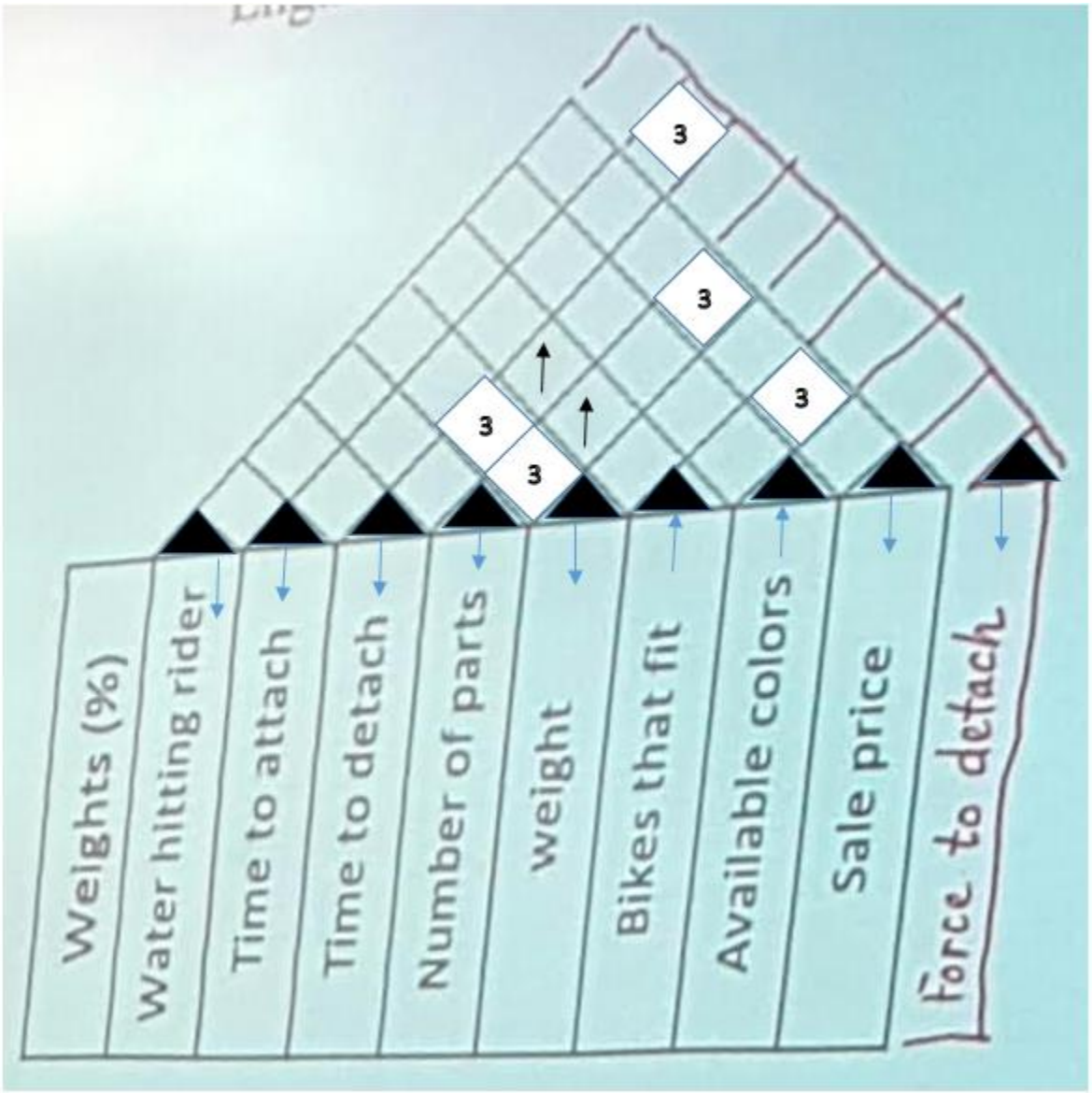
Room 8 – Relating engineering characteristics to engineering characteristics

- Each diamond-shaped cell represents how an engineering characteristics relates to another engineering characteristics
- Such relationship can be strong, moderate, weak or no relationship at all.

  ± 9: strong positive/negative relationship
  ± 3: medium positive/negative relationship
  ± 1: weak positive/negative relationship
  Blank: no/little relationship

  Engineering Characteristics vs. Engineering Characteristics



Room 9 – Setting targets

- First task is to list units ascites with the engineering characteristics
- Second task is to objectively evaluate competitions against the engineering characteristics (Room 5 contains only the subjective evaluations).
- Final task is to set targets for the design (that the company/organization undertakes).

		End Users	Marketing	Service	Weight (%)	Water Hitting Rider	Time to attach	Time to detach	Number of parts	Weight	Bikes that fit	Available colors	Sale price	Force to detach	Product A	Product B	Product C
Functional performance	Keeps water off rider					9											
	Fast to attach						9		3	1							
	Fast to detach							9	3	1							
Interface with bike	Good fit										9						
	NotS marring													3			
	Color matching											9					
Light weight									1	9							
Low cost													9				

Unit	%	sec	sec		g	%		$	N
Product A	25	25	5	6	130	94	5	12	5
Product B	0	5	3	2	140	65	1	15	15
Product C	30	10	10	1	100	100	4	20	0
Target	0	2	3	2	130	95	5	10	5

- Summary of information needed in each room (including roof):

1. Who are the customers?
2. What do the customers want?
3. Relative importance of customer requirements?
4. Who are the competitors?
5. Competition benchmarking.
6. By what will customers requirements be measured?
7. Relationship between customers requirements and engineering characteristics.
8. Dependence of engineering characteristics.
9. How much is good enough?

- Summary of scales used:

  Room 3: no consistent rules if ranked importance percentage if weighted importance.

  Room 5: 1-5

  Room 7: 9, 3, 1 or blank

  Room 8: ± 9, ± 3, ± 1 or blank

  Room 9: actual or targeted values with corresponding units

- A few words regarding QFD and HoQ:
  - Quality is a measure of how well a product meets its specifications and requirements
  - A "quality" design is one that meets or exceeds objectives, satisfies all constraints, and is fully functional.
  - In other words, all designs should be towards design for quality.
  - Building a HoQ takes a lot of time and effort, and iterations.
  - Time spent completing a HoQ is more than recovered later in the design process.
  - HoW helps tie together many concepts that we have learned.

- Remaining topics:
  - Morphological chart (Sec. 7.1.1)
  - Choosing a design (Ch. 8)

- Conceptual Design: Generating Design Alternatives (Ch. 7)
  - Generating the "Design Space" (Sec. 7.1)
  - Navigating, Expanding, and Contracting Design Spaces (Sec. 7.2)

- Generating "Design Space" (Sec. 7.1)
  - "Design space" is an imaginary space of design alternatives, a space containing all the potential solutions to the design problem.
  - Design space can be large or small. A large space suggests that the design problem at hand is, (1) a design with large number of design alternatives; and/or (2) a design with large number of design variables.
  - Tools for generating design spaces and for generating within such spaces design alternatives include:
    - Morphological chart (morph chart), Sec. 7.1.1
    - The 6-3-5 method, Sec. 7.1.3
    - The C-sketch method, Sec. 7.1.4
    - The gallery method, Sec. 7.1.5
  - Sec. 7.2: expanding and contracting design space
  - We focus on the morph chart

- Morphological chart or Morph chart
  - It builds on the function-means tree
  - In a Morph chart, the functions and key features are listed in the left column

- The entries in this column should be of a manageable size and at the same level.
- For each entry of functions or key features, a row of means to realize the function or feature will be generated.
- Design alternatives are then "assembled" by selecting one means from each row.
- Morphological chart example

Figures 7.1 and 7.2 for a reusable juice container

Function\Means	1	2	3	4	5	6
Contain Liquid	Can	Bottle	Bag	Box		
Fill and Seal Container	Fill and Heat Seal	Sealed Cap	Glue Container Material	Twist Top	Bottle Cap	
Empty Container	Pull Tab	Inserted Straw	Twist Top	Tear Corner	Unfold Container	Zipper
Resist Forces	Thick Walls	Flexible Materials				
Identify Product	Shape of Container	Distinctive Label	Color			

Figure 7.1: A morphological chart ("morph") for the juice container design problem with functions listed in the leftmost column. The means by which each can be implemented are arrayed along a row to each entry's right.

- Conceptual Design: Evaluating Design alternatives and choosing a design (Ch. 8)
  - Applying Metrics to Objectives Selecting the preferred Design (Sec. 8.1)

- Selecting the Preferred Design (Sec. 8.1)
  - The following is available from the text
  - Sec. 8.1.1 Numerical evaluation matrices
  - Sec. 8.1.2 Priority checkmark method
  - Sec. 8.1.3 The best-of-class chart

- Decision matrices with weighted objectives.

- Decision matrix:
  - Overall structure of the matrix

Objectives (Criteria)	Weights	Design Alternatives (Design Concepts)		
		scores	scores	scores
Total				

- Scores to evaluate concepts
  1- some integer with 1 being the lowest rank;
- Scoring or ranking is completed criterion by criterion;
- Ranking alternatives/concepts against the same criterion;

- The highest total indicates the preferred design;
- If two are close to each other, a new preferred design may be formulated by combining the better features of the two alternatives/concepts.

How students in upper year levels deal with Generation and Evaluation of design Alternatives:

- A team member will come up with at least one design alternative, independently;
- The team will meet to understand the alternatives;
- Decision matrix will be worked on
  (1) As a team; or
  (2) Individually, then the team comes up with an aggregated decision matrix

- Reading assignments:
    - S 7.1, pp. 92-95 (end of S7.1.1)
    - House of Quality
    - Decision Matrix (class notes)
  - Design teams: Send email to me to confirm memberships of your team, before 4:30pm Thursday, Nov. 10.