Chapter 9 - Process Modeling

Logical models remove biases that are the result of the way the system is currently implemented, or the way that any one person thinks the system might be implemented.

Logical models reduce the risk of missing business requirements because we are too preoccupied with technical results.

Logical models allow us to communicate with end-users in nontechnical or less technical languages.

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. DFDs have become a popular tool for business process redesign.
Chapter 9 – Process Modeling

Systems thinking is the application of formal systems theory and concepts to systems problem solving.

DFDs are a tool that supports systems thinking.

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

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

Decomposition diagram – a tool used to depict the decomposition of a system. Also called hierarchy chart.
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.
- An event is triggered by a discrete input and is completed when the 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.
- Should be named with a strong action verb followed by an object clause that describes what the work is perform on (or for).

Common Process Errors on DFDs

Process Logic
- Decomposition diagrams and data flow diagrams are effective tools for identifying processes, but are not good at showing the logic inside those processes.
- Eventually need to specify detailed instructions.
- Should effectively communicate with both users and programmers.
- Flowcharts and pseudocode are difficult for users to understand.
- Natural English is imprecise.
- Structured English has advantages of natural English with some of the rigor of programming logic.

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 CURRENT LOAN BALANCE for the CUSTOMER NUMBER.
      3) 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 all their data attributes as described in the data flow LOANS AT RISK.
      Else
      1) Exclude the CUSTOMER NUMBER and data from the data flow LOANS AT RISK.

Structured English Constructs (Part 1)
Structured English Constructs (Part 2)

Policies and Decision Tables

- A policy is a set of rules that govern how a process is to be completed.

- A decision table is a tabular form of presentation that specifies a set of conditions and their corresponding actions.
  - As required to implement a policy.

Data flow
- Data flow is data that is input to or output from a process.
- A data flow is 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 conservation – the practice of ensuring that a data flow contains only data needed by the receiving process.

- Sometimes called starving the processes.
- New emphasis on business process redesign to identify and eliminate inefficiencies.
- Simplifies the interface between those processes.
- Must precisely define the data composition of each data flow, expressed in the form of data structures.

**Data Structure**

<table>
<thead>
<tr>
<th>DATA STRUCTURE</th>
<th>ENGLISH INTERPRETATION</th>
</tr>
</thead>
</table>
| ORDER= ORDER NUMBER + ORDER DATE + (PERSONAL CUSTOMER NUMBER, CORPORATE ACCOUNT NUMBER) + \( \text{Selling Address Address}, \text{Product Description}, \text{Quantity Ordered}, \text{Product Price Source}, \text{Extended Price} \) + SUM OF EXTENDED PRICES + PREPAID AMOUNT + (CREDIT CARD NUMBER, EXPIRATION DATE) | An instance of ORDER consists of:
- ORDER NUMBER and ORDER DATE
- Either PERSONAL CUSTOMER NUMBER or CORPORATE ACCOUNT NUMBER
- \( \text{Selling Address Address} \)
- \( \text{Product Description} \)
- \( \text{Quantity Ordered} \)
- \( \text{Product Price Source} \)
- \( \text{Extended Price} \)
- SUM OF EXTENDED PRICES
- PREPAID AMOUNT
- Optionally: both CREDIT CARD NUMBER and EXPIRATION DATE |

**Data Structure Constructs**

- **Sequence of Attributes** - The sequence data structure indicates one or more attributes that may (or must) be included in a data flow.
- **Selection of Attributes** - The selection data structure allows you to show situations where different sets of attributes describe different instances of the data flow.

**Data Attribute** - the smallest piece of data that has meaning to the users and the business.

**Data Structure** - a specific arrangement of data attributes that defines a single instance of a data flow...

- The data attributes that comprise a data flow are organized into data structures.
- Data flows can be described in terms of the following types of data structures:
  - A sequence or group of data attributes that occur one after another
  - The selection of one or more attributes from a set of attributes.
  - The repetition of one or more attributes.

**Data Structure Examples**

- **Order**
  - ORDER= ORDER NUMBER + ORDER DATE + (PERSONAL CUSTOMER NUMBER, CORPORATE ACCOUNT NUMBER) + \( \text{Selling Address Address}, \text{Product Description}, \text{Quantity Ordered}, \text{Product Price Source}, \text{Extended Price} \) + SUM OF EXTENDED PRICES + PREPAID AMOUNT + (CREDIT CARD NUMBER, EXPIRATION DATE)

- **Address**
  - ADDRESS= POST OFFICE BOX NUMBER + STREET ADDRESS + CITY + \( \text{STATE, MUNICIPALITY} \) + ZIP CODE + \( \text{STATE, MUNICIPALITY} \) + \( \text{ZIP CODE} \)

- **Wage and Tax Statement**
  - WAGE AND TAX STATEMENT= TAXPAYER IDENTIFICATION NUMBER + TAXPAYER NAME + TAXPAYER ADDRESS + WAGES, TIPS, AND COMPENSATION + FEDERAL TAX WITHHELD + ...

**Deadlines**

- New emphasis on business process redesign to identify and eliminate inefficiencies.
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.

### Diverging data flow

- A data flow that splits into multiple data flows.
- Indicates data that starts out naturally as one flow, but is routed to different destinations.
- Also useful to indicate multiple copies of the same output going to different destinations.

### Converging data flow

- The merger of multiple data flows into a single packet.
- Indicates data from multiple sources that can (must) come together as a single packet for subsequent processing.

### External agent

- An outside person, organization 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.
- As scope changes, external agents can become processes, and vice versa.
- Almost always one of the following:
  - Office, department, division.
  - An external organization or agency.
  - Another business or another information system.
  - One of your system’s end-users or managers
- Named with descriptive, singular noun.

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**Data Structure**

<table>
<thead>
<tr>
<th>Data Structure</th>
<th>Format by Example</th>
<th>English Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repetition of Attributes</td>
<td>The repetition data structure is used to set off a data attribute or group of data attributes that may (or may not) repeat themselves a specific number of times for a single instance of the data flow.</td>
<td>The maximum number of repetitions is usually zero or one. The minimum number of repetitions may be specified as &quot;n meaning &quot;many&quot; where the actual number of instances varies for each instance.</td>
</tr>
<tr>
<td>Optional Attributes</td>
<td>The optional notation indicates that an attribute, or group of attributes, a repetition may be included or included in all instances of a data flow.</td>
<td>For the repetition data structure, a notation of &quot;n+&quot; means making the entire repeating group optional.</td>
</tr>
<tr>
<td>Reusable Attributes</td>
<td>For groups of attributes that are contained in many data flows, it is desirable to create a separate data structure that can be reused in other data structures.</td>
<td>Then, the reusable structures can be included in other data flow structures as follows:</td>
</tr>
</tbody>
</table>

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**Example Data Structure**

<table>
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<tr>
<th>Data Structure</th>
<th>Format by Example</th>
<th>English Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CLAIM</strong></td>
<td><strong>POLICY NUMBER</strong>+ <strong>POLICY HOLDER NAME</strong>+ <strong>DEPENDENT NAME</strong>+ <strong>SERVICE PROVIDER</strong>+ <strong>EXPENSE ACCOUNT</strong></td>
<td>An instance of CLAIM consists of POLICY NUMBER and POLICY HOLDER NAME and a set of (zero or more) instances of DEPENDENT NAME and SERVICE PROVIDER and EXPENSE ACCOUNT. Note: For the repetition data structure, a notation of &quot;n+&quot; means making the entire repeating group optional.</td>
</tr>
</tbody>
</table>

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**Example of External Agent**

[Diagram of External Agent]
Data store — stored data intended for later use. Synonyms are file and database.

- Frequently implemented as a file or database.
- A data store is "data at rest" compared to a data flow that is "data in motion."
- 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

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 the existing system including its limitations
  - Model the target system's logical requirements (meaning processes and data flows needed regardless of how the system will be implemented)
  - Model candidate technical solutions (physical DFDs only)
  - Model the target technical solution (physical DFDs only)

THE ABOVE METHODOLOGY IS RARELY PRACTICED ANYMORE BECAUSE IT IS VERY CUMBERSOME AND TIME-CONSUMING.

THE ABOVE METHODOLOGY, BASED ON EVENT PARTITIONING, IS MORE COMMONLY PRACTICED.
• **External events** are initiated by external agents. They result in an input transaction or data flow.

• **Temporal events** are triggered on the basis of time, or something that merely happens. They are indicated by a control flow.

• **State events** trigger processes based on a system’s change from one state or condition to another. They are indicated by a control flow.

**Use case** – an analysis tool for finding and identifying business events and responses.

**Actor** – anything that interacts with a system.
Event diagram – data flow diagram that depicts the context for a single event.
| Process                          | City 1 | City 2 | Region 1 | Region 2 | Region 3 | Region 4 | Region 5 | Region 6 | Region 7 | Region 8 | Region 9 | Region 10 | Region 11 | Region 12 | Region 13 | Region 14 | Region 15 | Region 16 | Region 17 | Region 18 | Region 19 | Region 20 | Region 21 | Region 22 | Region 23 | Region 24 | Region 25 | Region 26 | Region 27 | Region 28 | Region 29 | Region 30 | Region 31 | Region 32 | Region 33 | Region 34 | Region 35 | Region 36 | Region 37 | Region 38 | Region 39 | Region 40 | Region 41 | Region 42 | Region 43 | Region 44 | Region 45 | Region 46 | Region 47 | Region 48 | Region 49 | Region 50 | Region 51 | Region 52 | Region 53 | Region 54 | Region 55 | Region 56 | Region 57 | Region 58 | Region 59 | Region 60 | Region 61 | Region 62 | Region 63 | Region 64 | Region 65 | Region 66 | Region 67 | Region 68 | Region 69 | Region 70 | Region 71 | Region 72 | Region 73 | Region 74 | Region 75 | Region 76 | Region 77 | Region 78 | Region 79 | Region 80 | Region 81 | Region 82 | Region 83 | Region 84 | Region 85 | Region 86 | Region 87 | Region 88 | Region 89 | Region 90 | Region 91 | Region 92 | Region 93 | Region 94 | Region 95 | Region 96 | Region 97 | Region 98 | Region 99 | Region 100 |