

Understanding the Concept of Design Engineering and Its Usage in Manufacturing Industry

Dr. Jatin Gupta

IEEE Member North Section.

Permanent Member International Association of Engineers,
Chitkara University Institute of Engineering and Technology
Chitkara University
Punjab, India
jatin.gupta.1988@ieee.org

Abstract: - The word engineering means the process of creating and implementing technical knowledge in practical usage forms of the applications. Design engineering is the process of making anything. It includes various steps like gathering the requirements from the user and then converting it into desired product which meets all the expectations of the user. In this paper, the concept of design engineering is explained in detail. There are number of design engineering available. It will explain all types of design engineering in brief. Also, it will provide advantages and disadvantages of design engineering.

Keywords: - Design Engineering, Types of Design Engineering, Advantages, Challenges.

Introduction: - The process of information gathering and turning those specifications in technical language in order to deliver application, product etc is called design engineering. The design engineer is qualified to understand the user needs and then turn them into functional systems. It takes a lot of time and effort to first understand the requirements and then turn them into working systems. There are number of different domains and in order to build applications in each domain, there is specific unique design engineering. Not all design engineers can work across all the available domains. There is specific and unique design engineer for each type of domain. Hence, there are variety of design engineering available.

There is particular design life cycle which the design engineer should follow in order to convert the specifications in a working functional system.

Design Engineering Process stages: - [1]



Figure 1. Design Engineering Stages.

1. Requirement identification: - This is the first step of the design engineering of any domain. The design engineer sits with the users to understand their requirements. They will ask certain set of questions to get clarification of what user want from the application that will be delivered to them. This step is very crucial as if the engineer is not able to get clear picture of the specification, then he will not be able to proceed further

in the life cycle and even if he does so than the end result will be totally different from the user specifications.

2. Provide possible ideas and solution: - In this step the design engineer will provide all possible solutions which can be followed in order to meet the users needs. This step is to watch all possible solutions and methods by which the designing can be started. The actual design will take place in later stages.
3. Research: - Based upon the specifications and possible solutions, the design engineer does not want to limit his findings and explore and research on the same using various mediums.
4. Analysis and alternative methods: - In this stage, the designer will do analysis of all the provided solutions and check if there are any limitations in following those solutions, if yes then he will start looking for other options.
5. Selecting particular solution and start prototype: - Once the designer follows all the above-mentioned stages, it is time for him to decide the method and then he will start designing the prototype of the application based upon the outputs of the previous stages.
6. Testing the prototype: - Once the designing of the prototype is ready the designer will start testing the prototype. If everything goes well then, the designer will start designing the actual product. In case there is an issue in the prototype and the testing gives bugs then the designer will rectify them or else will start making the prototype again till the time he gets the prototype without any errors.
7. Redefine the scope and solution: - If the prototype is tested and giving bugs then the designer will discard that prototype and will start the prototype designing phase again. In this process he might redefine few characteristics or do some modifications to make sure that the prototype is free of bugs.
8. Communication: - Once the design engineer is satisfied from his prototype results, he will start designing the actual solution and, in the end, he will communicate it to the developers who will turn the designing into coding and then to final product.

Hence, the design engineer will undergo all the above-mentioned steps in order to create design which is reliable and gives best possible solutions.

Types of Design Engineering: -

The main two categories of design engineering are: -

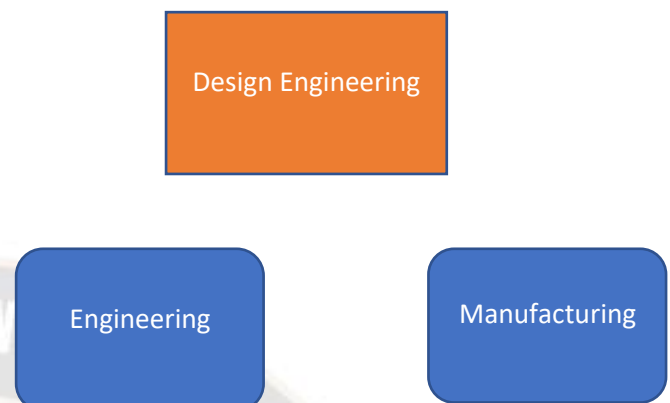


Figure2 Design categories.

- Engineering: - The concept of design engineering is used in converting the ideas, solutions, methods into technical working applications. There are many domains of design engineering.
- Industrial design engineering: - This is related to the designing of manufacturing process of the industries. The technical scope of the manufacturing is done under this category.

The difference between industrial design and industrial engineering is that they both focus on the process of converting user specifications into final product but they both follow different procedures to do so.

Categories of Design Engineering: -

- Civil Engineering
- Mechanical Engineering
- Electrical Engineering
- Manufacturing Engineering
- Software Engineering

The above-mentioned engineering are the main design engineering categories.

1. Civil Design Engineering: - This category of design engineering is related to the designing of the civil services like construction of the roads, bridges, towers, dams and so on. It is related to the construction of the buildings, roads, dams etc. This type of engineering will require various other engineering knowledge as well. The Civil Design engineer will gather all the information regarding the project. First, he will understand the user needs and then starts designing the flow charts, diagrams, etc of the project. He will even visit the site where the construction is supposed to take place. Analysis of the site is also mandatory before the beginning of the construction. It will

require other mathematical and scientific calculations to provide best possible solutions. There will be separate teams to decide about the type of material used, how much material will be used, from where to procure the material etc.

2. Mechanical design Engineering: - [2] This branch is related to the mechanics of the machines. This category of the design engineering is related to the designing of the machines. The designing of the machine will focus around the mechanism of the machines like it will study the strength of the materials, dynamics and statistics, etc. It will also decide the parts to be used in the machines like spring, pulleys, couplings etc. The designer should also focus on how the selected materials will be used to manufacture the final product. It is necessary that the mechanical engineer should study the thermodynamics of the machine to be manufactured. There are few challenges faced by the mechanical engineers.

Some of the clients needs faster delivery of their product, in such cases the mechanical design engineer has to work extra in order to deliver the prototype and manufacture the product faster, which is very difficult to achieve, as the designing of each component of the machine require study in detail.

3. Electrical design Engineering: - [3] As the name indicates, the electrical design engineer designs various electrical circuits of the devices and appliances. The task of electrical design engineer is to understand the mechanism of the appliance and then he can start designing the electrical circuits for the appliance to be in working conditions. First, they study the user specification document and based upon that starts suggesting the electrical circuits. They will research and start suggesting all the possible designs of the electrical circuit. The circuit design is then passed on to the manufacturing team who will convert the design into actual electric circuit. The electrical design engineer will provide full support during the manufacturing of the circuit. If there is any issue then the design engineer will check all the issues and helps to rectify. If there is any issue with the design then again, he will follow all the steps and will provide other circuit design.
4. Software Design Engineering: - The process of designing the software using various software approaches is called as software design engineering. The designer will undergo software life cycle approaches to provide best possible solutions to the team. The designing of the software is done at three levels: - [4]
 - Interface Design: - In this type of designing the design engineer will focus only on the designing of the interaction between the target and the audience. The engineer will focus only how the software responds to

the queries of the user. There is no internal designing of the software and only the outline of the software is designed in this phase.

- Architectural Design: - In this type of designing the parts of the designing which is ignored in the interface phase is completed in this stage. Identification of the components involved, its interaction, relation with other interfaces is done.
- Detailed Designing: -In this stage the final detailed designing of the whole software is done in detail. The internal designing if the software is completed in this stage. It will also involve the designing of flow charts, algorithms, data structures to explain the interaction of the various components of the system in detail.

5. Manufacturing Design Engineering: - [5]

This category of the design engineering is part of mechanical engineering which focuses on the process of designing and manufacturing of the product, machines etc. The design engineer studies the specifications of the product or machine and then provide with all possible manufacturing solutions. They also help to enhance the existing manufacturing process based on their knowledge which will result in efficient final products/machines. Following is the life cycle of the designing of the manufacturing process.

- Specification identification: - The design engineer will identify all the product needs and document all the details. Based upon this, he will decide the manufacturing process to be used.
- Designing: - Once the manufacturing process is selected, the design engineer will start designing the components of the product to be manufactured. He will draw all the necessary flow charts and diagrams to explain how the units or components of the product interacts with each other.
- Procuring material: - Based on the type of product to be made, the materials required to begin the manufacturing process is done in this stage. The designer will help to identify that which type of material will be best for manufacturing the product. He will also assist in identifying the mechanical factors to be considered while selecting the materials like which thermal qualities to look for, whether the material is durable etc.
- Identifying environment: - In this stage the environment under which the final product will work is identified.
- Evaluation: - Once all the stages are done then the evaluation of the product based on security basis is tested in this stage. It is tested whether the final product will function properly under all conditions and also it is if following and meeting all the standards protocols of the industries and the users.

Conclusion: - Hence this paper has explained the concept of Design engineering in detail. There are certain advantages of the design engineering and at the same time there are certain challenges faced by the design engineer. The responsibility of the design engineer in manufacturing industries is very crucial. But if has sound knowledge then he can provide best possible solutions and helps in the manufacturing process of the products.

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