Decision matrix for the design of a crane hook (Commented)

Next, assign **weighting factors** based on how important each objective is to the overall success of the design. In this example reliability has the highest weighting factor because if the crane hook fails, cargo will be destroyed or people can be killed. All weighting factors must sum to 1 (or 100%).

The **parameter** column lists the units (or **parameters**) for each objective. There are quantitative parameters (i.e. cost, time, speed, weight, etc.) and qualitative objectives (reliability, repairability, controllability, maneuverability, etc.). Quantitative objectives can be quantified by calculating a value from an equation, whereas qualitative objectives are assigned values based on the comparison of different design concepts.

The evaluation matrix contains **one column for each design concept** or idea. In this example, there are four ideas under consideration for the design of a mobile platform: one from each member of the group.

Select **objectives** which are important for the design concepts under evaluation.

Magnitude is the assigned value of each objective, whether quantitative or qualitative. Pay attention to significant units.

CRANE HOOK			Welded Plates			Riveted Plates			Cast Hook		
Objective	Weighting Factor	Parameter	Mag.	Score	Value	Mag.	Score	Value	Mag.	Score	Value
Material Cost	0.10	$	2500	8.8	0.9	2500	8.8	0.9	2200	10.0	1.0
Manufacturing Cost	0.20	$	1500	8.0	1.6	1200	10.0	2.0	2400	5.0	1.0
Manufacturing Time	0.10	hours	40	6.3	0.6	25	10.0	1.0	50	5.0	0.5
Durability	0.15	experience	great	10	1.5	good	8	1.2	good	8	1.2
Reliability	0.30	experience	good	8	2.4	great	10	3.0	okay	6	1.8
Repairability	0.15	experience	good	8	1.2	great	10	1.5	fair	4	0.6
Overall value					**8.2**			**9.6**			**6.1**

Qualitative Score Assignments:	
great	10
good	8
okay	6
fair	4
poor	2

Overall value is simply the sum of all the value computations for each design concept. Always highlight the design concept which receives the highest overall value.

Value is simply the weighing factor times the score for a particular conceptual design.

Score is the relative comparison of the different magnitudes. For example if the manufacturing time assessment (magnitude) for one concept is twice as much as another, that concept would receive half the score. Assign the "best" design a score of 10 and scale the others proportionally.

Include a **legend** defining any qualitative score assignments in the evaluation matrix. The purpose is to use logic to rationalize which score is most appropriate for each conceptual design. If two concepts receive magnitudes of "great", they MUST both receive scores of 10. If you are able to more closely distinguish between a score of 10 and a score of 9, then add another qualitative score assessment to this table, such as "very good: 9".

Important Tips for the Decision Matrices Required for Design Report #2:

1. *Whenever possible, place all decision matrices on the same page for compact formatting.*

2. *Your definitions and score assignments should be included in the report body instead of on the same page as the matrices. (They are included here simply so everything related to this example matrix is in one place for convenient reference.)*

3. *Note that your team's objectives and weighting factors will likely be different than the ones listed above and that the objectives and weighting factors for each subsystem on your design will be different as well.*

4. *Repeat the above for the other functional parts of your robot design (i.e. bucket/ball manipulator, ball hopper and/or release mechanism(s), etc.)*

5. *Pay attention to significant figures. For example, don't report estimated robot speed to 5 decimal places, as an estimate simply doesn't have that kind of precision. Think about the numbers you report: if you can't measure robot size to one thousandth of an inch, or manufacturing time to one thousandth of a second (which you clearly cannot), then don't report them that way under the magnitude columns of the matrix.*

6. *If two designs are assigned qualitative assessments of "good", they must both receive the same score; otherwise, the magnitude and score must be reported as a quantitative assessment and you must include the equation used to calculate the magnitudes.*

7. *All quantitative assessments must be clearly justified with estimated data, such as material costs, manufacturing times and robot speeds. Without this data, it's impossible to unbiasly and accurately compare individual ideas. This data should be placed in the report appendices where it can referenced during grading.*

8. *For the purpose of this class always use linear score assignments; for example, if material cost is an objective and one design costs twice as much as another, the more expensive design MUST receive half the score assignment or the matrix cannot serve its intended purpose. This applies for all quantitative assessments such as cost, manufacturing time, speed, etc.*

9. *After creating the decision matrices your group must choose the design from each matrix that achieves the highest value or again the matrices cannot serve their intended purpose of unbiasedly allowing selection of the best idea.*

10. *If a new idea develops while your group works through this part of the design process, simply add another column to the matrix (i.e. "Design 5") and compare the new idea to the other ideas already contained in the matrix. Note: Evaluating a fifth design in one matrix (i.e. mobile platform) does NOT require you to add a fifth design to the other matrices.*