Implementation

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- Proof of Concept
  - Functionally equivalent but incomplete representations tested in a controlled environment
  - Model certain relevant characteristics and apply those models to potential designs
- Models
  - Models are designed to behave in the same way as the real processes or systems but under certain conditions
- Prototypes
  - A prototype is the first of its kind
  - Prototypes are used to demonstrate that a product will function as designed, tested in actual/uncontrolled/real world operating environments
- What does your first prototype look like?
  - A proof of concept
  - Depends on your design, budget, goals
  - For the initial demo, use household items to show the functionality of your design
- Refining your Prototype
  - Mock-ups
    - Construct a mock-up of a 3D part from 2D cutouts
    - These 2D parts can be made using vinyl cutter or a laser cutter
    - Parts are then assembled into 3D mock-ups of design
    - Materials used for these mock-ups might be foam, thin plastic, or wood

  - Machining
    - Woodworking machines
    - Metal shop
  - Rapid Prototyping
    - A group of techniques used to fabricate a scale model of a physical part or assembly using three-dimensional computer-aided design (CAD) data
    - 3D printing is one of those techniques: Convert these 3D files into thin 2D layers to build the 3D part

- Planning
  - Determine the Critical Path
    - List your goals
    - Identify the main tasks
    - Identify subtasks
  - Evaluate tasks
    - Estimate durations
    - Estimate support
    - Estimate materials
  - Organize those tasks
    - Allocate the time needed
    - Assign to team members
    - Budget for materials

- Industry Barriers to Implementation
  - Manufacturing costs
  - Maintenance costs
  - Lack of suitable materials
  - Unreasonable labor demands
  - Unsustainable practices

- Design for X
  - X can be:
    - Manufacturing
    - Sustainability
    - Reliability
    - Quality

        * Maintainability
        * Disassembly
        * Recyclability

- Commonly Added Objectives
    - Minimize cost to us
    - Minimize price for consumer
    - Decrease time to market
    - Minimize maintenance and repair costs
    - Maximize level of quality and reliability
    - Make the design upgradable

- Design for Manufacturing Guidelines
    - Use standard parts
    - Design for an assembly line
        * Use machine assembly
        * Minimize number of assembly operations
        * Minimize tolerances for easy assembly
        * Provide access points for assembly
    - Minimize number of parts
        * Design parts to be multifunctional
        * Minimize part variations
        * Use reusable models and subassemblies
        * Avoid separate fasteners

- Design for Sustainability
    - Overall Design
        * Dematerialize the product
        * Use materials with low resource requirements
    - Manufacturing
        * Reduce process resource consumption
        * Reduce process emissions
        * Consider process and background and foreground supply chains
        * Dematerialize the product chain
        * Improve factory safety and ergonomics
        * Improve factory economics