동국대학교
dongguk university

Capstone Design

The Engineering Design Process

Department of Computer Science and Engineering

Engineering Design Processes

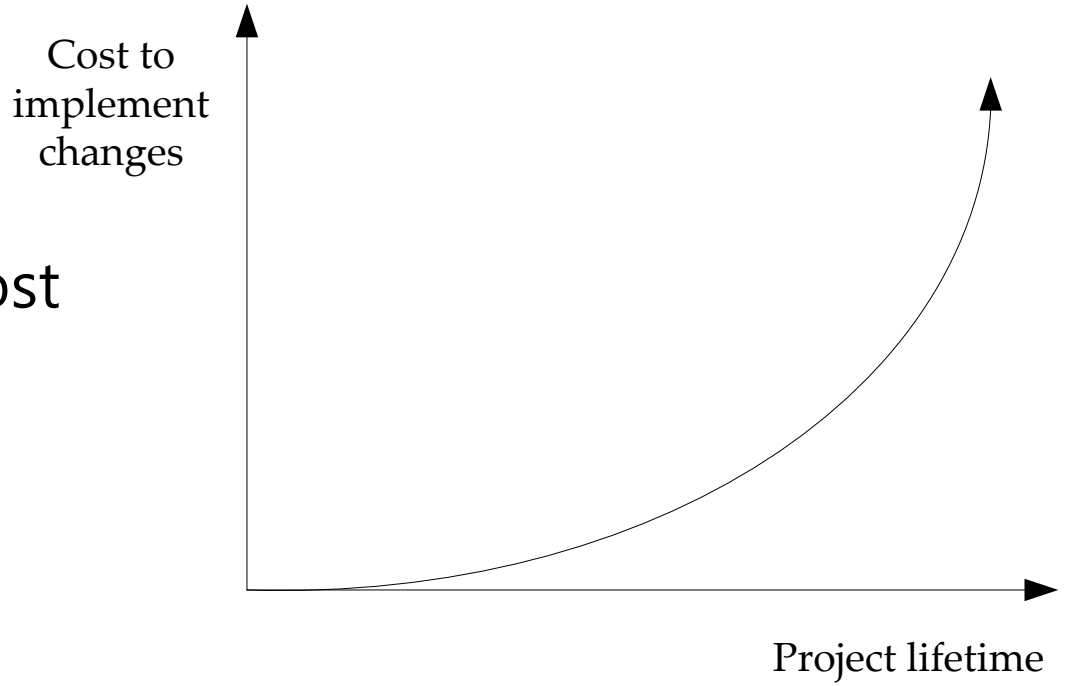
What is a design process?

Engineering design is the process of devising a system, component, or process to meet **desired needs**. It is a decision-making process (often iterative), in which the basic sciences, mathematics, and engineering sciences are applied to convert resources **optimally** to meet a stated objective. Among the fundamental elements of the design process are the establishment of objectives and criteria, synthesis, analysis, construction, testing, and evaluation. [ABET]

Design Processes – WHO CARES?

What is the value of the design process?

How much does it cost
to correct problems
as process proceeds?



Elements of the Design Process

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- Research phase
- Requirements specification
- Concept generation
- Design phase
- Prototyping and construction phase
- System integration
- Maintenance phase

Research Phase

- In the **research phase** the design team conducts research on the basic engineering and scientific principles, related technologies, and existing solutions.
- The objective is to **become experts on the problem**, save time and money by not reinventing the wheel, and be positioned to develop new and innovative solutions.

Requirements Specification

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- The **requirements specification** articulates what the system must do for it to be successful and to be accepted by the customer.
- It is important to focus on what the system must do, as opposed to how the solution will be implemented.
- This is challenging since engineers tend to focus on solutions and propose implementations early in the process. This is not surprising since engineering education focuses on solving problems instead of specifying them.

Concept generation

- In **concept generation**, many possible solutions to the problem are developed.
- The hall mark of design is that it is **open-ended**, meaning that there are multiple solutions to the problem and the objective is to develop the one that best meets the requirements and satisfies the constraints.
- In this phase, wild creativity is encouraged, but it is ultimately tempered with critical evaluation of the competing alternatives.

Design Phase

- In **design phase**, the team iteratively develops a technical solution, ultimately producing a detailed system design.
- Upon its completion, all major systems and subsystems are identified and described using an appropriate model that depends upon the particular technology being employed.

Prototyping and Construction Phase

- In the **prototyping and construction phase**, different elements of the system are constructed and tested.
- In rapid prototyping, the objective is to model some aspect of the system, demonstrating functionality to be employed in the final realization.
- Many prototypes are discarded or modified as the system evolves-the idea is to experiment, demonstrate proof-of-concept principles, and improve understanding.

System Integration & Test

- During **system integration**, all of the subsystems are brought together to produce a complete working system.
- This phase is challenging and time-consuming since many different pieces of the design must be interfaced, and the team must work closely to make it all work.
- Care taken in the design phase to clearly communicate the functionality and interfaces between subsystems aids in system integration.
- System integration is closely tied to the **test phase**, where the overall system is tested to demonstrate that it meets the requirements.

Maintenance Phase

- Ultimately the system is *delivered* to the customer where it is likely that it will be tested by a mutually agreed upon process.
- Development does not necessarily end when the system goes into service, as it will likely enter the **maintenance phase** where it is maintained, upgraded to add new functionality, or design problems are corrected.
- Following and understanding the design process improves the probability of successful system development.

Summary

- Engineering design is an iterative process.
- Design problems are open-ended with many potential solutions.

In addition,

“Working with others” means

- “If you have an apple and I have an apple and we exchange these apples then you and I will still each have one apple. But if you have an idea and I have an idea and we exchange these ideas, then each of us will have two ideas.”

  - George Bernard Shaw, writer (1856-1950)

- And from those two ideas, more idea may be easily followed, which could be better than the previous ones.

But, you should keep the manner

"I have learned that people will forget what you said, people will forget what you did, but they will never forget how YOU made them FEEL."