FIT2090
BUSINESS INFORMATION SYSTEMS AND PROCESSES

Lecture 3: Business Process Design and Data Flow Diagrams

CLAYTON, FACULTY OF INFORMATION TECHNOLOGY

MONASH UNIVERSITY

Ulric J. Gelinas, Richard B. Dull, and Patrick R. Wheeler, Accounting Information Systems 9e, South-Western Cengage Learning, 2012: Chapter 4

Laguna M & Marklund J, Business Process Modelling, Simulation and Design, 2nd Edition, CRC Press

GROUP OF EIGHT AUSTRALIA

Objectives

On completion of this lecture, you will :
- Define the terms processes and business processes
- Understand the need for designing, managing and monitoring business processes
- Discuss business process benchmarking as a technique for evaluating a firm's business process performance
- Read and evaluate data flow diagrams
- Prepare table of entities and activities
- Prepare context diagrams
- Prepare data flow diagrams from a narrative

Why should we study/understand – business process design and data flow diagrams

- The process oriented view enables value creation for firms

- Even though business process (re)design is a creative activity, use of appropriate tools can assist the business analyst.

- Preparing and using process documentation is an important skill for a business analyst.

- Data flow diagrams portray a business process activities, stores of data, and flows of data among those elements.

What is a Process?

Traditional Process definition

A process specifies the transformation of inputs to outputs

Inputs → **Process** → Outputs
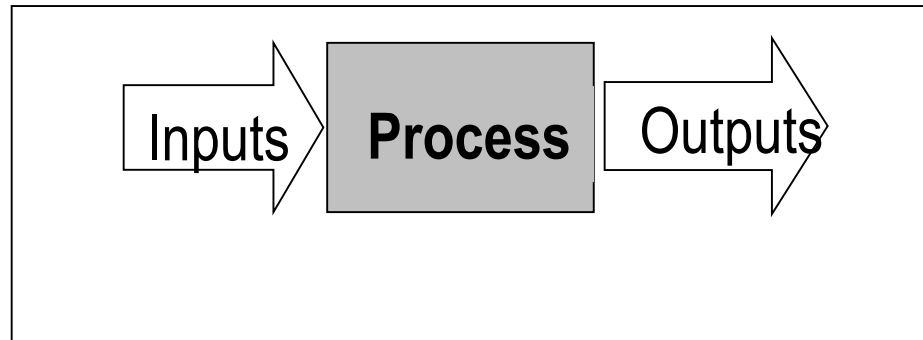
The transformation model of a process

Different types of transformations

- Physical (*Ex. raw material $\Rightarrow$ finished product*)
- Locational (*Ex. flying from Melbourne to Sydney*)
- Transactional (*Ex. depositing money in a bank*)
- Informational (*Ex. accounting data $\Rightarrow$ financial statement*)

What is a Business Process?

- A pragmatic definition

A Business Process describes how something is done in an organization

What is a Business Process?

A more comprehensive process definition

A business process is a network of connected activities and buffers with well defined boundaries and precedence relationships, which utilize resources to transform inputs into outputs with the purpose of satisfying customer requirements
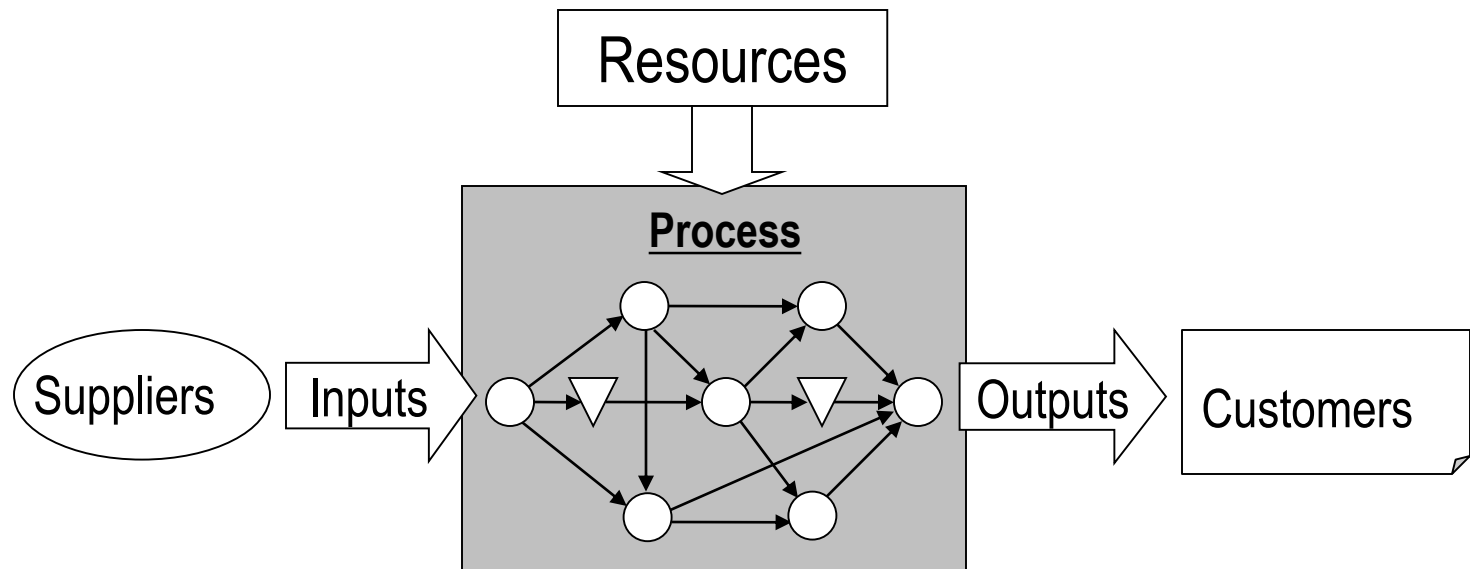
Process Types and Hierarchies

1. Individual processes
    – Carried out by a single individual

   Make up

2. Vertical or Functional processes
    – Contained within one functional unit or department

   Make up

3. Horizontal or Cross Functional processes
    – Spans several functional units, departments or companies

Process Types and Hierarchies (cont'd)

Core cross-functional processes often have highest improvement potential
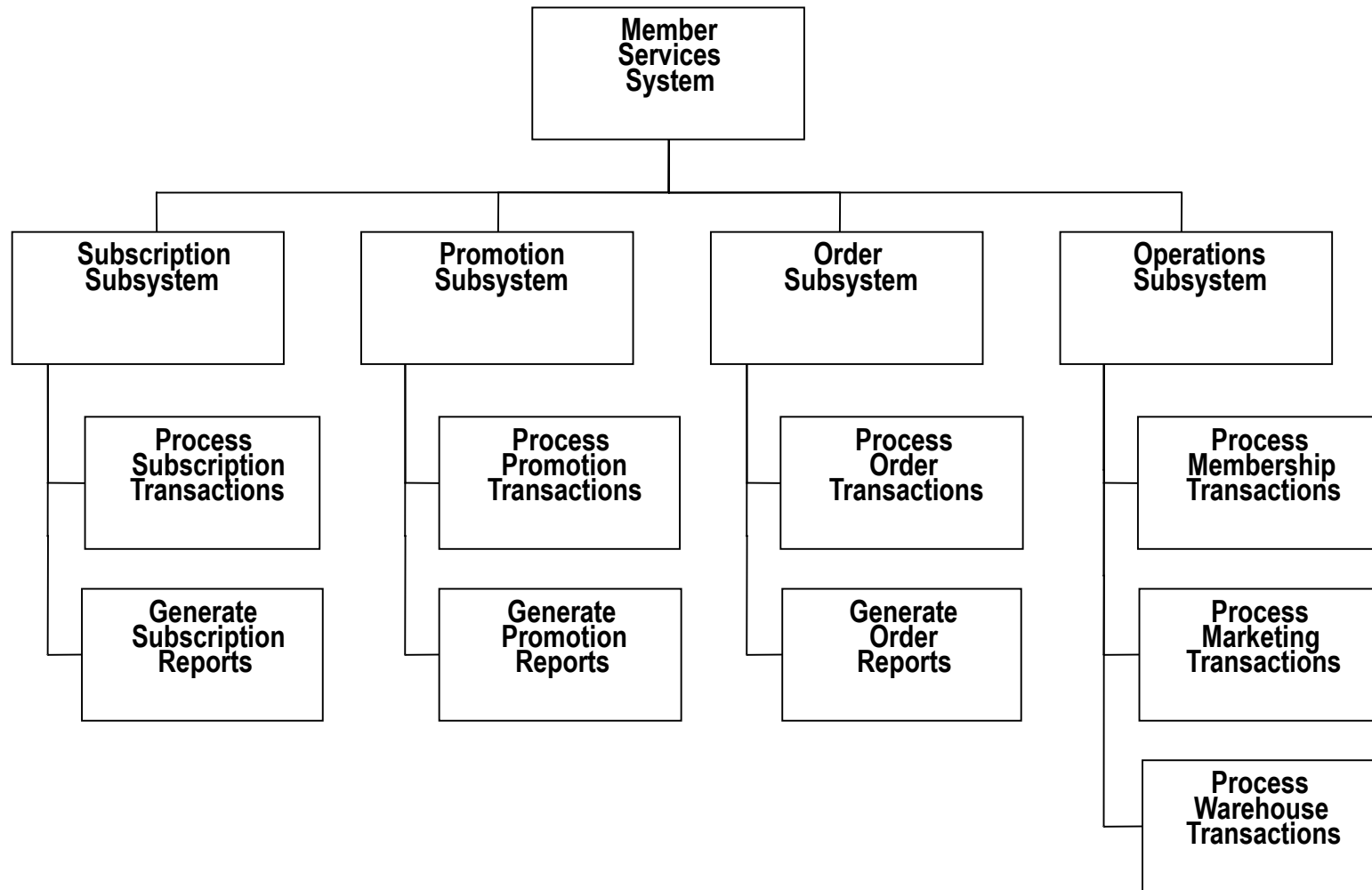
- Especially high improvement potential if there is a significant amount of non-manufacturing/service related activities

- Reasons
    - Difficult to coordinate
    - Have not kept up with improvements in manufacturing/production
    - Difficult to detect waste and inefficiencies
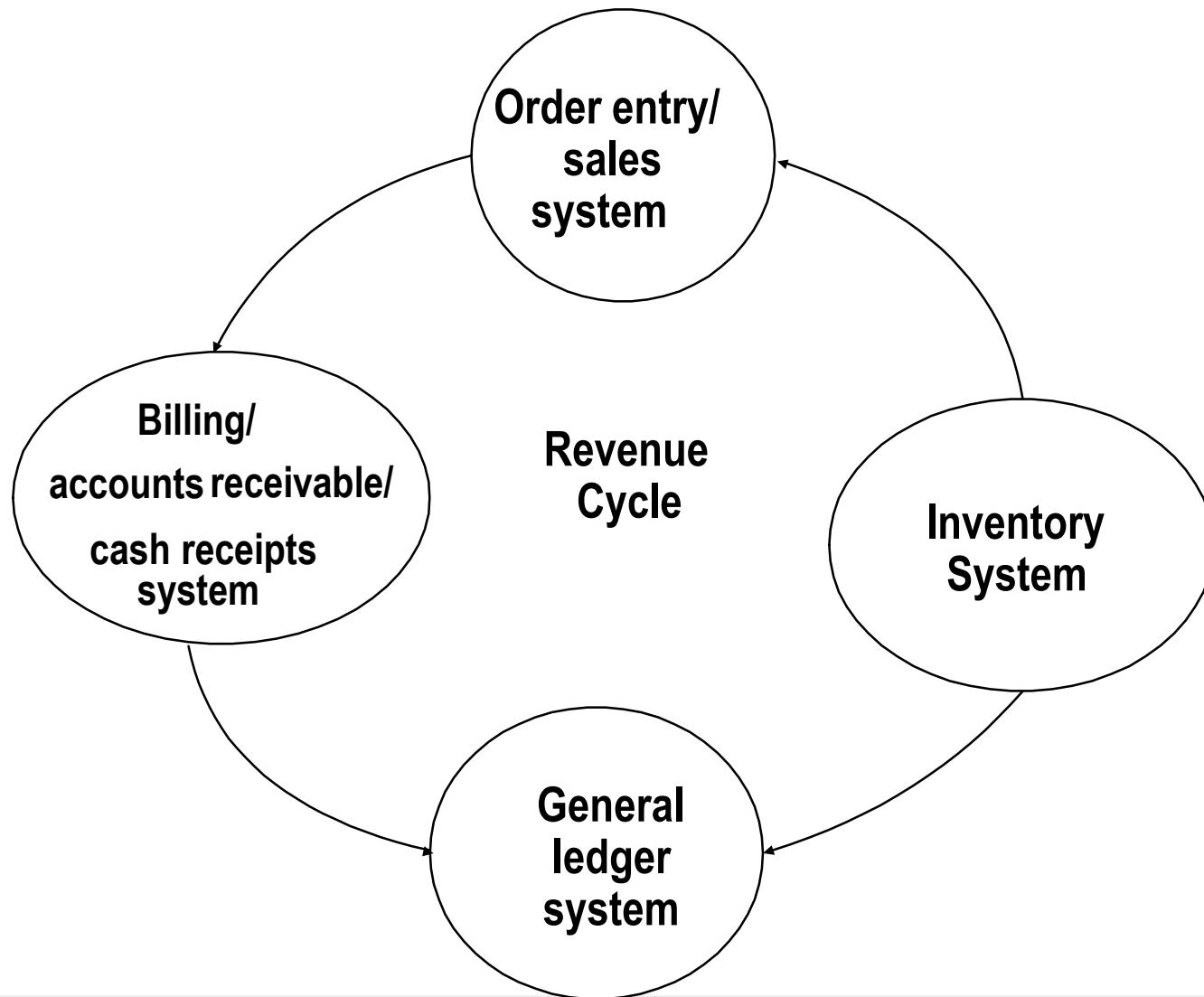   - Often as little as 5% of the time considered adding customer value

Examples of business processes

- It is easier to identify production and manufacturing processes
- The following are also business processes
  - Accounts payable and receivable
  - Admissions (hospitals, universities)
  - Billing
  - Credit approval
  - Inventory management
  - Order fulfillment
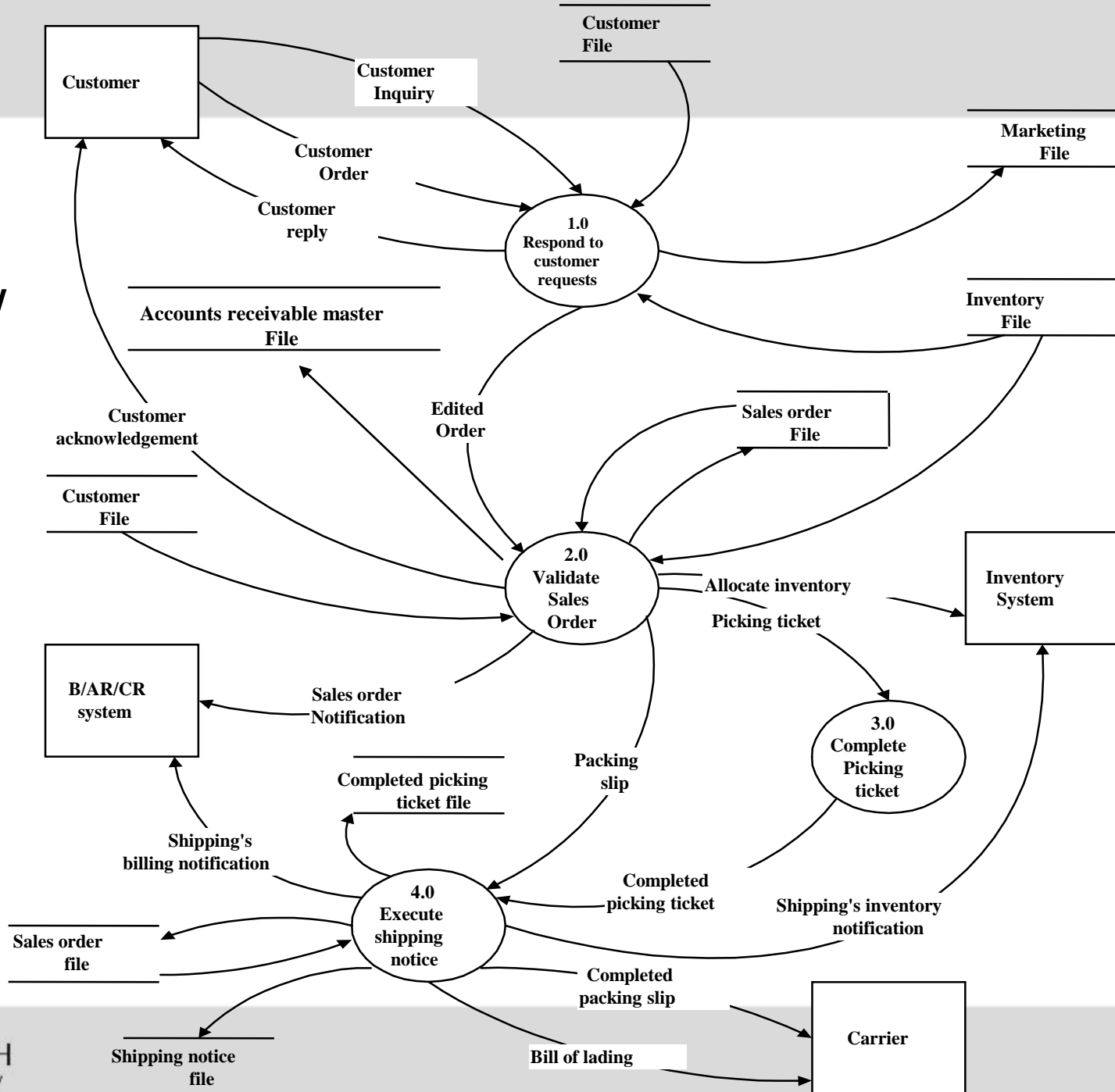 - Product development
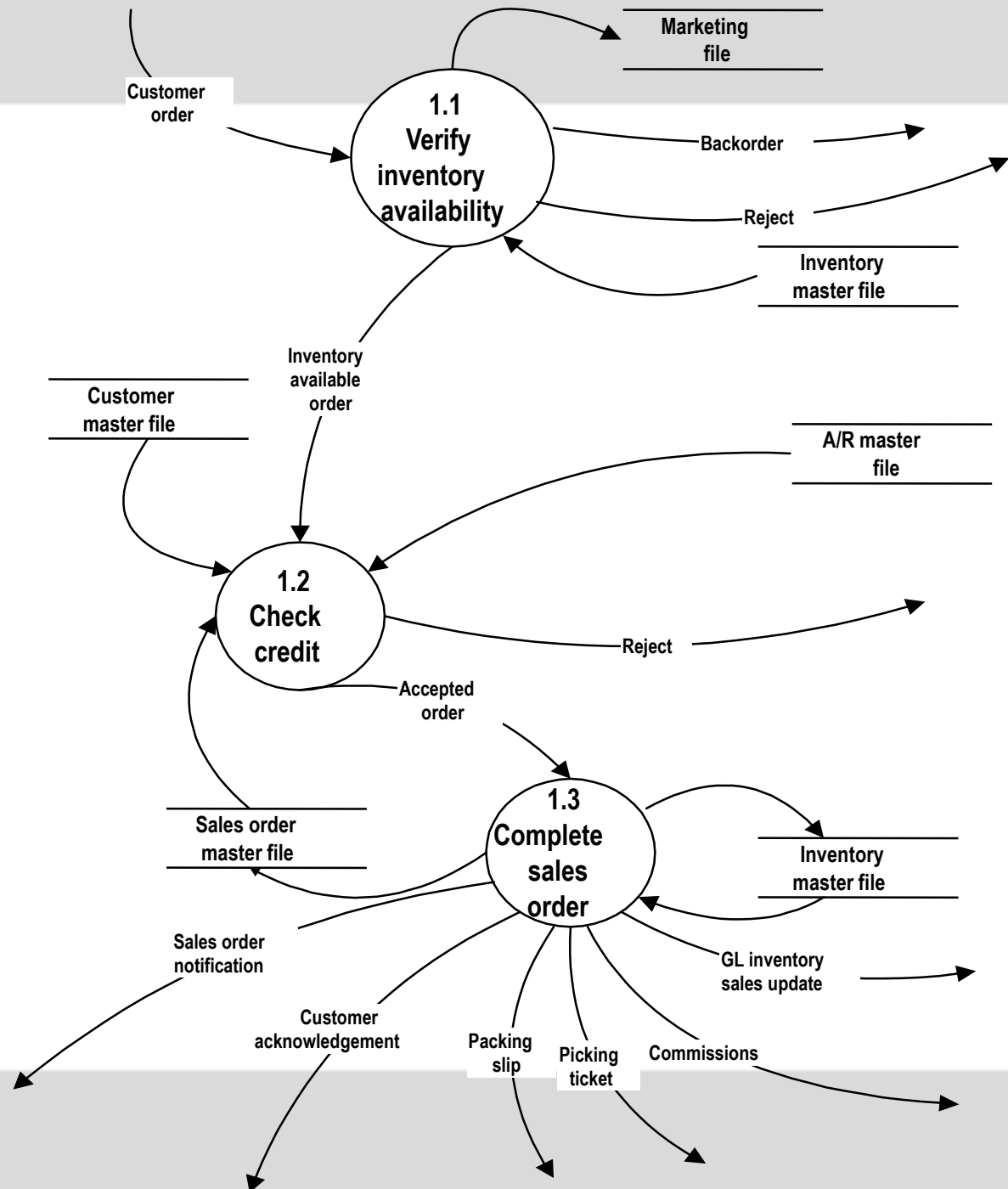 - Shipping

Process Hierarchies

Examples of business processes - Revenue Cycle (merchandising)

Order Entry Sales Systems Level 0 DFD

Customer File

Customer

Customer Inquiry

Marketing File

Customer Order

Customer reply

1.0 Respond to customer requests

Inventory File

Accounts receivable master File

Edited Order

Sales order File

Customer acknowledgement

Customer File

2.0 Validate Sales Order

Inventory System

Allocate inventory

Picking ticket

B/AR/CR system

Sales order Notification

Packing slip

3.0 Complete Picking ticket

Completed picking ticket file

Shipping's billing notification

4.0 Execute shipping notice

Completed picking ticket

Shipping's inventory notification

Sales order file

Completed packing slip

Shipping notice file

Bill of lading

Carrier

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Order Entry Sales System Level 1 DFD

Customer order

1.1 Verify inventory availability

Marketing file

Backorder

Reject

Inventory master file

Customer master file

Inventory available order

A/R master file

1.2 Check credit

Reject

Accepted order

Sales order master file

1.3 Complete sales order

Inventory master file

Sales order notification

GL inventory sales update

Customer acknowledgement

Packing slip

Picking ticket

Commissions

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Workflow Management

Definitions

- A workflow management system (WFMS) is a software package that can be used to support the definition, management and execution of workflow processes.

- A workflow system (WFS) is a system based on a WFMS that supports a specific set of business processes through the execution of computerized process definitions

Goal

- To manage the flow of work such that the work is done at the right time by the proper person.

Workflow

- The automation of a business process, in whole or part, during which documents, information or tasks are passed from one participant to another for action, according to a set of procedural rules.
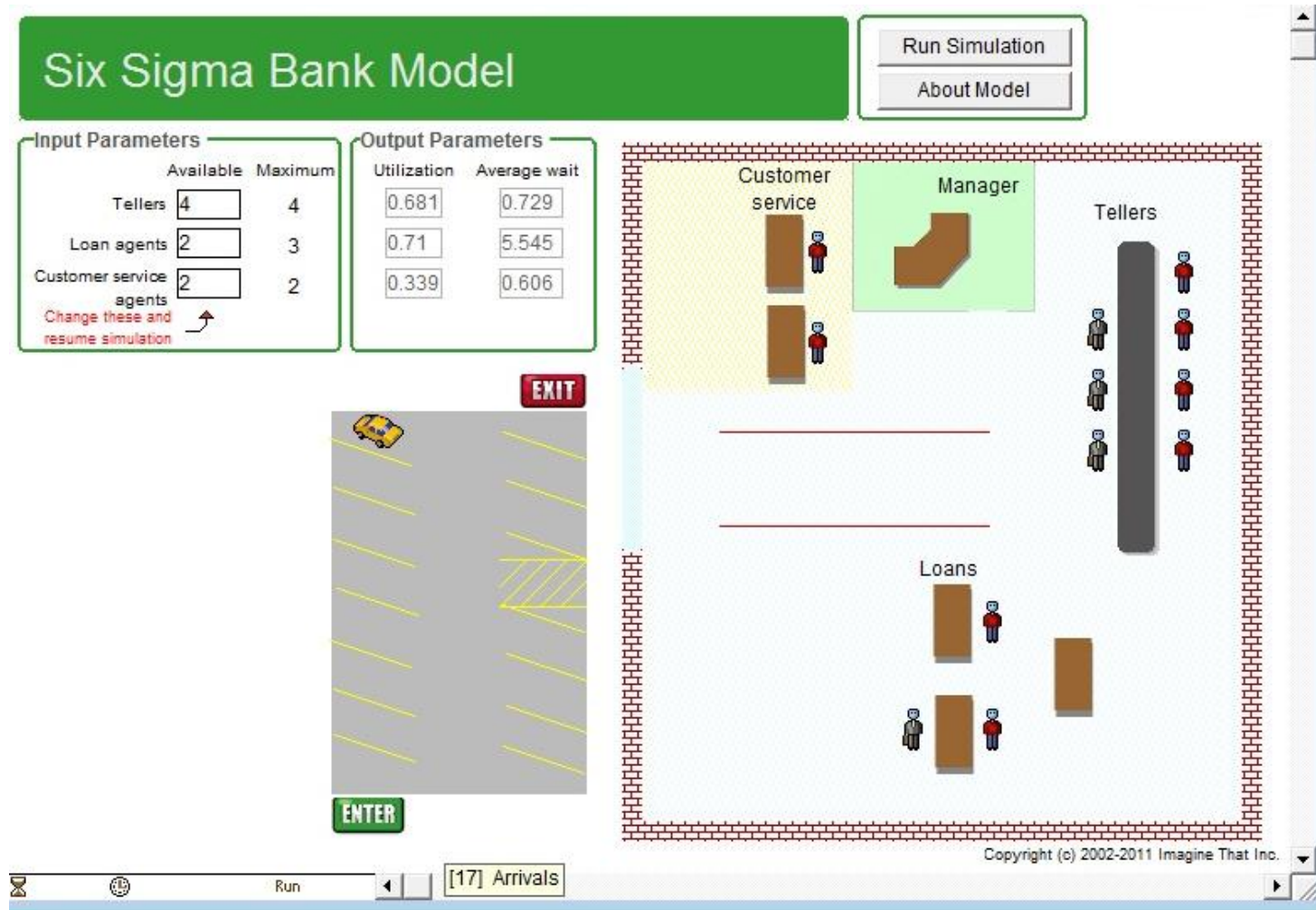
Modelling Processes and Workflow

Operational process

Information System
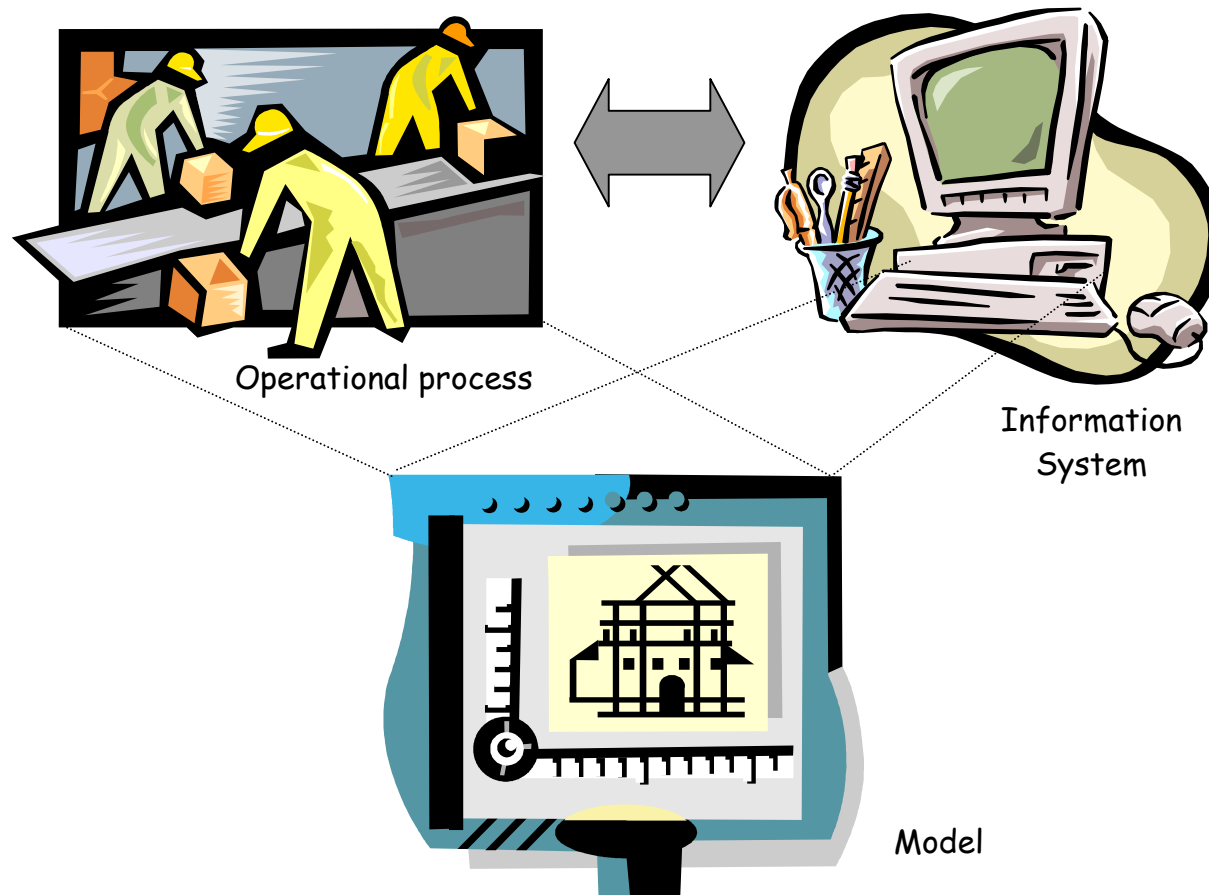
Model

Modelling Processes and Workflow - A visual example
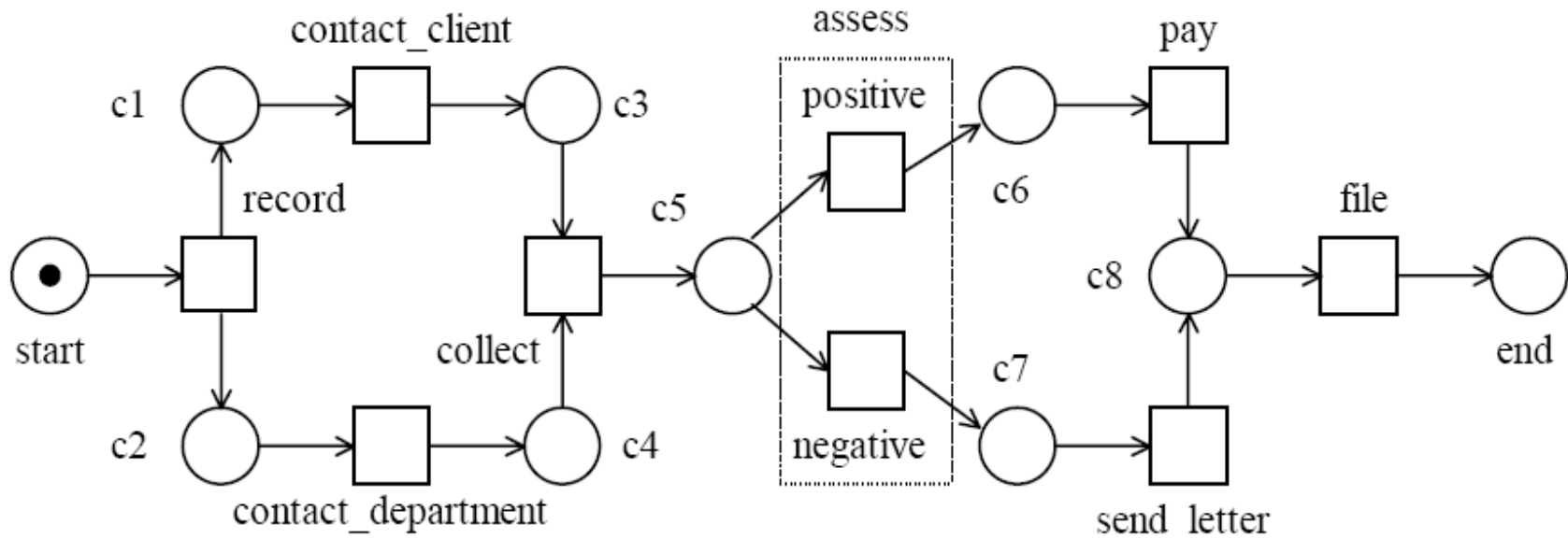
The process 'handle complaint' modeled as a Petri net

There are many other tools for modelling processes – e.g. Flowcharts

Simulating Processes and Workflow - A visual example


Screen shot from a simulation of customers entering and leaving a bank

ExtendSim s/w

Creative Process Design (I)

- Designing new processes is more of an art than a science
  - Cannot be achieved through a formalized method

- Most existing processes were not designed; they just emerged as new parts were added iteratively to satisfy immediate needs

- The end result of any design is very much dependent on the order in which information becomes available
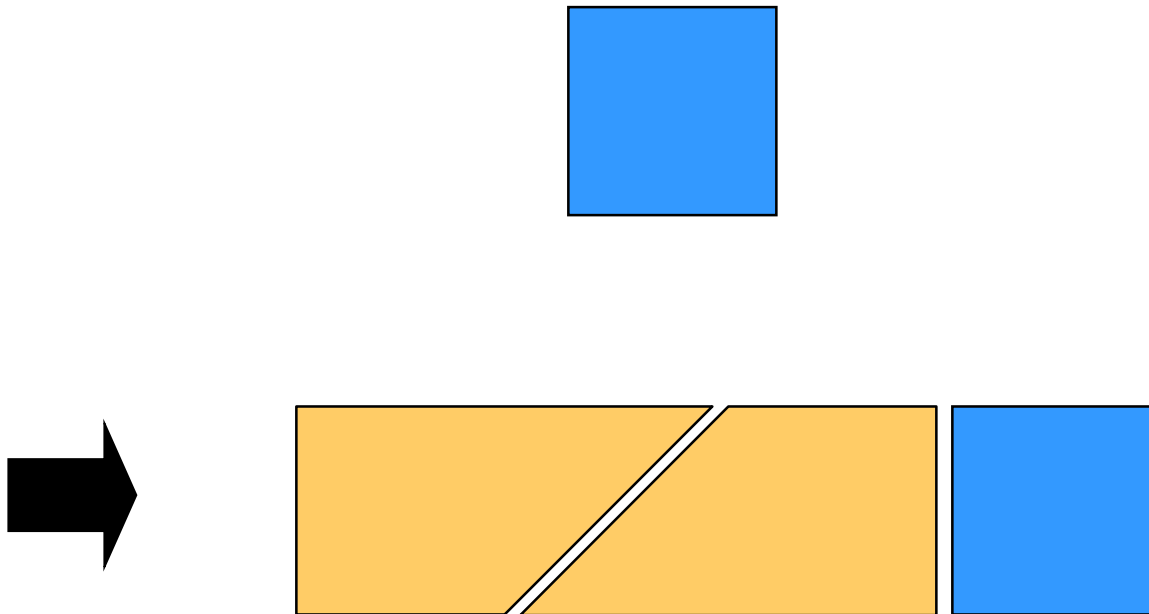 - Inefficient processes are created when iterative design methods are applied
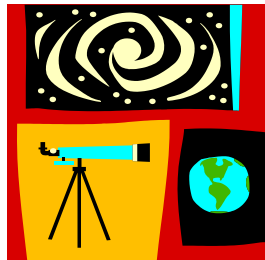
Illustration Process Evolution (I)

- Two pieces of plastic are given to you with instructions to arrange them in an easily described shape
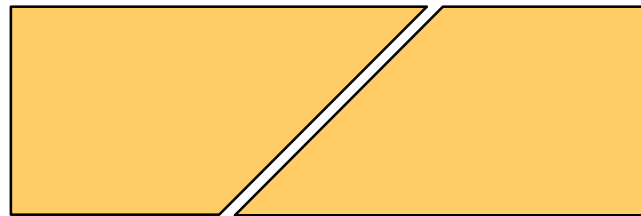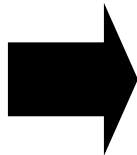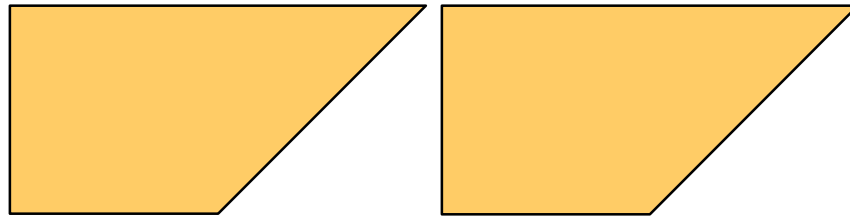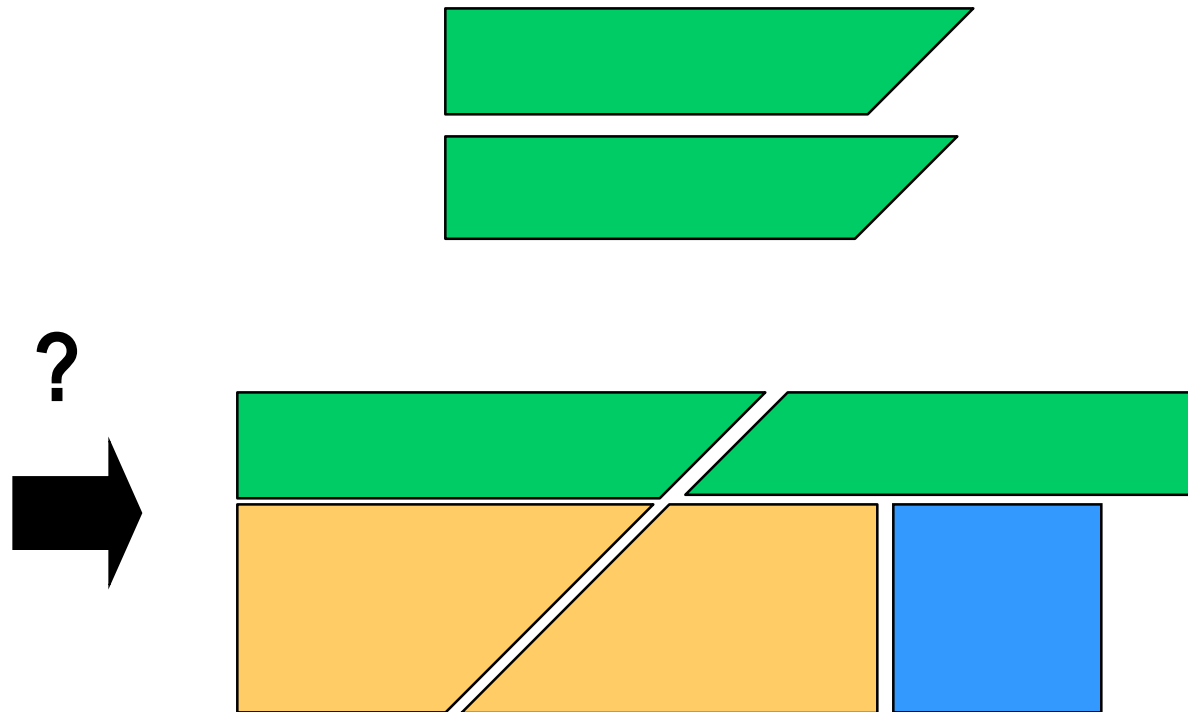
Illustration Process Evolution (II)

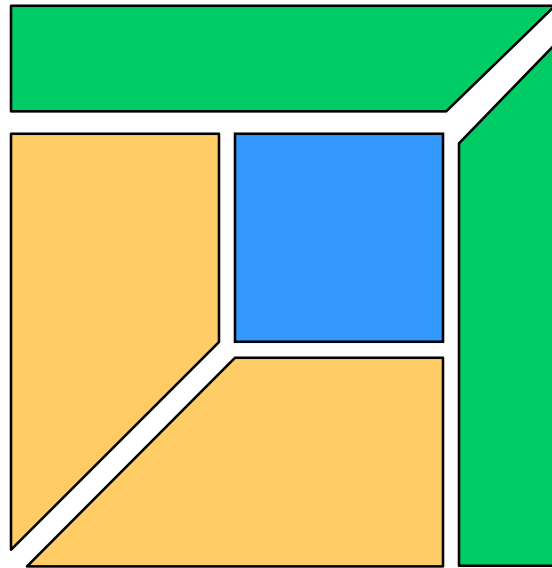- Then a third piece is added still the objective is to build a simple shape

Illustration Process Evolution (III)

- Two more pieces are added, but very few people are able to incorporate these and still obtain a simple shape

Illustration Process Evolution (IV)

Considering the pieces independently of the sequence by which they appear leads to a much better solution!

Benchmarking

- Comparing the firm's/process's activities and performance with what others are doing
  - In the same company, in the same industry or across industries
- Every benchmarking relationship involves two parties
  - The initiator firm – who initiates contact and observes (the pupil)
  - The target firm (or benchmark) – who is being observed (the master)
- Fruitful benchmarking relationships are usually characterized by reciprocity
- Two basic benchmarking purposes
  - To assess the firm's/process's performance relative to the competition $\Rightarrow$ identify performance gaps and goals
  - To stimulate creativity and inspire innovative ideas for how to do things better, i.e. improve process designs & process performance
- For Business Process Design projects both purposes are relevant

Business Process Benchmarking (I)

- Focus on how things are done
  - Typically the most involved type of benchmarking
- The underlying idea is to learn and be inspired by the best
  - The best in a certain industry (best-in-class benchmark)
  - The best across industries (best-of-the-best benchmark)
- Generally, the further away from the firm's own industry that the design team goes
  - Higher potential for getting breakthrough design ideas
  - More difficult to identify and translate similarities between processes
- After choosing a target firm a good starting point for a business process benchmarking effort is the 5w2h framework (Robinson 1991)
  - Can also be used to understand an existing process to be redesigned

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Business Process Benchmarking (II)

The 5w2h framework

Classification	5w2h questions	Description
People	Who?	Who is performing the activity? Why is this person doing it? Could/Should someone else perform the activity?
Subject matter	What?	What is being done in this activity? Can the activity in question be eliminated?
Sequence	When?	When is the best time to perform this activity? Does it have to be done at a certain time?
Location	Where?	Where is this activity carried out? Does it have to be done at this location?
Purpose	Why?	Why is this activity needed? Clarify its purpose.
Method	How?	How is the activity carried out? Is this the best way or are there alternatives?
Cost	How much?	How much does it currently cost? What would be the tentative cost after improvement?

- https://www.youtube.com/watch?v=ZJvJfVBYza8
- Process improvement cycle times

- Benchmarking
- https://www.youtube.com/watch?v=rH01JsZB020
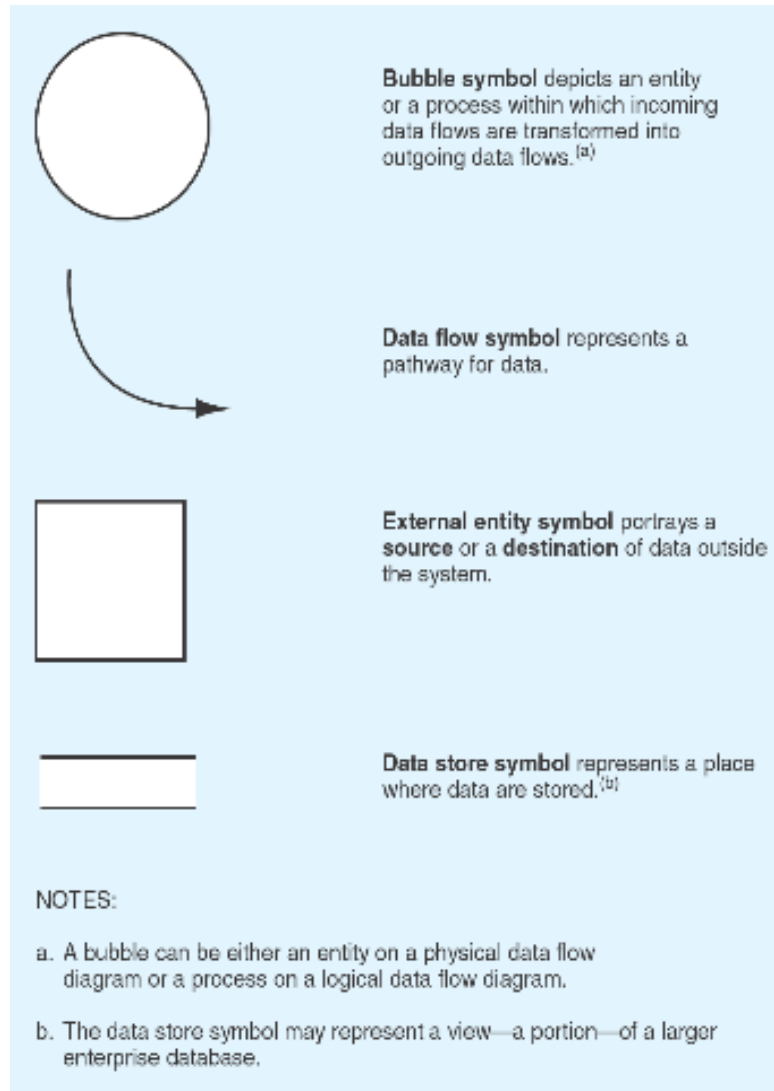
Data Flow Diagrams

- Data flow diagram: a graphical representation of a system that depicts the systems components; the data flows among the components; and the sources, destinations, and storage of data.

- Use a limited number of symbols.

- Do not depict management or operational elements of a system.

What are DFDs used for?

- A new (or part of an) implementation of a system
- A new (or part of a) business process reengineering project
- As part of the assessment of internal controls (e.g. for auditing purposes)

Basic DFD Symbols

- Movement of data among:
  - Entities (sources or destinations)
  - Processes
  - Data stores.
- Label should describe the information moving

Bubble symbol depicts an entity or a process within which incoming data flows are transformed into outgoing data flows. [a]

Data flow symbol represents a pathway for data.

External entity symbol portrays a **source** or a **destination** of data outside the system.

Data store symbol represents a place where data are stored. [b]

NOTES:

a. A bubble can be either an entity on a physical data flow diagram or a process on a logical data flow diagram.

b. The data store symbol may represent a view—a portion—of a larger enterprise database.
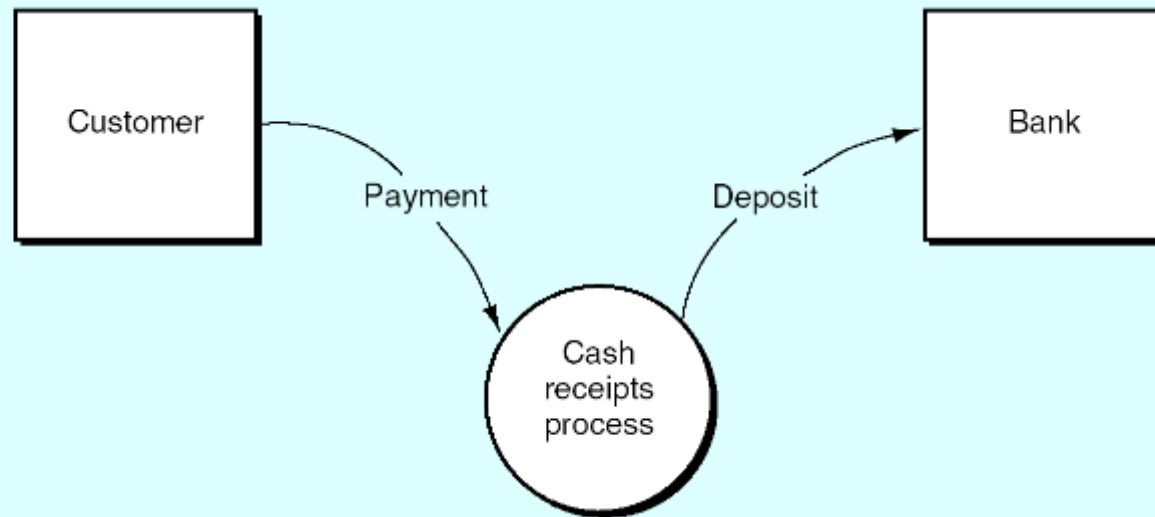
Data Flow Diagram Levels

- Context
  - Highest level (most general)
  - Purpose: show inputs and outputs into system
  - Characteristics: one process symbol only, no data stores.
- Level-0
  - Purpose: show all major activity steps of a system
  - Characteristics: processes are labeled 1.0, 2.0 and so on.
- Level-1
  - Purpose: show one major activity divided into sub-activities
  - Characteristics: processes are labeled 1.1, 1.2 and so on.

Context Diagram

- Context diagram
  - top-level, and less detailed, diagram of a system depicting the system and all its activities as a single bubble and showing the data flows into and out of the system and into and out of the external entities.
- External entities
  - those entities (i.e., persons, places, or things) outside the system that send data to, or receive data from, the system.
- Internal entities
  - those entities within the system that transform data
  - Includes, for example, accounting clerks (persons), departments (places), and computers (things)
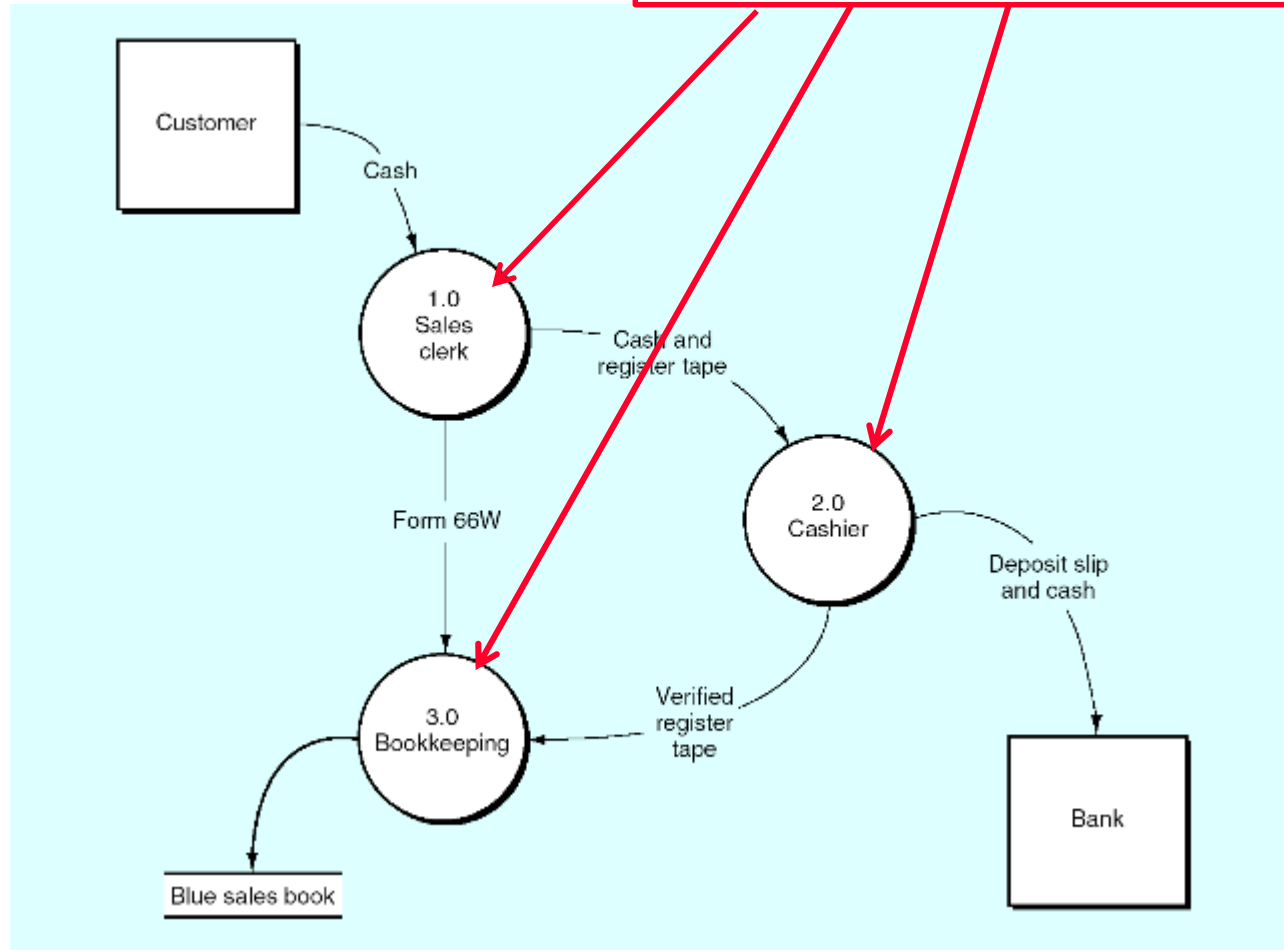
Context Diagram

Physical DFD

- Physical data flow diagram (DFD)
  - graphical representation of a system showing the system's internal and external entities, and the flows of data into and out of these entities.
- Specifies *where*, *how*, and by *whom* a system's processes are accomplished.
- Does not specify *what* is being accomplished.

Physical DFD

The bubbles represent physical entities, NOT processes

Customer

Cash

1.0
Sales clerk

Cash and register tape

Form 66W

2.0
Cashier

Deposit slip and cash

Verified register tape

3.0
Bookkeeping

Blue sales book

Bank

Exercise

A customer gives his purchase to a sales assistant who enters the sale in a cash register and puts the money in the register drawer. At the end of the day, the sales assistant gives the cash and the register tape to the cashier.

Describe the **who, what where** and **how** of the above scenario

Logical DFD

- Logical data flow diagram (DFD): graphical representation of a system showing the system's processes (as bubbles), data stores, and the flows of data into and out of the processes and data stores.

- Specifies *what* activities the system is performing, without specifying *how*, *where*, or by *whom* the activities are accomplished.

- Logical DFDs portray a system's activities. Physical DFDs depict a system's infrastructure.

Logical DFD

A Logical DFD (Level 0 Diagram)

The bubbles represent processes, NOT physical entities
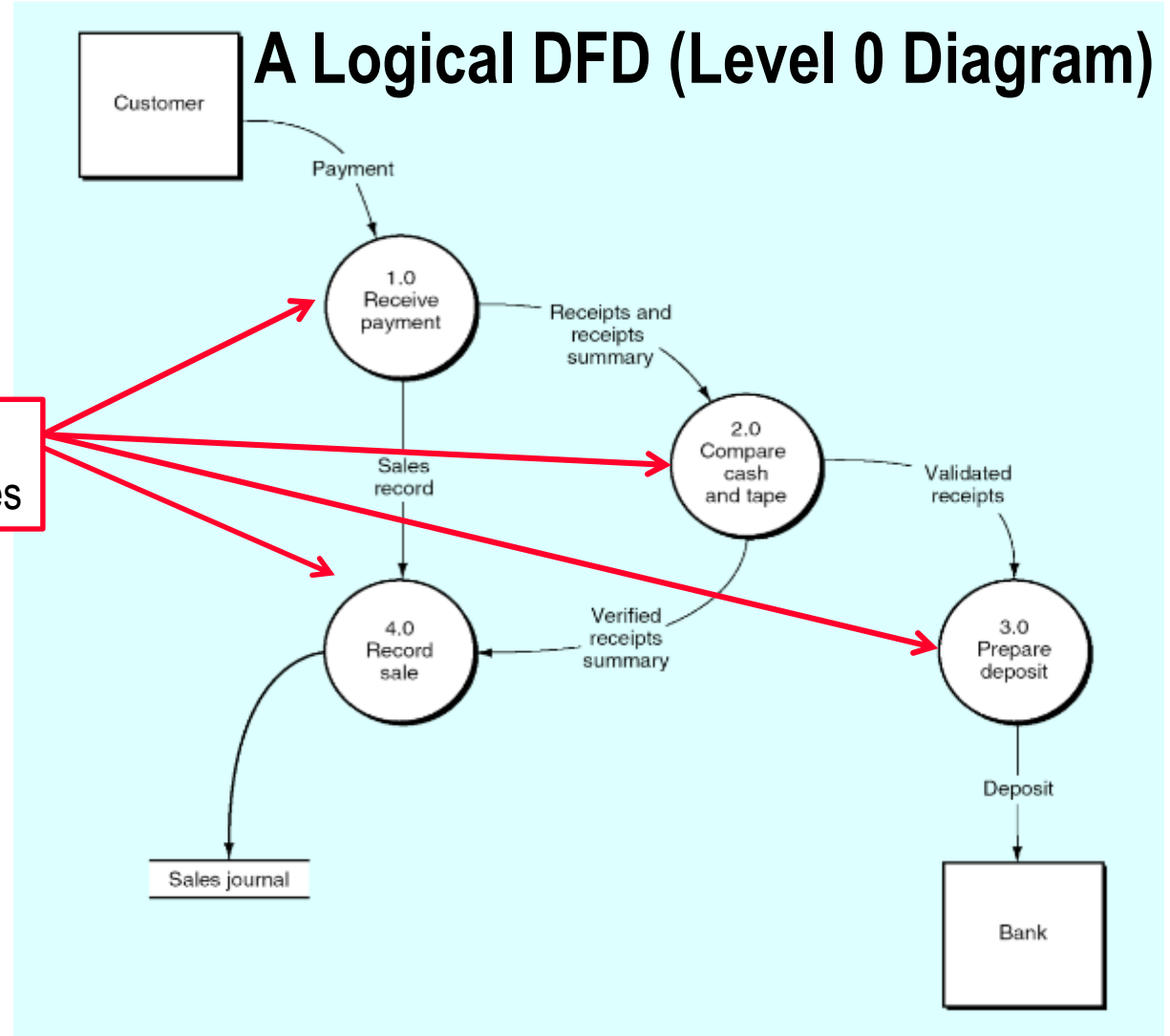
Balanced DFDs

- DFDs are balanced when the external data flows of two or more DFDs are equivalent.
- On the following slide
  - DFD (a) is a context diagram.
  - DFD (b) is an "explosion" of the context into a level 0 DFD.
  - DFDs (c) and (d) are explosions of level 0 bubbles 1.0 and 3.0. While DFD (e) is an explosion of bubble 3.1.
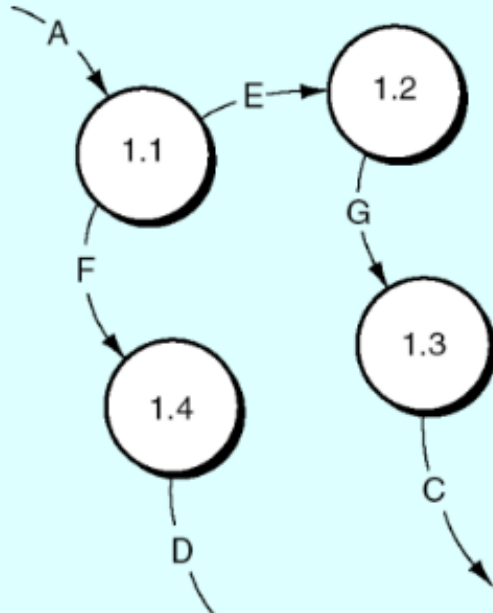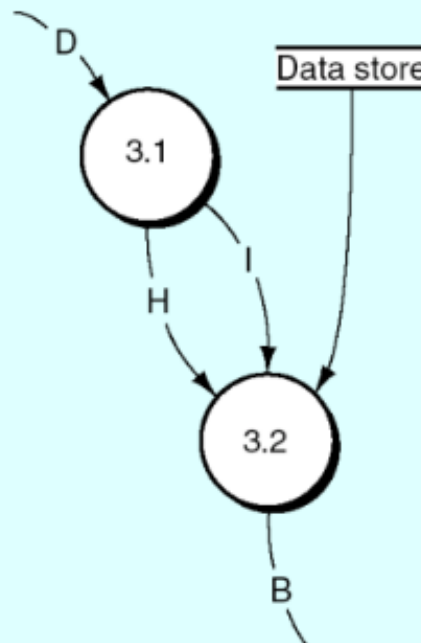
A Set of Balanced DFDs
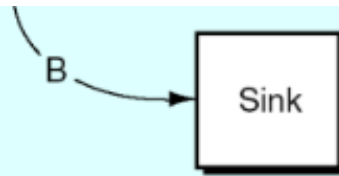
(a) The context diagram
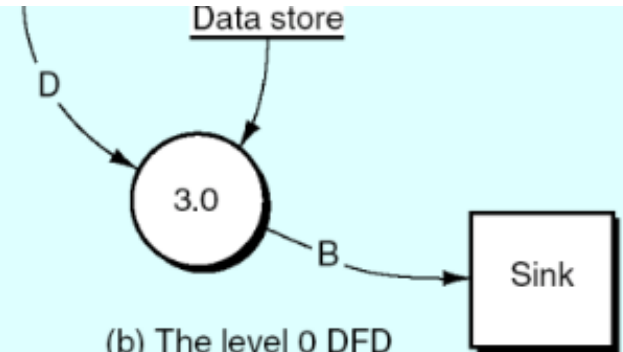
(b) The level 0 DFD

(c) Diagram 1.0

(d) Diagram 3.0

(e) Diagram 3.1

Ref: *Accounting Information Systems 9e*, Gelinas, Dull & Wheeler, pp. 109

Preparing Data Flow Diagrams

- Analyze narrative
  - Circle each activity

  - Place box on entities that perform activities

- Activity: any action being performed by an internal or external entity.
  - Actions related to data (send data, transform data, file or store data, retrieve data from storage, or receive data).

  - Operations process activities include picking goods in a warehouse, inspecting goods at a receiving dock, or counting cash.

An Example - Webster, Inc

Webster, Inc. sells plumbing supplies to contractors in the southern region of the United States. Each month, the IT division at Webster prints monthly statements and sends them to the accounts receivable (AR) department, where a clerk mails them to the customers.

Webster's customers mail their payments back to Webster, where a clerk in AR batches the cheques and sends them to the cashier. The AR clerk then uses the payment stub to enter the payments into the computer, where the AR master data is updated to record the payment.

Table of Entities and Activities

| Entities	Para	Activities
IT division	1	1. Print statements.
	1	2. Send statements to accounts receivable department.
Accounts receivable	1	3. Mail statements to customers.
Customers	2	4. Mail payments to Webster.
Accounts receivable	2	5. Batch checks.
	2	6. Send cheques to cashier.
	2	7. Enter payments.
Cashier	2	
Computer (IT division)	2	8. Update accounts receivable master data.

DFD Guidelines

1. Include *within* the system context (bubble) any entity that performs one or more information processing activities. (Information processing activities retrieve data from storage, transform data, or file data.)

2. For now, include only *normal* processing routines, *not* exception routines or error routines, on context diagrams, physical DFDs, and logical level 0 DFDs.

DFD Guidelines (cont'd)

3. Include in the process documentation all (and only) activities and entities described in the systems narrative.

4. When multiple entities operate identically, depict only one to represent all.

Webster Context Diagram
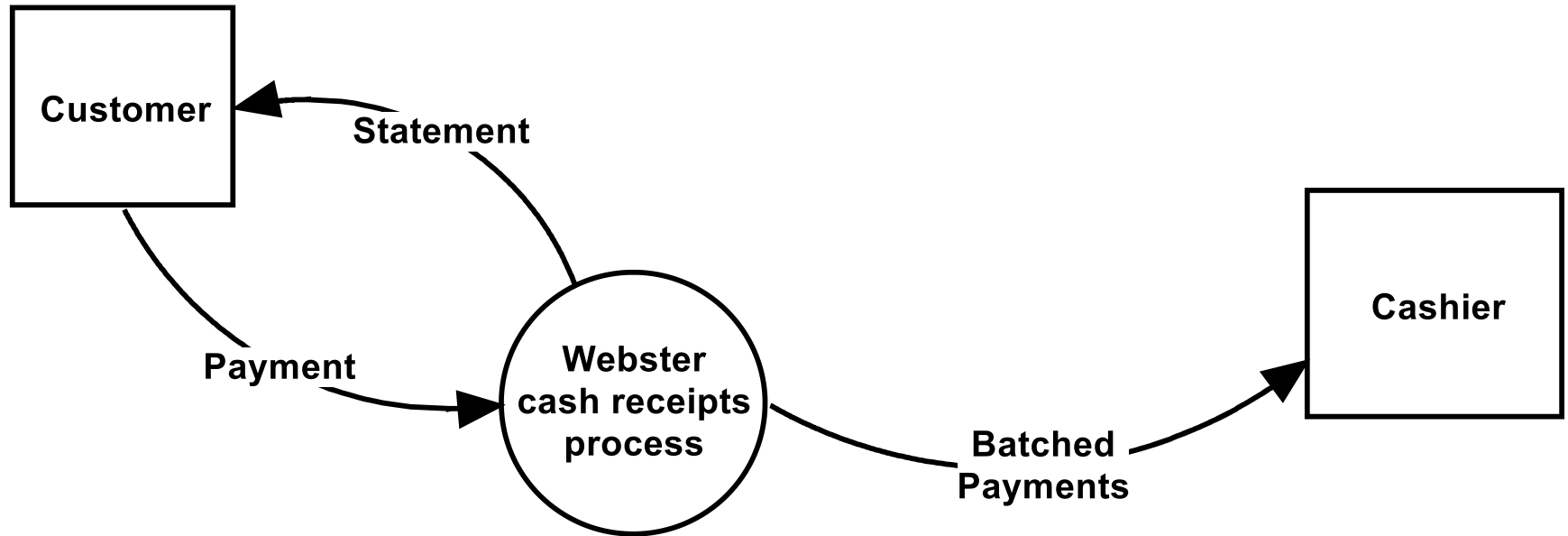
DFD Guidelines (cont'd)

5. For clarity, draw a data flow for each flow into and out of a data store. You may also, for clarity and to help you determine that you have included all necessary flows, label each flow with the activity number that gives rise to the flow or with a description of the flow (e.g., "retrieve accounts receivable master data").

6. If a data store is logically necessary (because of a delay between processes), include a data store in the diagrams, whether or not it is mentioned in the narrative.

Webster Physical DFD
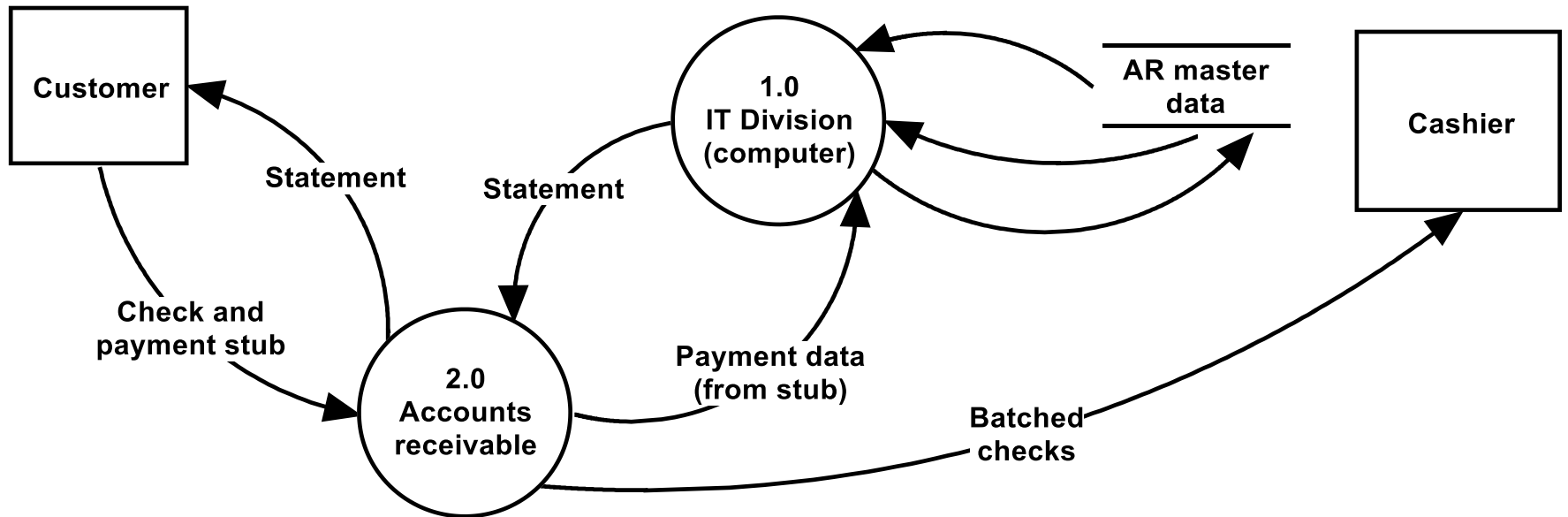
DFD Guidelines (cont'd)

7. Group activities if they occur in the same place and at the same time.

8. Group activities if they occur at the same time but in different places.

9. Group activities that seem to be logically related.

10. To make the DFD readable, use between five and seven bubbles.

Table of Entities and Activities (Annotated)

Entities	Para	Activities	Process
IT Division (computer)	1	1. Print statements.	1.0 Bill customers.
Accounts receivable	2	5. Batch cheques.	2.0 Record payments.
	2	7. Enter payments.	
IT Division (computer)	2	8. Update accounts receivable master data.	

Webster Logical DFD (Level 0)
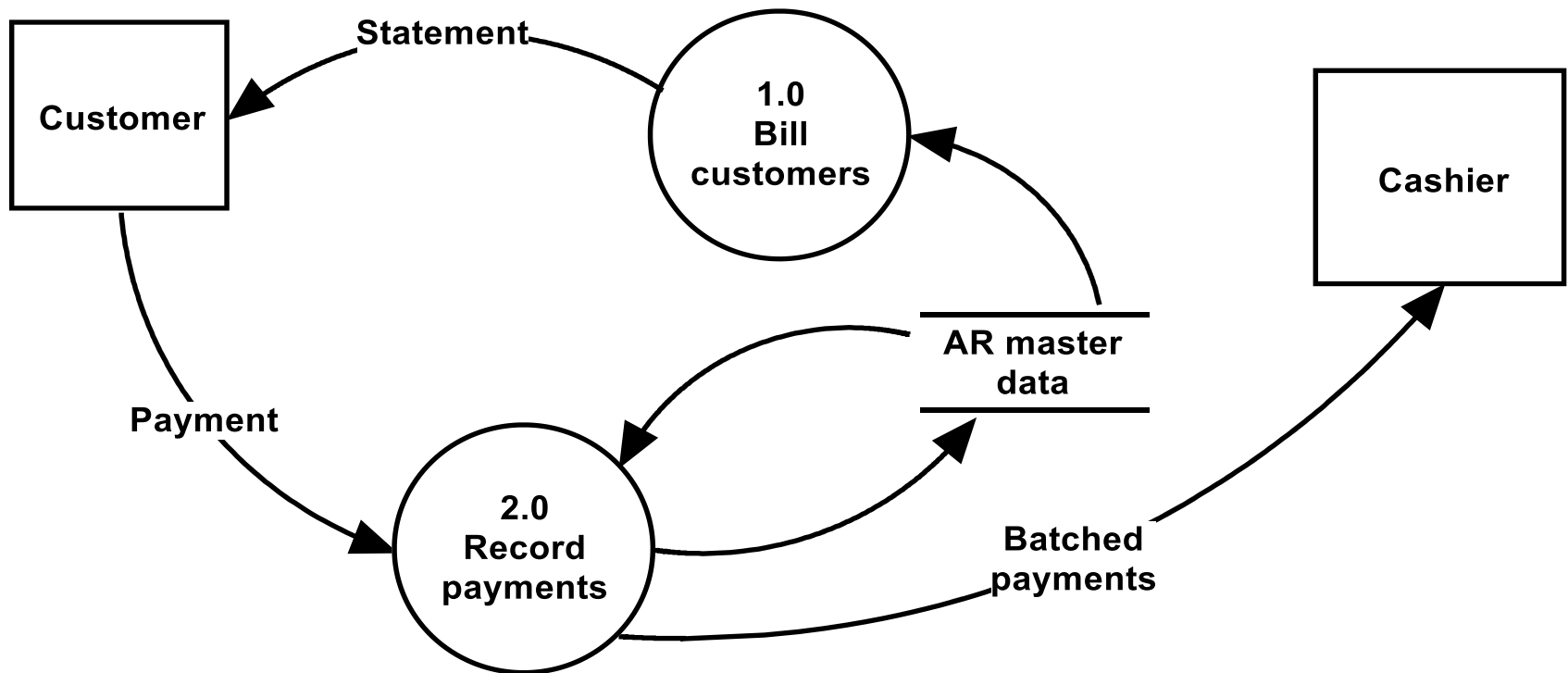
DFD Guidelines (cont'd)

11. A data flow should go to an operations entity *square* when only **operations process functions** (such as storing goods, picking goods, packing orders, and so on) are to performed by that entity. A data flow should enter an entity *bubble* if the operations process entity is to perform an **information processing activity**.

DFD Guidelines (cont'd)

12. On a physical DFD, reading computer data stores and writing to computer data stores must go through a computer bubble.

13. On a logical DFD, data flows cannot go from higher- to lower-numbered bubbles.

Documenting Abnormal Processing

- Processes called exception routines or error routines handle required actions for out-of-the-ordinary (exceptional) or erroneous events data; shown on systems flowcharts.
  - Processing performed in other-than-normal situations should be documented below the level 0 DFD with reject stubs that indicate that exceptional processing must be performed.
  - **Reject stub:** data flow assigned the label "Reject"; leaves a bubble; does not go to any other bubble or data store; shown only in lower-level diagrams.

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• **Summary**

- Processes and definitions

- Data flow diagrams

- In the tutorial for this lecture, you will learn how to prepare:
  - table of entities and activities
  - context diagrams
  - data flow diagrams

- Next week, we continue with process modelling tools

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References

Marshall B. Romney, Paul J. Steinbart, Joseph M. Mula, Ray McNamara and Trevor Tonkin. Accounting Information Systems (First edition), Pearson Australia, 2013: Chapter 3

Ulric J. Gelinas, Richard B. Dull, and Patrick R. Wheeler, Accounting Information Systems 9e, South-Western Cengage Learning, 2012: Chapter 4