Process DIAGRAMMING
Understanding HOW people do their work
Think VISUALLY
What tells a better Story

2 Design Principles for Assembly Instructions

Before we can develop automatic tools for designing assembly instructions, we must understand how people think about and communicate the process of assembling an object. Cognitive psychologists have identified a variety of techniques to investigate how people mentally represent ideas and concepts. We recently performed human-subject experiments based on these techniques to determine the mental representations underlying assembly ([Hutter and Tversky 2002]. We briefly describe our experimental setup.

In the first experiment, we asked participants to assemble a TV stand, given only a photograph of the completed stand as a guide. After they assembles the TV stand, we asked them to create a set of instructions that would show another person how to assemble it. Examples of the diagrams they drew are shown in Figure 2. In the second experiment, we asked a new group of participants to rank the effectiveness of a subset of the instructions produced in the first experiment. Finally, the third experiment tested whether the highly ranked instructions were more effective. Yet another group of participants used instruction ranked in the second experiment to assemble the TV stand, while experiencing recorded task completion time and error rates. We found that in general the highly ranked instructions were easier to understand and follow. Participants spent less time assembling the TV stand and made fewer errors.

Based on these experiments, as well as earlier cognitive research, we identified a set of design principles for creating assembly instructions that are easy to understand and follow.

Hierarchy and grouping of parts: People think of assemblies as a hierarchy of parts. At the base level, parts are segmented by perceived salience, instead of by context discontinuity: that is, parts that are disjoint are more likely to be segmented. Typically, the disjoint parts are also grouped by dimension functions (e.g., the legs of a chair or the drawers of a desk). [Tversky and Hemenway 1986]. When possible, people prefer that parts within a group are added to the assembly at the same time, or in sequence once another is added. The parts groups are usually considered as hierarchical structures, which parallel the subassembly structure of the objects.

Visual Diagram

OR

Figure 2: (a) diagram of the TV stand. (b) action diagram. (c) action diagram for the TV stand. (d) action diagram for the TV stand. (e) action diagram for the TV stand. (f) action diagram for the TV stand. (g) action diagram for the TV stand. (h) action diagram for the TV stand. (i) action diagram for the TV stand. (j) action diagram for the TV stand. (k) action diagram for the TV stand. (l) action diagram for the TV stand. (m) action diagram for the TV stand. (n) action diagram for the TV stand. (o) action diagram for the TV stand. (p) action diagram for the TV stand. (q) action diagram for the TV stand. (r) action diagram for the TV stand. (s) action diagram for the TV stand. (t) action diagram for the TV stand. (u) action diagram for the TV stand. (v) action diagram for the TV stand. (w) action diagram for the TV stand. (x) action diagram for the TV stand. (y) action diagram for the TV stand. (z) action diagram for the TV stand.

Structural diagrams and action diagrams: Based on analysis of the hand-drawn instructions we collected in the first experiment, we define two types of assembly diagrams: structural diagrams and action diagrams (see Figures 2). Structural diagrams present the parts of the assembly in either a flat, top-down perspective, or as a more complex, comparative two-dimensional diagram that interparts are to be attached. Action diagrams explicitly represent the parts to be attached from the parts that are already attached and guidelines to indicate when the new parts attach to the larger parts. We found that action diagrams are superior to structural diagrams for the TV stand assembly task. We believe that this is because action diagrams contain more information about the structural diagram and also explicitly show the structural diagram required to be attached. However, trying to attach the TV stand in order to create a new task is a common problem in many real-world assembly operations.
assembly process: IKEA
Core Requirement Components

- Business Rules
- Data (Attributes Entities)
- Processes (or Use Cases)
- External Agents (or Actors)
Workflow Diagrams

- How would you describe a process you routinely use to a friend who wanted to do the same thing?
- Is it easier to use words or draw a picture of the steps you take?
- What would some uses of this approach be?
ASK THEM QUESTIONS:

• Capturing a routine process and explaining it to someone else is difficult, especially for more complex processes. Understanding how something works is critical to improving it. Therefore, getting a good understand of what happens when, how its done, how the steps relate and who decides what questions with what information along the way is a key skill for the BA.

• Word descriptions can be ambiguous. Drawing out the steps is usually seen as a better way to communicate the information of how a process works.
  - Mapping a work process for general understanding
  - process improvement
    - documenting computer logic to be written
    - writing emergency procedures, etc.

• This is a key technique for BA, systems development, process improvement, startups, etc.
Workflow Diagrams

- One of a Business Analyst’s key tools, especially for analyzing the as-is situation
- Great way to begin to understand process you are dealing with at high level
- Different levels of workflow can be used to explain the process to different audiences
- Can document Standard Operating Procedures (SOP’s)
- Revising the flow to facilitate improvements is standard design technique
What Does a Workflow Diagram Reveal:

• The steps in a process
• A sequence of actions and responses/decisions
• Problems in a process and revisions to improve it
• How work is accomplished
• how tasks interrelate
• What information flows through the process
• What decisions are made
• How individual workers are involved with the process
Workflow Diagrams

• What would we want to include in a workflow diagram?

• There are many different types of workflow diagrams, we will focus on one.
  • Swim Lane Flowcharting
  • ANSI Flowcharting
  • UML Activity Diagrams
  • SIPOC (supplier-input-process-output-customer)
  • Use Case Diagram
<table>
<thead>
<tr>
<th>Flowchart Symbol</th>
<th>Name (Alternates)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Process</td>
<td>An operation or action step.</td>
</tr>
<tr>
<td></td>
<td>Terminator</td>
<td>A start or stop point in a process.</td>
</tr>
<tr>
<td></td>
<td>Decision</td>
<td>A question or branch in the process.</td>
</tr>
<tr>
<td></td>
<td>Delay</td>
<td>A waiting period.</td>
</tr>
<tr>
<td></td>
<td>Predefined Process</td>
<td>A formally defined sub-process.</td>
</tr>
<tr>
<td></td>
<td>Alternate Process</td>
<td>An alternate to the normal process step.</td>
</tr>
<tr>
<td></td>
<td>Data (I/O)</td>
<td>Indicates data inputs and outputs to and from a process.</td>
</tr>
<tr>
<td></td>
<td>Document</td>
<td>A document or report.</td>
</tr>
<tr>
<td></td>
<td>Multi-Document</td>
<td>Same as Document, except, well, multiple documents.</td>
</tr>
<tr>
<td></td>
<td>Preparation</td>
<td>A preparation or set-up process step.</td>
</tr>
<tr>
<td></td>
<td>Display</td>
<td>A machine display.</td>
</tr>
<tr>
<td></td>
<td>Manual Input</td>
<td>Manually input into a system.</td>
</tr>
<tr>
<td></td>
<td>Manual Operation</td>
<td>A process step that isn’t automated.</td>
</tr>
<tr>
<td></td>
<td>Card</td>
<td>A old computer punch card.</td>
</tr>
<tr>
<td>Symbol</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td>Punched Tape</td>
<td>An old computer punched tape input.</td>
<td></td>
</tr>
<tr>
<td>Connector</td>
<td>A jump from one point to another.</td>
<td></td>
</tr>
<tr>
<td>Off-Page Connector</td>
<td>Continuation onto another page.</td>
<td></td>
</tr>
<tr>
<td>Transfer</td>
<td>Transfer of materials.</td>
<td></td>
</tr>
<tr>
<td>Or</td>
<td>Logical OR.</td>
<td></td>
</tr>
<tr>
<td>Summing Junction</td>
<td>Logical AND.</td>
<td></td>
</tr>
<tr>
<td>Collate</td>
<td>Organizing data into a standard format or arrangement.</td>
<td></td>
</tr>
<tr>
<td>Sort</td>
<td>Sorting of data into some pre-defined order.</td>
<td></td>
</tr>
<tr>
<td>Merge</td>
<td>Merge multiple processes into one. Also used to show raw material storage.</td>
<td></td>
</tr>
<tr>
<td>Extract (Measurement)</td>
<td>Extract (split processes) or more commonly - a measurement or finished goods.</td>
<td></td>
</tr>
<tr>
<td>Stored Data</td>
<td>A general data storage flowchart symbol.</td>
<td></td>
</tr>
<tr>
<td>Magnetic Disk (Database)</td>
<td>A database.</td>
<td></td>
</tr>
<tr>
<td>Direct Access Storage</td>
<td>Storage on a hard drive.</td>
<td></td>
</tr>
<tr>
<td>Internal Storage</td>
<td>Data stored in memory.</td>
<td></td>
</tr>
<tr>
<td>Sequential Access Storage (Magnetic Tape)</td>
<td>An old reel of tape.</td>
<td></td>
</tr>
<tr>
<td>Callout</td>
<td>One of many callout symbols used to add comments to a flowchart.</td>
<td></td>
</tr>
<tr>
<td>Flow Line</td>
<td>Indicates the direction of flow for materials and/or information</td>
<td></td>
</tr>
</tbody>
</table>
Flowchart

HUMAN RESOURCES - HIRING PROCESS FLOWCHART

Samples links:
Flow Chart

Example

ANSI STANDARD FLOWCHART SAMPLE FOR MONITORING REVIEW DATES

Start
Produce Schedule of Review Dates
Employee Review Dates
Career Manager

For Each Employee, Examine Review Date

If Review Date Within 1 Month

No
If Project Completion Date within 1 Month

Yes
Send Project Review Form to Project Manager

Legend
A Approve Employee Review Step
B Complete Self Analysis Step
C Complete Project Review Step
D Update Career Development Step

Send Self-Analysis Forms to Employee

Send Project Review Form to Project Manager

Assemble Past Project Reviews & Career Development Plan

Send Review Package to Career Manager

Stop
SIPOC (supplier-input-process-output-customer)

Samples links:
Use Case Diagram

Samples links:
Swim Lane Diagram

Samples links:
Think:

Actors [who]

Actions [what]

Decisions [when]

Sequence [where]

Space

RELATIONSHIPS
Swim Lane Process Mapping

1. Name the process - subject+verb+object

1. What’s the business event that initiates the process?

1. What’s the outcome of the process?
Swim Lane Process Mapping

1. Name the process - subject+verb+object
   
   Warehouse Receives Materials

1. What’s the business event that initiates the process?
   
   Receive Materials

1. What’s the outcome of the process?
   
   Materials are Stored
ABC Assembly Company
Material Delivery Process

• Manufacture delivers and unloads materials at the ABC Assembly Company Loading Dock
• Receiving Clerk receives invoice paper work describing delivered materials and creates new entries of the materials in the Warehouse Management System
• Receiving Clerk send memo via hardcopy to the Warehouse Foreman indicating the new materials have arrived on the loading doc and are ready to be stored in the proper material bin locations which will later be used in the assemble process by the production teams.
• The Warehouse Foreman performs a visual scan of the location bins to determine where to store the arriving materials. The location for storage is critical as there are physical weight limitations on the quantity of material store in each bin and the material has expiration dates that require first in first out usage during manufacturing
• The Warehouse Foreman make the material location determinations and then will verbally tell the Forklift Driver where to place the newly arrived materials
• When the Forklift Driver has completed storing all the new materials in the verbally assigned bin location(s), they will then verbally communicate to the Warehouse Foreman the storage locations
• The Warehouse Foreman will log into the Warehouse Management System to update the new entries that the Receiving Clerk initially entered into the system with the storage locations
• The Receiving Clerk will periodically check the Warehouse Management System confirm the bin locations have been updated by the Warehouse Foreman
• The Material Delivery Process is completed
Swim Lane Workflow Exercise

• With your teammates,
• Take 15 minutes to imagine the steps of the steps a warehouse goes through when it receives material from its suppliers
• Sketch it out if you can
• Be ready to share your ideas
Swim Lane Process Mapping

- Receiving Dock
- Receiving Clerk
- Forklift Driver
- Warehouse Foreman
- Data Processing

List all people and departments that may be involved in the process
Swim Lane Process Mapping

Draw a lane next to each person
Swim Lane Process Mapping

What is the first step?

Materials → Unload Trucks
Swim Lane Process Mapping

What is the next step?
Swim Lane Process Mapping

1. Unload Trucks
2. Check Materials
3. Put Away
4. Where?
5. Record Location
6. WMS
7. WMS

Receiving Dock
Receiving Clerk
Forklift Driver
Warehouse Foreman
Data Processing
Individual Case Assignment: Sales Order Case
Develop Swim lane Process flow

Links to documents on the MIS 3504 Blog site
Case background (Sales Order Case)
Swim Lane Excel Template
Swim Lane PPT Template

Due class 6, October 1, 2014
Exercise: **draw the sales process described in the sales order case**

- **Actors** – Who are all of the people/departments involved?
- **Actions** – What are the steps they perform in the process?
- **Sequence** – Map the process in sequence using the swim lane method.