

## MFS606/ME606/EE606

- Introductory lecture –
  - engineering design process

## Example past projects

- Design of product for manufacturability (for prosthetic device), and design of manufacturing system
- Design of methodology for collection of items from warehouse
- Design of improved automated material handling system to reduce errors
- Improvement of workcells
- Improvement of warehousing operations
- Redesign of shipping department
- Redesign of processes for improved material handling and transport
- Analysis of flow of product, with redesign recommendations
- Development of Control methods for automated equipment

## Typical Issues

- Evaluation of waste
  - Flow, time, cost, motion
- Manufacturing system design
  - Recommendations for modifications
- Mechanical design (and sometimes electrical design)

## The Engineering Design Process

- Recognizing the need
  - What is the problem?
- Defining the Problem
  - Goals, Objectives, Constraints
- Planning the Project
  - Schedule and budget of Activities
  - What tasks, in what order
- Conceptualizing Alternative Approaches
  - Generate wide variety of alternatives
- Evaluating the alternatives
  - Analysis of performance
- Selecting the best alternative
- Communicating the Design
- Implementation of the preferred design

## Problem Formulation

- Design failures often traced to inadequate problem formulation
- Cost of change increases as design progresses
- Key steps:
  - Determining the need
  - Defining the problem

## Recognizing the Need

- Identifying the Client
- Does the client know what they want?
  - Issue: Confusing a potential solution with actual need
- Why does the client want this?
- Needs Statement defines current unsatisfactory situation
- Example:
  - “Current test procedures for the Widgimatic are too time intensive”

# Defining the Problem

3 parts: Goals, Objectives, Constraints

- Goal:
  - Brief and general and ideal statement
  - “How are we going to address the need”
  
  - Example Goal: “To design an improved test fixture for the Widgimatic”
  
  - Rules out other solutions to Needs statement

# Objectives

- Objectives = quantifiable expectations of performance of design
  
- Example Objective:
  - “Design a fixture that allows loading and unloading of items in less than 5 seconds, and which automatically sequences through the testing conditions” (assuming same test conditions as before?)
  
- Objectives can be refined later while keeping the general goal

## Constraints

- Constraints: Requirements that the design must satisfy
- Define permissible range of design and performance parameters
- Example:
  - The Widgimatic dimension cannot be modified
  - The test requires 110VAC power for the product
  - The fixture must be able to test at least 1000 Widgimatics per shift
  - Cost of the fixture must have payback in time savings within 6 months
- Constraints can become part of objectives

## Problem Statement Summary

- Needs Statement
- Goal Statement
- Objectives
- Constraints

## Planning the project

- Planning the Project
  - Schedule of Activities
    - Gantt Chart
    - Pert Chart
  - Cost of Activities
    - Personnel time
    - Budget constraints

## Design Journal

- Permanently bound notebook or diary
- Dated entries of thoughts, activities, notes, sketches, calculations, etc. related to your design projects.
  - Central record of all activity and information
  - Chronological record—for patent or liability
  - Documentation of time for budgeting and billing

## Early Design: Concept Generation

- Key: Generate Alternatives
- Techniques:
  - Brainstorming
    - Let imagination run wild
    - Avoid moving to detail
    - Avoid critiquing of any concepts
    - Problem: domination by a few team members

## Evaluating the alternatives

- Cost analysis
  - Labor
  - Equipment
  - Payback
- Implementation issues
- Performance issues

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