TYPES OF DESIGN PROJECTS

1) Variation of an Existing Product

2) Improvement of an Existing Product

3) Development of a New Product for a Low-Volume Production Run

4) Development of a New Product for Mass Production

5) One-of-a-kind Design
NEED ID AND PROBLEM DEFINITION

1. CUSTOMER NEED
   - CUSTOMER ID
   - INFO FROM CUSTOMER

2. BENCHMARK
   - WHO HAS DONE WHAT
   - METRICS OF SIMILAR PRODUCTS
   - ID DEFICIENCIES, STRENGTHS

3. CUSTOMER REQTS
   - PERFORMANCE
     operating characteristics, features,
     reliability/durability, aesthetics
   - TIME, COST, QUALITY

4. QFD
IDENTIFYING CUSTOMER NEEDS

1) Who are they?
   
   • External Customers
   
   • Internal Customers
   
     1) Management
     2) Manufacturing
     3) Sales
     4) Field Service Personnel

2) What do they want?
   
   • Interviews with present and potential customers
   
   • Focus Groups
   
   • Customer Surveys
   
   • Customer Complaints
Compact Disc Case
Product Improvement Survey

A group of students in ENES 190 is attempting to improve the design and usefulness of the standard storage case for compact discs. Please take 10 minutes to fill out this customer survey and return it to the student marketer.

Please indicate the level of importance you attach to the following aspects of a CD case.

1 = low importance     5 = high importance

1. A more crack-resistant case
2. A more scratch-resistant case
3. A hinge that doesn't come apart
4. A more colorful case
5. A lighter case
6. A streamlined look (aerodynamically sleek)
7. A case that fits your hand better
8. Easier opening CD case
9. Easier extraction of the CD from the circular fastener
10. Easier to take out leaflet describing contents of the CD
11. A more secure locking case
12. A waterproof case
13. Make the case from recyclable plastic
14. Make the cases interlock so they stack on each other without slipping

Please list any other improvement features you would like to see in a CD case.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Would you be willing to pay more for a CD if the improvements you value with a 5 or 4 rating are available on the market? yes no

If you answered yes to the previous question, how much more would you be willing to pay? ________

How many CD's do you own (approximately)? _____________
QUALITY FUNCTION DEPLOYMENT (QFD)

- Customer Requirements → Measurable Design Targets
- Graphical Method
- Group Activity
- ‘House of Quality’
FIGURE 2.4
House of quality format for QFD. Numbers of "rooms" correlate with description in text.
### QFD Table for the Compact Disc Case Example

<table>
<thead>
<tr>
<th>Strength</th>
<th>Toughness of plastic</th>
<th>Recyclable plastic</th>
<th>New hinge design</th>
<th>Time to open</th>
<th>Force needed to open</th>
<th>No. times to grab</th>
<th>Clearance / CD-case</th>
<th>Improved shape</th>
<th>Flat side / top &amp; bottom</th>
<th>Cost of manufacture</th>
<th>Customer importance</th>
<th>CD case on market</th>
<th>Planned CD case</th>
<th>Improvement ratio</th>
<th>Sales points</th>
<th>Improvement ratio</th>
<th>Relative weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Crack-resistant case</td>
<td>9</td>
<td>1</td>
<td></td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>1.3</td>
<td>1.5</td>
<td>9.9</td>
<td>0.14</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>2. Scratch-resistant case</td>
<td>9</td>
<td></td>
<td></td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>1.0</td>
<td>1.0</td>
<td>4.0</td>
<td>0.06</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Hinge doesn't come apart</td>
<td>9</td>
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<td>4</td>
<td>3</td>
<td>5</td>
<td>1.7</td>
<td>1.0</td>
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<td>0.10</td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Ergonomics</strong></td>
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<td></td>
<td>4</td>
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<td>5</td>
<td>1.7</td>
<td>1.5</td>
<td>10.2</td>
<td>0.15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Easier opening</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>1.7</td>
<td>1.5</td>
<td>10.0</td>
<td>0.15</td>
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<td></td>
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<tr>
<td>5. Easier to remove leaflet</td>
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<td>4</td>
<td>2</td>
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<td>1.0</td>
<td>8.0</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Easier extraction of CD</td>
<td>9</td>
<td></td>
<td></td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>1.0</td>
<td>1.0</td>
<td>4.0</td>
<td>0.06</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>7. Fits hand better</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>1.0</td>
<td>1.0</td>
<td>2.0</td>
<td>0.03</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>New features</strong></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>1.3</td>
<td>1.0</td>
<td>3.9</td>
<td>0.06</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>8. More secure locking</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>1.3</td>
<td>1.0</td>
<td>5.2</td>
<td>0.07</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>9. Recyclable plastic</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>1.7</td>
<td>1.5</td>
<td>10.2</td>
<td>0.15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Stacking stability</td>
<td></td>
<td></td>
<td></td>
<td>9</td>
<td>5</td>
<td>5</td>
<td>1.0</td>
<td>1.0</td>
<td>5.0</td>
<td>0.07</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Cost</td>
<td></td>
<td></td>
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<td>9</td>
<td>5</td>
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<td>1.0</td>
<td>1.0</td>
<td>5.0</td>
<td>0.07</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Abs. importance</strong></td>
<td>2.0</td>
<td>0.19</td>
<td>0.83</td>
<td>0.07</td>
<td>0.11</td>
<td>0.94</td>
<td>0.05</td>
<td>0.45</td>
<td>0.02</td>
<td>2.0</td>
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<td>0.27</td>
<td>0.35</td>
<td>0.14</td>
<td>0.35</td>
<td>0.63</td>
<td>0.63</td>
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<tr>
<td><strong>Rel. importance</strong></td>
<td>9.59</td>
<td>0.89</td>
<td>0.14</td>
<td>0.15</td>
<td>0.15</td>
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<td>0.15</td>
<td>0.15</td>
<td>0.15</td>
<td>0.15</td>
<td>0.15</td>
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<td>0.15</td>
<td>0.15</td>
<td>0.15</td>
<td>0.15</td>
<td>0.15</td>
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<tr>
<td><strong>CD case now on market</strong></td>
<td>2.0</td>
<td>X</td>
<td>5.0</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Direction of movement</strong></td>
<td>X</td>
<td></td>
<td>5.0</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Target value</strong></td>
<td>5.0</td>
<td>2.0</td>
<td>6.0</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Units</strong></td>
<td>mile</td>
<td>0.6</td>
<td>oz</td>
<td>mph</td>
<td>1</td>
<td>sec</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
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<td>1.0</td>
<td>1.0</td>
<td></td>
</tr>
</tbody>
</table>

**FIGURE 2.5**

QFD table for the compact disc case example.
PRODUCT DESIGN SPECIFICATION

1. SUMMARY OF PURPOSE
   • PRODUCT PURPOSE AND INTENDED USE
   • PRODUCT MARKET

2. FUNCTIONAL REQUIREMENTS
   • PERFORMANCE MUSTS (NEEDS)
   • PERFORMANCE WANTS - PRIORITIZED
     operational steps
     physical (size, weight, shape,...)
     service environment (moisture, environmental impact, people safety,...)
     life, maintenance and repair
     manufacturing
     cost

3. SOCIAL, LEGAL, ETHICAL REQUIREMENTS
   • STANDARDS
   • SAFETY REGULATIONS/PRODUCT LIABILITY
   • PATENTS

USE A QFD DIAGRAM TO JUSTIFY PRIORITIZED WANTS AND SPECS.

WHAT IT SHOULD DO, NOT HOW IT WILL BE DONE!
<table>
<thead>
<tr>
<th></th>
<th>Mechanic</th>
<th>Marketing</th>
<th>Rider</th>
<th>Water hitting rider (%)</th>
<th>Steps to attach (#)</th>
<th>Time to attach (sec)</th>
<th>Steps to detach (#)</th>
<th>Time to detach (sec)</th>
<th>Number of parts (#)</th>
<th>Weight (g)</th>
<th>Customers finding it visually appealing (%)</th>
<th>Colors available (#)</th>
<th>Bikes that fits (%)</th>
<th>Upward release force (N)</th>
<th>Sales price ($)</th>
<th>Whale Tale</th>
<th>Norco</th>
<th>Raincoat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keeps water off rider</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td>9</td>
<td>3</td>
<td>9</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Fast to attach</td>
<td>5</td>
<td>4</td>
<td>8</td>
<td>3</td>
<td>9</td>
<td>3</td>
<td>1</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Fast to detach</td>
<td>9</td>
<td>5</td>
<td>10</td>
<td>3</td>
<td>9</td>
<td>3</td>
<td>1</td>
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<td></td>
<td></td>
<td></td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Can attach when dirty</td>
<td>7</td>
<td>13</td>
<td>12</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Can detach when dirty</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>3</td>
<td>9</td>
<td>3</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>3</td>
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<td>2</td>
</tr>
<tr>
<td>Human factors</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Easy to attach</td>
<td>4</td>
<td>6</td>
<td>9</td>
<td>3</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Easy to detach</td>
<td>10</td>
<td>7</td>
<td>11</td>
<td>9</td>
<td>3</td>
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<td></td>
<td></td>
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<td>4</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Looks fast</td>
<td>2</td>
<td>10</td>
<td>2</td>
<td></td>
<td></td>
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<td>4</td>
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<td>2</td>
</tr>
<tr>
<td>Color matches bike</td>
<td>12</td>
<td>11</td>
<td>5</td>
<td></td>
<td>3</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>3</td>
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<td>Interface with bike</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fits bike</td>
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<td>3</td>
<td>3</td>
<td></td>
<td>9</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>3</td>
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<td>4</td>
</tr>
<tr>
<td>Does not mar bike</td>
<td>8</td>
<td>8</td>
<td>6</td>
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<td></td>
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</tr>
<tr>
<td>Light weight</td>
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<td>Competitive sales price</td>
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<td></td>
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<td></td>
<td></td>
<td>9</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

**FIGURE 6.3**
House of quality for the Splashgard.
EXAMPLE. The CD jewel case given in Secs. 2.3 and 2.6 is continued here. From the information in Figs. 2.3 and 2.5 we can write the preliminary product design specification.

Product title
Compact disc jewel case.

Purpose
To provide an improved way to store and protect compact discs.

New or special features
Stronger; less susceptible to cracking on dropping.
Easier and quicker to open and extract the CD.
Easier to remove the descriptive leaflet.
More stable in stacking.

Competition
Will compete against standard hinged CD case produced by many plastics manufacturers.

Intended market
We will sell direct to largest producers of prerecorded music. Approximately 500 million CD jewel boxes are sold each year in the United States. Secondary market will be CD for computer games.

Need for product
User survey has shown customer interest in new features; 50 percent of people surveyed expressed willingness to pay a bit more for an improved product. Our business strategy is to produce a superior product at the existing cost to music producers.

Relationship to existing products line
This is a start-up venture. No other products currently exist.

Market demand
Current U.S. market is about 500 million units annually. We anticipate a 5 percent market share by year 2 (25 million units), growing to 20 percent share by year 5.

Price
We anticipate selling CD jewel cases at a unit price of $0.15 in bulk lots. The manufacturing cost should be no more than $0.12 per unit.
Functional performance

Protects the CD from dirt, scratches, spilled liquids.
Secures the CD firmly in the case.
Allows for easy opening of case.
Allows for stable stacking of many CDs.
Allows easy removal of descriptive leaflet.
Able to be dropped on floor from height of 3 ft without opening or cracking.

Physical requirements

Same size as regular CD case (5.5 × 4.87 × 0.4 in).
Approximately same weight as regular CD case.
Rectangular shape with rounded corners.
Smooth, but not slippery surface.
Transparent, so that identification material can be read on both sides.

Service environment

Case material should be stable from −20 to 120°F, 20 to 100 percent relative humidity.

Life-cycle issues

Opening/closure mechanism must not fail for 1000 cycles.
Case made from recyclable material.

Human factors

Allows display of artwork or advertisements on two large flat surfaces.
No sharp corners or edges to cause cuts or snag clothing.
Rounded edges give good “feel.”
Opening of case must be simple. Closure must be positive, and give an audible click.

Corporate constraints

Must be in market within 6 months.
Manufacturing will be contracted to suppliers.
Will use the trademark CD-EASE.
Must conform to corporate code of ethics.

Legal requirements

No toxic materials to be associated with manufacture.
Use of rosette to hold CD firmly in cradle will require license to U.S. patent. See U.S. patents 4613044, 5450951, and 5425451.