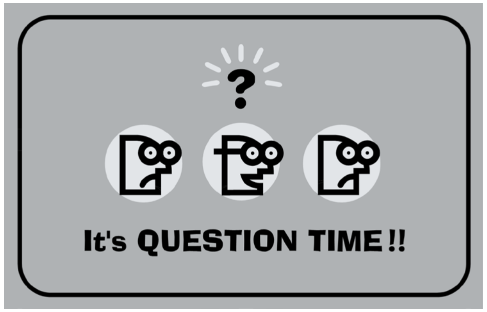
UNIVERSITY OF
WEST LONDON
The Career University

Entity Relationship Diagram 1/3

School of Computing and Engineering

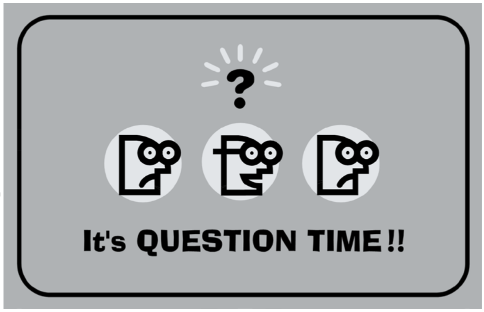
Recap from the previous lecture



- What is requirement? Describe by specifying the different types of requirements.

Requirement

- A requirement is an statement of what the system must do or what characteristics it needs to have. During a systems development project, requirements will be created that describe:
  - What the business needs (business requirement);
  - What the users need to do (user requirements);
  - What the software should do (functional requirements);
  - What characteristics the system should have (non-functional requirements);
  - How the system should be built (system requirements).



- *Review the Amazon.com Web site. Create a list of* ***functional requirements*** *that the system meets. What different kinds of* ***non-functional requirements*** *does the system meet? Provide examples of each kind.*

Answer (1/2)

Functional Requirements

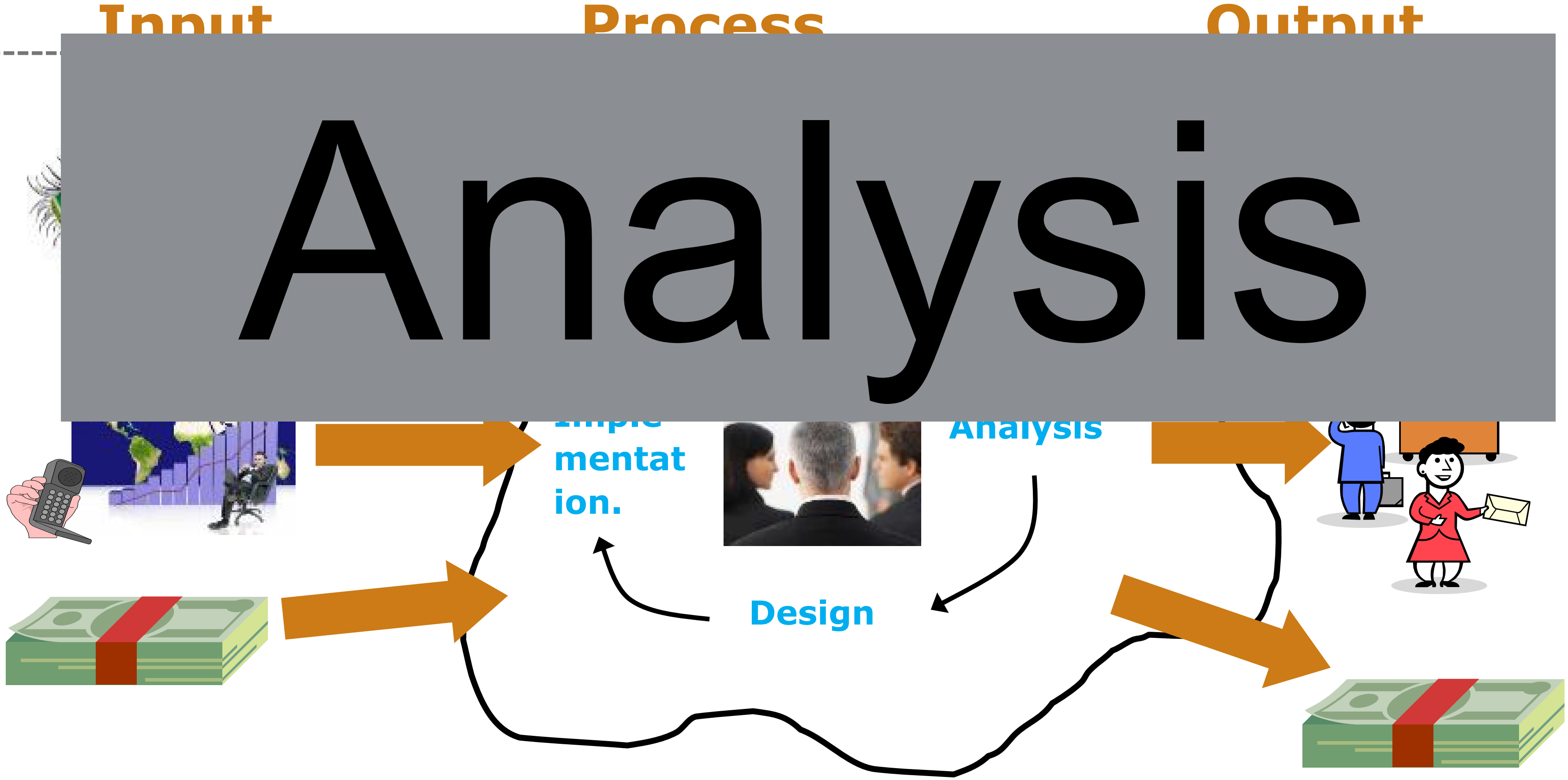
- The system **should** :
  - enable user to find item(s) based on variety of item characteristics
  - enable user to look through items
  - enable user to select and purchase items
  - enable user to submit his/her comments on items and read other users' comments on items
  - enable site to remember user's preferences based on previous use of the site and orders placed
  - enable user to participate in registry (e.g., wedding, baby); enable users to search registries
  - enable user to create and maintain a wish list of desired items; enable users to search a person's wish list for gift ideas.

Answer (2/2)

Non-functional Requirements

- Operational - the system should work on any web browser
- Performance - the system should be available 24/7/365.
- Security - the system enables registered customers to review their own accounts
- Cultural - the system exists in versions tailored to global users, e.g., French, Japanese, German, etc.

Analysis

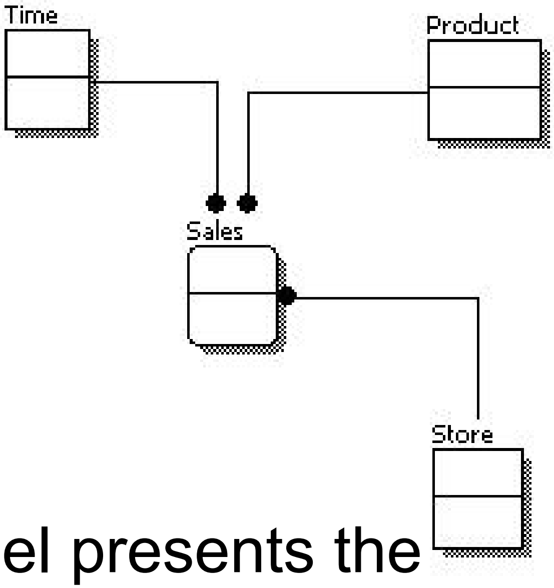


Systems Analysis and Design is about getting people, processes and technology together to sort out the bit in the middle!

Analysis

Step	***Technique***	***Deliverable***
Develop Analysis Strategy	•Business Process Automation •Business Process Improvement •Business Process Reengineering	System Proposal -Requirements Definition -Use-Cases -Logical *Process* Models -‘DFD *Process Logic’* Specification (Logic Model) -***Logical*** ***Data*** ***Model***
Determine Business Requirements	•Interview •Joint Application Design (JAD) •Questionnaire •Document Analysis •Observation	
Create Logical System Models	•Use-Case Analysis •Data Flow Diagramming (DFD) •Process Specification e.g. Structured English **•Entity Relationship Diagramming** •Normalisation	

Logical Data Model



- During the analysis phase, the data model presents the logical organisation of data without indicating how the data are stored, created, or manipulated so that analysts can focus on the business without being distracted by technical details.
- Later during the design phase, the data model is changed to reflect exactly how the data will be stored in databases and files.

Data Model

- A data model is a formal way of representing the data that are used and created by a business system;
- It illustrates people, places or things about which information is captured and how they are related to each other.
- During the analysis phase, analyst draw a logical data model, which shows the logical organisation of data without indicating how data are stored, created, or manipulated.
- This model is free of any implementation or technical details, the analyst can focus more easily on matching the diagram to the real business requirements of the system.

Entity Relationship Diagram (ERD)

- ERD developed by Dr Peter Chen (picture shown above) in 1976 is one of the most commonly used techniques for data modelling.
- An ERD is model that shows the information which is created, stored, and used by a business system.
- An analyst can read an ERD to discover the individual pieces of information in a system and how they are organised and related to each other.
- ERD represents information grouped together in boxes called entities and lines are drawn to show relationships among the data.

Creating an ERD

The basic steps in building an ERD:

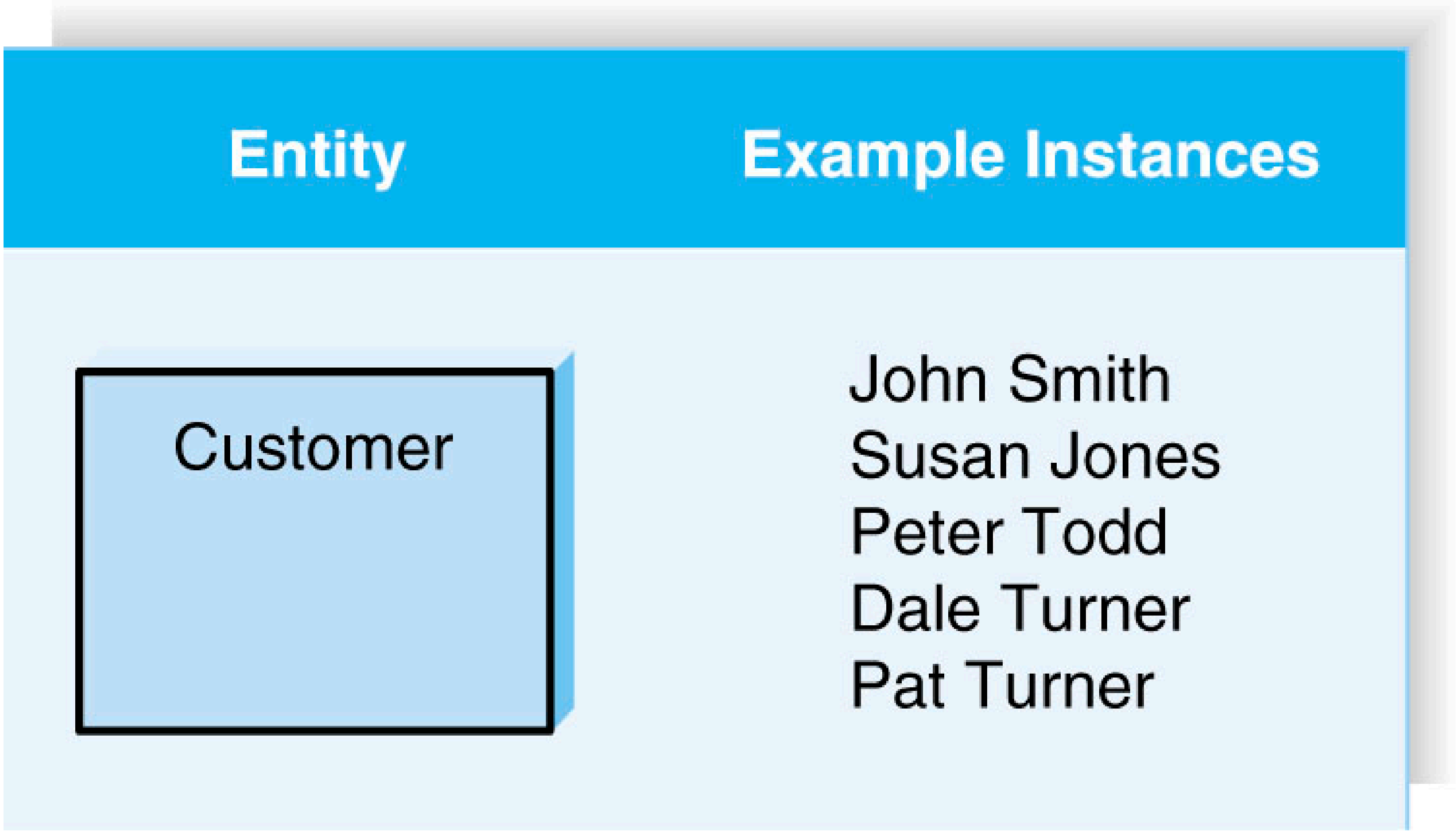
1. Identify the entities;

University Student Lecturer

Entity: a person, place, object, event or concept in the user environment about which data is to be maintained.

- The entity is the basic building block for a data model. It is a person, place, event, or thing about which data is collected. E.g. an employee, an order and a product
- **Entities** represent something for which there exist multiple ***instances***, or *occurrences*.

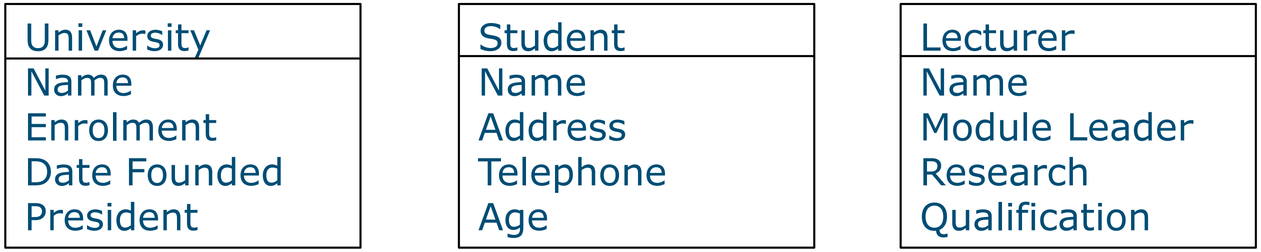
E.g. John Smith could be an instance of the Student entity.



Entity	Example Instances
Customer	John Smith Susan Jones Peter Todd Dale Turner Pat Turner

2. add the appropriate attributes to each entity;

- Attribute: a named property or characteristic of an entity that is of interest to the organization
  - Naming an attribute: i.e. Vehicle_ID
  - Place its name inside the rectangle for the associated entity in the ERD.
  - An attribute is some type of information that is captured about an entity.
  - Attributes are nouns that are listed with an entity.



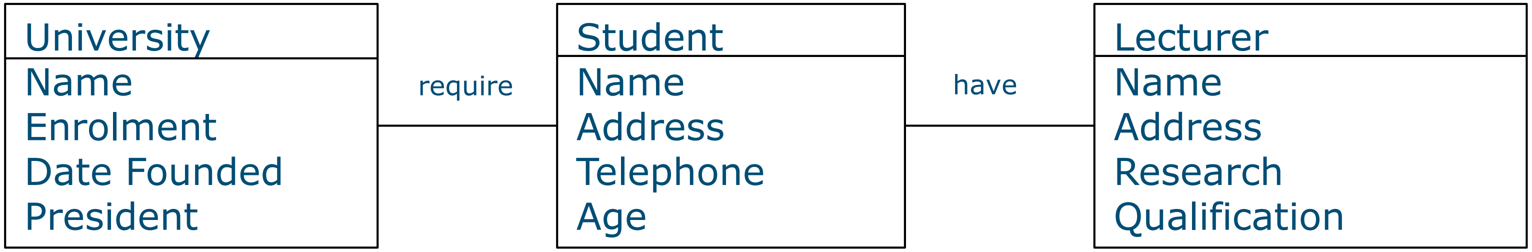
University
Name
Enrolment
Date Founded
President

Student
Name
Address
Telephone
Age

Lecturer
Name
Module Leader
Research
Qualification

3. draw relationships among entities.

Relationship: an association between the instances of one or more entity types that is of interest to the organization.



University
Name Enrolment Date Founded President

require

Student
Name Address Telephone Age

have

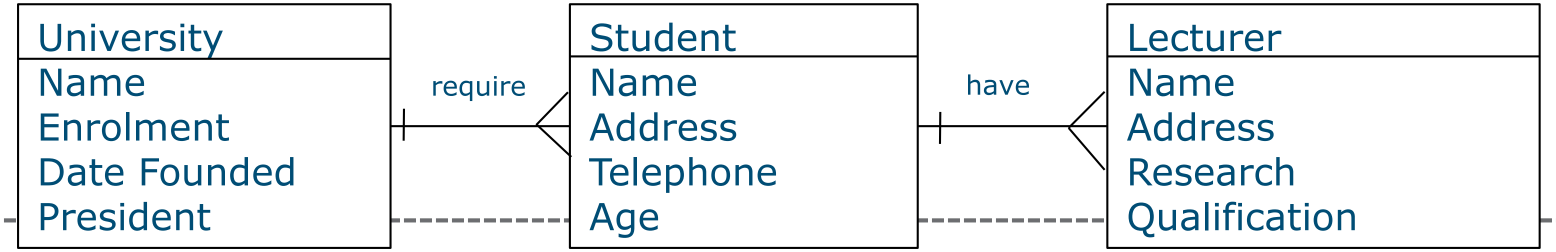
Lecturer
Name Address Research Qualification

….how the entities are related to each other.

- Lines are drawn between the entities that have **relationships**.

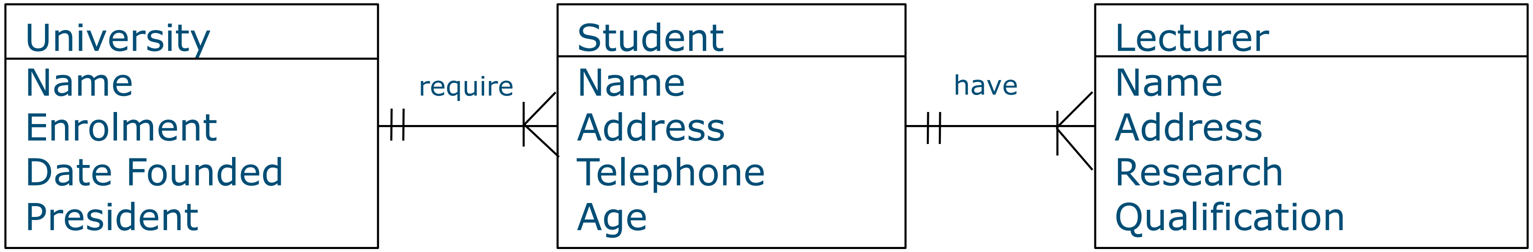
4. Identify cardinality

- Most relationships are not one-to-one
  - For example a manager usually manages more than one employee
- This is described by the cardinality of the relationship for which there are four possible categories:
  - One to one (1:1) relationship
  - One to many (1:m) relationship
  - Many to one (m:1) relationship
  - Many to many (m:n) relationship
- On an ERD if the end of a relationship is straight it represents 1 while a “crow’s foot” end represents many.



5. Identify modality

- A relationship have a modality of null or not null which refers to whether or not an instance of a child can exist without a related instance in the parent entity.
- It indicates whether the child-entity instance is required to participate in the relationship.
- It ask question like:
  - Can you have a university without any student?



University
Name
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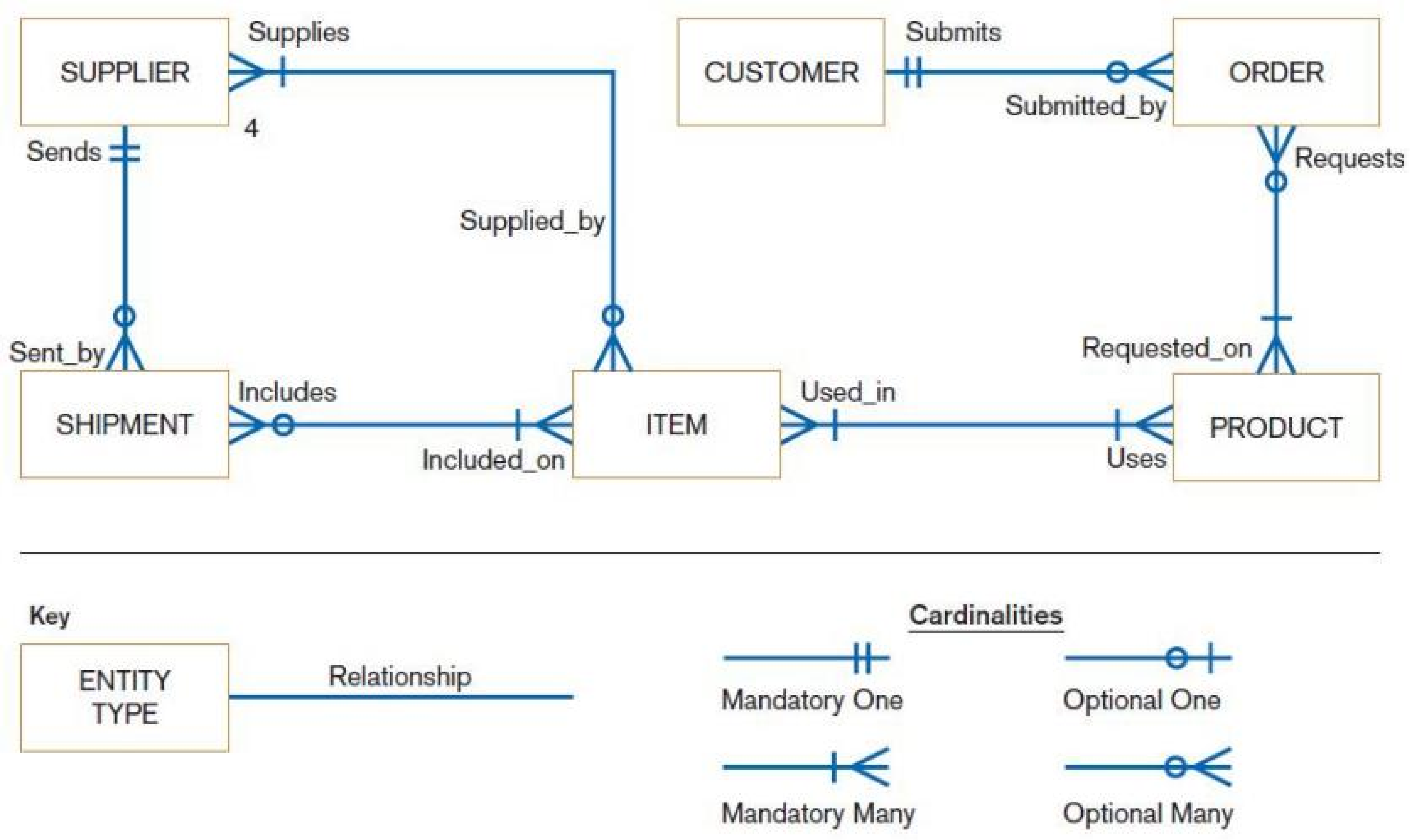
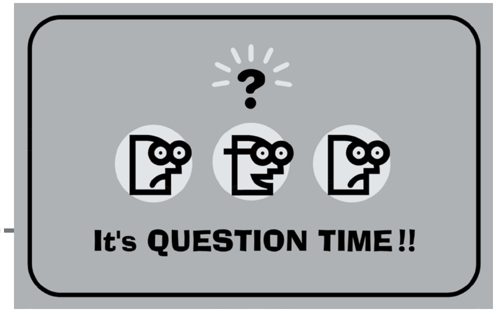
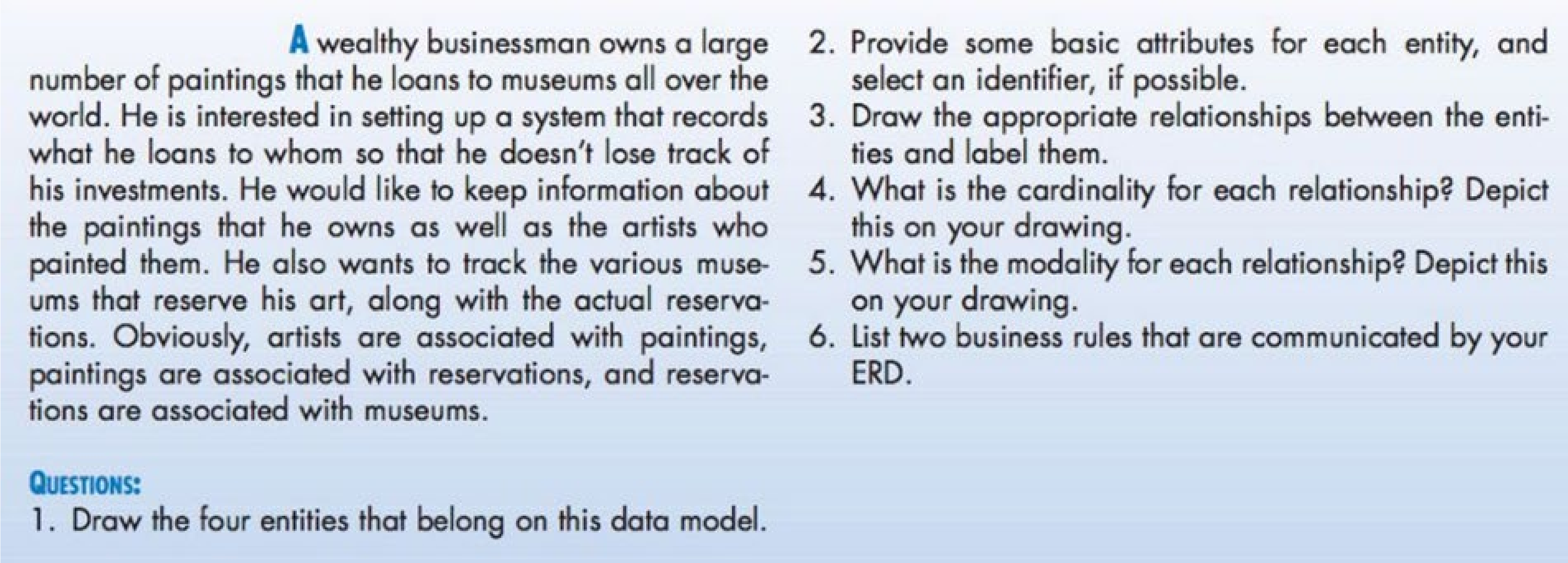
ERD


SUPPLIER
Supplies
4
CUSTOMER
Submits
ORDER
Submitted_by
Sends
Requests
Supplied_by
Sent_by
Requested_on
SHIPMENT
Includes
ITEM
Used_in
PRODUCT
Included_on
Uses
Key
ENTITY TYPE
Relationship
Cardinalities
Mandatory One
Optional One
Mandatory Many
Optional Many

Activity



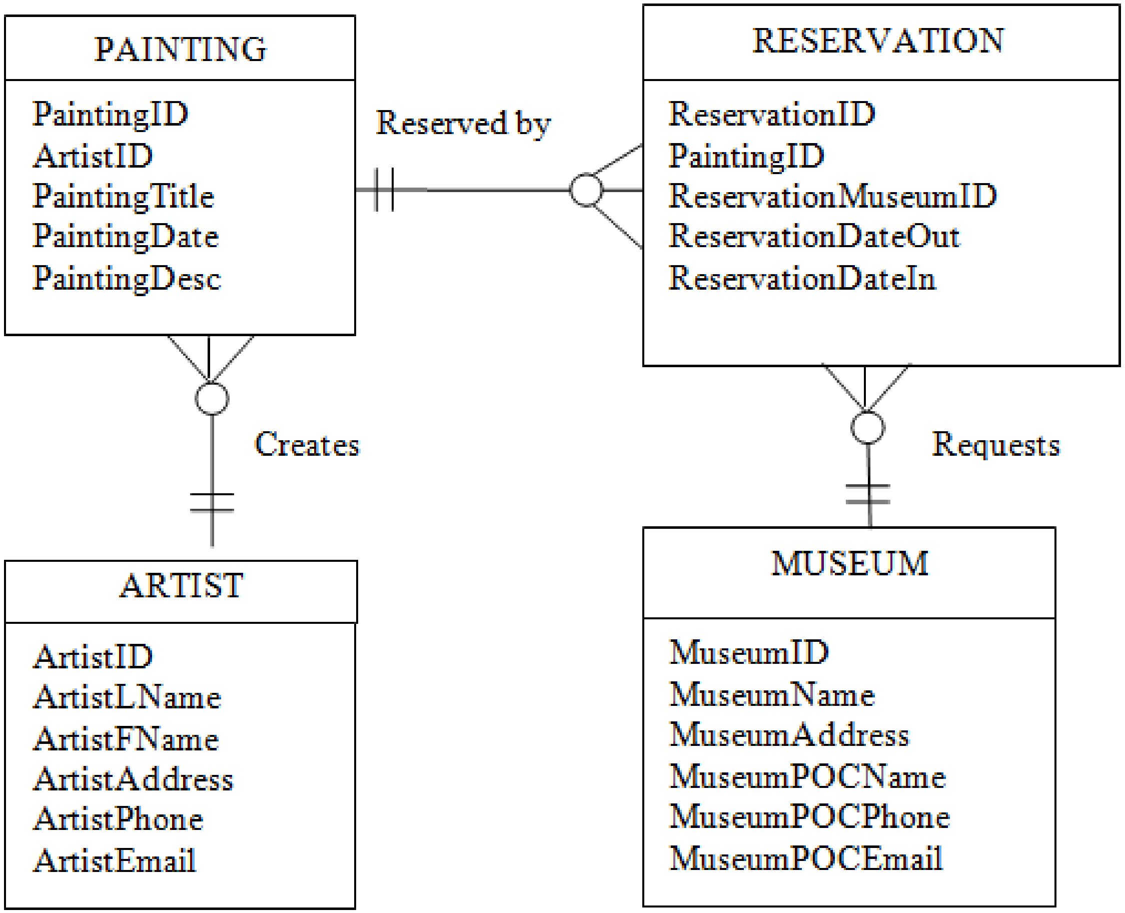


A wealthy businessman owns a large number of paintings that he loans to museums all over the world. He is interested in setting up a system that records what he loans to whom so that he doesn't lose track of his investments. He would like to keep information about the paintings that he owns as well as the artists who painted them. He also wants to track the various museums that reserve his art, along with the actual reservations. Obviously, artists are associated with paintings, paintings are associated with reservations, and reservations are associated with museums.

QUESTIONS:

1. Draw the four entities that belong on this data model.
2. Provide some basic attributes for each entity, and select an identifier, if possible.
3. Draw the appropriate relationships between the entities and label them.
4. What is the cardinality for each relationship? Depict this on your drawing.
5. What is the modality for each relationship? Depict this on your drawing.
6. List two business rules that are communicated by your ERD.

Answer to the class exercise



PAINTING

PaintingID
ArtistID
PaintingTitle
PaintingDate
PaintingDesc

Reserved by

RESERVATION

ReservationID
PaintingID
ReservationMuseumID
ReservationDateOut
ReservationDateIn

Creates

Requests

ARTIST

ArtistID
ArtistLName
ArtistFName
ArtistAddress
ArtistPhone
ArtistEmail

MUSEUM

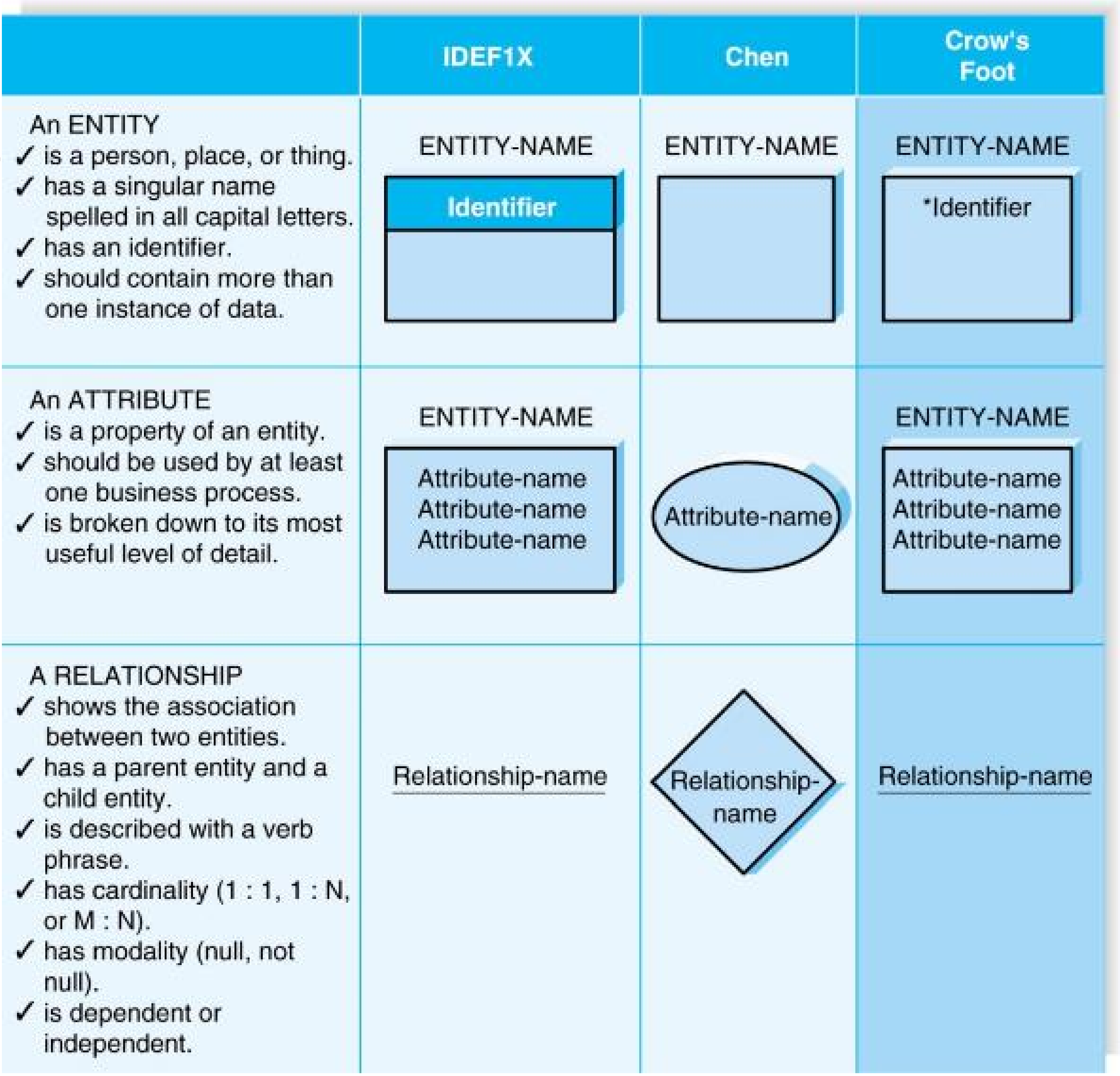
MuseumID
MuseumName
MuseumAddress
MuseumPOCName
MuseumPOCPhone
MuseumPOCEmail

Designing an ERD

- What are subjects/objects of the business?
  - Data entities and descriptions
- What unique characteristics distinguish between subjects/objects of the same type?
  - Primary keys
- What characteristics describe each subject/object?
  - Attributes and secondary keys
- How do you use the data?
  - Security controls and user access privileges
- Over what period of time are you interested in the data?
  - Cardinality and time dimensions

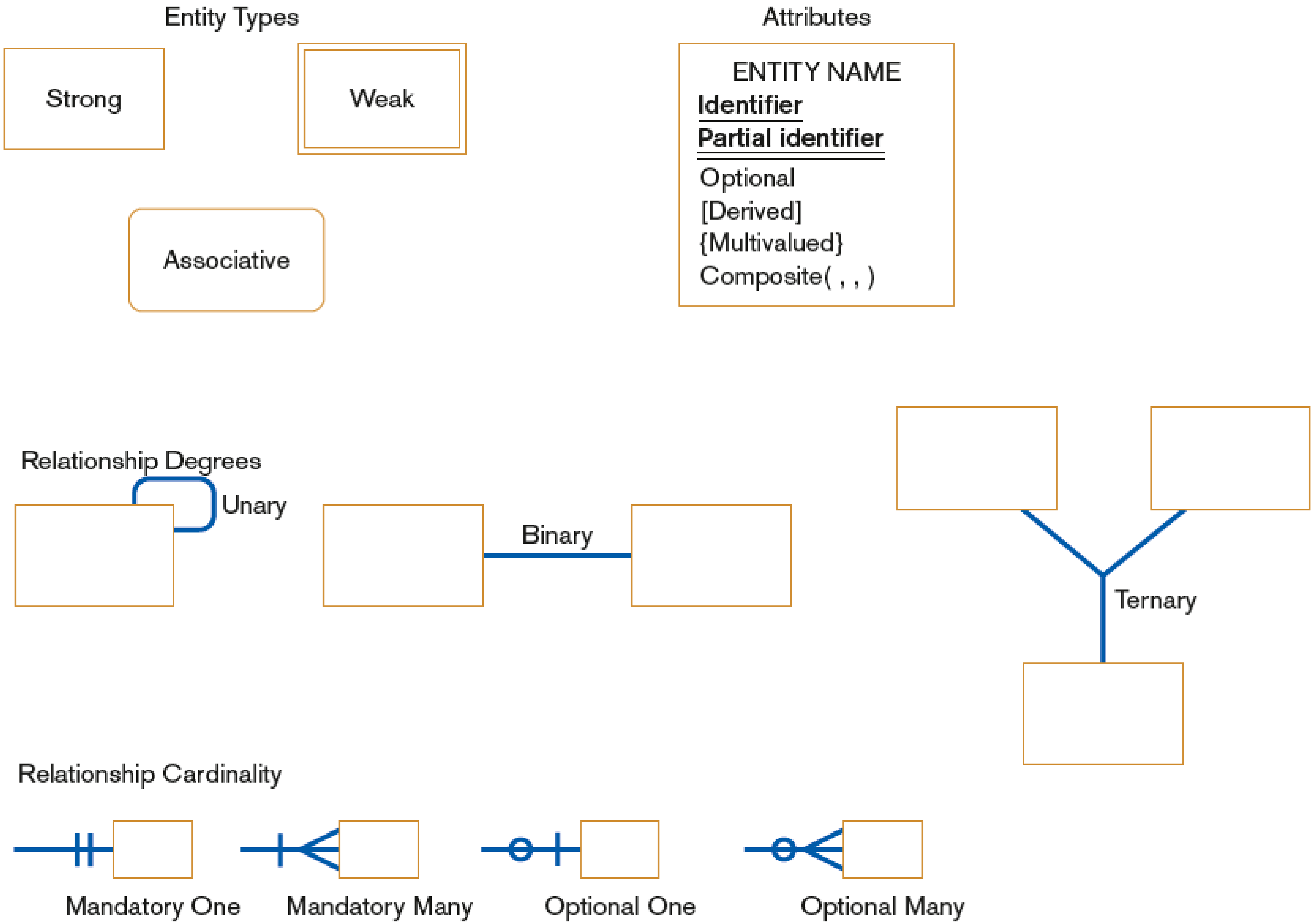
Elements of ERD:

Entity
Attribute
Relationship



	IDEF1X	Chen	Crow's Foot
An ENTITY ✓ is a person, place, or thing. ✓ has a singular name spelled in all capital letters. ✓ has an identifier. ✓ should contain more than one instance of data.	ENTITY-NAME Identifier	ENTITY-NAME	ENTITY-NAME *Identifier
An ATTRIBUTE ✓ is a property of an entity. ✓ should be used by at least one business process. ✓ is broken down to its most useful level of detail.	ENTITY-NAME Attribute-name Attribute-name Attribute-name	Attribute-name	ENTITY-NAME Attribute-name Attribute-name Attribute-name
A RELATIONSHIP ✓ shows the association between two entities. ✓ has a parent entity and a child entity. ✓ is described with a verb phrase. ✓ has cardinality (1 : 1, 1 : N, or M : N). ✓ has modality (null, not null). ✓ is dependent or independent.	Relationship-name	Relationship-name	Relationship-name

ERD notation



Entity Types

Strong

Weak

Associative

Attributes

ENTITY NAME
Identifier
Partial identifier
Optional
[Derived]
{Multivalued}
Composite(, ,)

Relationship Degrees

Unary

Binary

Ternary

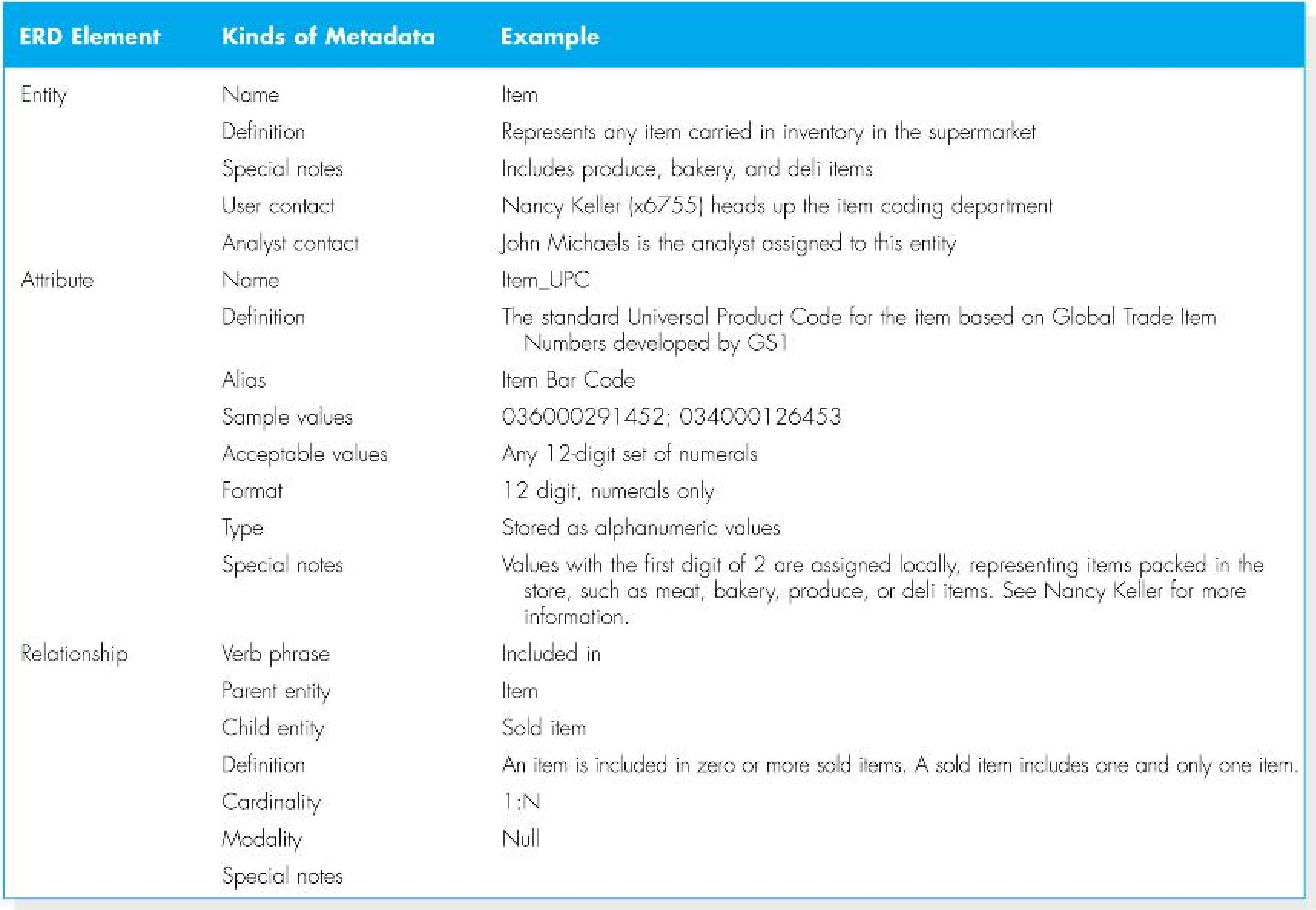
Relationship Cardinality

Mandatory One

Mandatory Many

Optional One

Optional Many



ERD Element	Kinds of Metadata	Example
Entity	Name	Item
	Definition	Represents any item carried in inventory in the supermarket
	Special notes	Includes produce, bakery, and deli items
	User contact	Nancy Keller (x6755) heads up the item coding department
	Analyst contact	John Michaels is the analyst assigned to this entity
Attribute	Name	Item_UPC
	Definition	The standard Universal Product Code for the item based on Global Trade Item Numbers developed by GS1
	Alias	Item Bar Code
	Sample values	036000291452; 034000126453
	Acceptable values	Any 12-digit set of numerals
	Format	12 digit, numerals only
	Type	Stored as alphanumeric values
	Special notes	Values with the first digit of 2 are assigned locally, representing items packed in the store, such as meat, bakery, produce, or deli items. See Nancy Keller for more information.
Relationship	Verb phrase	Included in
	Parent entity	Item
	Child entity	Sold item
	Definition	An item is included in zero or more sold items. A sold item includes one and only one item.
	Cardinality	1:N
	Modality	Null
	Special notes	

References

- Dennis, A., and Wixom, B. H, “Systems Analysis and Design”, 5th Edition, John Wiley & Sons (2013), Chapter Six.
- Hoffer, J. A., George, J. F., Valacich J. S., “Modern Systems Analysis and Design”, 7th Edition, Pearson Education. Chapter Eight.