

# Pugh Matrix

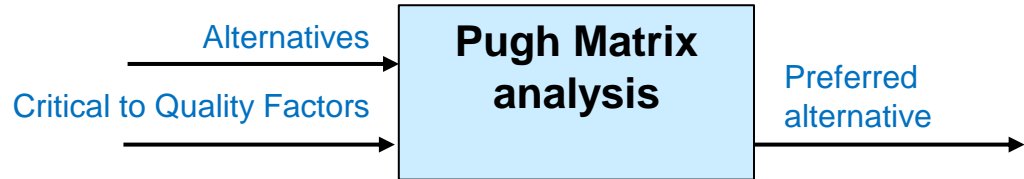
## Problem

How to choose among multiple alternatives?

## Difficulty

Some training required

- The **Pugh Matrix** is a simple technique for making a decision among multiple alternatives.
- The **Pugh Matrix** uses pairwise comparisons between the alternatives, for each defined criteria or requirement.
- The most time-consuming part of using a **Pugh Matrix** is creating the selection criteria.
  - The assessments are quick and the calculation is easy.



## Process

- Choose the alternatives to be compared
  - List them along the top of the matrix.
- Define the multiple selection criteria
  - These are the “Critical to Quality” (CTQ) factors.
  - They might come from the Voice of the Customer (VOC).
  - List them along the left side of the matrix.
  - Optionally, define weights for each CTQ (adding up to 1).
- Define one of the alternatives as the **Reference Design**.
- Have a team assign values for each alternative for each CTQ:
  - Compare each alternative to the Reference Design.
  - Assign one of the following values:
    - 0: alternative is comparable to the reference design
    - +1: alternative is better than the reference design
    - 1: alternative is worse than the reference design.
- Calculate the score for each alternative, by adding the values.
  - Optionally. weight each {-1,0,1} by that CTQ’s weight.

		Alternatives			
		Alternative A (Reference Design)	Alternative B	Alternative C	Alternative D
Criteria	Criteria 1	0	-1	-1	1
	Criteria 2	0	0	1	1
	Criteria 3	0	-1	-1	1
	Criteria 4	0	1	0	0
	Criteria 5	0	-1	0	-1
Total Score		0	-2	-1	2

# Pugh Matrix – Example – Buying a car

		Alternatives					Criteria weights
		Nissan Ariya	Volkswagen ID4	Chevrolet Bolt	Tesla Roadster	Mercedes-Benz EQC	
Criteria	Price	0	0	-1	1	-1	0.2
	Color choice	0	0	0	-1	0	0.1
	Small size	0	1	0	1	-1	0.1
	Maximum speed	0	1	0	1	1	0.1
	Nearby dealership	0	1	1	-1	1	0.2
	Distance on one charge	0	1	0	-1	1	0.3
Total Score		0	4	0	0	1	
Total Score (weighted)		0	0.7	0	-0.2	0.3	

(1) Reference Design

(3) Weighted case: each criteria has a weight

(2) Team created comparison values

(4) Computation when not using weights is a column sum:  
 $1 = (-1) + (0) + (-1) + (1) + (1) + (1)$

(5) Computation using weights is an inner product:  
 $0.3 = 0.2*(-1) + 0.1(0) + 0.1*(-1) + 0.1*(1) + 0.2*(1) + 0.3*(1)$

(6) Best alternatives

- Weighted: 4 is highest value
- Unweighted: 0.7 is highest value

# Pugh Matrix – Notes

## Slide 1

1. The Pugh Matrix was invented by Stuart Pugh.
2. The values in the matrix do not need to be  $\{-1,0,+1\}$ , other commonly used values are  $\{1,2,3\}$ . The values can be used to indicate the amount of difference from the Reference Design.
3. Best practices:
  - Carefully choose the evaluation criteria.
  - A weighted Pugh matrix is usually more appropriate than an unweighted one – carefully choose the weights aligned with the customer needs.
  - Use a diverse team of 4-8 people to determine the values.
  - Document the value discussions.
4. Common failures
  - Incorrect selection criteria
  - Incomplete selection criteria
  - Unclear selection criteria

## Slide 2

1. The example shows the same data evaluated using both a weighted and an unweighted Pugh matrix – the conclusion (best alternative) is the same in each case.
2. The computation for the unweighted Pugh matrix is very simple, just add up the  $\{-1,0,1\}$  values for each alternative.