

# Aircraft Design Project Urban Air Mobility (UAM)

Week 2

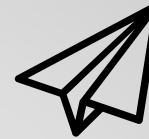
25/10 – 29/10



Instituto Superior Técnico  
Universidade de Lisboa

# Analytic Hierarchy Process (AHP)

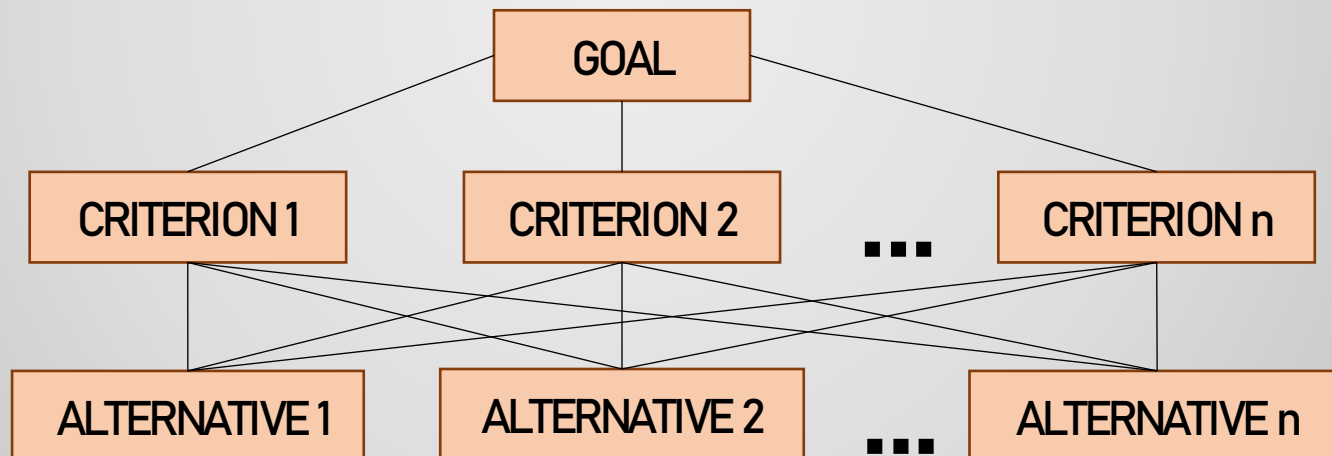
## Introduction



You proposed possible configurations, how to select the best one among them?

### What is the AHP?

- A basic approach to decision making
- Combines both the rational and the intuitive to select the best design from a number of alternatives evaluated with respect to several criteria



# Analytic Hierarchy Process (AHP)

## Implementation

### Steps

- 1 State the overall goal: what are you trying to achieve?
- 2 Define criteria/subcriteria that must satisfy/contribute to the overall goal
- 3 Propose an absolute measurement (scoring) to rank criteria and alternatives
- 4 Assign relative scores between criteria/subcriteria
- 5 Compute the eigenvector of the comparison matrix
- 6 Assign relative scores between alternatives for each criterion
- 7 Compute the eigenvector for each matrix and determine the best alternative

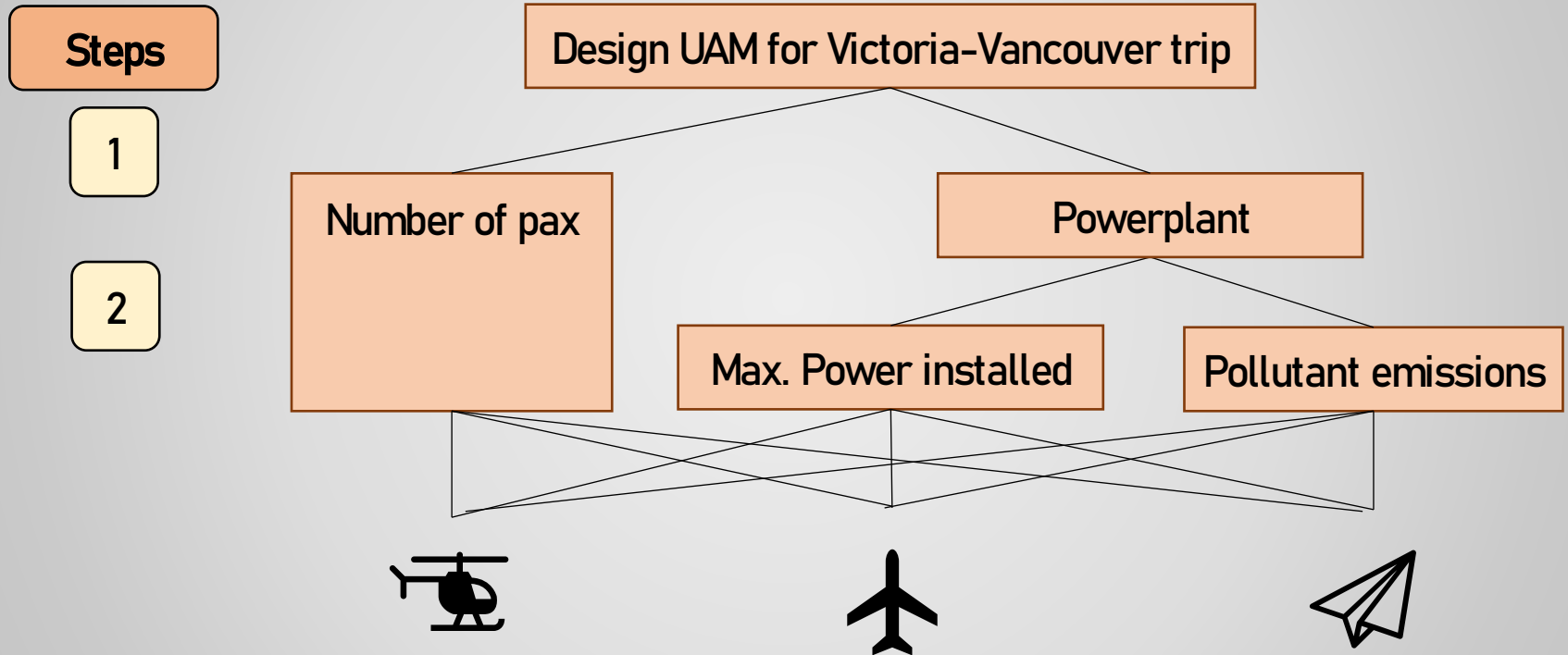
# Analytic Hierarchy Process (AHP)

## Examples



Confused?

Let's give a simple example and see how you can implement in the matlab tool:



### NOTES:

- You can create several sublevels of criteria!

# Analytic Hierarchy Process (AHP)

## Examples

### Steps

3

Intensity of importance	Definition
1	Equal Importance
2	Weak
3	Moderate Importance
4	Moderate plus
5	Strong importance
6	Strong plus
7	Very strong or demonstrated importance
8	Very.very strong
9	Extreme Importance

4

Criterion\Criterion	Max Power installed	Pollutant emissions
Max Power installed	1	1/7
Pollutant emissions	7	1

Criterion\Criterion	Number of Pax	Powerplant
Number of Pax	1	1/8
Powerplant	8	1

Max Power installed has **less importance** in relation to Pollutant emissions

# Analytic Hierarchy Process (AHP)

## Examples

Steps

6

Number of pax			
Alternative/ Alternative	Helicopter	Aircraft	Paper airplane
Helicopter	1	1/9	9
Aircraft	9	1	1/9
Paper airplane	1/9	9	1

Max Power installed			
Alternative/ Alternative	Helicopter	Aircraft	Paper airplane
Helicopter	1	1/7	9
Aircraft	7	1	9
Paper airplane	1/9	1/9	1

Pollutant emissions			
Alternative/ Alternative	Helicopter	Aircraft	Paper airplane
Helicopter	1	4	1/9
Aircraft	1/4	1	1/9
Paper airplane	9	9	1

# Analytic Hierarchy Process (AHP)

## MATLAB

### Steps

2

4

6

### Dictionary

```
{key_1:value_1, key_2:value_2, key_n:value_n}
```

You can edit the JSON file using an  
online editor e.g.:

<https://jsoneditoronline.org/>

You can learn more about the JSON format at.:

[https://www.w3schools.com/js/js\\_json\\_intro.asp](https://www.w3schools.com/js/js_json_intro.asp)

key

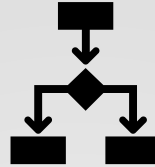
Value

```
1 {  
2   "concept": {  
3     "categories": {  
4       "name": "Awesome New Concept",  
5       "pairs": [  
6         [1, 0.14286],  
7         [7, 1]  
8       ],  
9       "categories": [  
10        {  
11          "name": "Number of Passengers",  
12          "pairs": [  
13            [1, 0.11111, 9],  
14            [9, 1, 0.11111],  
15            [0.11111, 9, 1]  
16          ]  
17        },  
18        {  
19          "name": "Powerplant",  
20          "pairs": [  
21            [1, 0.125],  
22            [8, 1]  
23          ]  
24        },  
25        "categories": [  
26          {  
27            "name": "Helicopter"  
28          },  
29          {  
30            "name": "Aircraft"  
31          },  
32          {  
33            "name": "Paper Plane"  
34          }  
35        ]  
36      }  
37    }  
38  }  
39 }  
40 }  
41 }  
42 }  
43 }  
44 }  
45 }  
46 }  
47 }  
48 }  
49 }  
50 }  
51 }  
52 }  
53 }  
54 }  
55 }  
56 }  
57 }
```

# Analytic Hierarchy Process (AHP)

## Objectives/deliverables

This week's objectives are:



Design selection using **AHP**

- Criteria/subcriteria selection
- Matrices with relative score
- Percentage distribution for each criterion/subcriterion
- Final design selection

For next week's meeting:



**Prepare Powerpoint presentation**

Max: 5 min, can be presented by group leader