Forward Engineering Design

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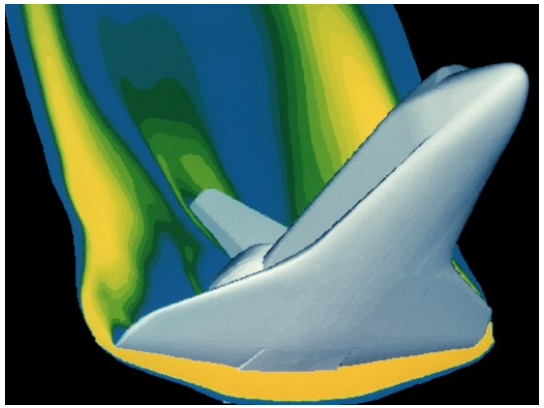
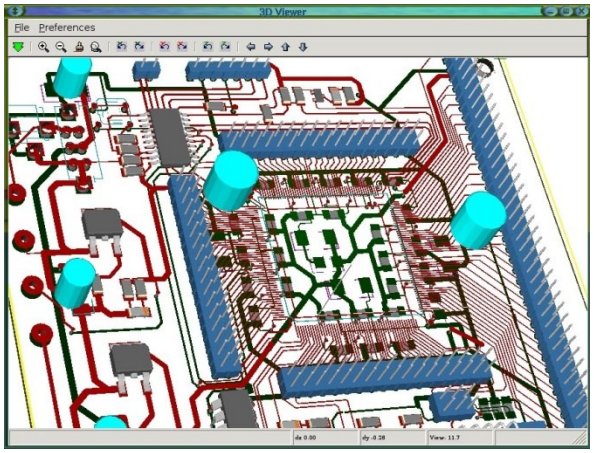
Introduction

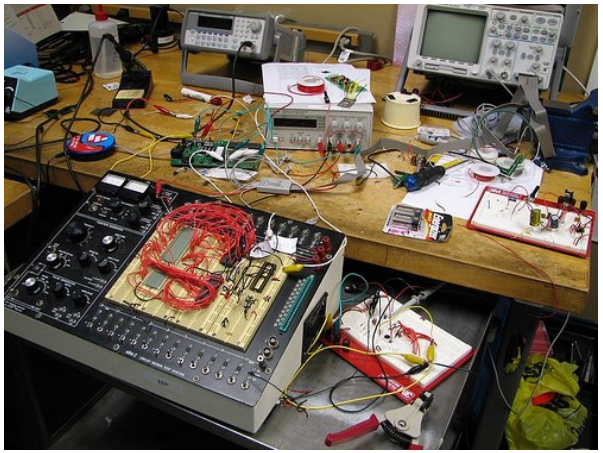
- In order to better understand the concepts and methods used in Reverse Engineering, it is necessary to review Engineering Design, which we refer to as forward design.

- In this presentation, the forward design is described as a seven step process.

What is Design?







Design

- Design is the process of originating and developing a plan for a new product.
- Engineering design is a scientific philosophy and therefore might vary between different schools of thought.
- Designing normally requires considering the product functionality which usually requires considerable research, thought, modeling, interactive adjustment, and re-design.

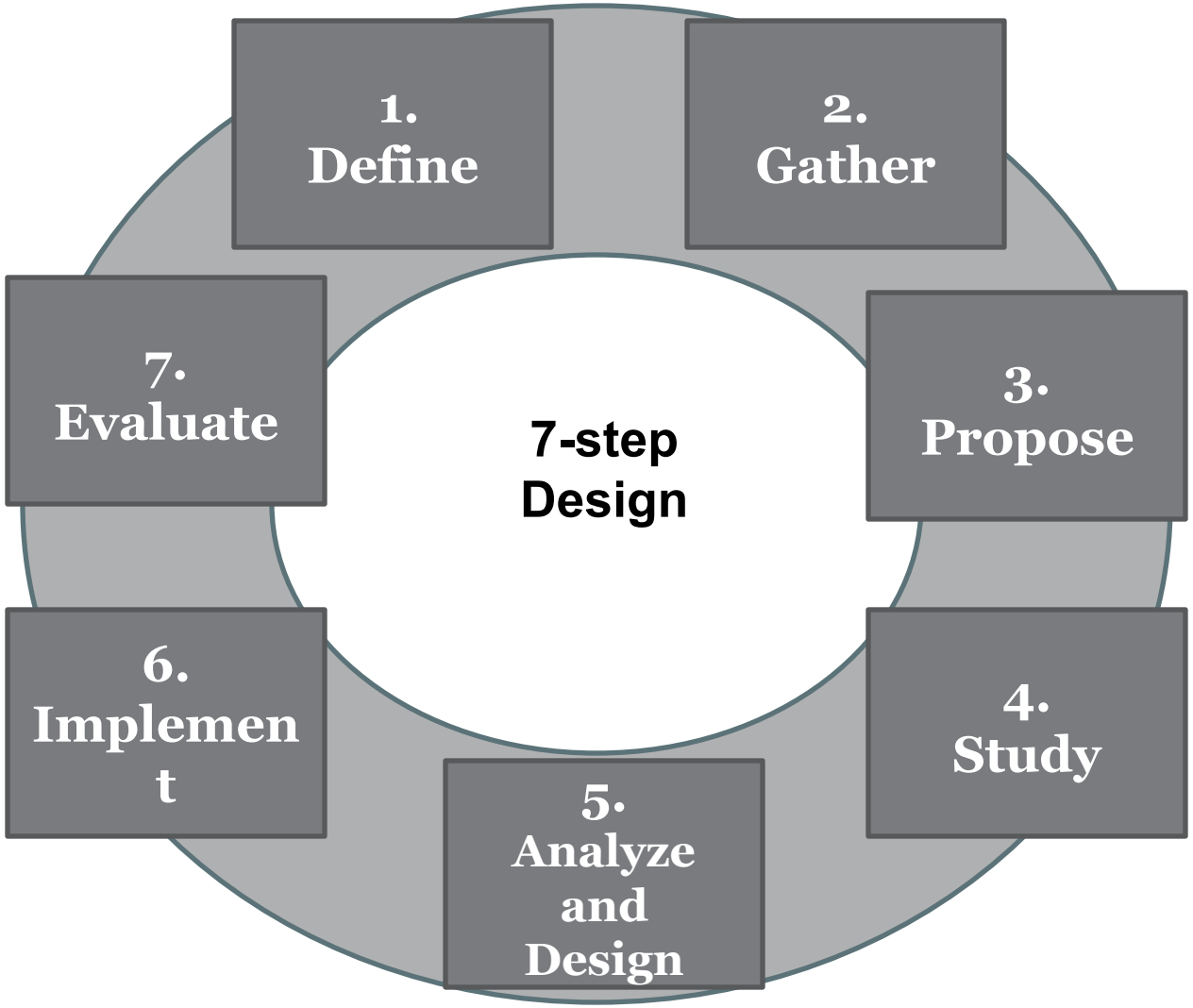
Engineering Design Process

- The Accreditation Board for Engineering and Technology defines the engineering design as

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 resource 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.

Seven Design Steps

1. **Define** the Problem
2. **Gather** Information
3. **Propose** Solutions
4. **Study** the Solutions
5. **Analyze** and **Design** the chosen solution
6. **Implement** the Design
7. **Evaluate** Performance


1. Define
2. Gather
3. Propose
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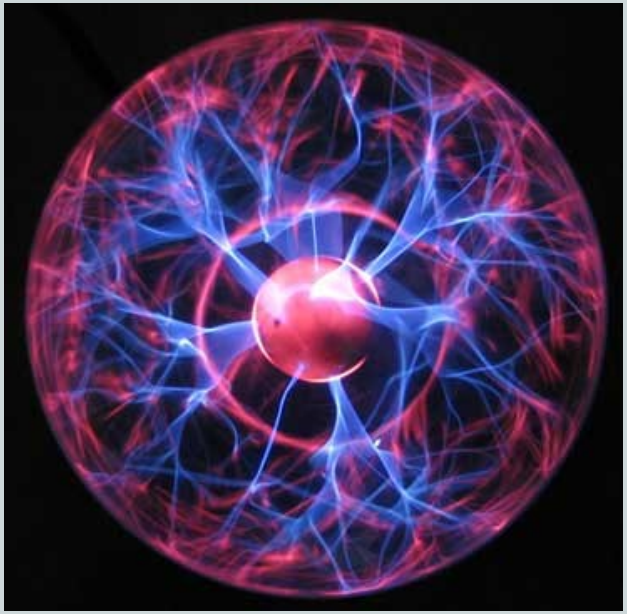
6. Implement
7. Evaluate
7-step Design

1. Define the Problem

- Society discovers a need and then presents that need to the engineering firm.
- Engineers must understand the customer needs and market requirement in order to establish a clear goal using a set of objectives and constraints
- A clear identification of the problem is the first step in any design process.



2. Gather Information

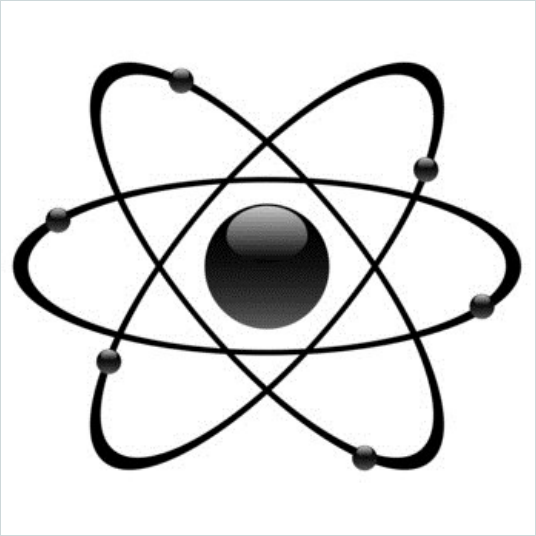
- Collect information through literature review
- Conduct thorough research about the problem
- Study all relevant products that might already exist in the market

3. Propose Solutions

- Find possible solutions through Brainstorming, free and creative thinking
  - Don't think about feasibility at this stage
- Generate preliminary solutions
  - Several designs should be proposed
  - A list of the possible solutions is made and the pros and cons of each solution are discussed

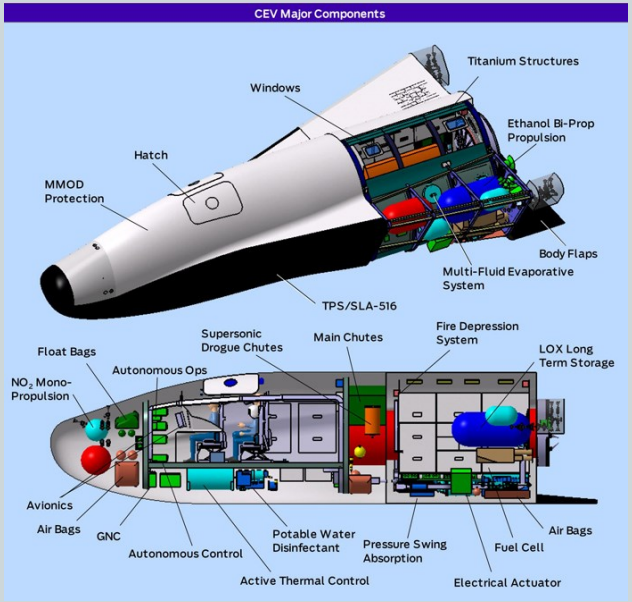
4. Study the Solutions

- Evaluate all the proposed designs detailing the strengths and weaknesses
- The study/analysis is composed of
  - Feasibility Study
    - Eliminate ideas without consuming time
  - Preliminary Design
    - General design
- Choose a Solution (Design)
- Might need to re-visit the design objective



5. Analyze and Design

- Use Engineering and Math skills to study the proposed design in order to transform it to reality
- All components / subsystems should be analyzed in details
- Hand Calculations, Modeling and Simulations, and Computer Aided Design is used
- Communicate with management and manufacturing
- Design modification might arise again



6. Implement the Design

- Supply working drawings, documentation, and plans for manufacturing
- Specify manufacturing tools and processing to be used
- Build Prototype

7. Evaluate the Performance

- Test the prototype according to customer specifications
- Take it one step further and test to harsh environment
- Re-visit the original design if needed

Conclusion

- Engineering design is an iterative process focused on originating a product.
- The design includes research, thought, modeling, prototype building and interactive adjustment.
- A 7-step design process was described. The steps are: problem definition, gathering information, proposal of solutions, study solution, analysis, implementation, and performance evaluation