330:135g Design for Manufacturing
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MIT Product Design course web site
• http://web.mit.edu/2.009/www/fall2001/pagenonFrameset.htm

Little Green wagon

Snow Blower

Folding scooter
Product Development Process

- Identify customer needs
- Establish target specifications
- Generate product specifications
- Select product concepts
- Test product concepts
- Set final specifications
- Plan manufacturing process

Goals of customer need identification

- Ensure that the product is focused on customer needs
- Identify latent or hidden needs as well as explicit needs
- Provide a fact base for justifying the product specification
- Create an archival record of the needs activity of the development process
- Ensure that no critical customer need is missed or forgotten
- Develop a common understanding of customer needs among members of the development team

Identify customer needs

- Gather raw data from customers
- Interpret the raw data in terms of customer needs
- Organize the needs into primary, secondary and tertiary needs
- Establish the relative importance of the needs
- Reflect on the results and the process
Gather raw data from customers

- Interviews
  - Audio recording
  - Notes
  - Video recording
- Focus groups
  - Group of 8 to 12 customers
- Observing the product in use
- Written survey

Interpret the raw data in terms of customer needs

- Express the need in terms of what the product has to do, not in terms of how it might do it.
- Express the need as specifically as the raw data
- Use positive, not negative phrasing
- Express the need as an attribute of the product.

Establish target specifications

- Prepare the list metrics, using the needs metrics, if necessary
- Collect the competitive benchmarking information
- Set ideal and marginally acceptable target values for each metric
- Reflect the result and the process
Problem

• A successful hand tool manufacturer is exploring the growing market for hand-held power tools
• After the initial research, the firm decided to enter the market with a cordless screwdriver
### Exhibit 4-5

Customer selection matrix for the coffee roast project.

<table>
<thead>
<tr>
<th>Position</th>
<th>Income Level</th>
<th>Salary in Rupees (Rs)</th>
<th>Service Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Middle</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>High</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

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### Exhibit 4-6

Customer case template filled in with sample customer statement and transactional needs. SS is an abbreviation for subscriber. Note that the template cannot be filled for a single customer case. The following section may show more than 90 customer statements and transactions.

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### Exhibit 4-7

<table>
<thead>
<tr>
<th>Customer Case Matrix</th>
<th>Bill Specifications</th>
<th>Integration</th>
<th>Implementation Date</th>
<th>Status</th>
</tr>
</thead>
</table>

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### Exhibit 4-8

<table>
<thead>
<tr>
<th>Question/Prompt</th>
<th>Customer Statement</th>
<th>Integrated Need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical Case</td>
<td>I need to drive screws fast, faster than by hand.</td>
<td>The drill drives screws faster than by hand.</td>
</tr>
<tr>
<td></td>
<td>incarnation does not work; use sheet metal screws.</td>
<td>The drill drives sheet metal screws into metal fast.</td>
</tr>
<tr>
<td></td>
<td>A list of sheet metal, switch screws, nuts, bolts, brake applications.</td>
<td>The drill can be used for screws on industrial devices.</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Question/Percept</th>
<th>Customer Statement</th>
<th>Interpreted Need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Like - current tool</td>
<td>I like the pedal grip feels the best. The GG is comfortable to grip.</td>
<td>The GG is comfortable to grip.</td>
</tr>
<tr>
<td>Dislike - current tool</td>
<td>I don't like how the bristles of the brush</td>
<td>The GG is not comfortable to grip.</td>
</tr>
<tr>
<td></td>
<td>I would like it to be softer and not come into contact with a dead battery.</td>
<td>The GG is not comfortable to grip.</td>
</tr>
<tr>
<td></td>
<td>I can't drive screws into hard wood, screws.</td>
<td>The GG is not comfortable to grip.</td>
</tr>
<tr>
<td></td>
<td>Sometimes it takes too long.</td>
<td>The GG is not comfortable to grip.</td>
</tr>
</tbody>
</table>

**Suggested improvements**

- An attachment to allow me to reach places above my head.
- A point or a spring point of a safety pin.
- A point to measure the point of a screwdriver.
- Would be nice if I could pick up a pilot hole.

**Exhibit 4-6**

Customer data template filled in with example customer statements and interpreted needs. SD is an abbreviation for SDM. Note that this template represents a partial list from a single interview. A typical interview session may yield more than 30 customer statements and interpreted needs.

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**Exhibit 4-7**

Examples illustrating the guidelines for writing need statements.

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**Exhibit 4-8**

Hierarchical list of primary and secondary customer needs for the chinon soundwinder.

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Project team

- Product Manager (Leader)
- Product Design Engineer
- Designer/drafter
- Manufacturing Manager
Project team

- **Product Manager**: The Product Manager is an individual appointed by the CEO from his/her staff for a particular product development.
- The Product Manager will, throughout the project, have the primary responsibility for the performance of the product development and conformance with the product needs. He/she is responsible for the Product Development File.

Project team

- **Product Design Engineer**: The Product Design Engineer is an individual appointed by the CEO from his/her staff for a particular product development.
- The Product Design Engineer will have primary responsibility for the design of the product, to release to production (assuming the product reaches production).

Project team

- **Designer/drafter**: The Designer/drafter is responsible for the documentation of the design.
- This includes all drawings of the design, parts lists, and Product Changes Notices (PCNs).
- He/she is also to assist of the Product Design Engineer in the development of the design.
Project team

- **Manufacturing Manager**: The Manufacturing Manager is responsible for assurance that the design is manufacturable.
- Additionally, he/she is responsible for developing Process Instructions for the assembly of the device.
- If manpower is limited, then the duties of the Manufacturing Manager will be combined with those of the Designer/drafter.

Product Development Report

- This is a group produced file covering the history of the design.
- Documents that should be in the Product Development File are:

Problem Appraisal Phase

- **Understanding the Problem**
  - Description of Customers: To be completed by Feb. 11th
  - Customer's Requirements
  - Weighting of Customer's Requirements
  - Competition's Benchmarks Versus Customer's Requirements
  - Engineering Requirements
  - Competition's Benchmarks Versus Engineering Requirements
  - Engineering Targets
Problem Appraisal Phase

- Planning the Project
  - Task Titles
  - Objectives of each Task
  - Personnel Required for Each Task
  - Time Required for Each Task
  - Schedule of Tasks
  
To be completed by Feb. 18th

Conceptual Design Phase

- Concept Generation
  - Functional Decomposition
  - Literature and Patent Search Process and Results
  - Function-Concept Mapping
  - Sketches of Overall Concepts
  
To be completed by March 24th

Conceptual Design Phase

- Concept Evaluation
  - Assessment of Technology Readiness
    - Identification of Failure Modes
    - Identification of Critical Parameters
  - Concept Selection
    - Decision Matrices to Determine Best Concepts
    - Analysis, Experiments and Models Supporting Evaluation
  
To be completed by April 7th
Product Design Phase

• Product Generation  To be completed by April 14th
  – Usable Off-the-Shelf Products
  – Shape Development Driven by Function
  – Material(s) Selection
  – Manufacturing Process(s) Selection

Product Design Phase

• Product Evaluation  To be completed by April 21st
  – Comparison to Engineering Requirements
  – Functional Changes Noted
  – Design for Assembly Evaluation
  – Cost Evaluation
  – Analysis, Experiments and Models
    Supporting Evaluation

Product Design Phase

• Final Product Documentation  To be completed by April 28th
  – Layout Drawings
  – Detail Drawings of Manufactured Parts
  – Parts List (Bill of Materials)
  – Assembly Instructions
Questions and Comments