

3.2 Problem Definition

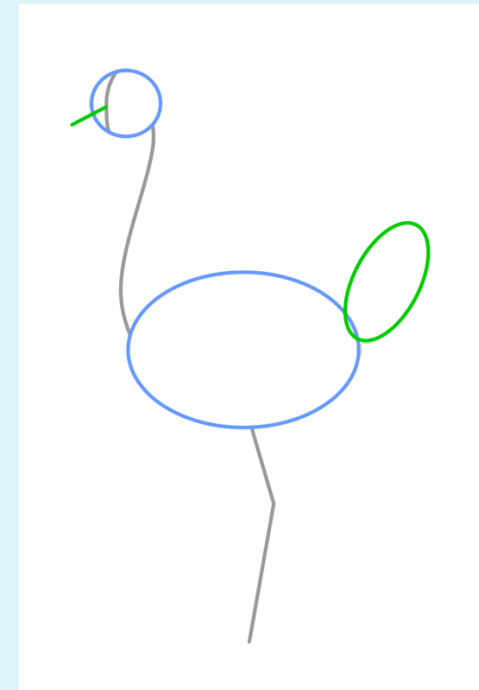
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Preview

- In the previous sequence, we introduced a seven step design methodology.
- In this sequence, the first step in the design process, *problem definition* will be presented.

Where to Begin?

- Write down the problem statement
 - A clear-cut and definite definition of the problem
- Identify
 - Need (who will benefit? Who is the customer)
 - Objectives
 - Criteria for success (Constraints & Specifications)
- Clearly understand all aspects of the problem
- Solve the correct problem

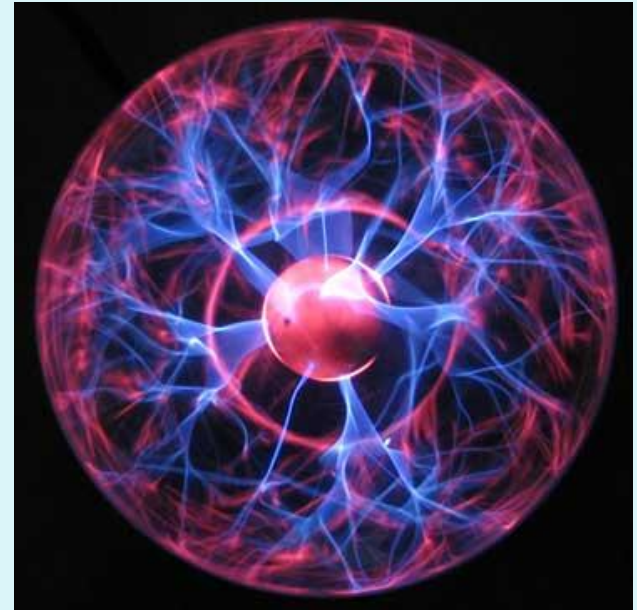


Seven Design Steps

- 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

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.



Identify and Establish the Need

- Recognize and understand the need for a new product, system, or machine.
- Markets establish the need for a new design.
 - Consumers will purchase a product that provides a need, such as health, or improves a want, such as comfort.
 - Private companies survive by making products that can be sold at a profit
 - Government decide their own needs, such as highways and power systems.

Develop a Problem Statement

- Once a need has been established, engineers define that need in terms of an engineering design problem statement.
- To reach a clear definition, they collect data, run experiments, and perform computations that allow that need to be expressed as part of an engineering problem-solving process.

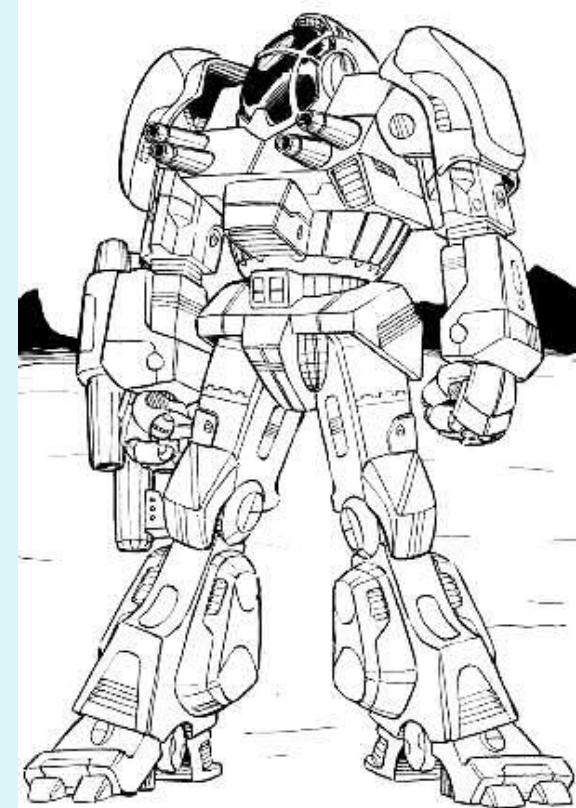


Criteria for Success

- Criteria for success are the *specifications* that a design solution must meet to be considered successful.
- This criteria should be included in the problem statement to provide direction toward the solution.
- As the design solution develops, the initial criteria might need to be redefined or modified. Preliminary criteria must not be too specific so they allow flexibility through the design process.

Design Specifications

- Performance
- Quality
- Power Consumption
- Size and weight
- Product life
- Cost
- Operating environment
- Production quantity
- Look
- Human Factors
- Safety
- Interface
- Logistics
- Maintainability
- Reliability



Identify Constraints

- A constraint is anything that prevents a system from reaching its goal
- The most common constraints are
 - Budget
 - Time
 - Personnel
 - Equipment / Manufacturability / Material availability
 - Legal / Policy

Specifications and Constraints

- Use numerical values and tolerances
- Must be measurable
 - Poorly written specification: The product must withstand high temperature
 - Properly written specification: The product will operate up to a temperature of $200\text{ C} \pm 10\text{ C}$

Problem Definition Example 1

- Need: The city council realizes that *in-roads for the city are congested and causing delays for commuters.*



Problem Definition Example 1

- Need: The city council realizes that *in-roads for the city are congested and causing delays for commuters.*
- Criteria for Success: Decrease commuters delay by 25%
- Constraints: Budget , Time, Personnel, and Policy.

- Problem Statement: *In-roads are congested and there is a need by the city to establish a transportation system (or modify existing one) to move commuters quickly and therefore decrease their commuting time by 25%.*

Problem Statement Example 2

- Need: A company (Nokia) needs to better compete in the smart phone market because it is losing market share to competition.



Problem Statement Example 2

- Need: A company (Nokia) needs to better compete in the smart phone market because it is losing market share to competition.
- Criteria for Success: Increase the smart phone sales by 20% in the next year.
- Constraints: Time and Technology.
- Problem Statement: Nokia is losing market share and should develop better smart phone systems in order to increase its share in the market by 20%

Conclusion

- Design can be divided into seven-steps
- The first step, *problem definition*, was described in this sequence
- The problem definition should be clear and should include the criteria for success