Phase 1: Planning/Specification Development

1. Establish Need (Target Market)
2. Form Design Team
3. Understand Design Problem
4. Develop Project Plan
5. Generate Design Records (1)

Iterate

Design Review

Terminate Project

Phase 2: Conceptual Design

Big Idea!

Source: D.G. Ullman, The Mechanical Design Process
Phase 1: Planning/Specification Development

- Establish Need
  - What problem is solved by your product?
  - What need does it fulfill?
  - What market does it serve?
  - Who is your target customer?

- Form Design Team
  - What skills/services do you need that you cannot provide on your own?
    - Product Design
    - Industrial Design
    - Plastic Part Design
    - Tooling Design
    - Contract Manufacturing
  - Is there someone in your network that can provide these services, or do you need to outsource?

- Understand Design Problem
  - Identify and define the fundamental design problem
    - Identify your customer(s)
    - Identify end user
    - Identify customer requirements
    - Translate customer requirements into a technical description for design
    - Identify functional performance requirements
    - Identify time constraints
    - Identify cost requirements

- Develop Project Plan
  - Identify tasks required to complete project
  - State objectives for each task and resources required to complete each task
  - Determine timing required to complete each task, and sequencing of tasks
  - Develop project budget

- Generate Design Records (Phase 1)
  - Inventors/Design notebook. Use a bound journal with numbered pages. Sign and date all entries and have witness sign as well.
  - Use notebook to document design for patent purposes.
  - Record findings of all previous tasks to date (listed above) concerning project.
    - Schedule document (Gantt Chart or other form of schedule)
    - Customer requirements, Task Titles, Budget, etc...
    - Rough Sketches

- Design Review
  - Gather documentation and prepare presentation for design review
    - Present to Managers, Investors, Other Team Members
    - At the conclusion of reviewing the design, decide if the project can move to Phase 2. If not review new problems discovered during review or terminate the project.

Source: D.G. Ullman, The Mechanical Design Process
Phase 1: Planning

Phase 2: Conceptual Design

- Generate Concepts
- Evaluate Concepts
- Update Plans
- Generate Design Records (2)

Design Review

Iterate

Phase 3: Product Design

Terminate Project

Source: D.G. Ullman, The Mechanical Design Process
Phase 2: Conceptual Design

– Generate Concepts
  • Based on what has been learned in the Planning phase, begin to develop more detailed sketches of the product
  • Form follows function. Develop the form that is desired around the function that is required
  • Generate concepts for each function of your product and then combine the concepts into a cohesive unit
  • Use common sense and creativity. Every combination of individual concepts will not be feasible
  • Generate multiple overall product concepts so that the best can be chosen for further development
  • Build/Obtain Prototypes (SLA, Foam Models, SLS, 3D Printing, etc...)

– Evaluate Concepts
  • Feasibility
  • Technology required and available
  • Cost
  • Marketability
  • Manufacturability
  • Evaluate Form, Fit, and Function of Prototypes

– Generate Design Records (Phase 2)
  • 2D CAD Prints/3D CAD Models (Preliminary)
  • Patent Search

– Update Plans
  • Reevaluate Schedule and Budget
  • Evaluate Demand and determine forecast for production volume
  • Obtain Tooling Quotes for Prototype and Production Tooling
  • Based on updated plans revisit any other area of Conceptual Design before proceeding to Design Review

– Design Review
  • Based on all evaluations make decision to proceed to Product Development, Terminate Project, or revisit part of the Conceptual Design Phase.

Source: D.G. Ullman, The Mechanical Design Process
Phase 3: Product Design

- Generate Products
- Evaluate Products
- Generate Design Records (3)
- Production Release
- Production
- Iterate
- Terminate Project

Phase 2: Conceptual Design

Source: D.G. Ullman, The Mechanical Design Process
Phase 3: Product Design

- **Generate Products**
  - Obtain parts off of Prototype Tooling, or through other prototyping means that produces production quality parts.
  - Obtain all required components and complete a sample build. Sample build parts are typically built in a lab/garage, etc. Pilot build will utilize production equipment to build parts. Build enough units for product testing and/or field testing.
  - Use samples to supply to manufacturer (contract manufacturer or in-house manufacturing department) so that production fixtures can be designed and built based on a physical product sample.

- **Evaluate Products**
  - Submit parts to a lab where product testing can be performed. Test plan should be developed to test product in a way simulates how the product will be used by the end user in the field.
  - Test product in actual end usage application through field testing. Place products with individuals who will use the product in a realistic manner, and who will provide substantive feedback on product performance, aesthetics, and any other areas of concern.
  - Submit parts to a certified lab for certification testing. Research any testing that will be required by UL, CSA, NSF, WQA, or any other regulatory body for which your product will require certification.
  - Certification testing can be done concurrently with other testing, however be careful to make sure that the product design is as close to its final state as possible as certification testing will be expensive and time consuming.

- **Generate Design Records (Phase 3)**
  - Detailed 2D CAD Prints
  - 3D CAD Models (Final)
  - Bill of Materials (BOM)
  - Cost Roll-up (Materials, Labor, Overhead, etc...)
  - Patent Application (if patentable)
  - Test Reports

- **Production Release**
  - Qualify and release all production tooling (Injection Molds, Stamping Dies, etc...)
  - Pilot Build prior to release. *Pilot Build is to be completed with production ready components built on production equipment. The purpose of the pilot build is to test the manufacturing process and make sure the product can be built to specification.*
  - Finalize cost structure.
  - Finalize all production fixtures.

Source: D.G. Ullman, The Mechanical Design Process