CHAPTER 4

Data and Process Modeling
(Phase 2: Systems Analysis)
DATA FLOW DIAGRAMS

A data flow diagram (DFD) shows how data moves through an information system but does not show program logic or processing steps. A set of DFDs provides a logical model that shows what the system does, not how it does it.

DFD Symbols

- Process symbol

A process receives input data and produces output that has a different content, form, or both. Process contain the business logic, also called business rules, that transform the data and produce the required results.

Processing details are not shown in a DFD.
FIGURE 1 Data flow diagram symbols. Symbol names, and examples of the Gane an Sarson and Yourdon symbol sets.
When the analyst wishes to show additional levels of detail, he or she can zoom in on a process symbol and create a more in-depth DFD that shows the process’s internal working—which might reveal even more processes, data flows, and data stores.

**DATA FLOW SYMBOL**

A data flow is a path for data to move from one part of the information system to another. A data flow in a DFD represents one or more data items. Although the DFD does not show the detailed contents of a data flow, that information is included in the data dictionary.
FIGURE 2 Examples of correct combinations of data flow and process symbols.
FIGURE 3 shows three data flow and process combinations that you must avoid:

- **Spontaneous generation.** Produces output, but has no input data flow.
- **Black hole.** Which is a process that has input, but produces no output.
- **Gray hole.** The input obviously is insufficient to generate the output shown.

FIGURE 3 Examples of incorrect combinations of data flow and process symbols.
DATA STORE SYMBOL

A data store is used in a DFD to represent data that the system stores because one or more processes need to use the data at a later time. A DFD does not show the detailed contents of data store - the specific structure and data elements are defined in the data dictionary.

A data store must be connected to a process with a data flow. The data store has at least one incoming and one outgoing data flow and is connected to a process symbol with a data flow.
FIGURE 4 Example of correct uses of data store symbols in a data flow diagram.
FIGURE 5 Example of incorrect uses of data store symbols
ENTITY SYMBOL

A DFD shows only external entities that provide data to the system or receive output from the system. A DFD shows the boundaries of the system and how the system interfaces with the outside world.

FIGURE 6 Example of correct uses of external entities in a data flow diagram.
FIGURE 7 Example of incorrect uses of external entities. An external entity must be connected by a data flow to a process, and not directly to a data store or to another external entity.
<table>
<thead>
<tr>
<th>DATA FLOW THAT CONNECTS</th>
<th>OKAY TO USE?</th>
</tr>
</thead>
<tbody>
<tr>
<td>A process to another process</td>
<td>YES</td>
</tr>
<tr>
<td>A process to an external entity</td>
<td>YES</td>
</tr>
<tr>
<td>A process to a data store</td>
<td>YES</td>
</tr>
<tr>
<td>An entity to another entity</td>
<td>NO</td>
</tr>
<tr>
<td>An entity to a data store</td>
<td>NO</td>
</tr>
<tr>
<td>A data store to another data store</td>
<td>YES</td>
</tr>
</tbody>
</table>

**FIGURE 8** Rules for connection processes, data stores, and entities in a DFD.
CREATING A SET OF DFDS

Step 1 : Draw a context diagram
Step 2 : Draw a diagram 0 DFD
Step 3 : Draw the lower-level diagrams

Step 1 : Draw a context diagram

A context diagram is a top-level view of an information system that shows the system’s boundaries and scope. To draw a context diagram, you start by placing a single process symbol in the center of the page. The symbol represents the entire information system, and you identify it as process 0. You do not show any data stores in a context diagram because data stores are internal to the system.

You begin by reviewing the system requirements to identify all external data sources and destinations.
FIGURE 9 Context diagram DFD for a grading system.
FIGURE 10  Context diagram DFD for an order system.
Drawing Guidelines

When you draw a context diagram, and other DFDs, you follow certain guidelines:

1. Draw the context diagram so it fits on one page.
2. Use the name of the information system as the process name in the context diagram.
3. Use unique names within each set of symbols.
4. Do not cross lines.
5. Provide a unique name and reference number for each process. The context diagram contains process 0, the next level of detail inside process 0, you must create a DFD named diagram 0.
6. Reviewing models with users allows you to obtain their feedback and approval for the logical design of the system.
Step 2: Draw a diagram 0 DFD

Diagram 0 zooms in on the context diagram and shows major processes, data flows, and data store. Diagram 0 also repeats the entities and data flows that appear in the context diagram.

The process numbers do not suggest that the processes are accomplished in a sequential order. If processes must be performed in specific sequence, you document the information in the process descriptions.
When you create a set of DFDs for a system, you break the processing logic down into smaller units, called functional primitives, that programmers will use to develop code. A functional primitive is a process that consists of a single function that is not exploded further.
Step 3: Draw the lower-level diagrams

**Leveling** is the process of drawing a series of increasingly detailed diagrams, until all functional primitives are identified. **Balancing** maintains consistency among a Set of DFDs by ensuring that input and output data flows align properly.

**FIGURE 12** Diagram 0 DFD for the order system.
**FIGURE 13** Diagram 1 DFD shows detail of the FILL ORDER process in the order system.
FIGURE 14 Order System Diagram 3 DFD
DATA DICTIONARY

A data dictionary, or data repository, is a central storehouse of information about the system’s data dictionary to collect, document, and organize specific facts about the system, including the contents of data flows, data stores, entities, and processes. The data dictionary also defines and describes all data elements and meaningful combinations of data that has meaning within an information system. Data elements are combined into records, also called data structures. A record is a meaningful combination of related data elements that is included in a data flow or retained in a data store.
FIGURE 15 Contents of the data dictionary, including data flows, data stores, data structures and records, data elements, external entities, and processes.
Documenting the Data Flows

The typical attributes of data flow are as follows:

- **Data flow name or label.** The data flow name as it appears on the DFDs.
- **Description.** Description the data flow and its purpose.
- **Alternate name(s).** Aliases for the DFD data flow name(s).
- **Origin.** The DFD beginning, or source, for the data flow; the origin can be a process, data store, or an entity.
- **Destination.** The DFD ending point(s) for the data flow; the destination can be a process, a data store, or an entity.
- **Volume and frequency.** Describes the expected number of occurrences for the data flow per unit of time. For example, if a company has 300 employees, data flow would involve 300 transactions and records each week.
Documenting the Data Stores

typical characteristics of a data store are as follows:

**Data store name or label.** The data store name as it appears on the DFDs.

**Description.** Describes the data store and its purpose.

**Alternate name(s).** Aliases for the DFD data store name.

**Attributes.** Standard DFD names that enter or leave the data store.

**Volume and frequency.** Describes the estimated number of records in the data store and how frequently they are updated.
Documenting the Processes

Following are typical characteristics of a process:

- **Process name or label.** The process name as it appears on the DFDs.
- **Description.** A brief statement of the process’s purpose.
- **Process number.** A reference number that identifies the process and indicates relationships among various levels in the system.
- **Process description.** This section includes the input and output data flows.
Documenting the Entities

Typical characteristics of an entity include the following:

- **Entity name.** The entity name as it appears on the DFDs.
- **Description.** Describe the entity and its purpose.
- **Alternate name(s).** Any aliases for the entity name.
- **Input data flows.** The standard DFD names for the input data flows to the entity.
- **Output data flows.** The standard DFD names for the data flows leaving the entity.
PROCESS DESCRIPTION TOOLS

A process description documents the details of a functional primitive, and represents a specific set of processing steps and business logic.

1. Modular Design

Modular Design is based on combinations of three logical structures, sometimes called control structures, which serve as building blocks for the process.

FIGURE 16  Sequence structure.
FIGURE 17  Selection structure.

FIGURE 18  Iteration structure.
2. Structured English

Structured English is a subset of standard English that describes logical processes clearly and accurately.

- Use only the three building blocks of sequence, selection, and iteration
- Use indentation for readability
- Use a limited vocabulary, including standard terms used in the data Dictionary and specific words that describe the processing rules.
SAMPLE OF A SALES PROMOTION POLICY:

- Preferred customers who order more than $1,000 are entitled to a 5% discount and an additional 5% discount if they used our charge card.
- Preferred customers who do not order more than $1,000 receive a $25 bonus coupon.
- All other customers receive a $5 bonus coupon.

STRUCTURED ENGLISH VERSION OF THE SALES PROMOTION POLICY:

IF customer is a preferred customer, and
  IF customer orders more than $1,000 then
    Apply a 5% discount, and
    IF customer uses our charge card, then
      Apply an additional 5% discount
    ELSE
      Award a $25 bonus. Coupon
  ELSE
    Award a $5 bonus coupon.

FIGURE 19 Sample of a policy with logical rules, and a structured English version of the policy. Notice the alignment and indentation of the logic statements.
3. Decision Tables

A decision table shows a logical structure, with all possible combinations of conditions and resulting actions. Analysts often use decision tables, in addition to structured English, to describe a logical process and ensure that they have not overlooked any logical possibility.

FIGURE 20 Example of a simple decision table showing the processing logic of the VERIFY ORDER process.
FIGURE 21 A more complex situation is presented

FIGURE 22 Sample decision table based on the sales promotion policy.
This is the initial version of the table, before simplification.
4. Decision Trees

A decision tree is a graphical representation of the conditions, actions, and rules found in a decision table.

**FIGURE 4-23** Sample decision tree. Like a decision table, a decision tree illustrates the action to be taken. This decision tree is based on the sales promotion policy...
Exercise 4

1. Create a set of DFDs for assignment system.
2. Write the data dictionary.
3. Simplify the decision table and draw the decision tree.

Reference

ระบบสายสินค้า

1. โปรแกรมซื้อขายคุ้มค่าใน Food Center
2. โปรแกรมร้านขายหนังสือ
3. โปรแกรมร้านขายพิซซ่า
4. โปรแกรมร้านขาย KFC
5. โปรแกรมร้านขายคอมพิวเตอร์
6. โปรแกรมร้านขายโทรศัพท์มือถือ
7. โปรแกรมร้านขายเครื่องเขียน/อุปกรณ์สำนักงาน
8. โปรแกรมร้านขายเครื่องใช้ไฟฟ้า
9. โปรแกรมร้านขายสินค้าแม่และเด็ก
10. โปรแกรมร้านขายอุปกรณ์กีฬา
11. โปรแกรมร้านขายเครื่องประดับตกแต่ง
12. โปรแกรมร้านขายวัสดุก่อสร้าง
13. โปรแกรมร้านขายเครื่องหน่ม/อุปกรณ์กันหนาว
14. โปรแกรมร้านขายเครื่องดนตรี
15. โปรแกรมร้านขายของที่ระลึก
16. โปรแกรมร้านขายพิมพ์
17. โปรแกรมร้านขายกล้องถ่ายรูป
18. โปรแกรมร้านขายเครื่องพิมพ์ (Printer)
19. โปรแกรมร้านขายของชำร่วยเพื่องานแต่งงาน
20. โปรแกรมร้านขายดอกไม้
ระบายจำหน่าย

1. โปรแกรมจองตั๋วเครื่องบิน
2. โปรแกรมจองตั๋วชมภาพยนตร์
3. โปรแกรมจองตั๋วรถทัวร์
4. โปรแกรมจองตั๋วรถไฟ
5. โปรแกรมจองท้องพักโรงแรม
6. โปรแกรมร้านขาย VCD
7. โปรแกรมร้านขายหนังสือ
8. โปรแกรมเข้าเรียนที่ปรึกษา
9. โปรแกรมจองท้องขัดเปลี่ยนโรงแรม
10. โปรแกรมจองห้องประชุมในมหาวิทยาลัย
11. โปรแกรมจองรถของมหาวิทยาลัย