Chapter 5

Process Modeling

SYSTEMS ANALYSIS AND DESIGN

SEVENTH EDITION

DENNIS, WIXOM, AND ROTH

Learning Objectives

- Explain the rules and style guidelines for data flow diagrams.
- Describe the process used to create data flow diagrams.
- Create data flow diagrams.

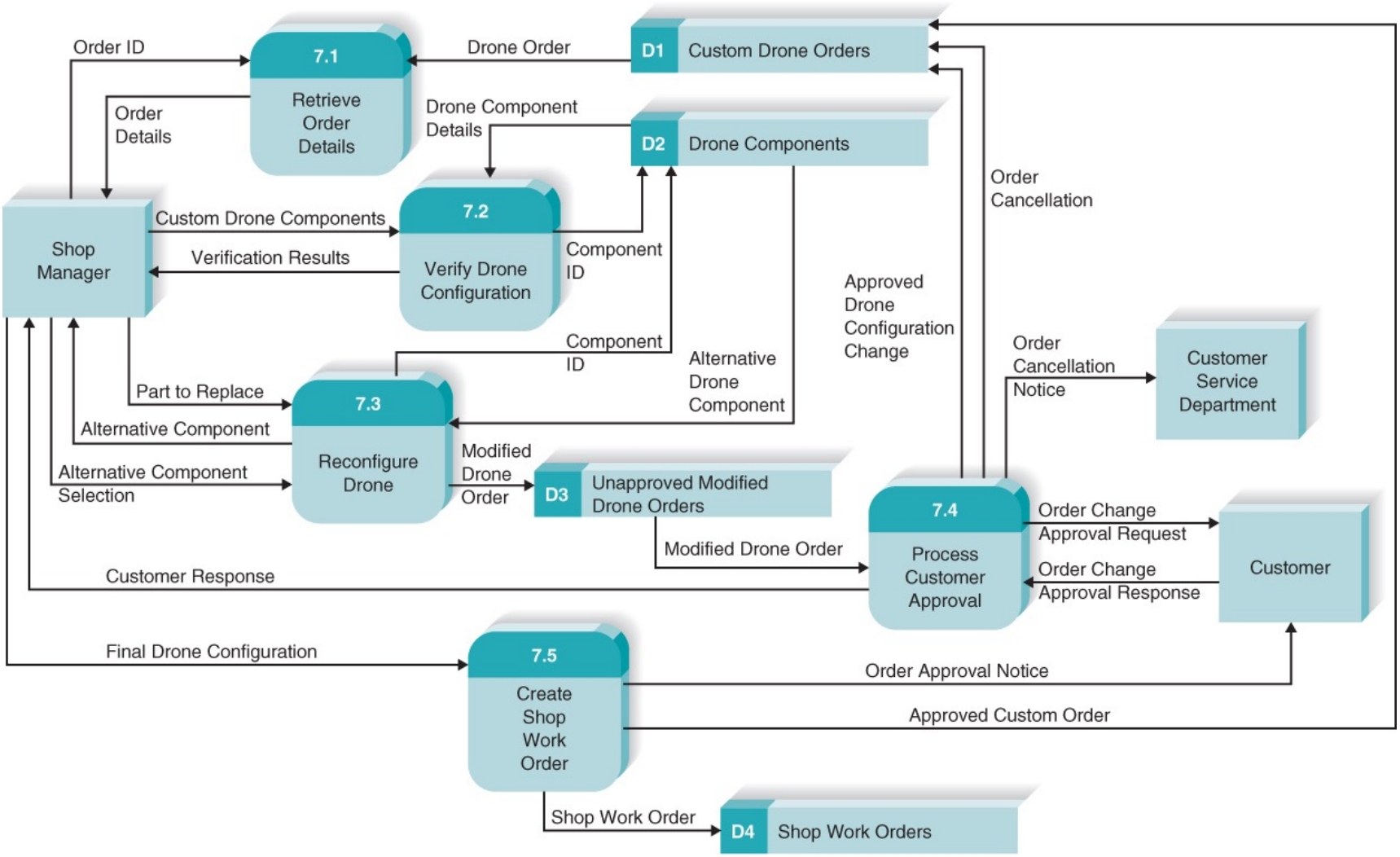
Key Definitions

- Process model
  - A formal way of representing how a business process operates
  - Illustrate activities that are performed and how data moves between them
  - *Logical* process models describe processes without suggesting how they are conducted.
  - *Physical* process models include process implementation information
- Data flow diagramming
  - A popular technique for creating process models

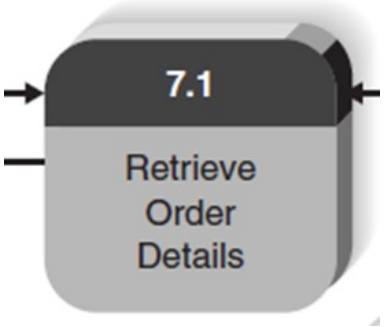
Data Flow Diagrams

WHAT DO DFDS TELL US?

Reading a Data Flow Diagram

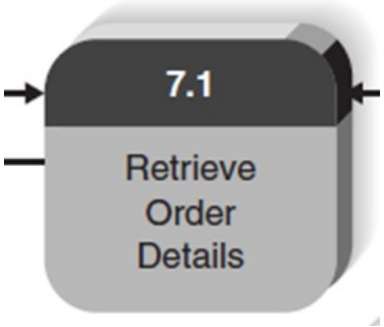


DFD Elements (1 of 7)



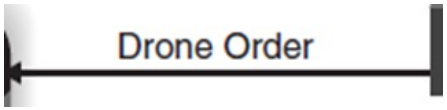
- Process
  - An activity or function performed for a specific business reason
  - Can be manual or computerized
  - Includes the following:
    - A number
    - A name (verb phrase)
    - A description
    - At least one output data flow
    - At least one input data flow

DFD Elements (2 of 7)



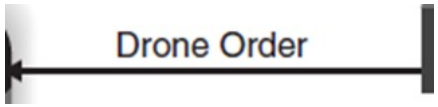
- Process
  - Logical process models omit any processes that simply move or route data and leave the data unchanged.
  - You do include logical processes that:
    - ***Perform computations*** (e.g., calculate grade point average)
    - ***Make decisions*** (e.g., determine availability of ordered products)
    - ***Sort, filter or otherwise summarize data*** (e.g., identify overdue invoices)
    - ***Organize data*** into useful information (e.g., generate a report or answer a question)
    - ***Trigger other processes*** (e.g., turn on the furnace or instruct a robot)
    - ***Use stored data*** (create, read, update or delete a record)

DFD Elements (3 of 7)



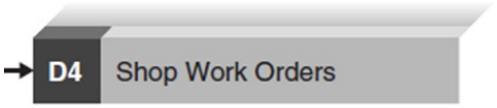
- Data flow
  - A single piece of data or a logical collection of data
  - Data Flow names describe the **content** of the data flow but not how it is implemented
  - Always starts or ends at a process
  - Includes the following:
    - A name (noun)
    - Description
    - One or more connections to a process

DFD Elements (4 of 7)



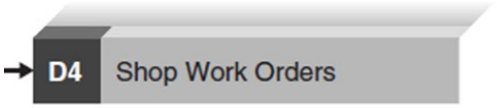
- Data flow
  - A data flow is *data in motion*.
    - an input of data to a process, or the output of data (or information) from a process.
    - the creation, deletion, or update of data in a file or database (called a data store on the DFD).
    - A data flow is depicted as a solid-line with arrow. ⟶
    - Control flows (non-data flows) trigger processes, such as 'time to run the weekly payroll'
    - The control flow is depicted as a dashed-line with arrow. - - - - - →

DFD Elements (5 of 7)



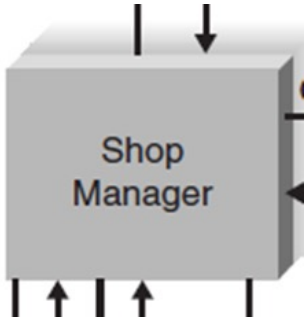
- Data Store
  - Most information systems capture data for later use.
  - A data store is a collection of data that is stored in some way
  - Include the following:
    - A number
    - A name (noun)
    - Description
    - One or more input data flows (somewhere in process model)
    - One or more output data flows (somewhere in process model)

DFD Elements (6 of 7)



- Data Store
  - If data flows are data in motion, think of data stores as data at rest.
  - Data stores should describe “things” about which the business wants to store data.
  - Data flows leaving the data store are data retrievals
  - Data flows entering the data store are updates or new data added

DFD Elements (7 of 7)



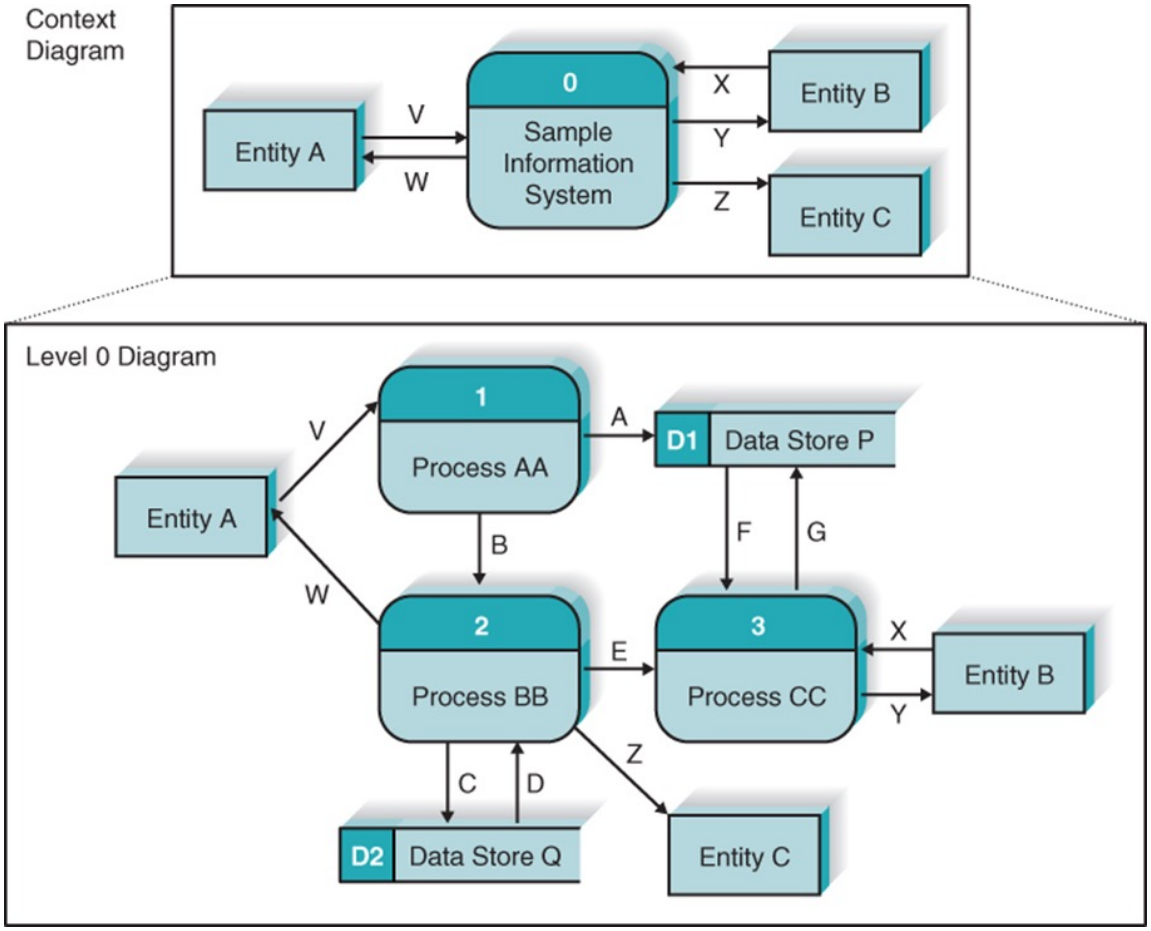
- External entity
  - A person, organization, or system that is external to the system
  - Has interactions with the system (adds data to system or receives data from system)
  - Include the following:
    - A name (noun)
    - Description

Depicting Business Processes with DFDs

- Business processes are too complex to be shown on a single DFD
- A deliberate hierarchy is created with multiple “levels” of DFDs
- To build the hierarchy, use ***Decomposition***
  - Child diagrams show a portion of the parent diagram in greater detail

DFD Hierarchy (1 of 3)

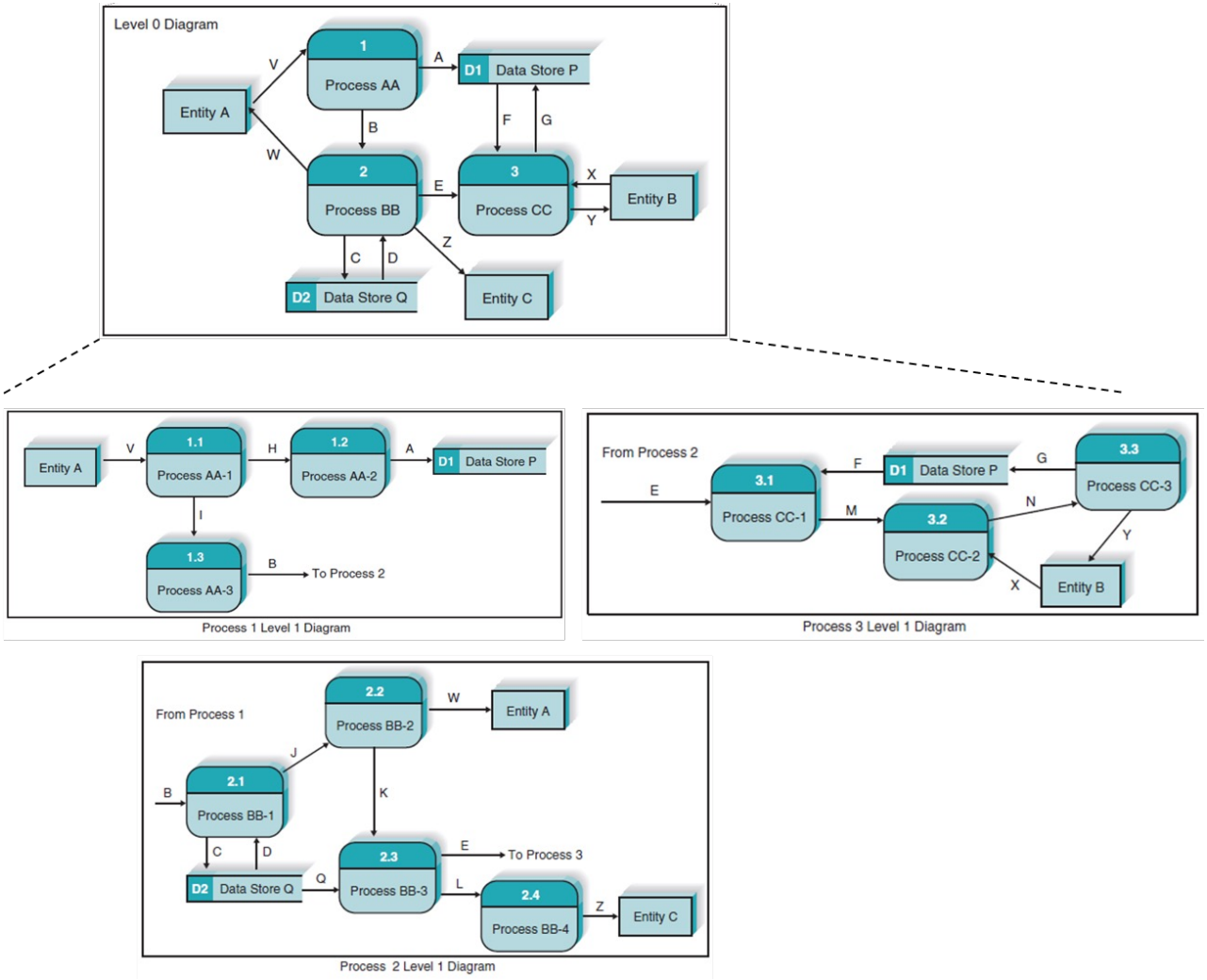
- Context Diagram decomposes into Level 0 diagram



DFD Hierarchy (2 of 3)

- Processes on Level 0 diagram each decompose into separate Level 1 diagrams
- Processes on Level 1 diagrams may or may not be decomposed into separate Level 2 diagrams.
- Processes are decomposed until each process is a single-purpose, *primitive* process.

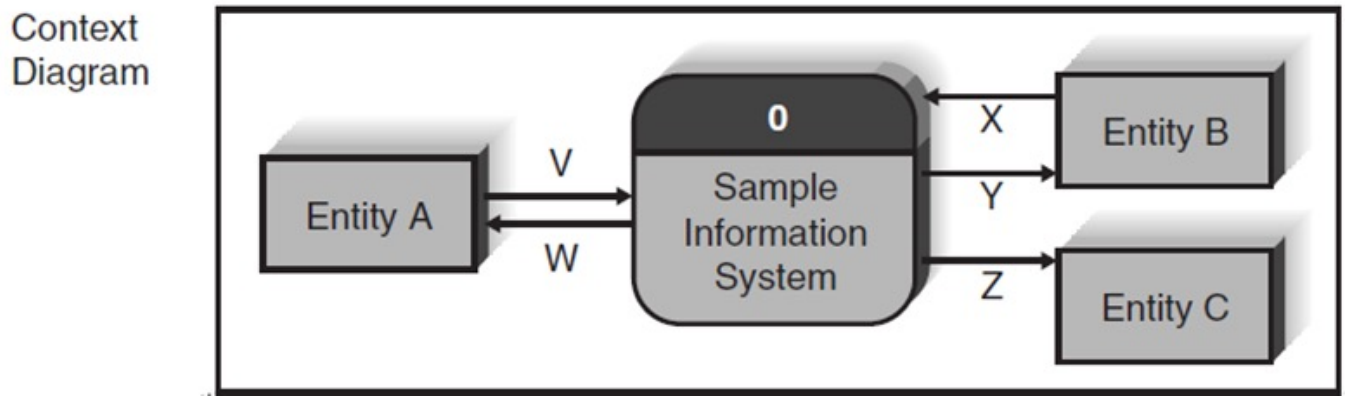
DFD Hierarchy (3 of 3)



Balancing

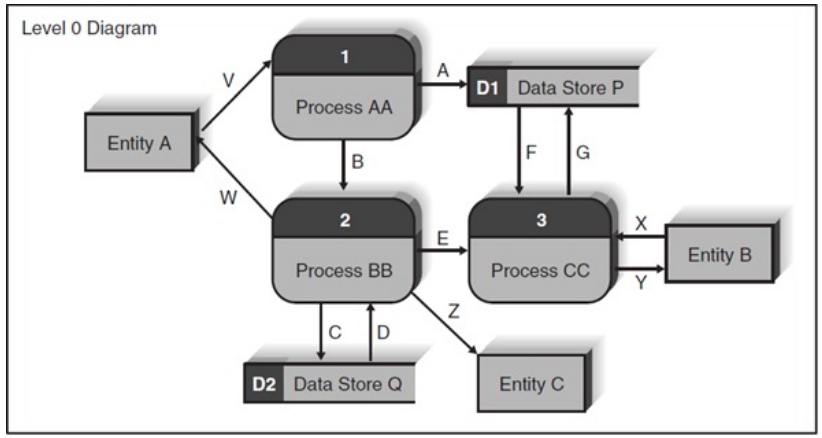
- Ensures that information presented at one level of a DFD is accurately represented in the next level DFD.
- Data flows on parent diagram are carried down to child diagram.
- Child diagram adds new processes and new data flows

Context Diagram



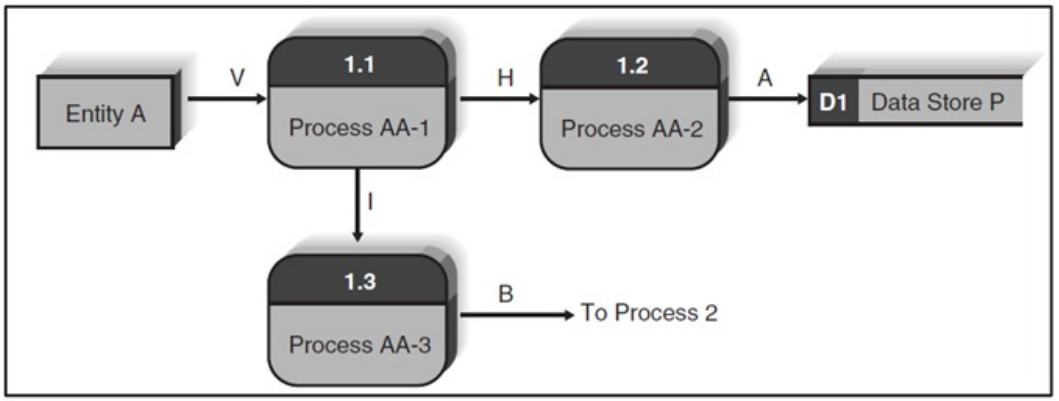
- Top-level DFD in every process model
- Shows the context into which the business process fits
- Shows the overall business process as just one process (process ‘zero’)
- Shows all the external entities that receive information from or contribute information to the system

Level 0 Diagram



- Shows all the major processes that comprise the overall system – the internal components of process 0
- Shows how the major processes are interrelated by data flows
- Shows external entities and the major processes with which they interact
- Adds stored data via the data stores

Level 1 Diagrams



Process 1 Level 1 Diagram

- Create one level 1 diagram for every major process on the level 0 diagram
- Shows the internal processes that comprise a single process on the level 0 diagram
- Shows how information moves to and from each of these processes
- If a parent process is decomposed into, say, three child processes, then these three child processes wholly and completely make up the parent process

Level 2 Diagrams

- Shows all processes that comprise a single process on the level 1 diagram
- Shows how information moves to and from each of these processes
- Level 2 diagrams may not be needed for all level 1 processes
- Correctly numbering each process helps the user understand where the process fits into the overall system

Diagram Numbering

- Correctly numbering each process helps the user understand where the process fits into the overall hierarchy
  - Context Diagram is always “Process 0”
  - Level 0 processes are always numbered with integer value (1, 2, 3, etc.)
  - Level 1 processes always have one “dot”: parent number “dot” unique number (1.1, 1.2, 1.3, etc.)
  - Level 2 processes always have two “dots”: parent number “dot” unique number (1.1.1, 1.1.2, 1.1.3, etc.)

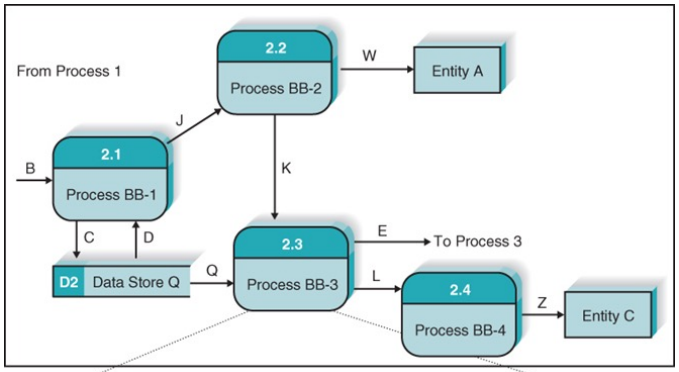
Alternative Data Flows

- Where a process can produce different data flows given different conditions
- We show both data flows and use the process description to explain why they are alternatives
- Tip -- alternative data flows often accompany processes with IF statements

Process Descriptions

- Text-based process descriptions provide more information about the process than the DFD alone
- CASE tools enable easy creation of descriptions
- If the logic underlying the process is quite complex, more detail may be needed in the form of:
  - Structured English
  - Decision trees
  - Decision tables

CASE Entry of Process Description



Entry Description

Name:	Process BB-3
Entry Type:	Process
Process #:	2.3
Short Description:	This process calculates Result1 and provides Result1 to process 3, or calculates Result2 and provides Result2 to process 2.4

Process Description:	Receive data flow K from process 2.2
	Using data flow K, retrieve correct record (data flow Q) from data store D2
	If record meets all selection criteria,
	Compute Result1
	Provide Result1 to process 3 as data flow E
	Else
	Compute Result2
	Provide Result2 to process 2.4 as data flow L
	EndIf

Notes:	Detailed calculations for Result1 and Result2 will be provided by Jeff Essex in the Marketing Dept.

Save | Clear | Copy | Previous | Next | Exit

Your Turn

- At this point in the process it is easy to lose track of the “big picture”.
- Describe the contribution of data flows, data stores, and processes to a process model.
- Describe in your own words the relationship between the DFDs and the ultimate new application being developed.

Creating Data Flow Diagrams

HOW DFDS ARE DEVELOPED

Steps in Building DFDs (1 of 2)

- Build the context diagram
  - Identify the external entities and the major inflows they supply and the outflows they receive
- Identify all major processes encompassed by the Context Diagram
  - Each major event / use case is “handled” by a process
- Create DFD “fragments” for each event / use case
  - Each DFD fragment is a mini-diagram showing the process and the external entities and data stores with which it interacts.

Steps in Building DFDs (2 of 2)

- Organize DFD fragments into level 0 diagram
- Decompose each level 0 process into a level 1 diagram; decompose level 1 processes into level 2 diagrams as needed; etc.
- Validate DFDs with user to ensure completeness and correctness

Integrating Use Cases

- DFDs start with events, use cases and the requirements definition
- The DFDs often flow directly from the use cases
  - Names of use cases become major processes on the Level 0 diagram
  - Steps in the use case become processes on the Level 1 diagram
  - Inputs and outputs become data flows on the Level 1 diagram (and below)

Illustration – Developing DFDs (1 of 6)

Creating the Context Diagram

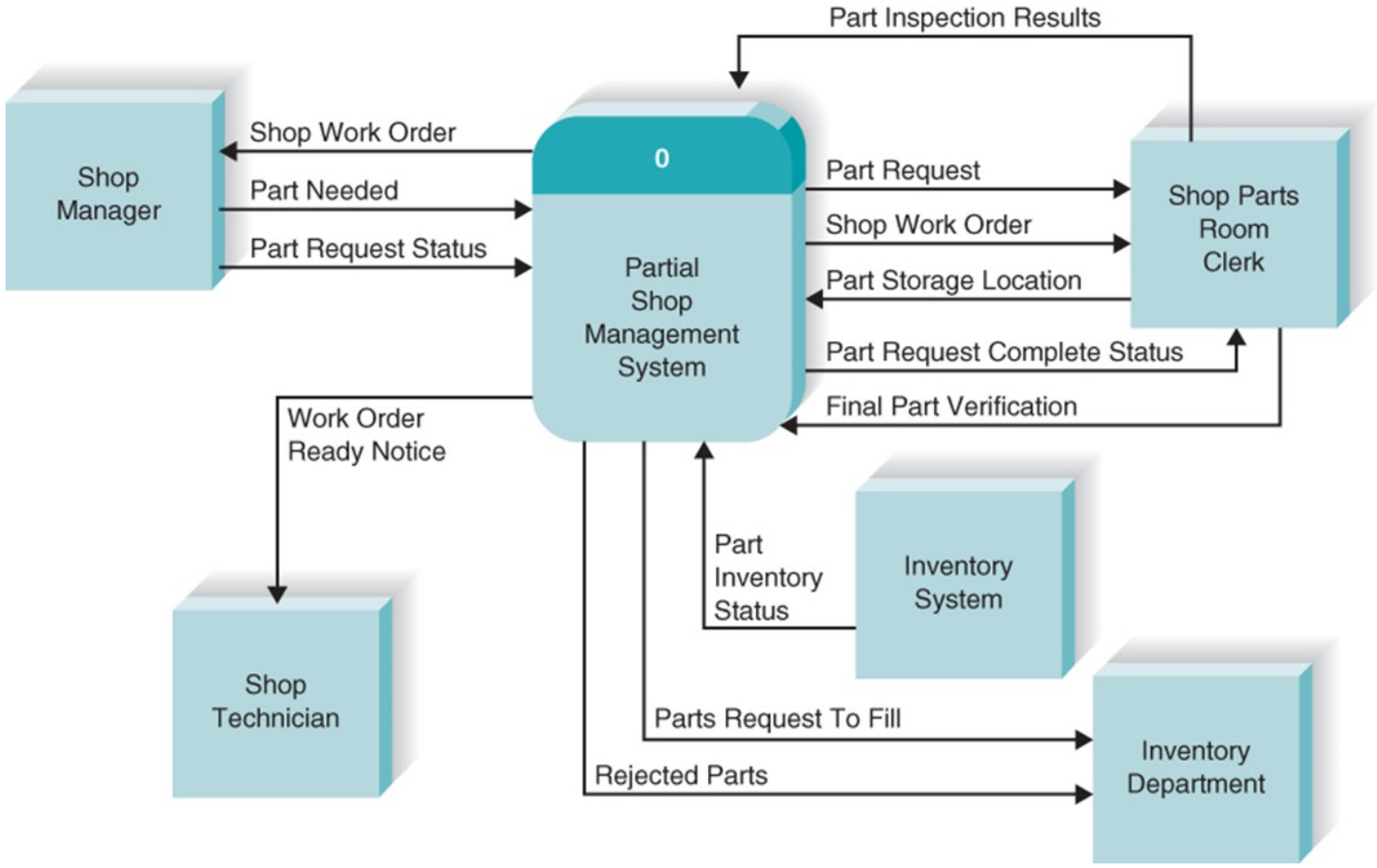


Illustration – Developing DFDs (2 of 6)

Create a DFD "fragment" based on a use case

Use Case Name: Create Parts Request	**ID:** UC-3	**Priority:** High
Actor: Shop Manager		
Description: This use case describes how the Shop Manager creates a Parts Request		
Trigger: Shop Manager receives notice of new shop work order arrival from Sales System		
Type: ☑ External ☐ Temporal		

Summary Inputs	Source	Summary Outputs	Destination
Part ID and quantity Part inventory status Part request status Shop work order	Shop manager Inventory System Shop manager Shop work order data store	Shop work order New part request record Parts Request to fill	Shop manager Parts Request datastore Inventory department

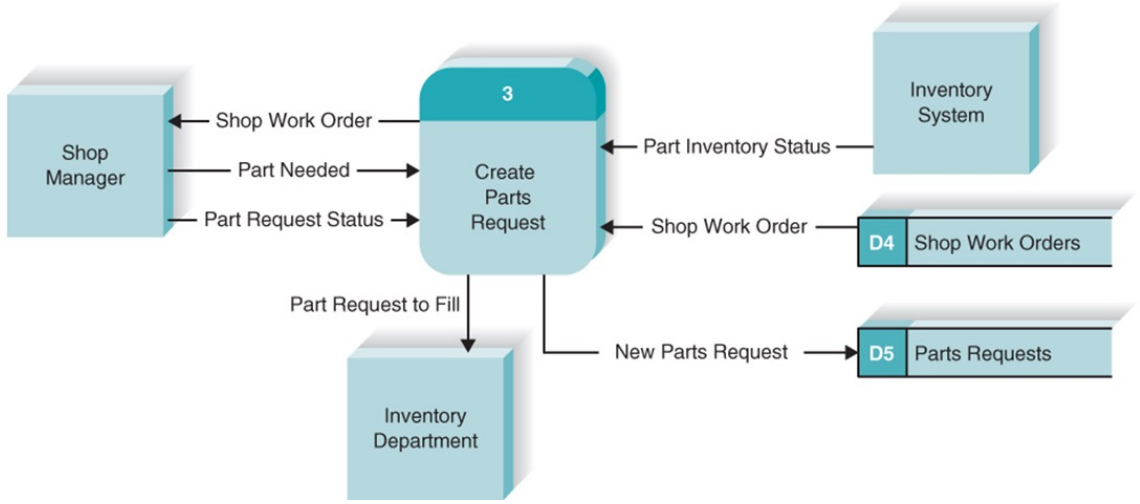


Illustration – Developing DFDs (3 of 6)

Merge DFD "fragment" diagrams into the Level 0 diagram

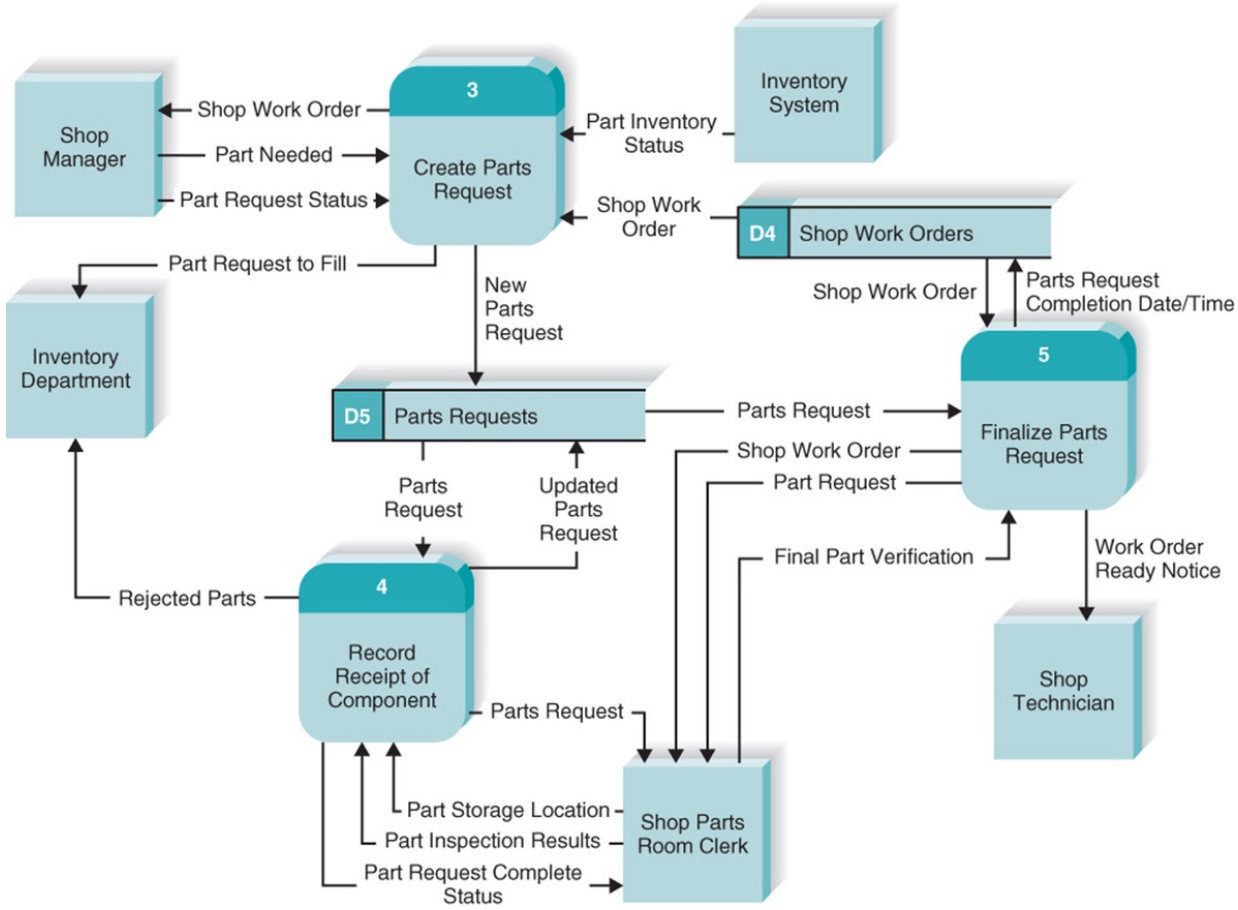


Illustration – Developing DFDs (4 of 6)

Develop Level 1 diagrams for every process on the Level 0 diagram

- Level 1 – Process 3: Create Parts Request

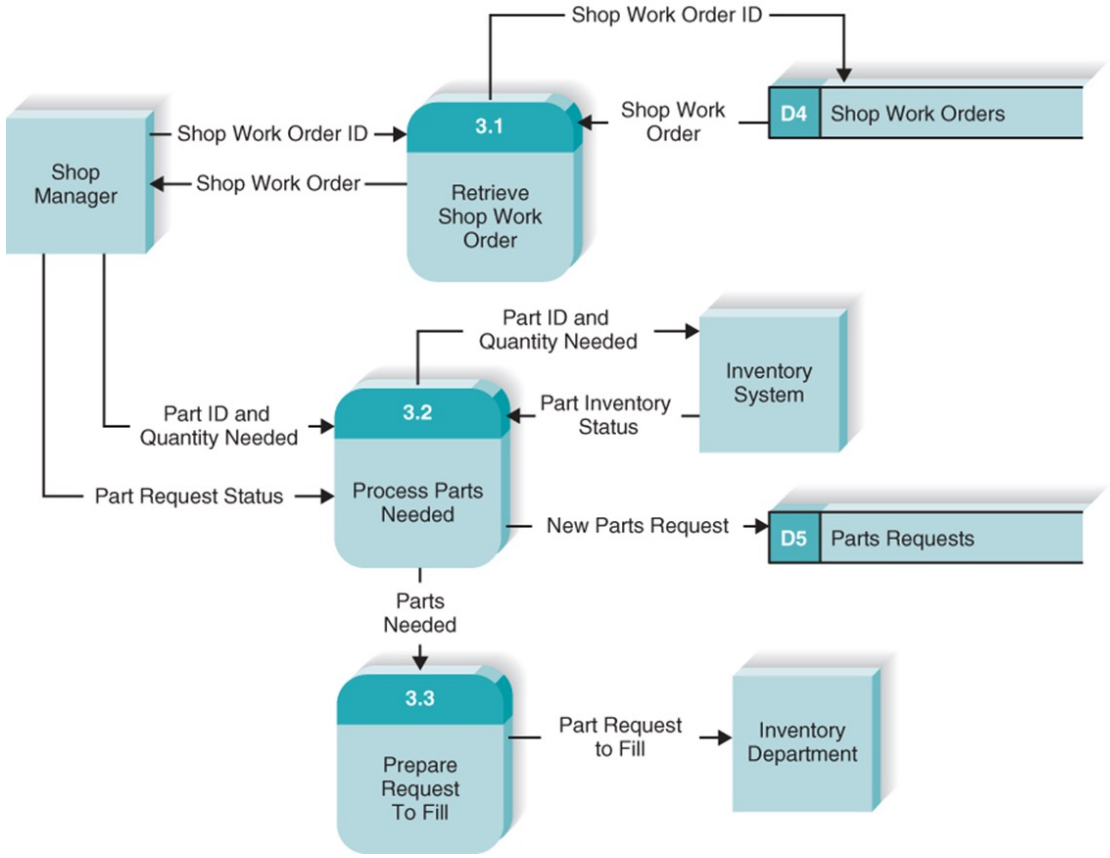


Illustration – Developing DFDs (5 of 6)

Develop Level 1 diagrams for every process on the Level 0 diagram

- Level 1 – Process 4: Record Receipt of Components

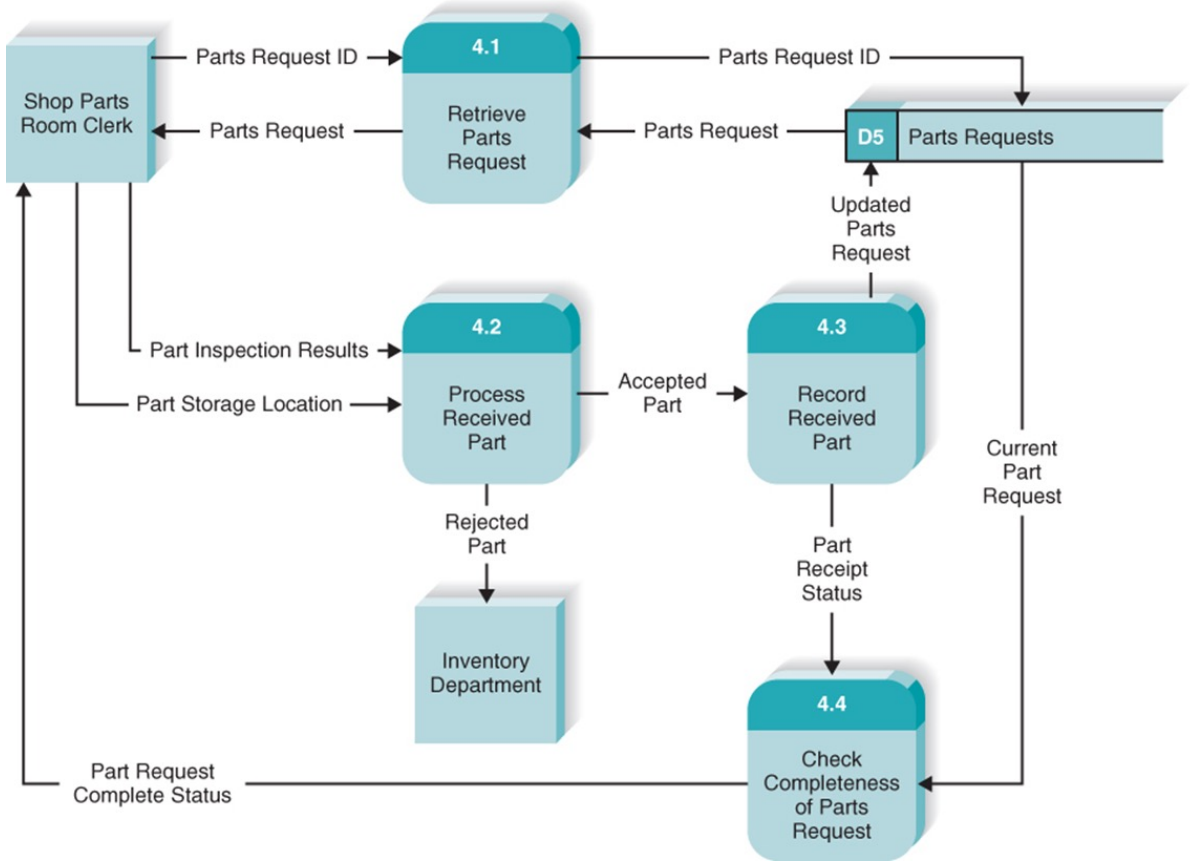
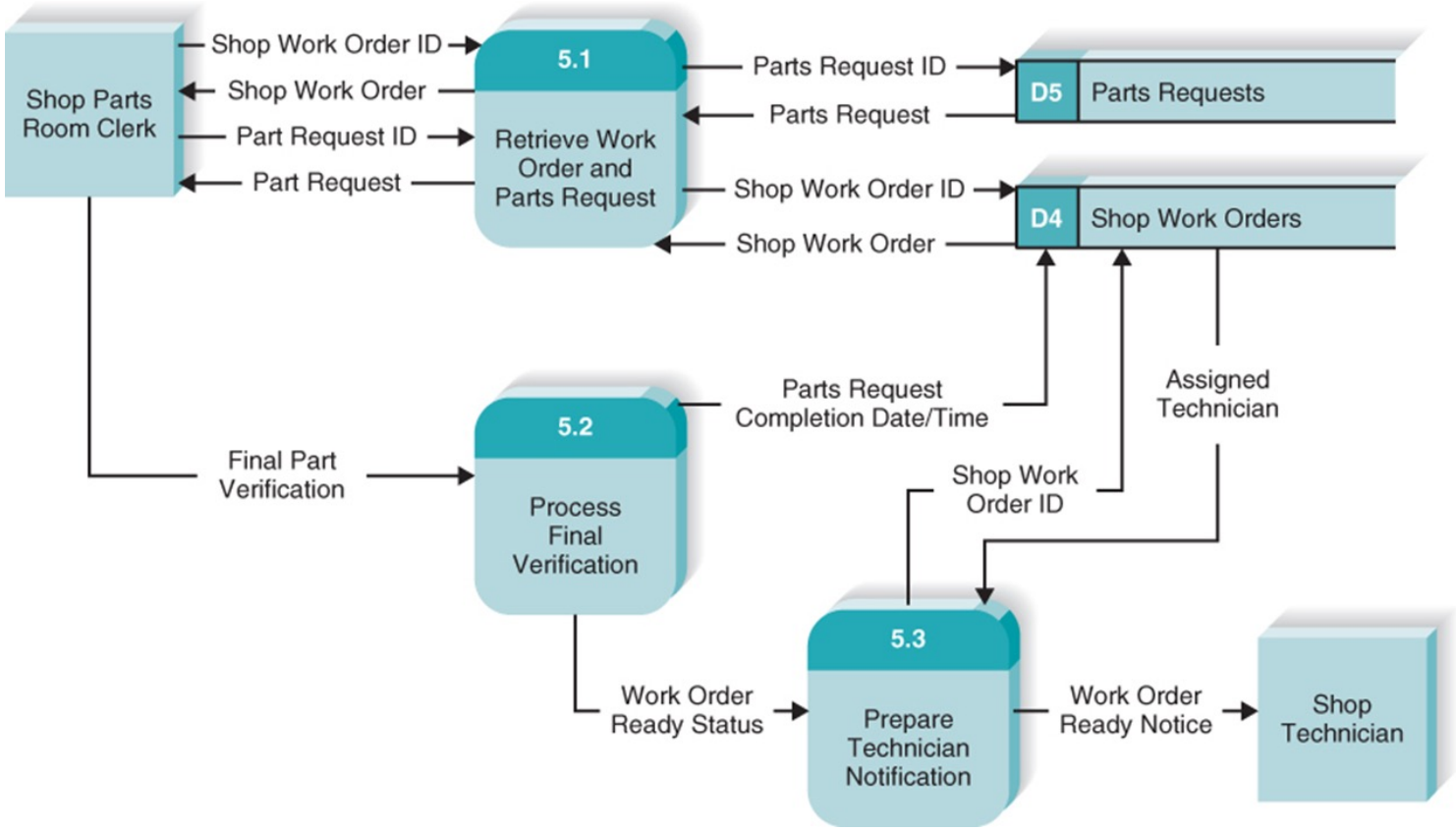


Illustration – Developing DFDs (6 of 6)

Develop Level 1 diagrams for every process on the Level 0 diagram

- Level 1 – Process 5: Finalize Parts Request



Evaluate DFDs for Quality (1 of 2)

Syntax

Within DFD	
Process	• Every process has a unique name that is an action-oriented verb phrase, a number, and a description. • Every process has at least one input data flow. • Every process has at least one output data flow. • Output data flows usually have different names than input data flows because the process changes the input into a different output in some way. • There are between three and seven processes per DFD.
Data Flow	• Every data flow has a unique name that is a noun, and a description. • Every data flow connects to at least one process. • Data flows only in one direction (no two-headed arrows). • A minimum number of data flow lines cross.
Data Store	• Every data store has a unique name that is a noun, and a description. • Every data store has at least one input data flow (which means to add new data or change existing data in the data store) on some page of the process model. • Every data store has at least one output data flow (which means to read data from the data store) on some page of the process model.
External Entity	• Every external entity has a unique name that is a noun, and a description. • Every external entity has at least one input or output data flow.

Evaluate DFDs for Quality (2 of 2)

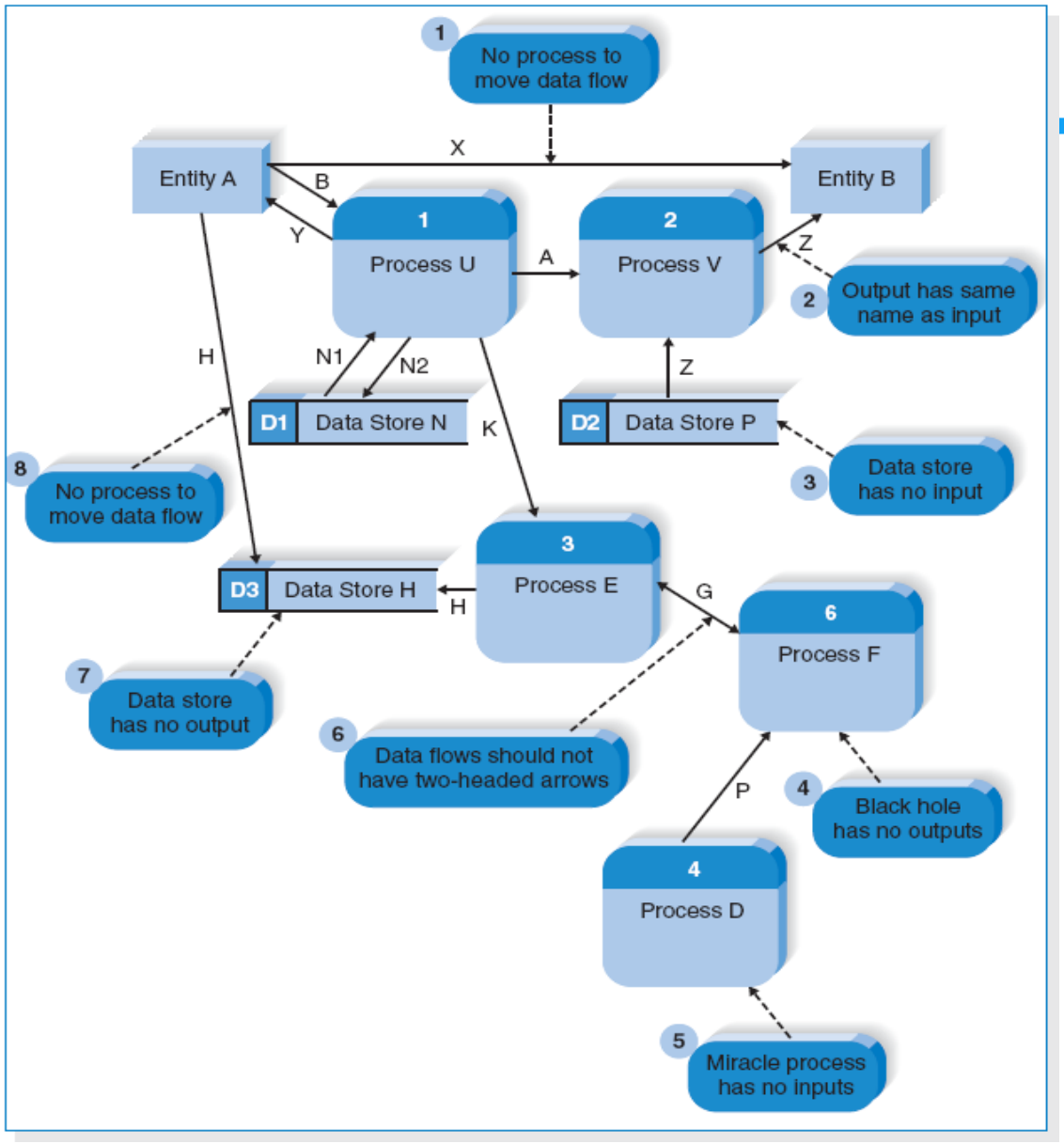
Across DFDs	
Context diagram	• Every set of DFDs must have one context diagram.
Viewpoint	• There is a consistent viewpoint for the entire set of DFDs.
Decomposition	• Every process is wholly and completely described by the processes on its children DFDs.
Balance	• Every data flow, data store, and external entity on a higher level DFD is shown on the lower-level DFD that decomposes it.
Semantics	
Appropriate Representation	• User validation • Role-play processes
Consistent Decomposition	• Examine lowest-level DFDs
Consistent Terminology	• Examine names carefully

Common DFD Errors

- Syntax errors – violating “drawing” rules
  - Every data flow must connect to a process.
  - Every process must have at least one inflow and one outflow.
- Semantics errors – errors in the meaning of the diagrams
  - Walk-through diagrams with users
  - Verify that inputs shown are logically sufficient to produce the outputs
  - Check for consistent levels of decomposition
  - Check for consistent use of terminology

(cont'd)

Common Syntax Errors



After reading and studying this chapter, you should be able to: (1 of 2)

- Define the meaning and purpose of the four basic symbols found on a data flow diagram.
- Explain the meaning and purpose of a process model's context diagram.
- Explain the meaning and purpose of a process model's level 0 diagram.
- Explain the meaning and purpose of a process model's level 1 diagrams

After reading and studying this chapter, you should be able to: (2 of 2)

- Explain the concept of decomposition and why process models are created as a hierarchy of DFDs.
- Describe several common syntax and semantic errors found on DFDs.
- Discuss the process used to create a process model.
- Discuss how the process model contributes to the development of the new information system.

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