**Design for Product Lifetime**

**Access a product's components.**

**Design for Disassembly**

Ensure products are easy to take apart quickly.

- **Parts**
  - Minimize the number of parts.
  - Simplify structure and form.
  - Use ferromagnetic materials to enable sorting and disassembly.

- **Tools & Fasteners**
  - Require only a few standard tools.
  - Avoid requiring tools for the most common actions.
  - Minimize the number and variety of fasteners.
  - Use intuitive snap-fits, clips, or sliding connections.
  - Design connections that are visually and physically accessible.
  - Access fasteners from the same axis.
  - Hold multiple parts with one fastener.
  - Use coarse threaded screws for speed; use nuts and bolts for strength.
  - Use human-scale fasteners.
  - Avoid glues, and use only glues that are easily soluble or heat reversible.
  - Ensure fasteners are adequate for structural integrity.
  - Use fasteners that will hold up over repeated use.

- **Documents**
  - Embed clear, graphical disassembly instructions onto the product.
  - Document materials and methods for deconstruction for the user.

**Design for Repair**

Ensure product repair is simple for everyone.

- **Product Architecture**
  - Use modular assemblies that enable the replacement of discrete components.
  - Ensure easy access to parts likely to need maintenance.
  - Use self-locating parts.
  - Use robust connectors.
  - Label and color-code parts to enable troubleshooting.
  - Standardize between product lines and across generations.

- **Documents**
  - Make technical documentation freely available or open-sourced.
  - Include parts list and part numbers.
  - Create user interfaces and troubleshooting tools to diagnose problems.

- **Business**
  - Make repair and services options clear to customers.
  - Consider repair-friendly warranty terms.
  - Make replacement parts available and affordable.

**Design for Upgrade**

Keep products relevant and useful longer.

- **Product Architecture**
  - Use standard-size modular parts to enable interchangeability and customization.
  - Design easy access to parts likely to become obsolete.
  - Use standard, cross-platform connections (for example, USB).

- **Documents**
  - Build diagnostic tools to help users understand the components that are limiting performance.

**Design for Recycling**

Make it easy to properly dispose of the product.

- **Materials**
  - Choose materials that are recycled everywhere.
  - Minimize the number of materials used. When possible, use only one.
  - Label parts with recycling codes or other permanent ways to identify materials.
  - Avoid paints, additives, and surface treatments. Use inherent color.
  - Avoid combinations of materials that are difficult to separate.
  - Make it easy to separate components that are hazardous, toxic, or not conventionally recyclable.

- **Business**
  - Specify the use of recycled materials in your products (this also helps stimulate demand for recycling).
  - Create easy take-back programs to ensure proper disposal of complicated products.

**Design for Remanufacturing**

Enable reuse of old components in new products.

- **Business**
  - Create product-as-service business model.
  - Design smooth touchpoints between the company and users.
  - Design a quality-control system for testing returned components.