Today in class:

• Review of the Design Process
• Design for Manufacture
  – No Spare Parts
• Books Assignment
• Readings
D-Lab
Design for Manufacture
DfM Definition:

Adapting a design to make it more easily manufactured and to reduce its manufacturing costs.
DfM Definition:

To give consideration at the design phase of a product how it will be manufactured.
DfM in the Product Development Process

Planning

Concept Development → System-Level Design → Detail Design → Testing and Refinement → Production
Special Considerations for Developing Countries

- Job creation
- Resource availability
- Supply chains
- Scale
- Replicability
Manufacturing Costs

Components
- Off-the-Shelf
- Custom

Assembly
- Labor
- Equipment & Tooling

Overhead
Four Paradigms

- Manufactured locally
  - Assembled locally
  - Maintained locally
- Manufactured in urban centers
  - Assembled locally
  - Maintained locally
Commonly Available Materials

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Car Parts
Bicycle Parts
Best Live-Action Manufacturing in Developing Countries Short Film

Image of “Oscar” film award trophy removed due to copyright restrictions.
Jigs & Fixtures
Keys to DfM in Developing Countries

• Understand manufacturing capabilities

• Incorporate the most accessible, affordable manufacturing techniques into your detailed design
Design for Assembly

"a process for improving product design for easy and low-cost assembly, focusing on functionality and on assemblability concurrently."

--Vincent Chan & Filippo A. Salustri
Design for Assembly

- Reduce cost of assembly
- Improve quality and reliability
- Reduce part inventory
- Reduce production equipment
Special Considerations for Developing Countries

- Job Creation
- Resource Availability
- Scale
- Repeatability
Assembly Methods

- Manual assembly
- Fixed automatic assembly
- Flexible automatic assembly

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Design Guidelines for Manual Assembly

• eliminate the need for workers to make decisions or adjustments.
• ensure accessibility and visibility.
• eliminate the need for assembly tools and gauges (i.e. prefer self-locating parts).
Basic DFA Guidelines

• minimize the number of different parts - use "standard" parts.
• minimize the number of parts.
• avoid or minimize part orientation during assembly (i.e. prefer symmetrical parts).
• prefer easily handled parts that do not tangle or nest within one another.
Basic DFA Guidelines

• Minimize part count by incorporating multiple functions into single parts
• Modularize multiple parts into single subassemblies
• Assemble in open space, not in confined spaces; never bury important components or components that require maintenance
• Make parts such that it is easy to identify how they should be oriented for insertion
Basic DFA Guidelines

• Prefer self-locating parts
• Provide alignment features
• Eliminate fasteners
• Don’t put fasteners in places where you can’t get access to