is used in a variety of AIS course and featured in a variety of AIS textbooks, both in the United States and internationally.

Questions

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Homework 2

- Download and read the College Computing case from Blackboard (under Assignments)
- Prepare EER and UML diagrams, and Data Repository Structures for:
  - Materials Acquisitions
  - Sales
  - Fixed Assets
- Submit as a WORD document via the Digital Drop Box - I recommend, but do not require, VISIO 2003
- Come to class prepared to discuss Production and Human Resource Management – you do NOT need to turn these in