

EML2322L Decision Matrix Example - Bad

MOBILE PLAFTORM			Design 1			Design 2			Design 3			Design 4			Design 5		
Objective	Weighting Factor	Parameter	Mag.	Score	Value	Mag.	Score	Value	Mag.	Score	Value	Mag.	Score	Value	Mag.	Score	Value
Speed	0.20	feet	2.30	0.0	0.0	3.10	6.7	1.3	2.60	2.5	0.5	3.50	10.0	2.0	2.30	0.0	0.0
Controllability	0.30	experience	fair	4.0	1.2	good	8.0	2.4	great	9.0	2.7	poor	2.0	0.60	great	10.0	3.0
Manufacturing Time	0.20	hours	6.5	4.23	0.8	8.0	6.40	1.3	10.0	10.00	2.0	6.0	3.60	0.7	6.0	3.60	0.7
Modularity	0.20	fasteners	2	10	2.0	3	7	1.3	4	5	1.0	2	10	2.0	2	10	2.0
Material Cost	0.10	experience	okay	6	0.6	okay	6	0.6	okay	6	0.6	okay	6	0.6	okay	6	0.6
Overall value			4.65			6.9			6.8			5.9			6.3		

Mobile Platform (bad)

Objective Definitions & Weighting Factor Justifications:

Speed is how fast the robot goes. Its important because we want our robot to fly through the course. We gave it a score of 20%.

To make sure we can get the balls into the bucket, we need to control the robot with controllability.

If you are reading this circle here. Other fluff...

Manufacturing Time ...

Modularity ...

Material Cost ...

Score Assignments:

Design 1

Design 1 uses the 44 rpm Entstort right angle gearmotors and 12" diameter drive wheels, which result in a loaded vehicle speed of 2.3 ft/sec (as seen in Appendix A: Wheel Speed Calculations).

Since design 1 travels at 66% of the fastest design's speed (3.5 ft/sec), design 1 receives a score of 6.6 out of 10 using a linear score assignment. As for controllability, design 1 is slow enough that it can be controlled well from what our friends told us. But, since it has four wheels, it isn't a great design so we gave it a rating of fair and a score of 4.0. Regarding manufacture time...

Design 2

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Bucket Manipulator

Objective Definitions & Weighting Factor Justifications:

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Score Assignments:

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Ball Hopper / Sorter

Objective Definitions & Weighting Factor Justifications:

...

Score Assignments:

...

Appendix A: Decision Matrix Calculations / Summaries

Speeds:

Design 1: 2.3001, Design 2: 3.1015, Design 3: 2.5993, Design 4: 3.5030, and Design 5: 2.3001

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Errors in the Decision Matrix Example – Bad

1. **Are separate matrices used for different parts of the design?**
 - a. Two matrices (rather than the required 3+ matrices) are used.
2. **Does each matrix contain an appropriate number of objectives?**
 - a. Matrix 2 does not contain sufficient objectives to compare ball hopper / sorter designs. Thus, matrix 2 does not contain an appropriate number of objectives.
3. **Are different objectives used for different matrices?**
 - a. The objectives in matrix 2 are just copied from matrix one and were not thought through.
4. **Do weighting factors for each matrix sum to one (or 100%)?**
 - a. Matrix 2 has weighting factors that sum to 0.9
 - b. Matrix 1 has speed parameterized by feet which is likely wrong.
5. **Does each objective have a clearly written definition?**
 - a. Objective Definitions: Speed is ambiguously defined. What is the measure of how fast the robot goes? Do you measure the fastness while it is in free fall?
 - b. Objective Definitions: Controllability is ambiguously defined.
 - c. Objective Definitions: No discussion is provided for why each objective received its weighting factor.
6. **Do quantitative objectives use quantitative assessments?**
 - a. Matrix 1 - Material Cost: Material cost will never be qualitative since a quantitative magnitude can be determined using the material cost sheets and online pricing.
7. **Do all quantitative assessments include clear calculations and results summaries in tabular format?**
 - a. No clear calculations.
 - b. Result summaries are not in tabular format.
 - c. Significant figures are not used properly. Speeds are reported (without units) to four decimal places.
 - d. All information should be justified from material provided to the students (i.e. motor speeds, material costs, and manufacturing time estimates) or from reliable online sources (for example: McMaster-Carr).
8. **Do qualitative objectives use qualitative assessments?**
 - a. Matrix 1 – Controllability: Design 3 and design 5 have the same magnitude but different scores. This should not be ☹.
 - b. Matrix 1 – Material Cost: Since all magnitudes are the same, this objective is not contributing to the comparison of the designs and should not be included.
9. **Does every qualitative magnitude assessment have a clearly written justification?**
 - a. Simply, NO!
10. **Does every magnitude assessment use linear score assignments?**
 - a. Matrix 1 – Speed: Scores should be assigned as a linear ratio. For example, if design A is the fastest, then any design half the speed of A receives a score of 5. Alternatively, if 3.0 ft/sec is the target speed, any design that runs at 1.5 ft/sec receives a score of 5 and any design that runs at 6 ft/sec receives a 5.

- b. Matrix 1 – Manufacturing Time: Score should be assigned as a linear ratio. This objective uses a quadratic score assignment.
- 11. Are quantitative magnitude assessments correct?**
 - a. Matrix 1 – Manufacturing Time: Here, the score assignment is inverted. The lowest magnitude should result in the highest score on objectives like material cost, manufacturing time, and modularity (as defined here).
- 12. Is the design with the highest composite score selected?**
 - a. Matrix 1 does not have the highest scoring design selected. Design 2 should be selected.
- 13. Are new design ideas properly incorporated into the evaluation matrix?**
 - a. Matrix 1: A new design is incorporated into the matrix, however, that design does not score higher than the existing designs and should not be shown.
- 14. Are reasonable and consistent significant figures reported in the matrices?**
 - a. Matrix 1 – Speed: Speed cannot be estimated with an accuracy of one-hundredth of a foot per second. Report speeds to a tenth of a foot per second.
 - b. Matrix 1 – Controllability: Qualitative evaluations should never be shown with a decimal place since doing so implies that there is a (distinguishable) difference between scores of 7.0 and 7.5. If this level of precision exists, then the objective should be evaluated quantitatively.
 - c. Matrix 1 – Design 4: The value column should contain consistent significant figures.
 - d. Matrix 1 – Manufacturing Time: Scores should be reported to one decimal place since the magnitudes are reported as such.
 - e. Matrix 1 – Overall value: In general, overall values should be reported to one decimal place unless reporting a second decimal place distinguishes two designs tied for first place.
 - f. Qualitative Score Assignments: A qualitative score assignment of 8.6 is wrong as it implies there is a difference between a score of 8.6 and 8.5. If this level of precision exists, then the objective should be evaluated quantitatively.
- 15. Are grammar and formatting at a collegiate level?**
 - a. Grammar & Spelling
 - i. Matrix 1: Mobile Platform is misspelled.
 - ii. Matrix 2: Speed is misspelled.
 - iii. Matrix 2: Controllability is misspelled.
 - iv. Matrix 2 – Design 2: Score is misspelled.
 - v. Objective Definitions: Definitions is misspelled.
 - vi. Objective Definitions: Sentence structure, word use and content are not at a collegiate level.
 - vii. Objective Definitions – Speed: “Its” should be “It’s”.
 - viii. Objective Definitions – Speed: “Coarse” should be “Course”.
 - ix. Score Assignments: Sentence structure, word use and content are not at a collegiate level.
 - b. Formatting

- i. If possible, matrices should be printed on a single page.
- ii. Matrix 1: Table borders should be shown as in the template.
- iii. Matrix 1 – Design 5: The ‘value’ column has been resized.
- iv. Matrix 2: Winning design must be highlighted.
- v. Matrix 2: Manufacturing time is erroneously in bold.
- vi. Matrix 2: Manufacturing time is too large to fit in the Objective column and is cut off.
- vii. Page: Random ‘k’ should not be present.
- viii. Objective Definitions: Formatting is unclear. It is difficult to see where each objective is defined or even which objective is being defined.
- ix. Objective Definitions: Formatting is inconsistent. Speed is not bold. Modularity is bold.
- x. Score Assignments: All designs should be discussed relative to each objective, not the other way around (as shown here).
- xi. The content in appendix A should not begin until the page following “Appendix A: Decision Matrix Calculations / Summaries.”