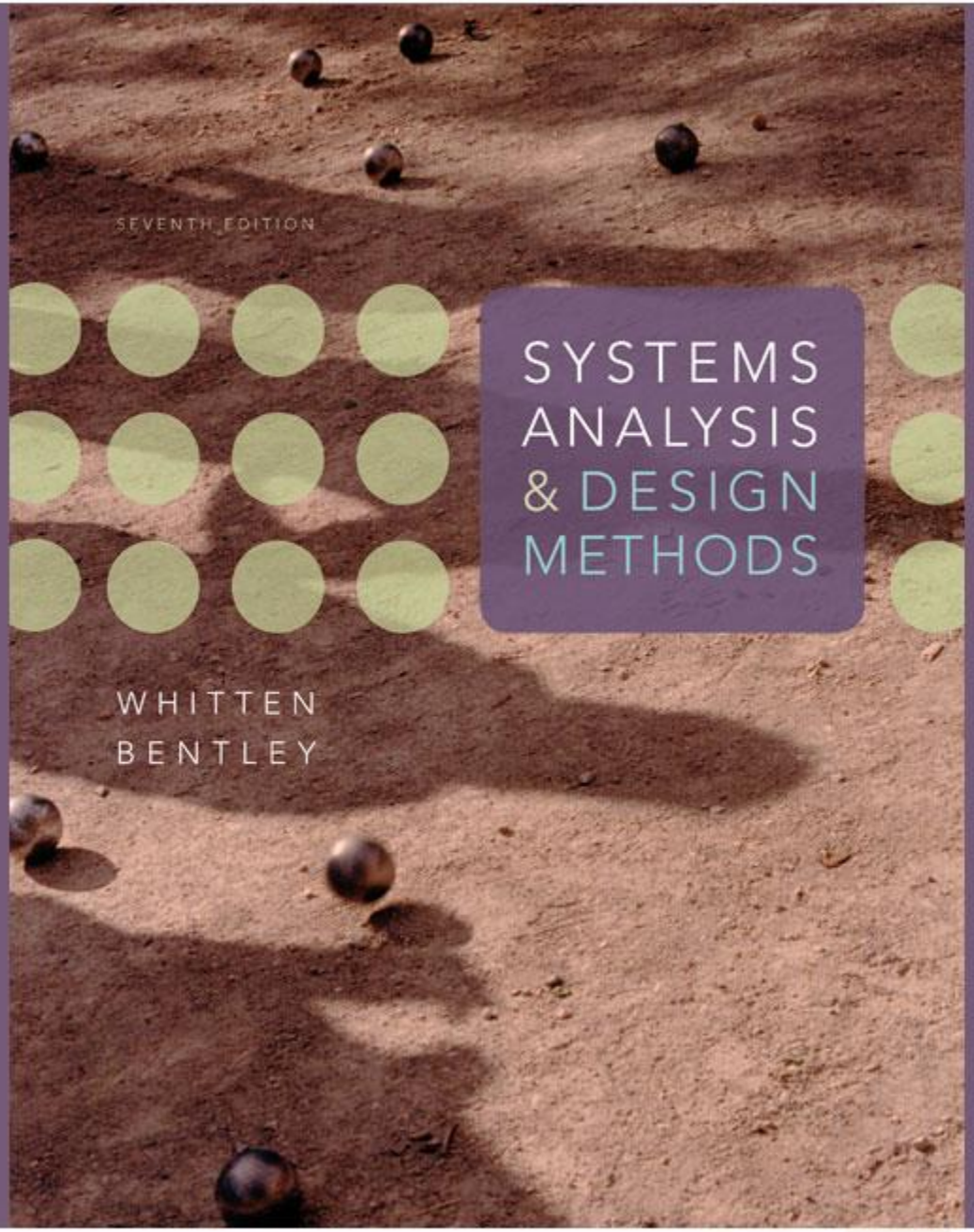

SEVENTH EDITION
SYSTEMS ANALYSIS & DESIGN METHODS
WHITTEN
BENTLEY

Process Modeling and DFDs

Process modeling – a technique used to organize and document a system's processes.

- Flow of data through processes
- Logic
- Policies
- Procedures

Data flow diagram (DFD) – a process model used to depict the flow of data through a system and the work or processing performed by the system. Synonyms are bubble chart, transformation graph, and process model.

- The DFD has also become a popular tool for business process redesign.

External Agents

External agent – an outside person, unit, system, or organization that interacts with a system. Also called an *external entity*.

- External agents define the "boundary" or scope of a system being modeled.
- Almost always one of the following:
  - Office, department, division.
  - An external organization or agency.
  - Another business or another information system.
  - One of system's end-users or managers
- Named with descriptive, singular noun

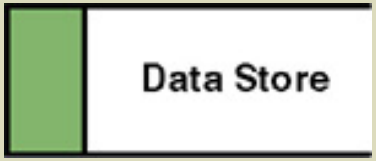
Gane and Sarson shape

DeMarco/Yourdon shape

Data Stores

Data store – stored data intended for later use. Synonyms are *file* and *database*.

- Frequently implemented as a file or database.
- Almost always one of the following:
  - Persons (or groups of persons)
  - Places
  - Objects
  - Events (about which data is captured)
  - Concepts (about which data is important)
- Data stores depicted on a DFD store all instances of data entities (depicted on an ERD)
- Named with plural noun



Gane and Sarson shape

DeMarco/Yourdon shape

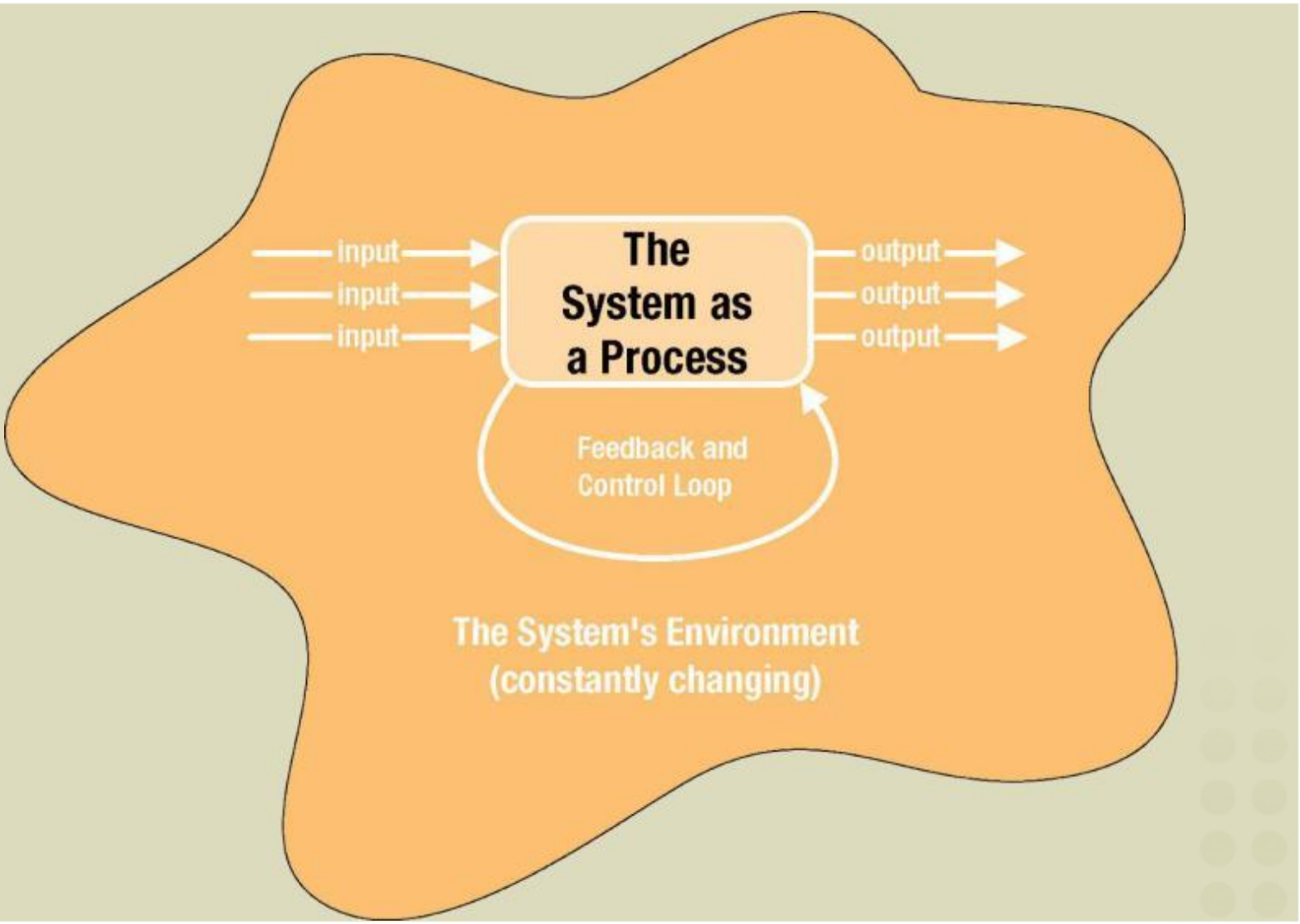
Process Concepts

Process – work performed by a system in response to incoming data flows or conditions. A synonym is *transform*.

- Processes respond to business events and conditions and transform data into useful information
- Modeling processes helps us to understand the interactions with the system's environment, other systems, and other processes.
- Named with a strong action verb followed by object clause describing what the work is performed on/for .

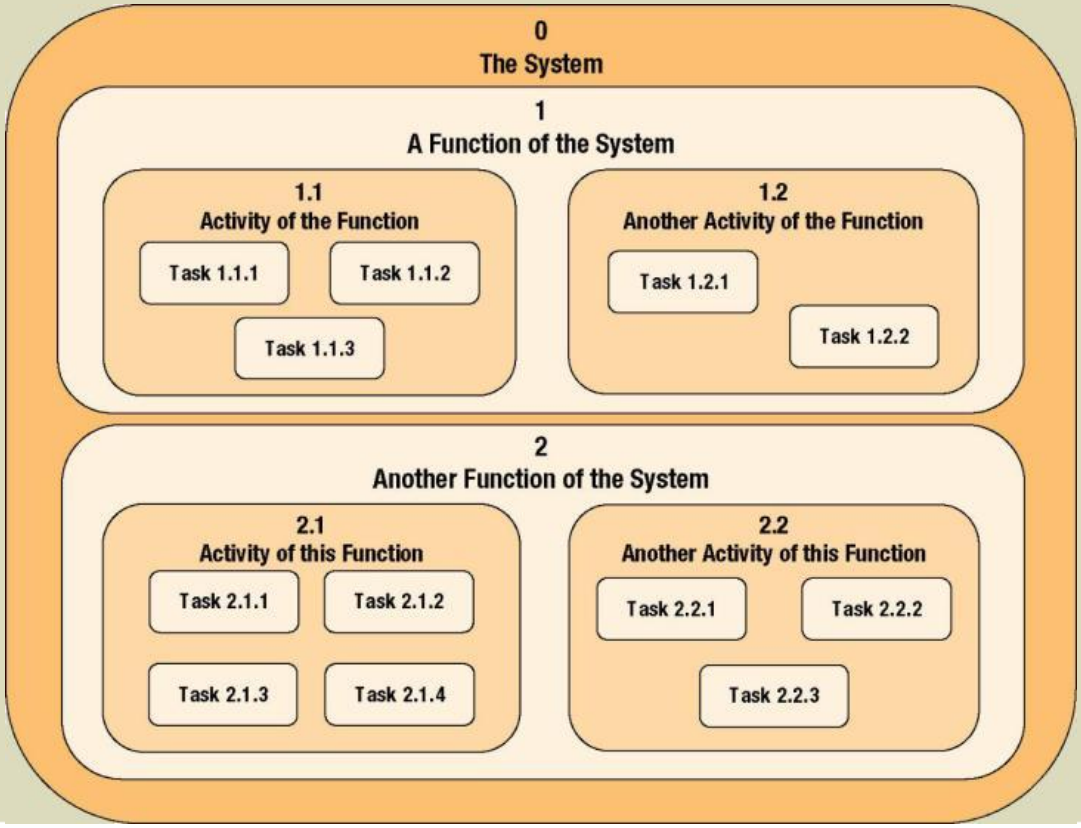
Gane and Sarson shape

The System is Itself a Process



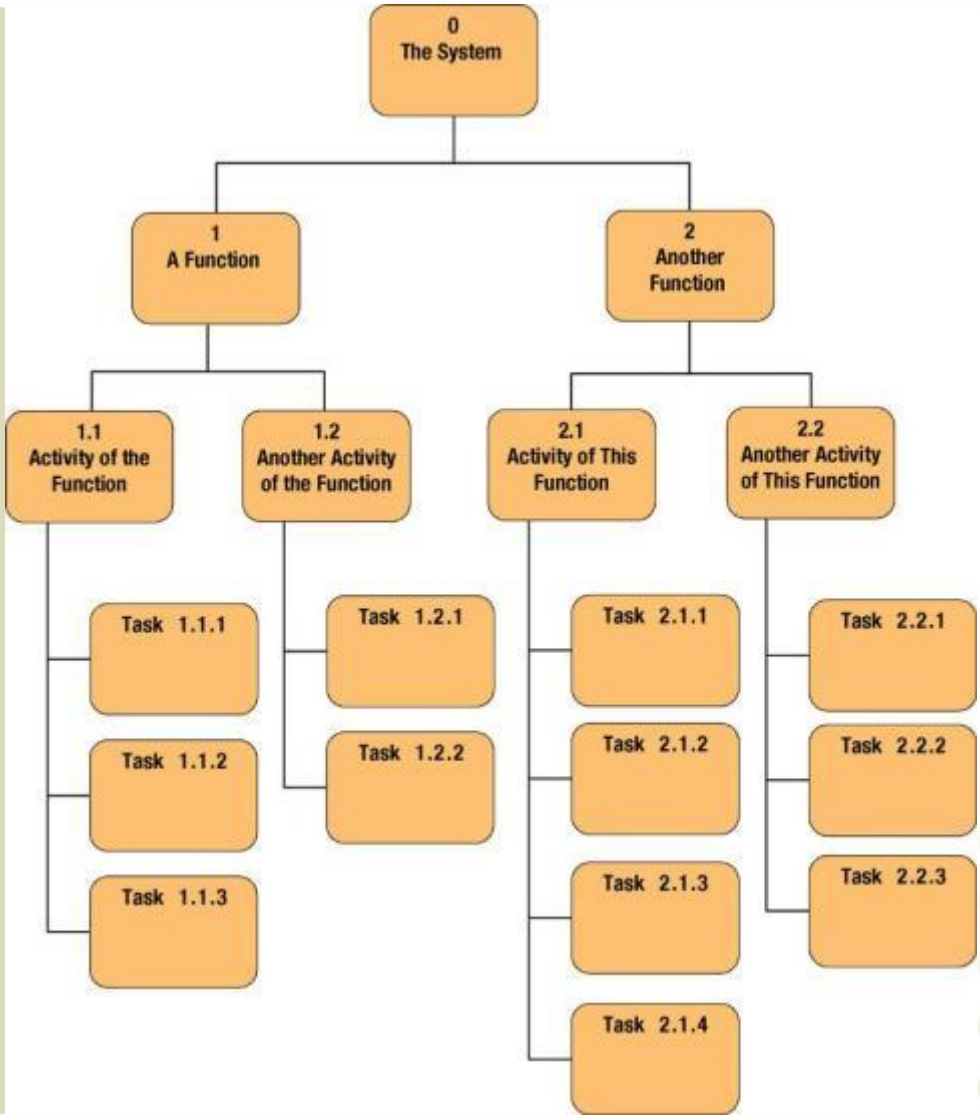
Process Decomposition

Decomposition – the act of breaking a system into sub-components. Each level of abstraction reveals more or less detail.



Decomposition Diagrams

Decomposition diagram – a tool used to depict the decomposition of a system. Also called hierarchy chart.



Optional: Types of Logical Processes

Function – a set of related and ongoing activities of a business.

- A function has no start or end.

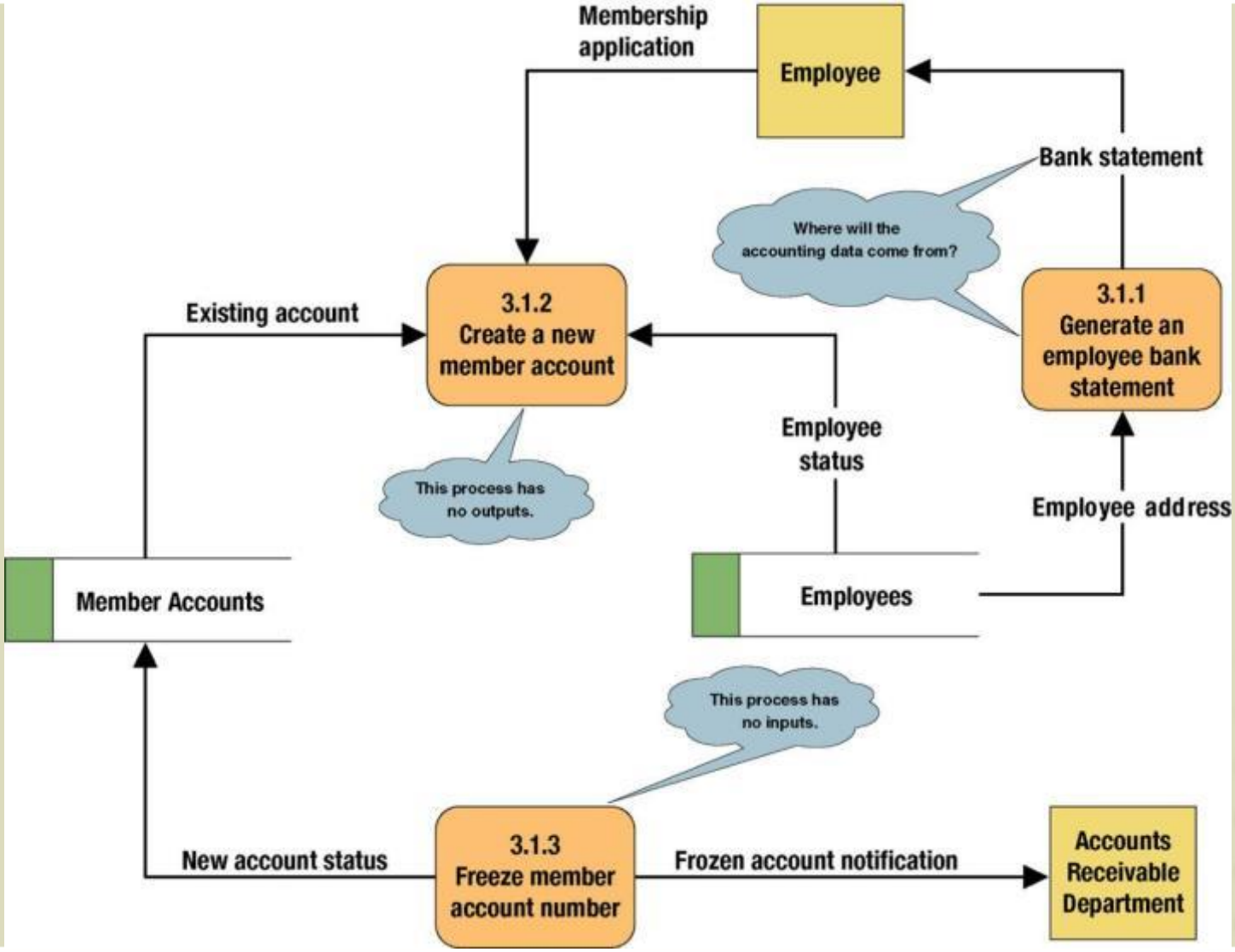
Event – a logical unit of work that must be completed as a whole. Sometimes called a *transaction*.

- Triggered by a discrete input and is completed when process has responded with appropriate outputs.
- Functions consist of processes that respond to events.

Elementary process – a discrete, detailed activity or task required to complete the response to an event. Also called a *primitive process*.

- The lowest level of detail depicted in a process model.

Common Process Errors on DFDs



Data Flows & Control Flows

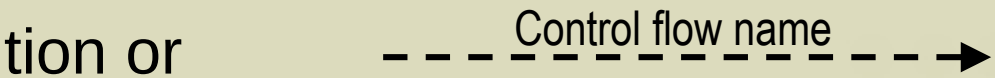
Data flow – data that is input to or output from a process.

- A data flow is data in motion
- A data flow may also be used to represent the creation, reading, deletion, or updating of data in a file or database (called a data store).

Composite data flow – a data flow that consists of other data flows.

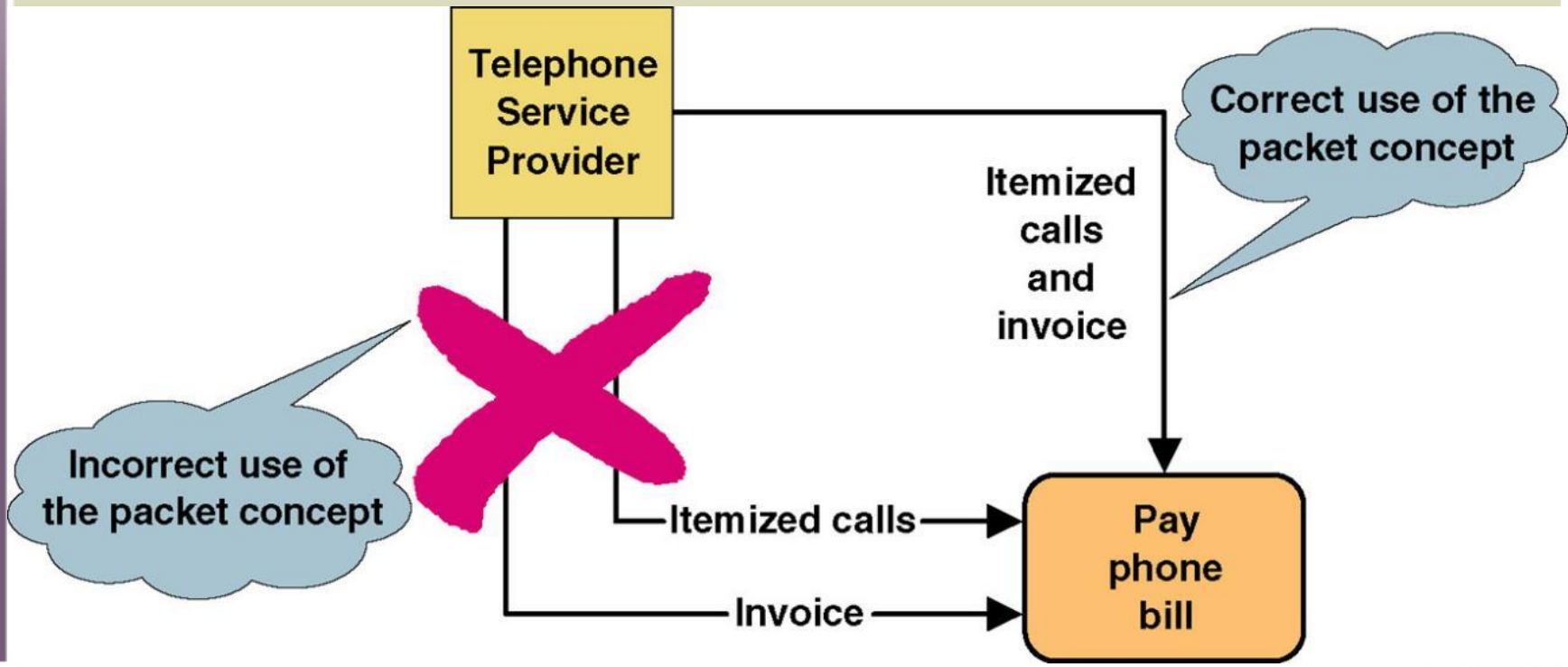
Control flow – a condition or nondata event that triggers a process.

- Used sparingly on DFDs.

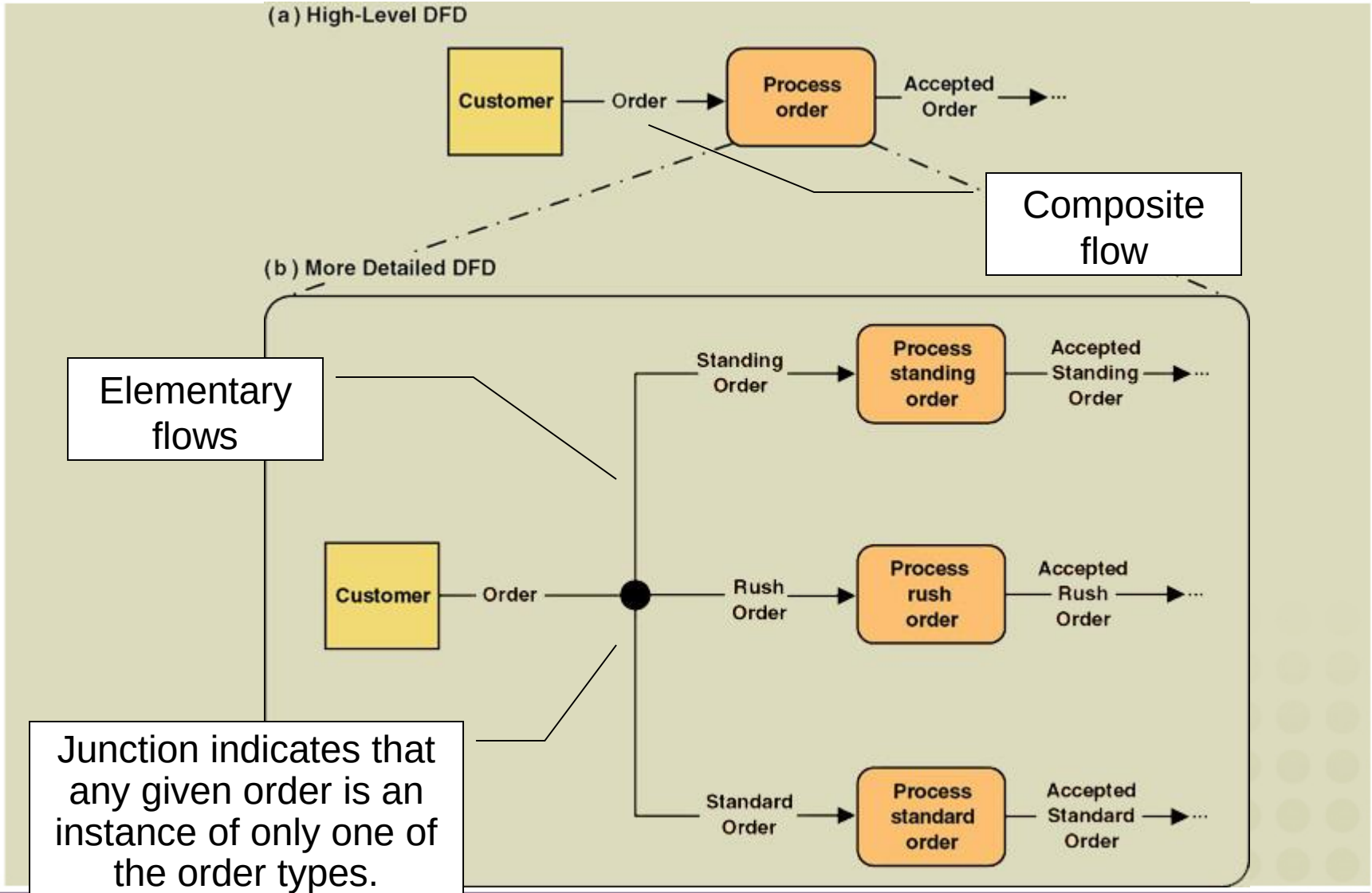


Data Flow Packet Concept

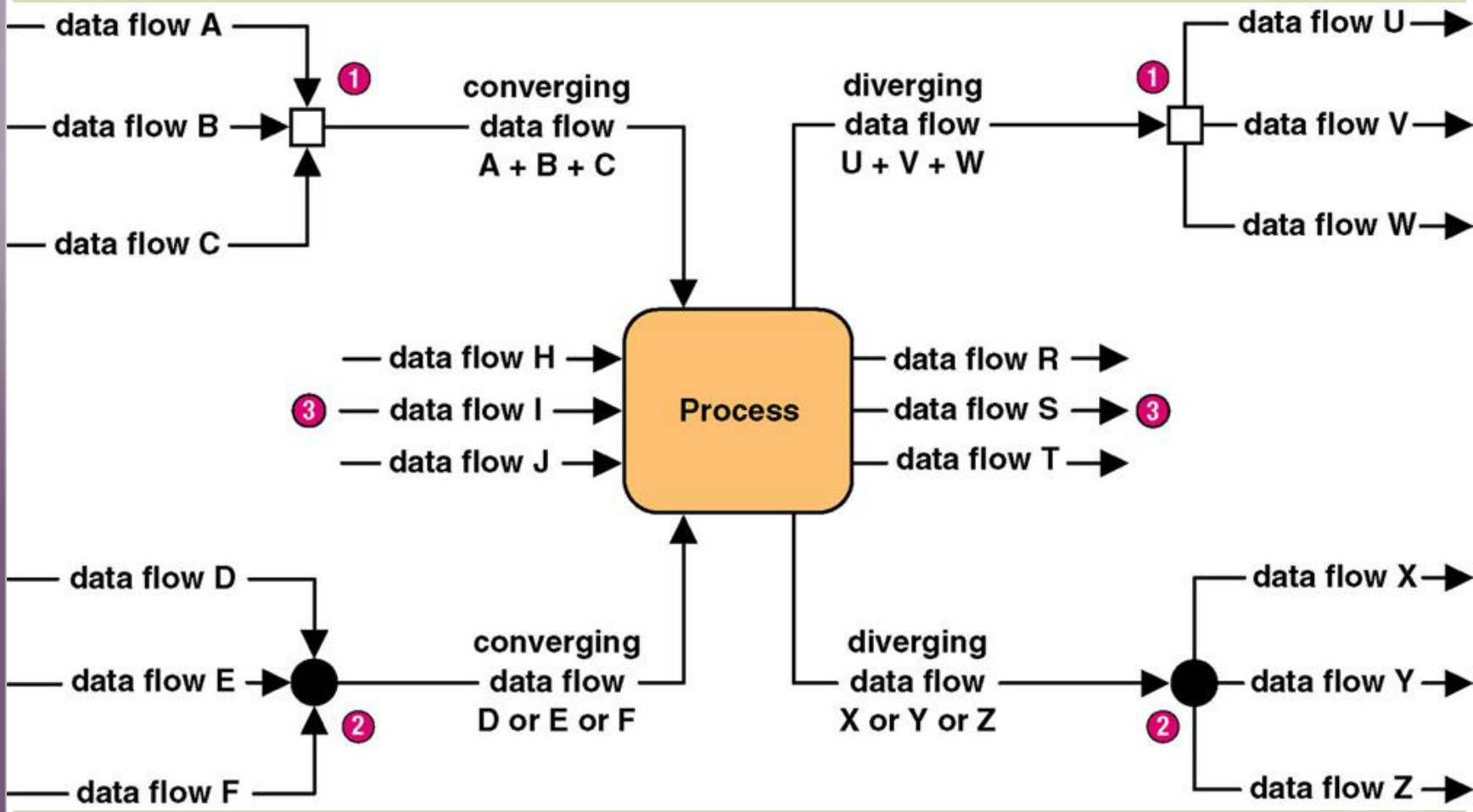
- Data that should travel together should be shown as a single data flow, no matter how many physical documents might be included.



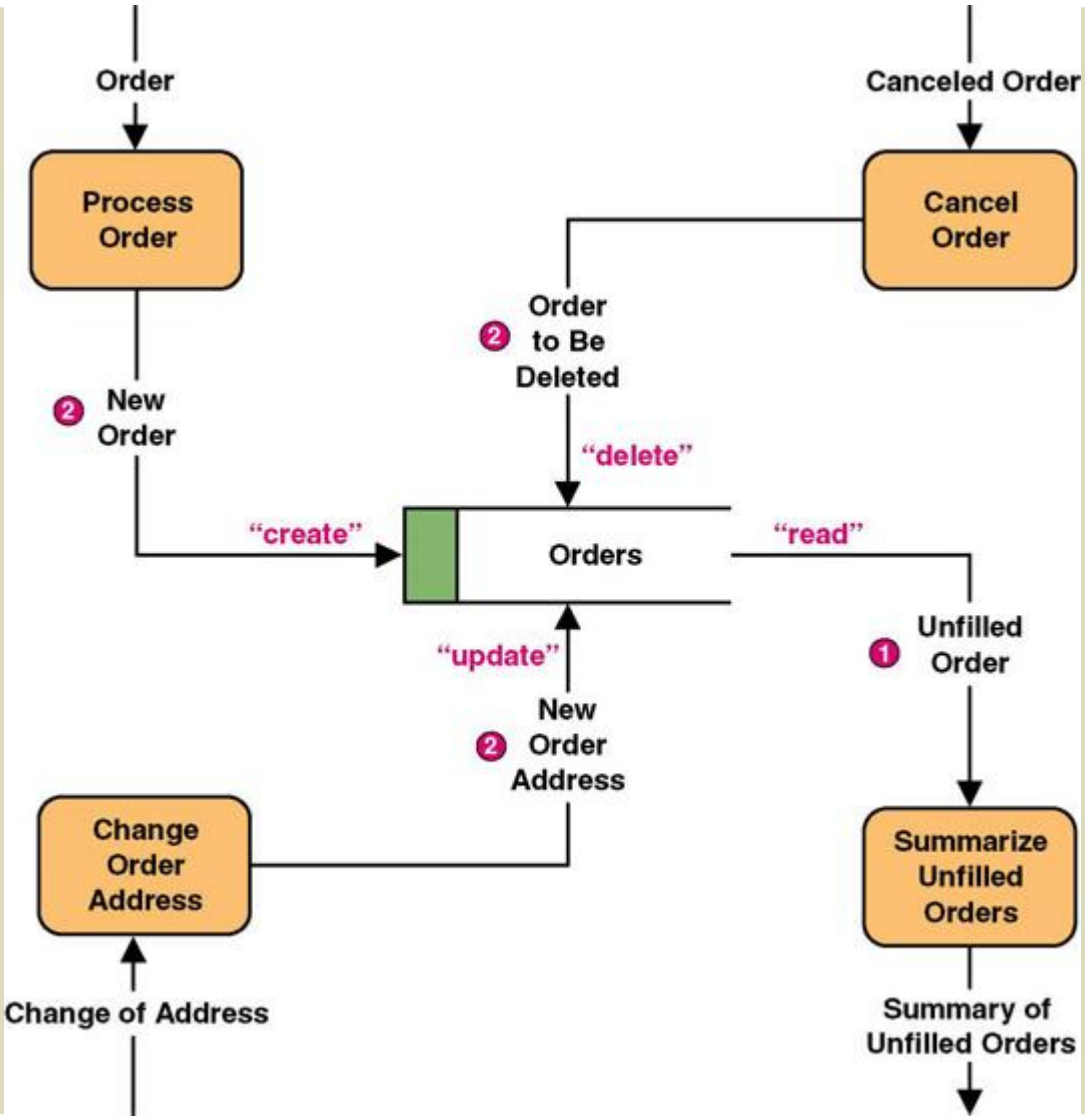
Composite and Elementary Data Flows



Diverging and Converging Data Flows

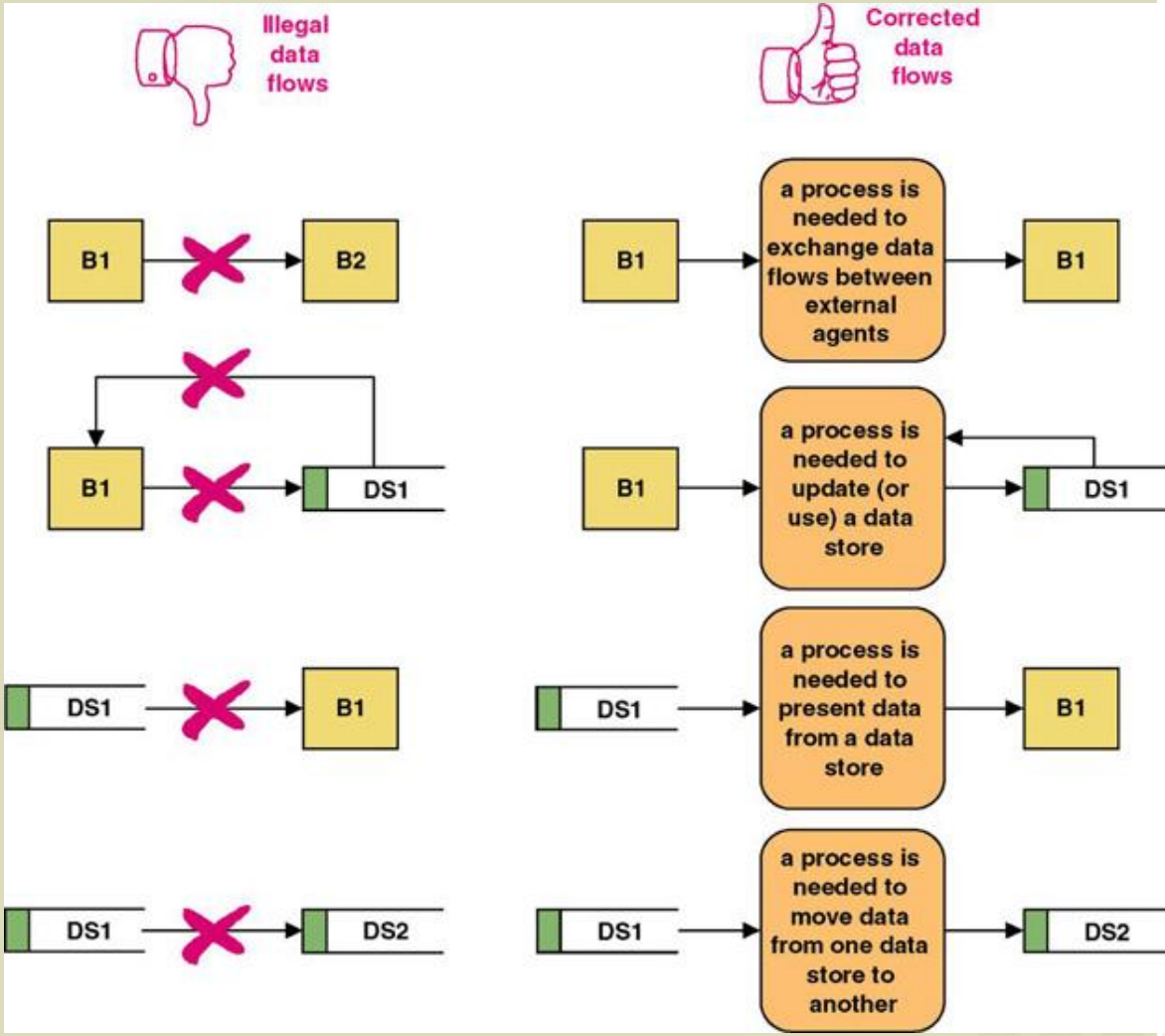


Data Flows to and from Data Stores



Rules for Data Flows

- A data flow should never go unnamed.
- In logical modeling, data flow names should describe the data flow without describing the implementation
- All data flows must begin and/or end at a process.



Data Conservation

Data conservation – the practice of ensuring that a data flow contains only data needed by the receiving process.

- Sometimes called *starving the processes*.
- Must precisely define the data composition of each data flow, expressed in the form of *data structures*.

Data Structure for a Data Flow

DATA STRUCTURE	ENGLISH ENTERPRETATION
ORDER= ORDER NUMBER + ORDER DATE+ [PERSONAL CUSTOMER NUMBER, CORPORATE ACCOUNT NUMBER]+ SHIPPING ADDRESS=ADDRESS+ (BILLING ADDRESS=ADDRESS)+ 1 {PRODUCT NUMBER+ PRODUCT DESCRIPTION+ QUANTITY ORDERED+ PRODUCT PRICE+ PRODUCT PRICE SOURCE+ EXTENDED PRICE } N+ SUM OF EXTENDED PRICES+ PREPAID AMOUNT+ (CREDIT CARD NUMBER+EXPIRATION DATE) (QUOTE NUMBER)	An instance of ORDER consists of: ORDER NUMBER and ORDER DATE and Either PERSONAL CUSTOMER NUMBER or CORPORATE ACCOUNT NUMBER and SHIPPING ADDRESS (which is equivalent to ADDRESS) and optionally: BILLING ADDRESS (which is equivalent to ADDRESS) and one or more instances of: PRODUCT NUMBER and PRODUCT DESCRIPTION and QUANTITY ORDERED and PRODUCT PRICE and PRODUCT PRICE SOURCE and EXTENDED PRICE and SUM OF EXTENDED PRICES and PREPAID AMOUNT and optionally: both CREDIT CARD NUMBER and EXPIRATION DATE
ADDRESS= (POST OFFICE BOX NUMBER)+ STREET ADDRESS+ CITY+ [STATE, MUNICIPALITY]+ (COUNTRY)+ POSTAL CODE	An instance of ADDRESS consists of: optionally: POST OFFICE BOX NUMBER and STREET ADDRESS and CITY and Either STATE or MUNICIPALITY and optionally: COUNTRY and POSTAL CODE

Data Types and Domains

Data attributes should be defined by data types and domains.

Data type - a class of data that be stored in an attribute.

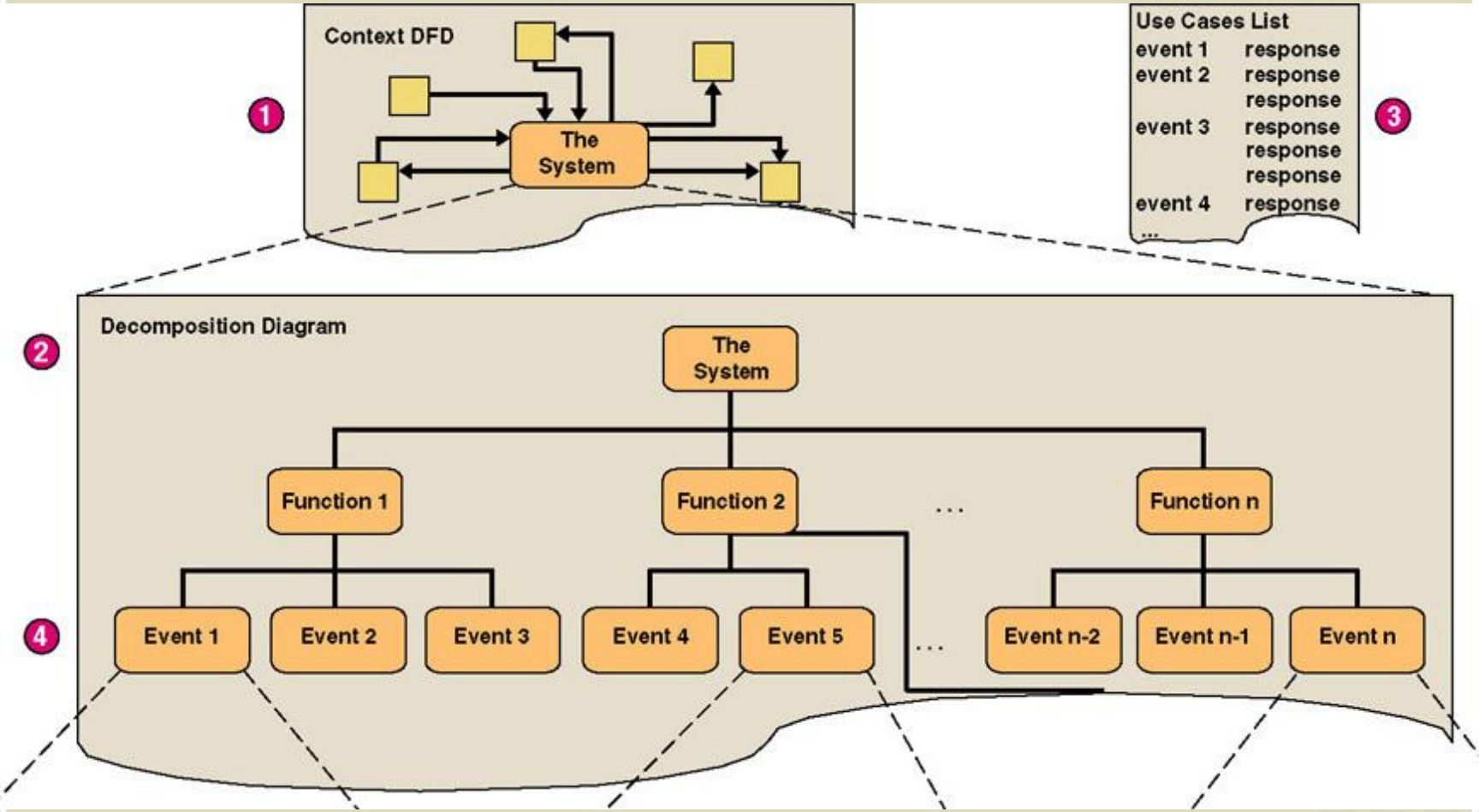
- Character, integers, real numbers, dates, pictures, etc.

Domain – the legitimate values for an attribute.

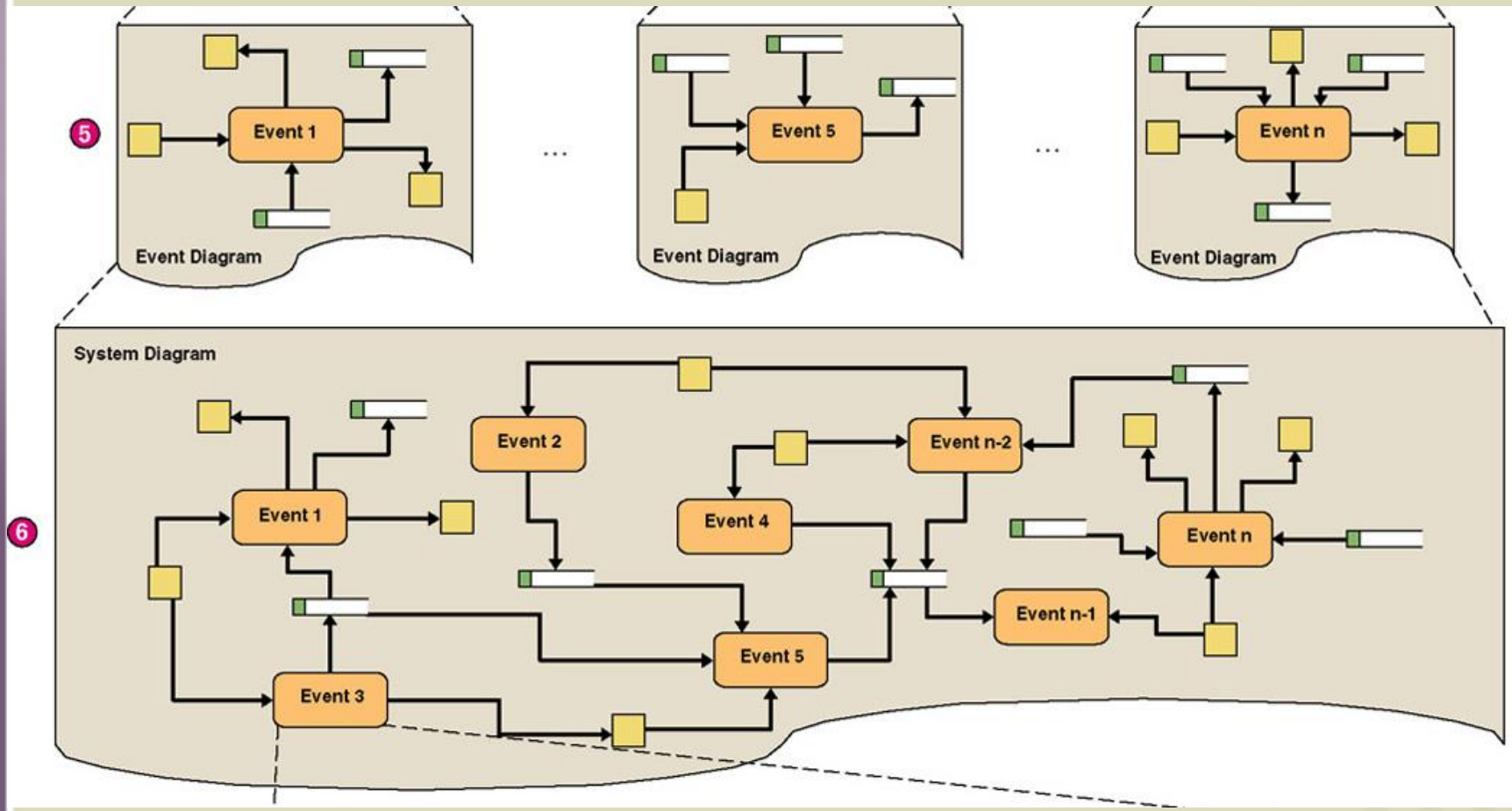
When to Draw Process Models

- Strategic systems planning
  - Enterprise process models illustrate important business functions.
- Business process redesign
  - “As is” process models facilitate critical analysis.
  - “To be” process models facilitate improvement.
- Systems analysis (primary focus of this course)
  - Model existing system including its limitations
  - Model target system’s logical requirements
  - Model candidate technical solutions
  - Model the target technical solution

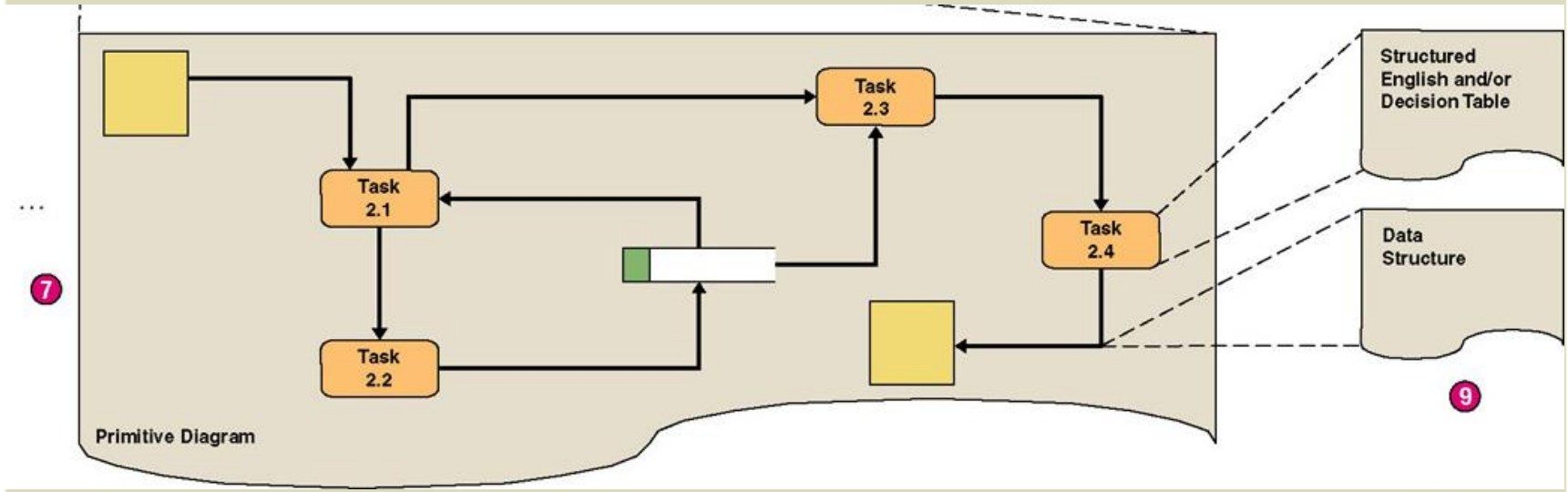
Structured Analysis Diagram Progression (1 of 3)



Structured Analysis Diagram Progression (2 of 3)



Structured Analysis Diagram Progression (3 of 3)



Balancing

Balancing - a concept that requires that data flow diagrams at different levels of detail reflect consistency and completeness

- Quality assurance technique
- Requires that if you explode a process to another DFD to reveal more detail, you must include the same dta flows and data stores

Process Logic

- Data Flow Diagrams good for identifying and describing processes
- Not good at showing logic inside processes
- Need to specify detailed instructions for elementary processes
- How to do it?
  - Flowcharts & Pseudocode - most end users do not understand them
  - Natural English - imprecise and subject to interpretation

Structured English

Structured English – a language syntax for specifying the logic of a process.

- Based on the relative strengths of structured programming and natural English.

1. For each CUSTOMER NUMBER in the data store CUSTOMERS:
   a. For each LOAN in the data store LOANS that matches the above CUSTOMER NUMBER:
      1) Keep a running total of NUMBER OF LOANS for the CUSTOMER NUMBER.
      2) Keep a running total of ORIGINAL LOAN PRINCIPAL for the CUSTOMER NUMBER.
      3) Keep a running total of CURRENT LOAN BALANCE for the CUSTOMER NUMBER.
      4) Keep a running total of AMOUNTS PAST DUE for the CUSTOMER NUMBER.
   b. If the TOTAL AMOUNTS PAST DUE for the CUSTOMER NUMBER is greater than 100.00 then
      1) Write the CUSTOMER NUMBER and data in the data flow LOANS AT RISK.

   Else
      1) Exclude the CUSTOMER NUMBER and data from the data flow LOANS AT RISK.

Policies and Decision Tables

Policy – a set of rules that govern show a process is to be completed.

Decision table – a tabular form of presentation that specifies a set of conditions and their corresponding actions.

- As required to implement a policy.

A Simple Decision Table

A SIMPLE POLICY STATEMENT

CHECK CASHING IDENTIFICATION CARD

A customer with check cashing privileges is entitled to cash personal checks of up to $75.00 and payroll checks from companies pre-approved by *LMART*. This card is issued in accordance with the terms and conditions of the application and is subject to change without notice. This card is the property of *LMART* and shall be forfeited upon request of *LMART*.

SIGNATURE *Charles C. Parker, Jr.*

EXPIRES **May 31, 2003**

THE EQUIVALENT POLICY DECISION TABLE

	Conditions and Actions	Rule 1	Rule 2	Rule 3	Rule 4
Condition Stubs	C1: Type of check	personal	payroll	personal	payroll
	C2: Check amount less than or equal to $75.00	yes	doesn't matter	no	doesn't matter
	C3: Company accredited by *LMART*	doesn't matter	yes	doesn't matter	no
Action Stubs	A1: Cash the check	X	X		
	A2: Don't cash the check			X	X
		Rules			

Data & Process Model Synchronization CRUD Matrix

Data-to-Process-CRUD Matrix

Entity . Attribute	Process Customer Application	Process Customer Credit Application	Process Customer Change of Address	Process Internal Customer Credit Change	Process New Customer Order	Process Customer Order Cancellation	Process Customer Change to Outstanding Order	Process Internal Change to Customer Order	Process New Product Addition	Process Product Withdrawal from Market	Process Product Price Change	Process Change to Product Specification	Process Product Inventory Adjustment
Customer	C	C			R	R	R	R					
.Customer Number	C	C			R	R	R	R					
.Customer Name	C	C	U		R		R	R					
.Customer Address	C	C	U		RU		RU	RU					
.Customer Credit Rating		C		U	R		R	R					
.Customer Balance Due					RU	U	R	R					
Order					C	D	RU	RU					
.Order Number					C		R	R					
.Order Date					C		U	U					
.Order Amount					C		U	U					
Ordered Product					C	D	CRUD	CRUD		RU			
.Quantity Ordered					C		CRUD	CRUD					
.Ordered Item Unit Price					C		CRUD	CRUD					
Product					R	R	R	R	C	D	RU	RU	RU
.Product Number					R	R	R	R	C			R	
.Product Name					R		R	R	C			RU	
.Product Description					R		R	R	C			RU	
.Product Unit of Measure					R		R	R	C		RU	RU	
.Product Current Unit Price					R		R	R			U		
.Product Quantity on Hand					RU	U	RU	RU					RU

C = create R = read U = update D = delete

Process Distribution

Process-to-Location-Association Matrix

Process	Customers	Kansas City	. Marketing	. Advertising	. Warehouse	. Sales	. Accounts Receivable	Boston	. Sales	. Warehouse	San Francisco	. Sales	San Diego	. Warehouse
Process Customer Application	X					X			X			X		
Process Customer Credit Application	X						X							
Process Customer Change of Address	X					X			X			X		
Process Internal Customer Credit Change							X							
Process New Customer Order	X					X			X			X		
Process Customer Order Cancellation	X					X			X			X		
Process Customer Change to Outstanding Order	X					X			X			X		
Process Internal Change to Customer Order						X			X			X		
Process New Product Addition			X											
Process Product Withdrawal from Market			X											
Process Product Price Change			X											
Process Change to Product Specification			X	X										
Process Product Inventory Adjustment					X					X				X

Optional: Differences Between DFDs and Flowcharts

- Processes on DFDs can operate in parallel (at-the-same-time)
  - Processes on flowcharts execute one at a time
- DFDs show the flow of data through a system
  - Flowcharts show the flow of control (sequence and transfer of control)
- Processes on a DFD can have dramatically different timing (daily, weekly, on demand)
  - Processes on flowcharts are part of a single program with consistent timing