Please sit with your project team
DfM  Design for Manufacturing
DfA  Design for Assembly
DfC  Design for Cost
DfR  Design for Reliability
DfE  Design for the Environment
On an index card, write down two reasons why you, as a current future professional designer, might want to pay attention to DfE. Or in other words, why does it matter?
U.S. Recycling Rates

- Single-Use Cameras: 74%
- Corrugated Containers: 73%
- Aluminum Cans: 63%
- Steel Cans: 58%
- Bottles: 33%

www.kodak.com
Design for the Environment

• What if products were designed with ingenious connectors that allow quick and easy disassembly?

• What if all plastic parts in products were clearly marked by resin type, kept uncontaminated by paint, and no hazardous materials were used during manufacturing?
Product Design

- Function & Performance
- Customer Appeal
- Manufacturability
- Product Safety
- Environment
- Product Economics
DfE challenges

• Do you go with a snap-fit or an adhesive?
• Should your product be easy to take apart using destructive methods, or should it be designed for reuse after take apart using nondestructive methods?
• How do you determine the environmental cost of a component or material you purchased?
• Should you care about the amount of electricity used in the steel mini-mill to make the 1/8 inch sheet that is part of your product?
Product Life-Cycle

Manufacturing

End of Product Life

Use of Products
Stages in a product life-cycle

STAGE 1: Premanufacture

STAGE 2: Manufacturing

STAGE 3: Product distribution

STAGE 4: Customer use

STAGE 5: End of life
<table>
<thead>
<tr>
<th>Questions a design team could ask</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Supplier</strong></td>
</tr>
<tr>
<td>Are the parts and materials coming from</td>
</tr>
<tr>
<td>suppliers that have a good environmental track</td>
</tr>
<tr>
<td>record?</td>
</tr>
<tr>
<td><strong>Manufacture</strong></td>
</tr>
<tr>
<td>Is the use of hazardous materials avoided</td>
</tr>
<tr>
<td>during manufacturing?</td>
</tr>
<tr>
<td><strong>Distribution</strong></td>
</tr>
<tr>
<td>Is packaging minimized and is reusable</td>
</tr>
<tr>
<td>transport packaging (such as collapsible totes)</td>
</tr>
<tr>
<td>used to transport the product?</td>
</tr>
<tr>
<td><strong>Use</strong></td>
</tr>
<tr>
<td>Is the use of disposable 'one time use'</td>
</tr>
<tr>
<td>cartridges, containers, or batteries avoided?</td>
</tr>
<tr>
<td>Is the product energy efficient?</td>
</tr>
<tr>
<td><strong>End-of-life</strong></td>
</tr>
<tr>
<td>Is the product easy to disassemble for reuse</td>
</tr>
<tr>
<td>or recycling of materials?</td>
</tr>
</tbody>
</table>
DfE basics

• Entire life-cycle of a product is accounted for.

• First considered during the early stages of the design cycle.

• Specific design methods exist for good process.
DfE methods

• Assessment tools
  – Questionnaires
  – Impact analysis

• Design
  – Materials
  – Disassembly
  – Minimize energy

• Labeling
  – Use
  – Material identification
DfE methods

• Reduce the weight
• Replace a screw with a snap
• Minimize the number of parts
• Use standard parts
• Avoid regulated material
• Use recycled materials
• Label materials
• Minimize adhesives
Estimate pounds of batteries used per year (typical student)
Regulations

- The real driver
- Europe, Japan *way* ahead of the U.S.
- California leads the way
Want more?

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www.me.umn.edu/courses/me4054/dfe