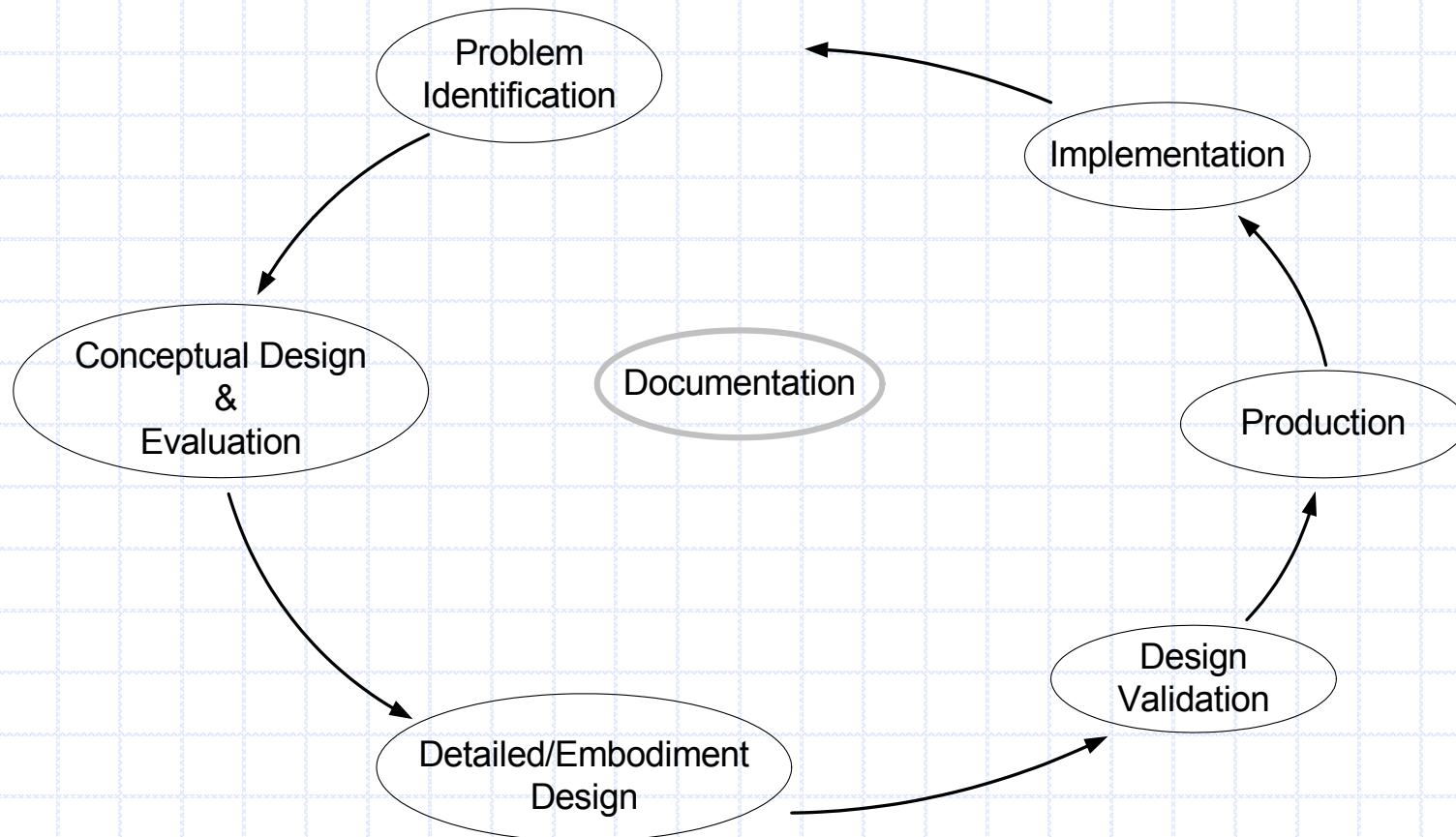


Design Process Overview

Professor Frank J. Fronczak
Mechanical Engineering Department
&
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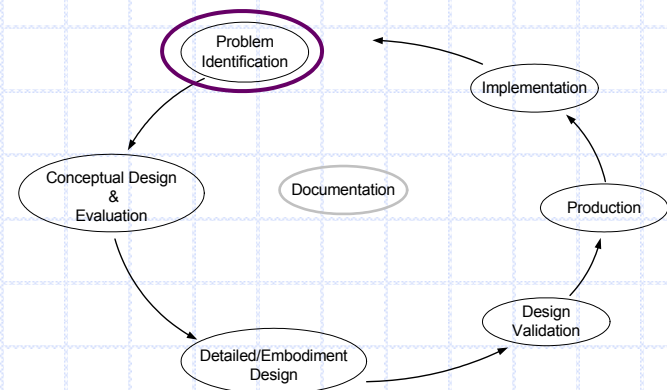
Design Process - *Idealized*



Design Process Overview

Problem Identification

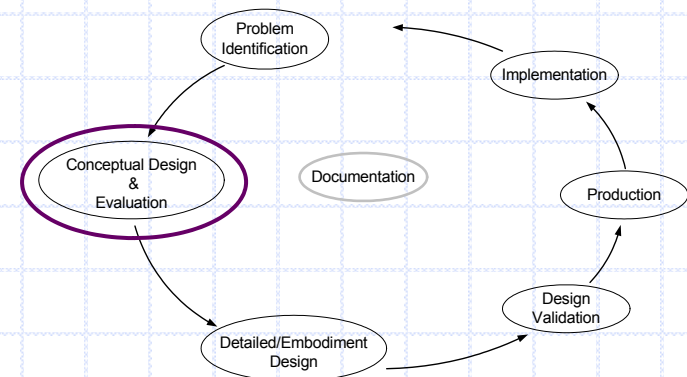
- Problem Statement
 - Concise statement of the needs
- Design Specification
 - Detailed transformation into engineering specifications



Design Process Overview

Concept Generation

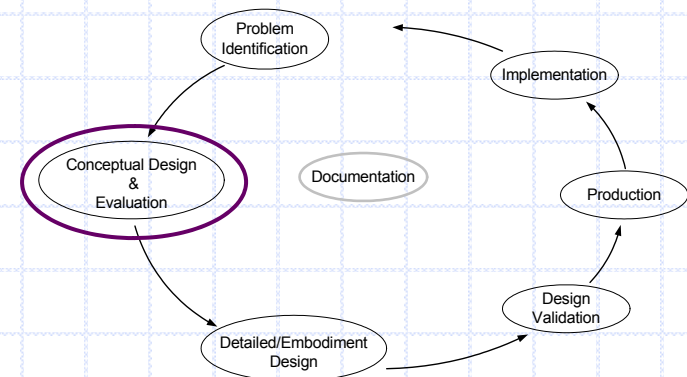
- Generate Multiple Potential Solutions
 - Functional decomposition
 - ◆ Physical → Abstract
 - Energy
 - Material
 - Information
 - Brainstorming
 - ◆ Osborne's Checklist
 - Morphological Chart



Design Process Overview

Concept Evaluation

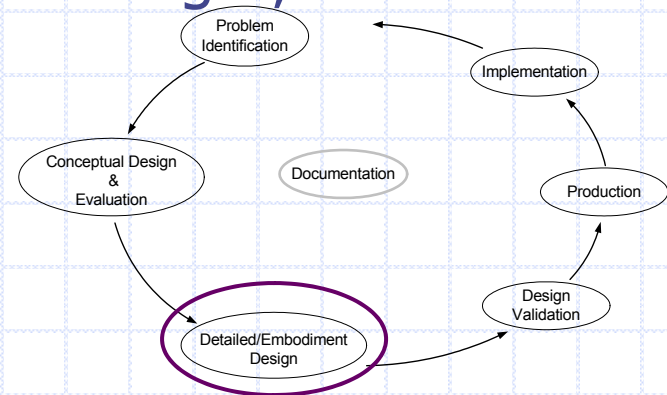
- Identify Most Promising Option
 - Feasibility
 - Pros and Cons
 - Formal optimization
 - Controlled Convergence Chart



Design Process Overview

Embodiment Design

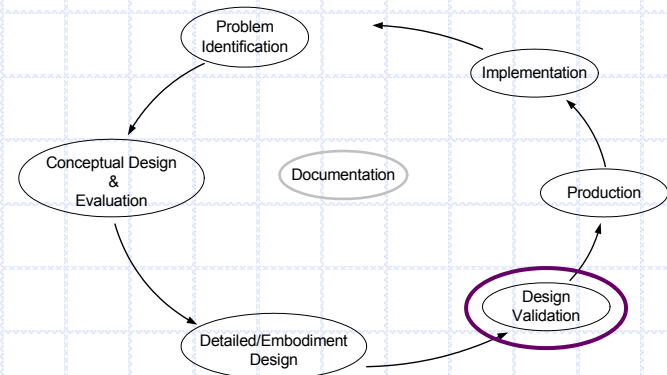
- Working out the details
 - Design for DFX
 - ◆ Safety
 - ◆ Manufacturability
 - ◆ Assembly
 - ◆ Environment
 - ◆ Effective material usage – strength, stiffness
 - ◆ Ergonomics
 - ◆ Etc.



Design Process Overview

Design Validation

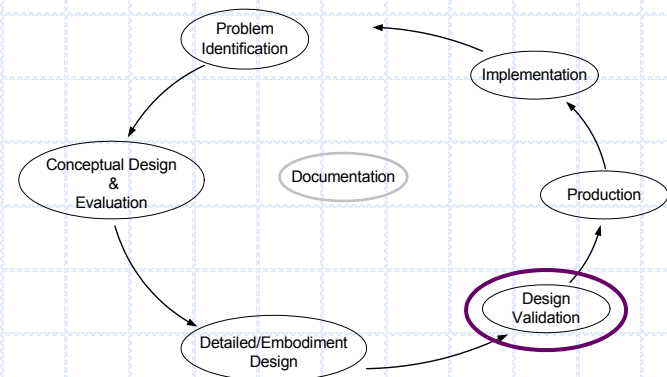
- Improving the odds that it will work as planned
 - Analysis
 - Testing



Design Process Overview

Design Validation - *Analysis*

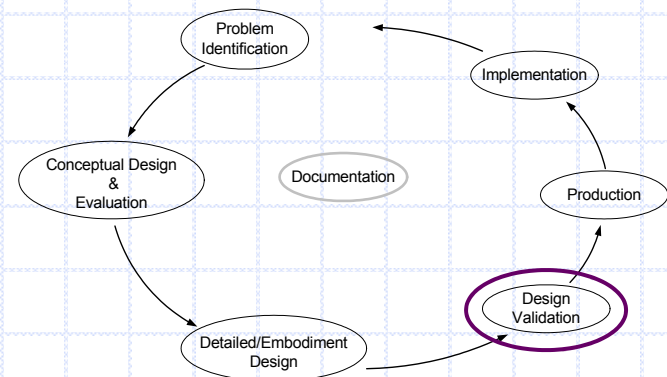
- Analysis
 - Classical
 - ◆ Simplified
 - ◆ Comprehensive
 - Computational
 - FEA
 - CFD
 - Simulation
 - Kinematic
 - Dynamic
 - Etc.



Design Process Overview

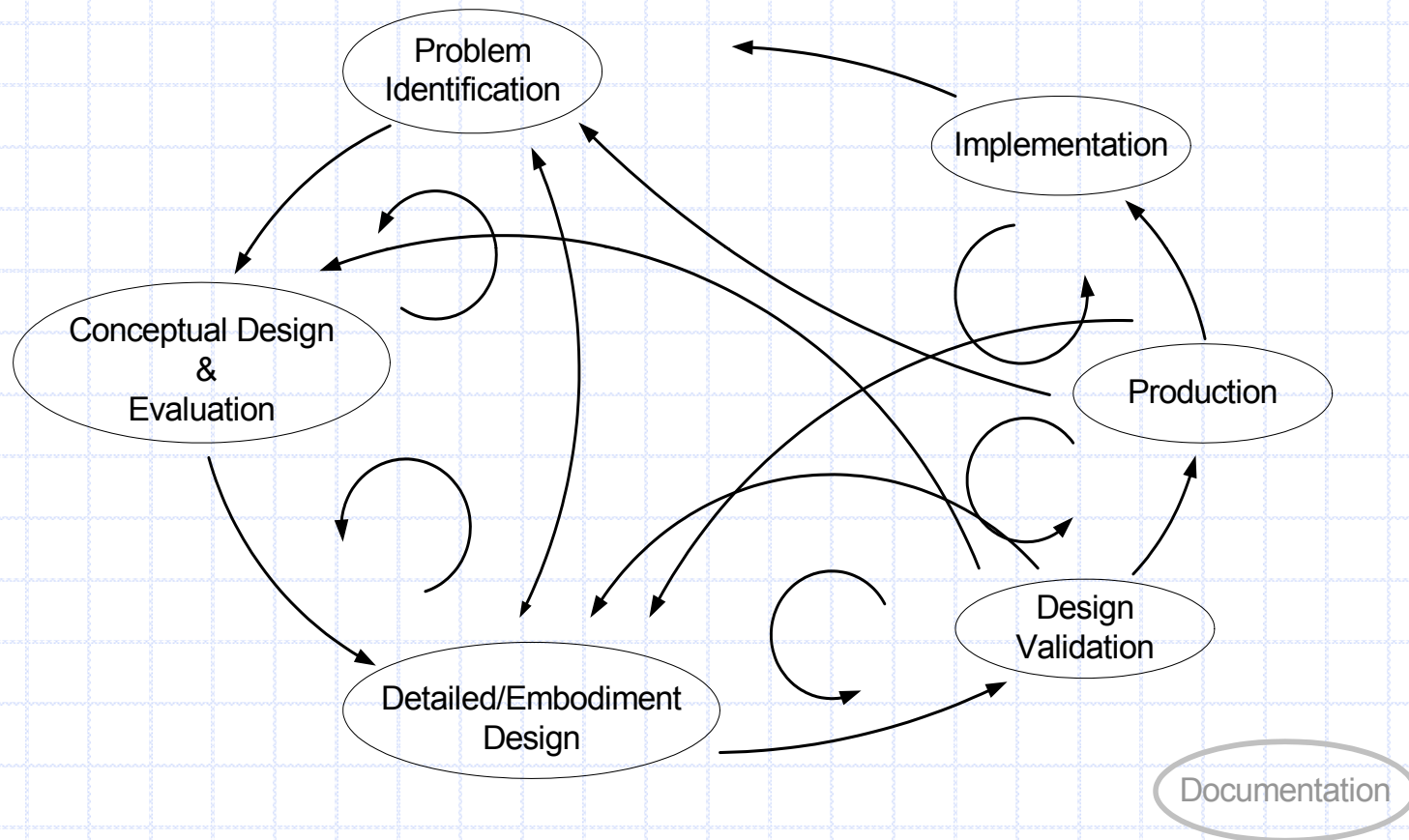
Design Validation - *Testing*

- Mock-ups
 - Spatial/layout issues
- Proof-of-concept devices
 - Independent functional issues
- Prototypes
 - Operational issues



Design Process Overview

Design Process - *Actual*



Design Process Overview

What it Takes

- Knowledge
 - Engineering, math, and science principles
 - Technology
- Skill
 - Ability to utilize knowledge
- Attitude
 - Explorer
 - Persistence

Selected References

- *The Mechanical Design Process*, David Ullman
- *Engineering Design Methods – Strategies for Product Design*, Nigel Cross
- *Engineering Design – A Project Based Introduction*, Clive Dym and Patrick Little
- *Engineering Design – A Materials and Processing Approach*, George Dieter
- *Engineering Design – A Systematic Approach*, Pahl and Beitz