EGR 107
Introduction to Engineering Design

Project Specifications, Design Criteria, & * DESIGN SELECTION *

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Project Specifications

- Developed from project description and requirements
- Define project goals
- Types of
  - Design (performance)
  - Construction
    - Model or Prototype
    - Manufacturing

Project Specifications

Design (performance) Specifications

- Measurable statement of the objectives that a design must achieve.
- Developed early in the design process
- Requires input from:
  - potential clients, marketing personnel,
  - investors, manufacturing specialists,
  - legal experts, management, etc.

Project Specifications

Construction (detailed) Specifications

- After a decision has been made to proceed with the build and test phase
- Written and visual communications
- Prescribe construction details
  - Location,
  - Size,
  - Tolerances,
  - Material Type,
  - Surface Finishes, etc.

Project Specifications

Construction (detailed) Specification, cont'd

- Manufacturing phase:
  - After the build and test phase is complete
  - Further expansion of detailed specifications
  - Assembly Techniques,
  - Packaging,
  - Shipping Instructions, etc.

Design Criteria

- Developed from specifications to
  - Ensure compliance with client's requirements
  - Discriminate between designs
  - Identify a 'best' design
- Two Types
  - Feasibility Criteria
    - Eliminate infeasible designs
  - Merit Criteria
    - Identify characteristics of 'best' designs

Design Criteria

Feasibility Criteria

- Factors that limit the scope of a project
- Normally expressed as constraints
  - unit must weigh less than 100 lbs.
  - unit must accelerate to a velocity of 60 mph in less than 10 seconds.
- Go / No-Go Criteria
  - (Feasible / Not-Feasible)
- Project Specifications are a primary source

Design Criteria

Merit Criteria

- Factors that promote **discrimination between FEASIBLE** design alternatives.
- Provides a logical method for selecting the "best" design
- Should be presented in a form which will facilitate the decision making process

Design Criteria

Merit Criteria

- Specific while still providing a basis for choosing between alternatives
- Examples include:
  - low unit production cost, low shipping cost, low storage cost, etc.
  - high acceleration, high velocity, high efficiency, etc.
- Project Specifications are good starting point
- Ask: What is the overall project goal?

Design Criteria

Example Project: Toothpick Bridge

- Design Specifications (handout):
  -
- Feasibility Criteria (engineer):
  -
- Merit Criteria (engineer):
  -

Feasibility Analysis

- Eliminate some of the design concepts
- Reveal ways that other alternatives may overcome their limitations
- Produces at least two feasible alternatives
  - In practice, this will not always occur
  - *In this class, it must!!*
    - *Your project grade depends on it.*
- A single table comparing each design to the feasibility criteria with pass/fail (√ or X) notation is a common approach
  - Good visual of why designs are succeeding of failing

Merit Analysis

- **Structured way** to make a **logical, documentable decision** concerning the **"best" design alternative**
- It is not a "foolproof" way of selecting the best design.
- Also applies to problem solution, manufacturing process, product supplier, etc.

Merit Analysis, cont'd

- Provides a point of departure for engaging in intelligent debate over design decisions
- Shows why one of the alternatives was selected over the others
- Provides basis for retracing the steps that led to the decision
- Better than simply declaring victory based on some sort of "gut feeling"

Merit Analysis Steps

1. Criteria Importance

2. Develop Merit Curves

3. Merit Factor Assignment

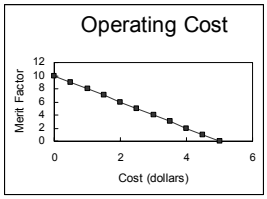
4. Calculation Step One

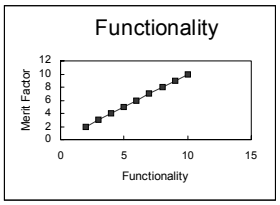
5. Calculation Step Two

1. Criteria Importance

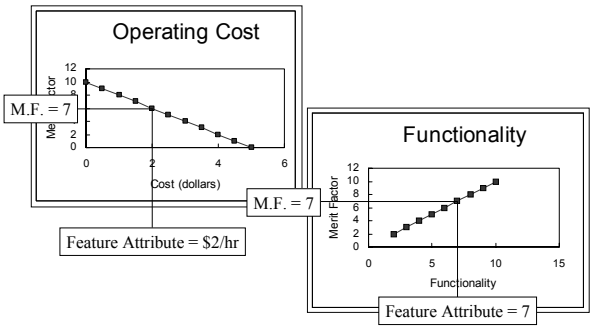
Criterion	Points
Functionality	40
Production cost	30
Operating cost	15
System weight	10
Aesthetics	5
Total	100

2. Develop Merit Curves





3. Merit Factor Assignment



4. Calculation Step One

- Calculate merit associated with each criteria for each design
- criteria merit = (weight) x (merit factor)

5. Calculation Step Two

- Calculate total merit associated with each design
- Total merit = Σ (merit criteria)

Example

			Alternative #1	
	Weight (%)	Feature Attribute	Merit factor	Total Merit
Functionality	40	7	7	280
Production cost	30	$1000/unit	6	180
Operating cost	15	$2.00/hr	6	90
System weight	10	60 lbs	6	60
Aesthetics	5	10	3	15
Total	100			625

Making a Decision

- Discuss the scoring of the designs and consider:
  - What would a 'perfect' design score?
  - How different are the numbers?
  - Which merit criterion are making the biggest difference?
  - Is one merit criterion driving the decision?
  - Can the merit criterion, weighting, curves, etc. be improved?

Example

Merit Criteria	Weight (%)
Functionality	40
Production cost	30
Operating cost	15
System weight	10
Aesthetics	5
Total	100

Alternative #1

Feature Attribute	Merit factor	Total Merit
7	7	280
$1000/unit	6	180
$2.00/hr	6	90
60 lbs	6	60
10	3	15
		625

Alternative #2

Feature Attribute	Merit factor	Total Merit
9	9	360
$500/unit	8	240
$4.00/hr	2	30
70 lbs	2	20
50	7	35
		685

Alternative #3

Feature Attribute	Merit factor	Total Merit
8	8	320
$750/unit	7	210
$3.00/hr	4	60
50 lbs	10	100
25	5	25
		715

Comments and Discussion