GNG1103 – Engineering Design
GNG1503 – Génie de la conception

Benchmarking, Design Criteria and Specifications

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http://www.mason-uk.co.uk/images/Specification1.jpg

Agenda

- Quiz 1
- Reminders
- **Review Questions**
- **Problem Statement:** Case Study – Ski-Hill Rescue Device
- **Definitions: Design Criteria, Metric, Specification**
- **Turning Customer Needs into Design Criteria**
- **Benchmarking** & Activity
- **Design Specifications & Process** & Activity

Comments on Quiz 1

- 40 attendees, **82.5%** succeeded , **17,5%** failed
- Highest mark: **9/10**, Lowest mark: **3/10**
- **Point to improve**
  - 4 types of energies building the total energy of a team
    - ✓ Production energy
    - ✓ Solidarity energy
    - ✓ Maintenance energy
    - ✓ Residual energy
  - Managing the energies within in a team
    - ✓ Minimize residual energy
    - ✓ Maximize production energy while keeping certain amount of energy for solidarity and maintenance

Reminders

- Due date for **Deliverable B (**Needs & Problem): Jan 26
- **Lab3** (Basic Training): This week
- in your email **Subject** always add your **course code** and Lab section

  e.g. Question – **GNG1103F** – **F01**
- Answer the **Review Question** after each lecture
- What is your summary of **Lecture 4&5**?
  - Things to consider for an effective customer interview
  - Customer needs identification process
  - Turning customer statements into interpreted needs
  - Lead user
  - Good problem statement

Review Questions

1. What is a **design criterion** and what is a **metric**?
2. Define the concept of **target specifications** and describe the steps of the **engineering design specification process**.
3. List two **types of benchmarking data**. What is the importance of benchmarking in engineering design.
4. Determine the **best solution** among the three proposed solutions using the data in the following table.

Rescue Device / *Specifications*	Importance (Weight)	Squadra Patrol Toboggan #231	Cruiser SS	Franco Garda Stretcher
Company		Traverse Rescue	Cascade Rescue	TSL Rescue
Cost	5	3	2	1
Weight	3	2	1	3
Stored Size	3	1	2	3
Braking System	5	2	3	2
Steering Assistance	5	2	2	3
Total				

Problem Definition

"A need exists for ski patrollers to safely and easily transport injured persons down a ski-hill with a portable device that is easy to control, compact and cost effective for owners"

"Design a ski-hill rescue device for ski patrollers and owners, which improves and eases the safety control of reference products to respond to a great market opportunity"

What are Design Criteria?

- A precise description of what the product has to be based on **interpreted needs**, also called:
  - "Requirements"
  - "Characteristics"
- Functional Requirements**:** Are design criteria that affect the solutions "function" (if measurable, then also a metric)
- Non-Functional Requirements**:** Are design criteria that do not affect the "function" of the solution
- Constraints: Set of important considerations that must be taken into account in your design

What is a Metric?

- Metrics are a list of measurable attributes you want your solution to have (i.e., weight, size, speed, impact resistance, etc.)
- Metrics have readily identifiable units of measure
- Metrics can be used to measure solution performance
- Metrics are obtained from
  - Functional design criteria ("Musts" i.e., **mandatory** and "Wants" or **optional** i.e., would be nice)
  - Benchmarking (what is the competition doing?)

Engineering Design Specifications

- Target Specifications are numerical values based on defined metrics that are desired of potential solutions

1. Create a list of Design Criteria based on interpreted customer needs

2. Do product Benchmarking
   - Look at other products that satisfy some/all needs
   - Gather data about those products

3. Set Target Specifications:
   - Set values considered to be ideal
   - Set values considered to be acceptable

Translating Needs into Design Criteria

- Last lecture we developed a list of needs. Now define specific design criteria used to evaluate solutions

Number	Need	Design Criteria
1	The stretcher can be controlled	
2	The stretcher is easy to stop	
3	The stretcher is capable of stopping when out of control	
4	The stretcher is low cost	
5	The stretcher is light weight	
6	Compact in size when stored	
7	Compact in size when carried up the hill	

Group activity 1: Translate Needs into Design Criteria (10min)

- Divide yourselves into groups of 3-5 people
- Develop design criteria based on the interpreted needs
- Think of other important design criteria!

Translating Needs into Design Criteria

Safety

#	Need	Design Criteria
1	The stretcher can be controlled	Weight (lbs) Steering control Stretcher shape
2	The stretcher is easy to stop	Stopping distance (ft) Gradient braking
3	The stretcher is capable of stopping when out of control	Fail-safe braking
4	The stretcher is low cost	Cost ($)
5	The stretcher is light weight	Weight (lbs)
6	Compact in size when stored	Collapsed volume (in^3)
7	Compact in size when carried up the hill	Maximum length (in) Maximum width (in)

Design Criteria and Constraints (Case Study)

- Functional requirements
  - Transport a person across snowy terrain
  - Weight supported (lbs)
  - Fail-safe braking
  - Gradient braking
  - Quick set-up time (min)
  - Stability (stretcher shape)
- Constraints
  - Weight (lbs)
  - Cost ($)
  - Size when deployed (LxWxH ft)
  - Size when collapsed (ft^3)
  - Operating conditions: temperature (°C)
  - Operating conditions: snow, ice and slush
- Non-functional requirements
  - Aesthetics
  - Product life (years)
  - Corrosion and UV resistance
  - Safety: minimal pinch points
  - Safety: ability to use gloves
  - Reliability

Benchmarking

- Two kinds of benchmarking data:
  - Benchmarking competitive products in terms of customers' perceptions
  - Benchmarking competitive products in terms of technical performance
- To create a competitively superior product, the team must know what the competition can do
- There are opportunities to learn specific design approaches by observing competitors' products

Course Attendance: Registration

- Use your smartphone or laptop to **register/notify** your attendance in this lecture
- Allow **geo location** in the attendance site
- Accept **cookies** from third parties applications
- Log in using only your **Uottawa** account at the link below

  https://attendance.azarm.ca/attendancerecord/gng1103f

- Your attendance must be registered only **during the lecture** and at the **time specified by the professor**
- You can also use the **QR code** below, to register quickly

Group Activity 2: Benchmarking Exercise (10min)

- In your same groups, go through one of these products and do some benchmarking
  - Franco Garda: https://youtu.be/tGKXKnAiY5c
  - Cruiser SS: http://www.cascade-rescue.com/cascade-rescue-cruiser-ss/
  - Squadra Patrol: https://www.traverserescue.com/index.php/ski-patrol/squadra-toboggan
- Discuss…

Benchmarking

Rescue Device / *Specifications*	***Squadra Patrol Toboggan #231***	***Cruiser SS***	***Franco Garda Stretcher***
Company	Traverse Rescue (a Ferno Group Company)	Cascade Rescue	TSL Rescue
Cost	$1,264 (CAD)	$1,625 (CAD)	$9,400 (CAD)
Weight	57 (lb)	65 (lb)	40 (lb)
Tub Material	Kevlar Composite	Composite	TWINTEX composite shell, stainless steel frame
Tub Shape	Flat bottom with a slightly raised center	Flat bottom	Flat bottom
Lateral Stability	Stainless Steel Running Fins	Stainless Steel Running Fins	Aluminum blades
Stored Size	96.5 x 8 x 12 in	91 x 21.5 x 5 in	41.5 x 21 x 10 in
Deployed Size	157 x 24 x 12 in	150 x 21.5 x 5 in	Not Specified
Braking System	Chain Brake	Chain Brake/Parking spike	Rope (Chain) Brake
Failsafe	None	Parking spike	None
Steering Assistance	None	None	Flex rubber joints

Group Activity 3: Best Specs (5min)

- Now we know the specifications (specs) of various competitor products, which are the best specs among these ski-hill rescue devices?
  - In your groups, take **5 min** and figure out which specs are better and why (Start with Table 1)

The Best Specs

- Let's evaluate each spec and see which ones are better on a scale of 1-3 (Value) 3=green(High), 2=yellow (Average), 1=red (Low)
- Better specs will depend on the **priority** of the interpreted need and the scale **value**
- Remember how we prioritized the needs? Let us apply that concept to the competitions' specs

1. Multiply the weight (priority) of each spec with its value
2. Add them together for each product to form a sum
3. Compare the sum each other

Benchmarking

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Stored Size	96.5 x 8 x 12 in	91 x 21.5 x 5 in	41.5 x 21 x 10 in
Braking System	Chain Brake	Chain Brake/Parking spike	Rope (Chain) Brake
Steering Assistance	None	None	Flex rubber joints

Benchmarking

Rescue Device / *Specifications*	*Importance (weight)*	*Squadra Patrol Toboggan #231*	*Cruiser SS*	*Franco Garda Stretcher*
Company		Traverse Rescue	Cascade Rescue	TSL Rescue
Cost	**2**	**3**	**2**	**1**
Weight	**3**	**2**	**1**	**3**
Stored Size	**2**	**1**	**2**	**3**
Braking System	**5**	**2**	**3**	**2**
Steering Assistance	**5**	**2**	**2**	**3**
Total		**34**	**36**	**42**

Setting Target Specifications

- From the list of design criteria and based on benchmarking, set target specifications by defining ideal and acceptable values

Examples (ideal "perfect world" values or range of values):

- Exactly X
- A list of discrete values
- The "sweet spot" in a range of values

Examples (marginally-acceptable "on the edge" values):

- At least X
- At most X
- Between X and Y
- No worse than…

Engineering Design Specifications (EDS) Template

	Design Specifications	Relation (=, < or >)	Value	Units	Verification Method
	Functional Requirements				
1					
2					
	Constraints				
3					
4					
	Non-Functional Requirements				
5					
6					

Group Activity 4: Developing EDS for the Ski-Hill Rescue Device (10min)

- In your groups use the engineering design specifications template to develop EDS for the ski-hill rescue device
  - Use the customer needs from last lecture
  - Use benchmarking info

EDS: Functional Requirements

	Design Specifications	Relation (=, < or >)	Value	Units	Verification Method
	Functional Requirements				
1	Transport a person across snowy terrain	=	yes	N/A	Test
2	Weight supported	>	250	lbs	Analysis, final test
3	Fail-safe braking	=	yes	N/A	Test
4	Gradient braking	=	yes	N/A	Test
5	Quick set-up time	<	5	min	Test
6	Stability (stretcher shape)	=	yes	N/A	Test

EDS: Constraints

	Design Specifications	Relation (=, < or >)	Value	Units	Verification Method
	Constraints				
1	Weight	<	60	lbs	Analysis
2	Cost	<	1,500	$	Estimate, final check
3	Size when deployed	=	8x2x1.5	ft	Analysis
4	Size when collapsed	<	24	ft^3	Analysis
5	Operating conditions: temperature	=	-40 to 25	°C	Test
6	Operating conditions: snow, ice and slush	=	yes	N/A	Test

EDS: Non-Functional Requirements

	Design Specifications	Relation (=, < or >)	Value	Units	Verification Method
	Non-Functional Requirements				
1	Aesthetics	=	yes	N/A	Test
2	Product life	>	7	years	Test
3	Corrosion and UV resistance	=	yes	N/A	Test
4	Safety: minimal pinch points	=	yes	N/A	Test
5	Safety: ability to use gloves	=	yes	N/A	Test
6	Reliability	=	yes	N/A	Test

Summary

- Once the problem has been identified, the next step is to develop a set of design criteria
- Those design criteria are based on the customer needs, as well as benchmarking the competition.
- The design criteria should include functional and non-functional requirements, as well as constraints
- If functional requirements can be represented using units of measure, then they are metrics