MIS 3504
Digital Design and Innovation

Process Flow

Stephen Salvia

Process DIAGRAMMING
Understanding **HOW** people do their work
Think VISUALLY
planning and presentation are strongly interwoven. Therefore both issues must be considered simultaneously.

The contributions of our work include:

1. Cognitive design principles for effective assembly instructions: We performed cognitive psychology experiments to identify how mental concrete of the assembly process and to characterize the properties of well-designed instructions. Based on the results of these experiments and prior cognitive psychology research, we identify design principles for effective assembly instructions. These principles connect people's conceptual model of the assembly task to the visual representation of the task.

2. Design principles for assembly instructions: There exist two design principles for assembly instructions. The first principle is that instructions are clear and easy to read. The second principle is that instructions are easy to understand and follow. Participants spent less time assembling the TV stand and made fewer errors.

3. Hierarchical and grouping of parts: People think of assemblies as a hierarchy of parts. At the base level, parts are segmented by pre-defined surfaces instead of by contour discontinuity; that is, parts that are disjoint are likely to be segmented. Typically, the disjoint parts are also disjoint by dimension functions (e.g., the faces of a chair or the drawings of a desk) [Winter and Honorovsky 1984]. When possible, people prefer that parts within a group are added to the assembly at the same time, or in sequence across another.

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.

**Hierarchical and Grouping of Parts**

- People think of assemblies as a hierarchy of parts. At the base level, parts are segmented by pre-defined surfaces instead of by contour discontinuity, that is, parts that are disjoint are likely to be segmented. Typically, disjoint parts are also disjoint by dimension functions (e.g., the faces of a chair or the drawings of a desk) [Winter and Honorovsky 1984]. When possible, people prefer that parts within a group are added to the assembly at the same time, or in sequence across another. The part groups are usually considered in hierarchical structures, which parallel the assembly structure in the diagram.


**OR**

**Visual Diagram**

- Structural Diagram
- Action Diagram

**Figure 2:** Schematic diagrams for the TV stand. The action diagram is designed to illustrate the structural components of the assembly and the sequence of actions required to attach each part. The structural action diagram uses lines drawn in linear form to connect the parts.

**Hierarchy of Operations**

- People think of the attachment operations required to build an assembly as a hierarchy of actions on the parts [Zacks et al. 2001]. At the higher levels, people consider the operations required to assemble the sub-assemblies. For example, in the assembly of a TV stand, they eventually consider the operations required to join significant individual parts. At this lower level of the hierarchy, people consider attaching smaller parts and features to the more significant parts. This hierarchy is based on a number of factors including function, size, and simplicity.

**While the hierarchy of operations may contain many levels for some complex objects with numerous sub-assemblies (e.g., a car engine), we have found that a two-level hierarchy (significant parts and less important parts = features) is common for many home objects, including most furniture.** In this paper we focus on design rules for these two levels.

**Step-by-Step Instructions**

- Our experiments continued the results of Novick et al. (2000) showing that making explicit the instructions that present the assembly operations across a sequence of diagrams rather than in a single diagram has no effect on the instructions. Moreover, if the assembly contains significant parts as well as less important parts, people generally prefer that each diagram show how to attach only one significant part at a time. However, each diagram will usually show multiple non-significant part attachments. In Figure 1, the non-significant parts include the hardware and the screws.

- While it is essential that the assembly diagrams are clear and easy to read, each diagram should also present in an organized form. If instructions are not across too many diagrams, they become tedious to use. Similarly, some assemblies require the same sequence of operations to be repeated multiple times. For example, when assembling a bookcase, each shelf is attached in exactly the same way. Explicating each operation as it should occur makes the instructions unnecessarily long and tedious. A better approach is to skip repetitive operations after they have been presented in detail a few times.

- 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 Figure 2). Structural diagrams present the parts of the assembly (other than non-structural parts) and compare two consecutive diagrams to infer which parts are to be attached. Action diagrams simplify the parts to be attached from the parts that are already attached and use guidelines to indicate when the new parts attach to the parts that are already attached.

**Conclusion:** Almost certainly, having a set of nested instructions or preferred views (Palmer et al. 1981; Blayr et al. 1999). These instru-
assembly process: IKEA
What tells a better Story

If you need to explain to your team members how Steve’s consultants firm is financially performing in terms of

- Income vs Expense over twelve months
- Profitability over twelve months

Which approach would you prefer?

- Textual
- Graphical
Example
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
## Flowchart Symbol Cheat Sheet

<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>
</tbody>
</table>

**Flow Chart Symbols**
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Punched Tape</td>
<td>An old computer punched tape input.</td>
</tr>
<tr>
<td>Connector</td>
<td>A jump from one point to another.</td>
</tr>
<tr>
<td>Off-Page Connector</td>
<td>Continuation onto another page.</td>
</tr>
<tr>
<td>Transfer</td>
<td>Transfer of materials.</td>
</tr>
<tr>
<td>Or</td>
<td>Logical OR</td>
</tr>
<tr>
<td>Summing Junction</td>
<td>Logical AND</td>
</tr>
<tr>
<td>Collate</td>
<td>Organizing data into a standard format or arrangement.</td>
</tr>
<tr>
<td>Sort</td>
<td>Sorting of data into some pre-defined order.</td>
</tr>
<tr>
<td>Merge (Storage)</td>
<td>Merge multiple processes into one. Also used to show raw material storage.</td>
</tr>
<tr>
<td>Extract (Measurement)</td>
<td>Extract (split processes) or more commonly - a measurement or finished goods.</td>
</tr>
<tr>
<td>Stored Data</td>
<td>A general data storage flowchart symbol.</td>
</tr>
<tr>
<td>Magnetic Disk (Database)</td>
<td>A database</td>
</tr>
<tr>
<td>Direct Access Storage</td>
<td>Storage on a hard drive.</td>
</tr>
<tr>
<td>Internal Storage</td>
<td>Data stored in memory.</td>
</tr>
<tr>
<td>Sequential Access Storage</td>
<td>An old reel of tape.</td>
</tr>
<tr>
<td>Callout</td>
<td>One of many callout symbols used to add comments to a flowchart.</td>
</tr>
<tr>
<td>Flow Line</td>
<td>Indicates the direction of flow for materials and/or information</td>
</tr>
</tbody>
</table>
Flow Chart Example
UML Activity Diagram

Samples links:
SIPOC (supplier-input-process-output-customer)

Samples links:
Use Case Diagram

Samples links:
Swim Lane Diagram

Samples links:
Swim Lane Diagram

Ergo Chair Value Chain Order Fulfillment Process

Customer
Sales
Order Entry
Inventory
Production
Delivery
Supplier

- Customer
  - Sales: Process Orders
  - Order Entry: approved orders
  - Inventory: Perform Setup
  - Production: Assemble Chairs
  - Delivery: Deliver Chairs
  - Supplier: Ship Parts

Diagram illustrates the flow of orders and processes involved in the fulfillment of chair orders.
Think: Actors
   Actions
   Decisions
   Sequence
   Space
   RELATIONSHIPS

[who]
[what]
[when]
[where]
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?
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 paperwork 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

List all people and departments that may be involved in the process

Receiving Dock
Receiving Clerk
Forklift Driver
Warehouse Foreman
Data Processing
Swim Lane Process Mapping

Draw a lane next to each person
What is the first step?
Swim Lane Process Mapping

What is the next step?
Swim Lane Process Mapping

- **Receiving Dock**: Unload Trucks → Check Materials
- **Receiving Clerk**: WMS
- **Forklift Driver**: Data Processing
- **Warehouse Foreman**: Where? → WMS

- **Show decisions as diamonds, note business rules elsewhere**
- **Show databases as cylinders**
Swim Lane Process Mapping

Receiving Dock
- Materials
- Unload Trucks

Receiving Clerk
- Check Materials

Forklift Driver
- Put Away

Warehouse Foreman
- Where?
- Record Location

Data Processing
- WMS
Individual Case Assignment:
Sales Order Case
Develop Swim lane Process flow

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

Due class 6, October 6, 2016
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.