CULTURAL HERITAGE 2.0

INTRODUCTION TO

DECISION MAKING

Author: ALEX ZABEO

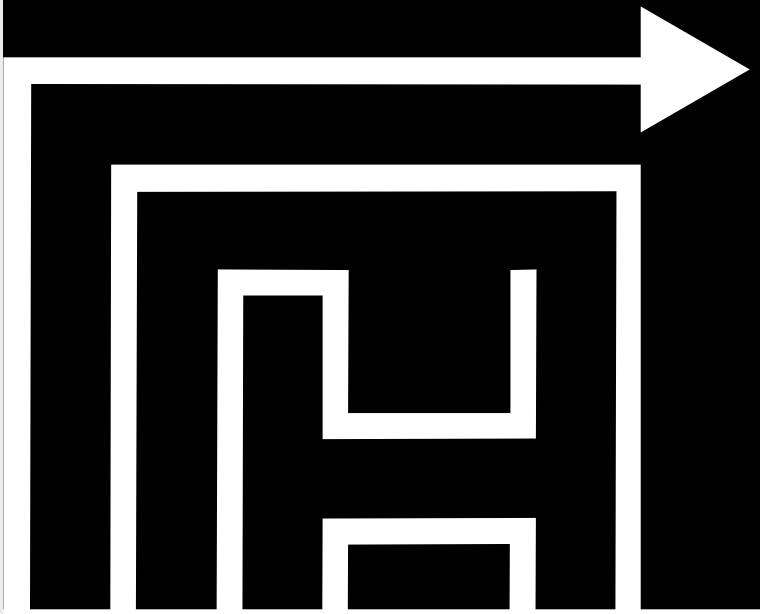
Co-funded by the
Erasmus+ Programme
of the European Union

TABLE OF CONTENTS

This programme as been funded with support from the European Commission. The author is solely responsible for this publication (communication) and the Commission accepts no responsibility for any use that may be made of the information contained therein 2021-1-IT02-KA220-HED-000032050

Co-funded by the Erasmus+ Programme of the European Union

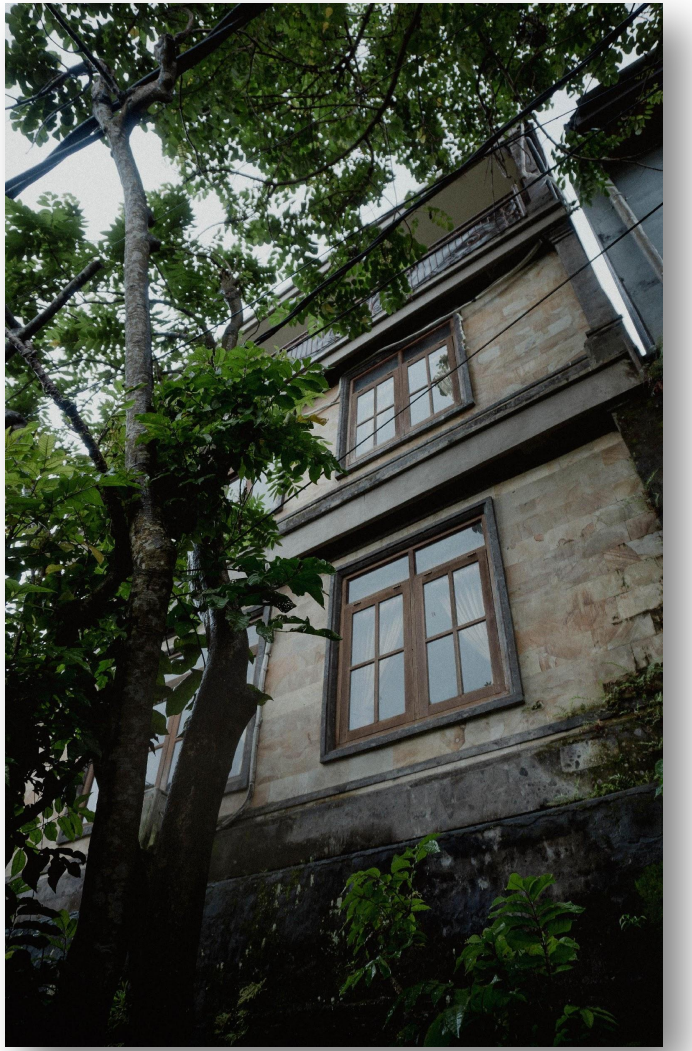
01



INTRODUCTION: WHY DECISION ANALYSIS?

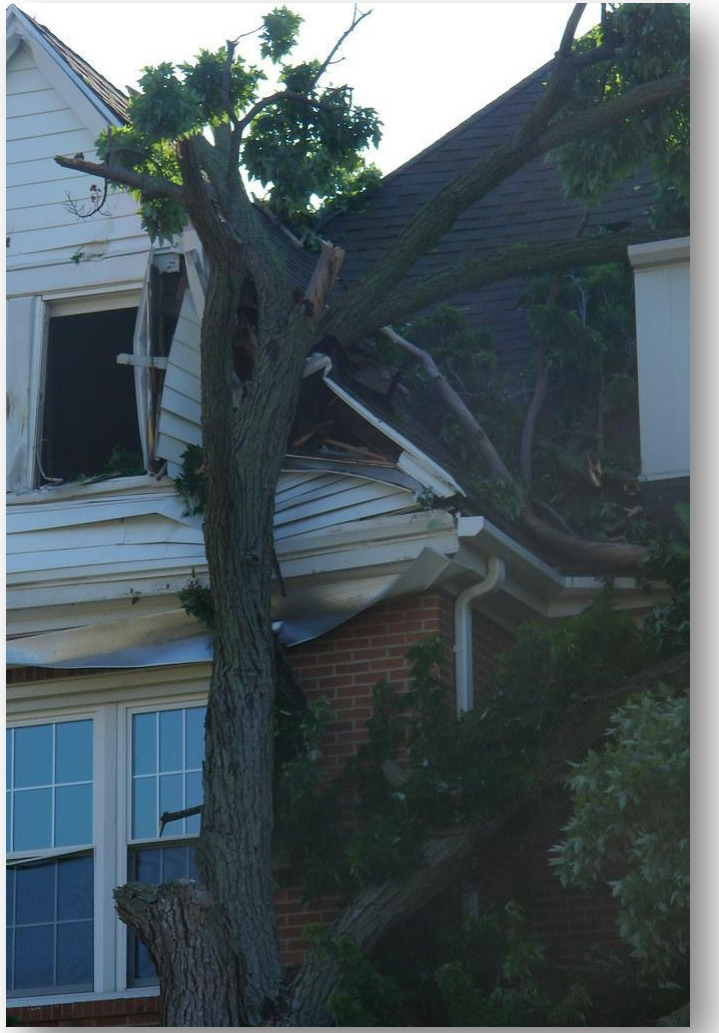
Why decision analysis?

Let’s cut this tree shading my house!



Why decision analysis?

Ops!!!

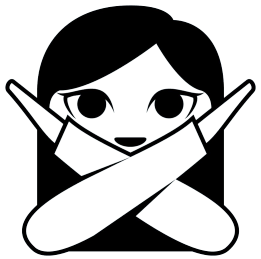


“Humans are quite bad at making complex, unaided decisions” (Slovic et al., 1977).

Individuals respond to complex challenges by using intuition and/or personal experience

Would you pay €25,00 for a coke?

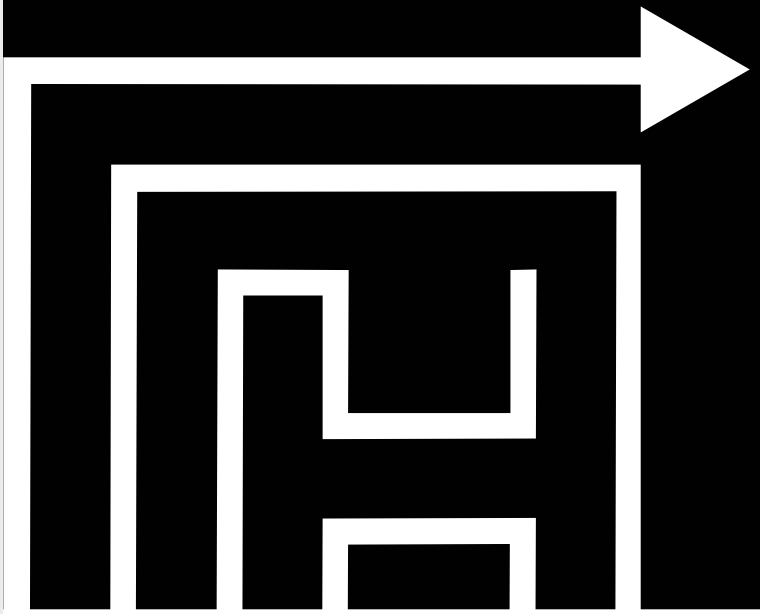
Hell no!!!



Would you pay €25,00 for a coke?

OUCH!

02



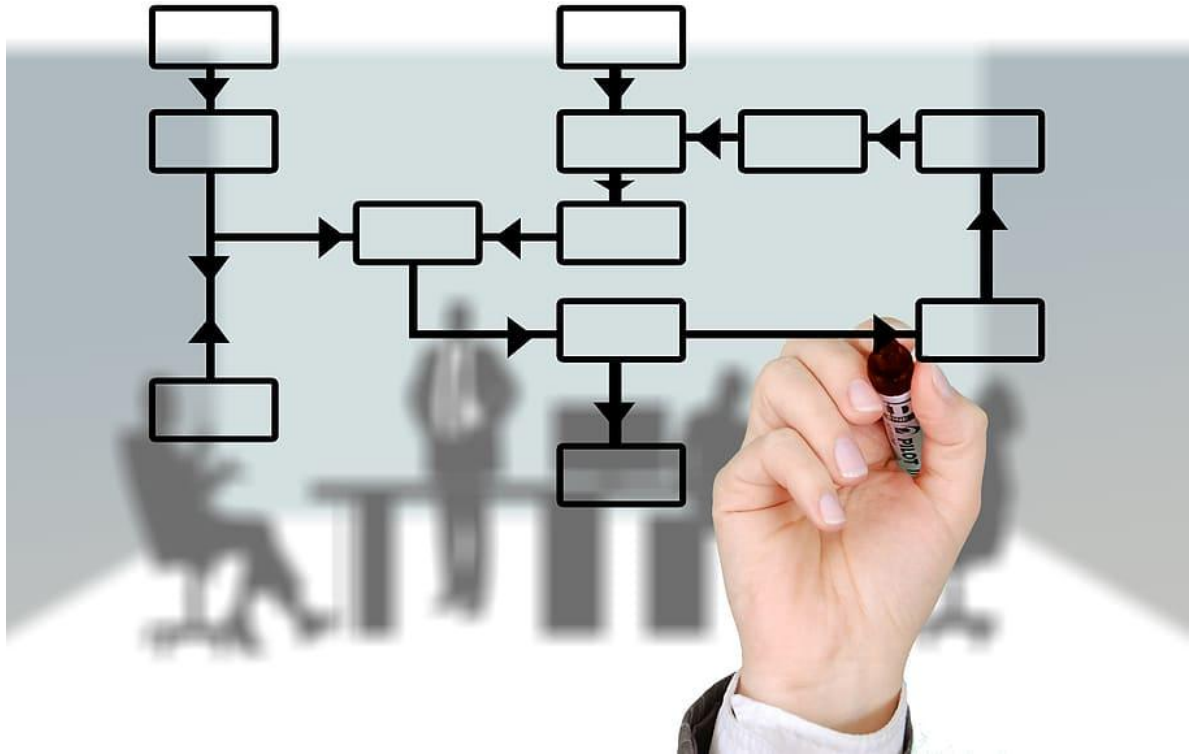
STRUCTURED DECISION

STRUCTURED DECISION

- Improves objectiveness
- Decreases uncertainty
- Allows repeatability
- Fosters transparency
- Simplifies group decisions
- Force coherence

How to structure a decision?

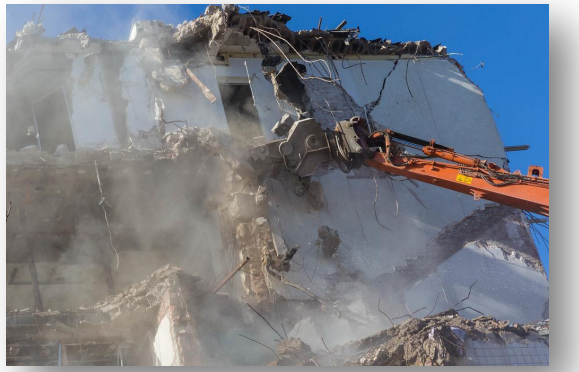
- Understand the problem
- Select alternatives
- Select criteria
- Quantify criteria
- Define the Decision Maker
- Elicit preferences
- Model the process
- Take the decision



Understand the problem

How to get rid of it?

Select alternatives



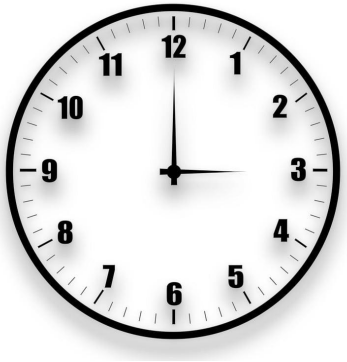
Tear down the wall

Set the hive on fire

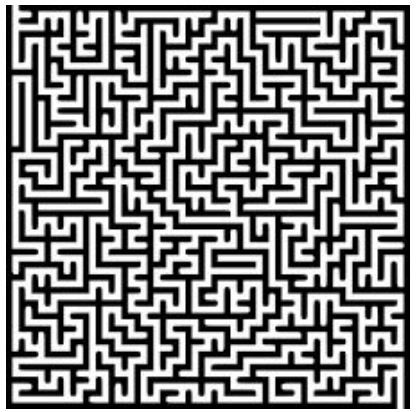
Smash the hive

Smoke the hornets
and remove the hive

Select criteria



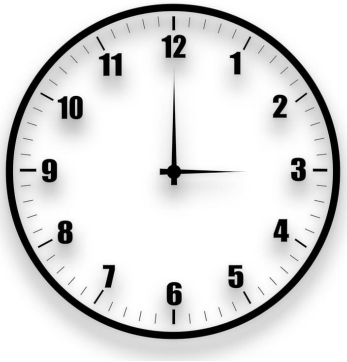
Time



Feasibility

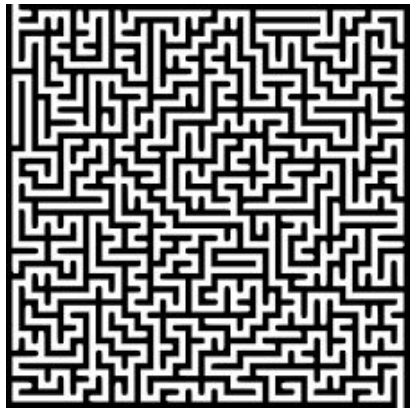
Cost

Quantify criteria



Time = Hours

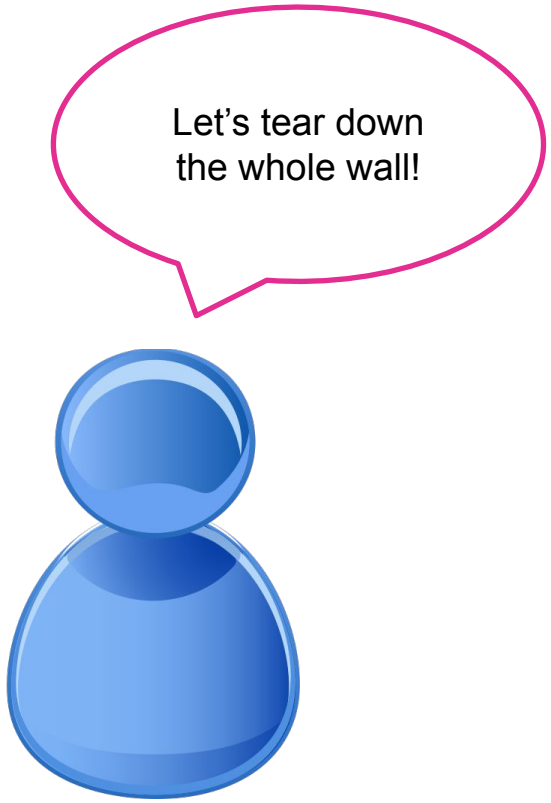
Cost = Euros



Feasibility = not measurable, need to find indicators (location, materials…)

Define the decision maker

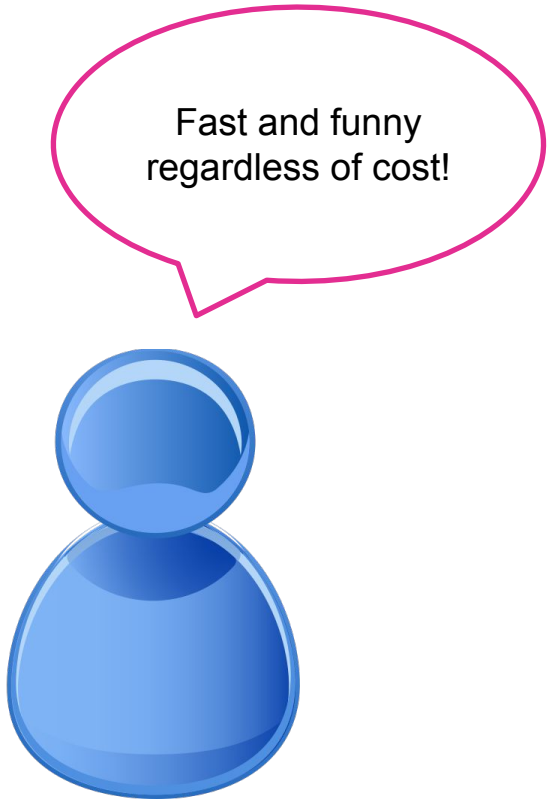
Single DM



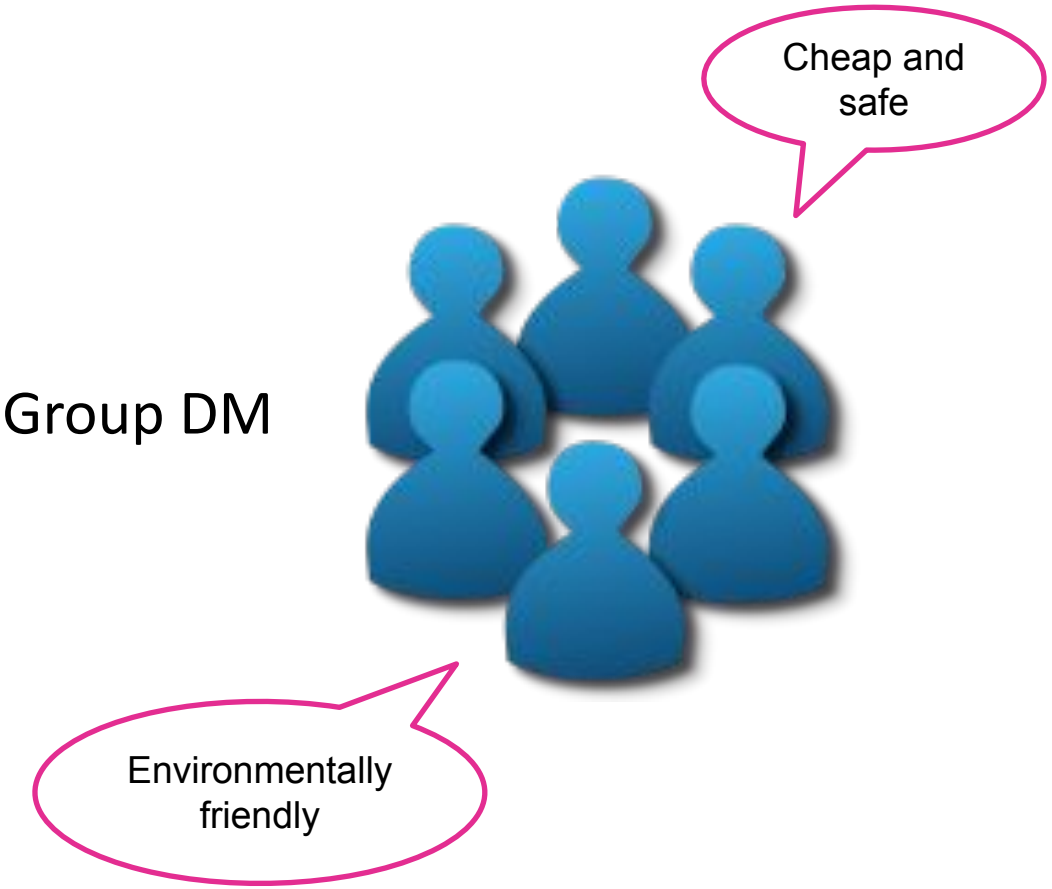
Group DM

Elicit preferences

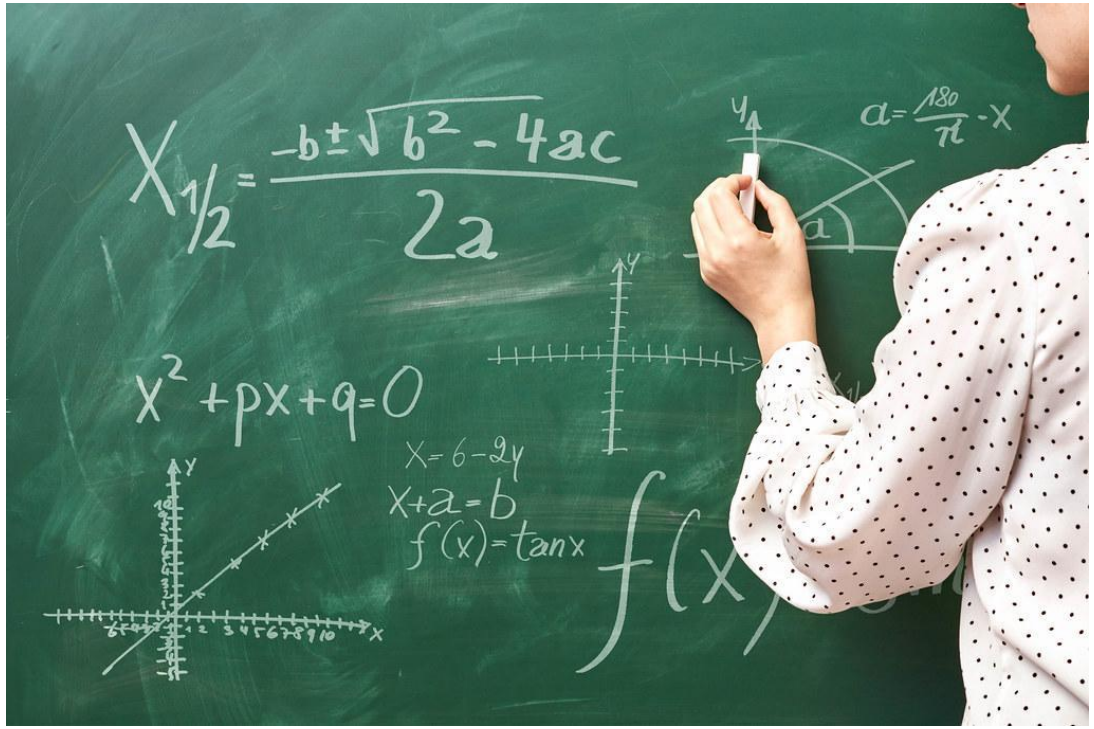
Single DM



Group DM

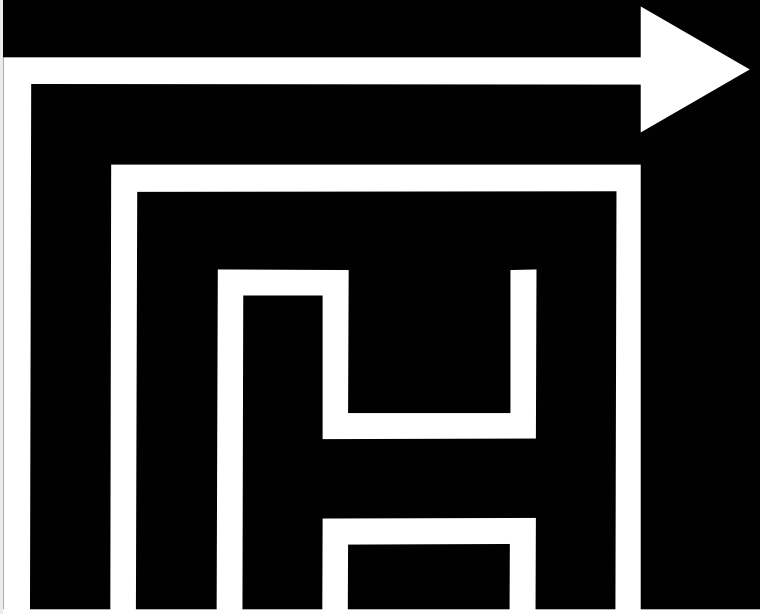


Model the decision process



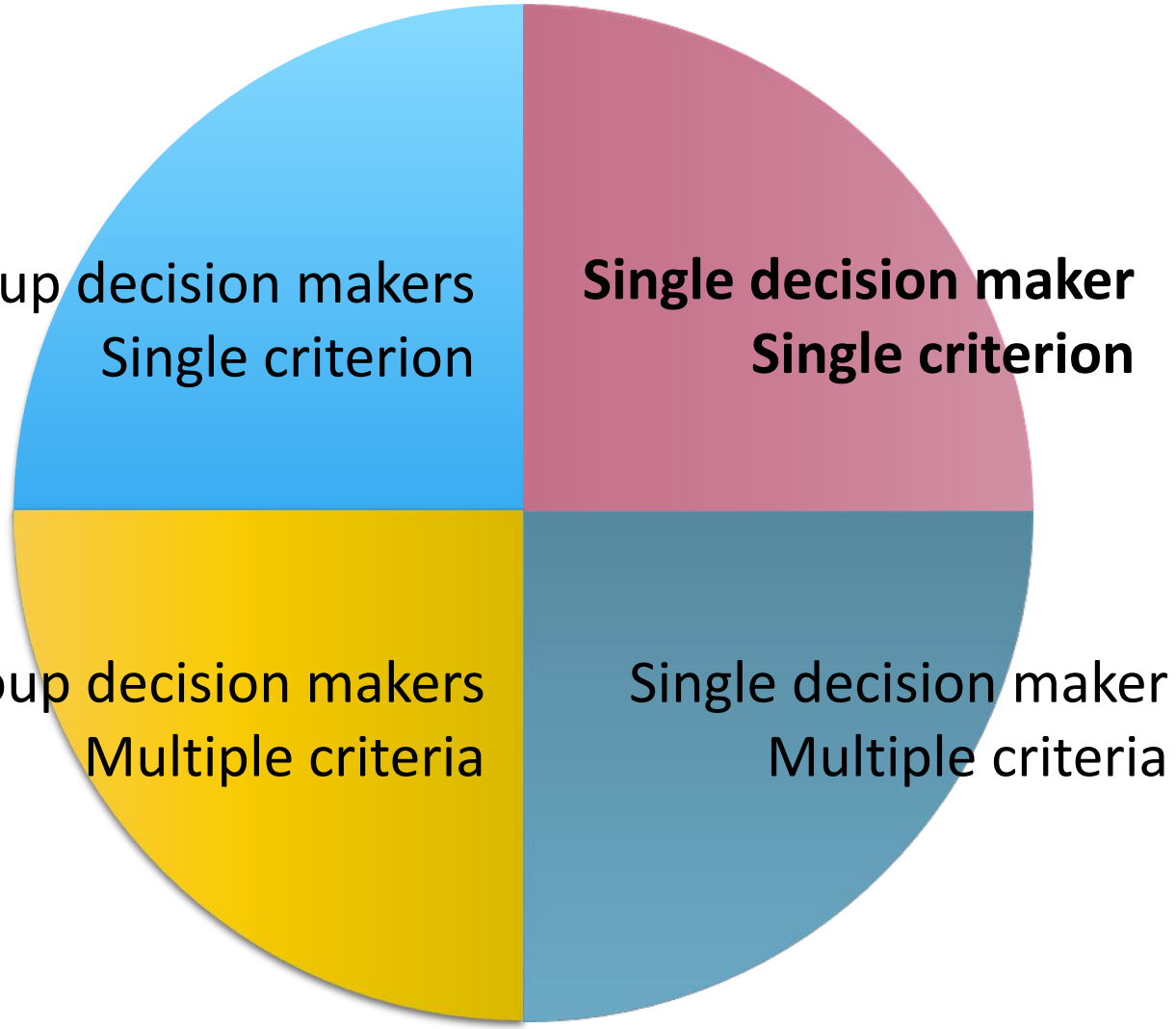
Take the decision

03



DECISION PROCESSES: Single criterion

Four kinds of Decision processes



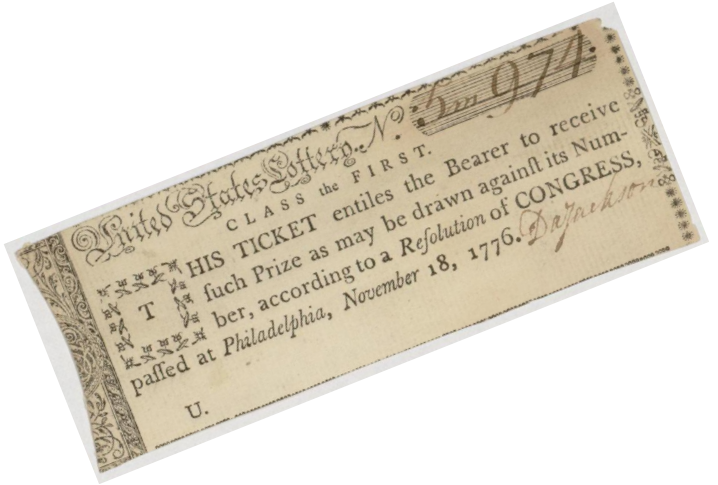
Single criterion single DM

Participating in a lottery

A

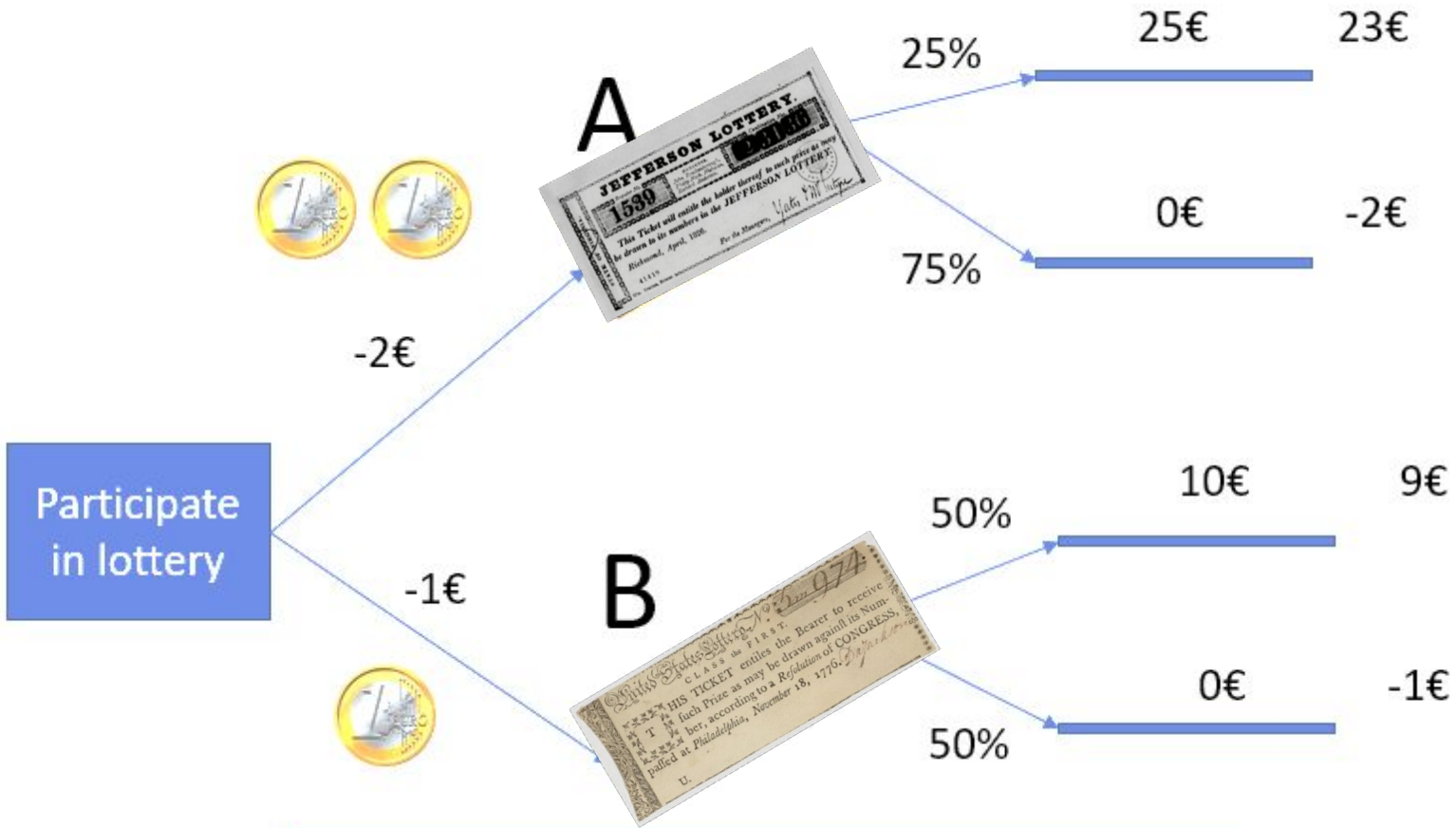
- Costs 2€
- Win 25€
- Winning 25%

B



- Costs 1€
- Win 10€
- Winning 50%

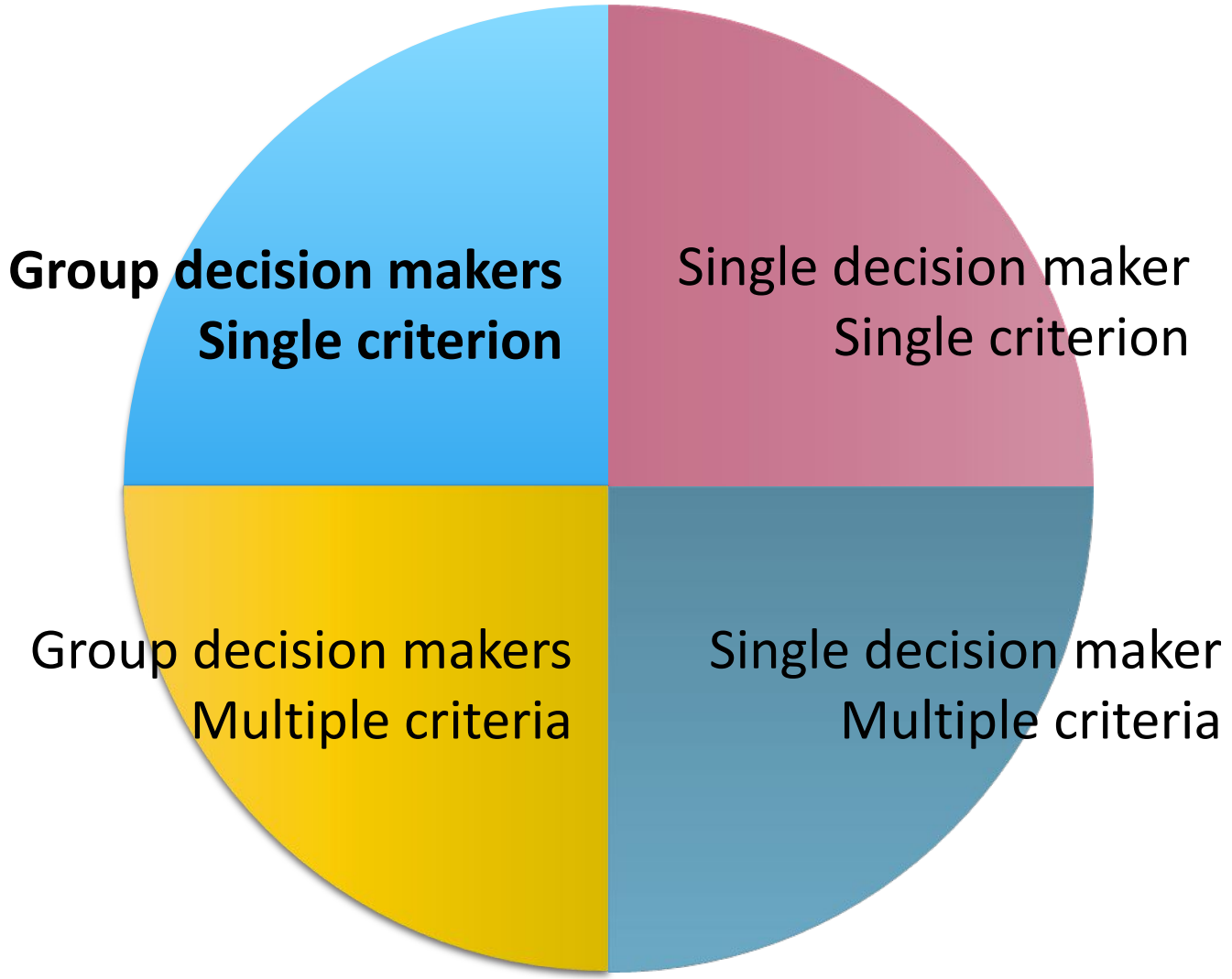
Decision tree



$$\mathrm{EMV}(A) = 0.25 \cdot 23€ + 0.75 \cdot -2€ = 4.25€$$

$$\mathrm{EMV}(B) = 0.50 \cdot \ \ 9€ + 0.50 \cdot -1€ = 4.00€$$

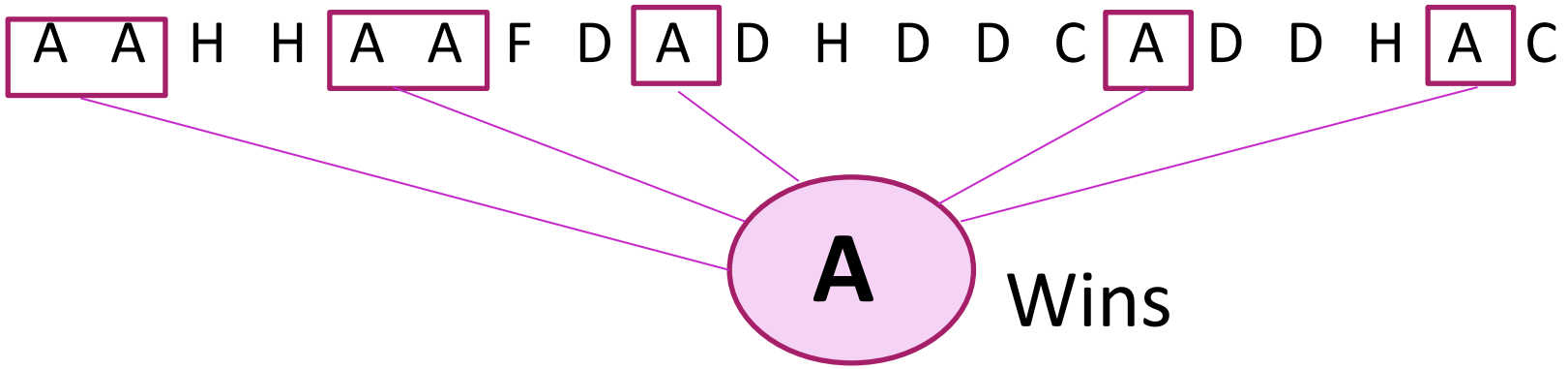
Four kinds of Decision processes



Single criterion multiple DM

Elections

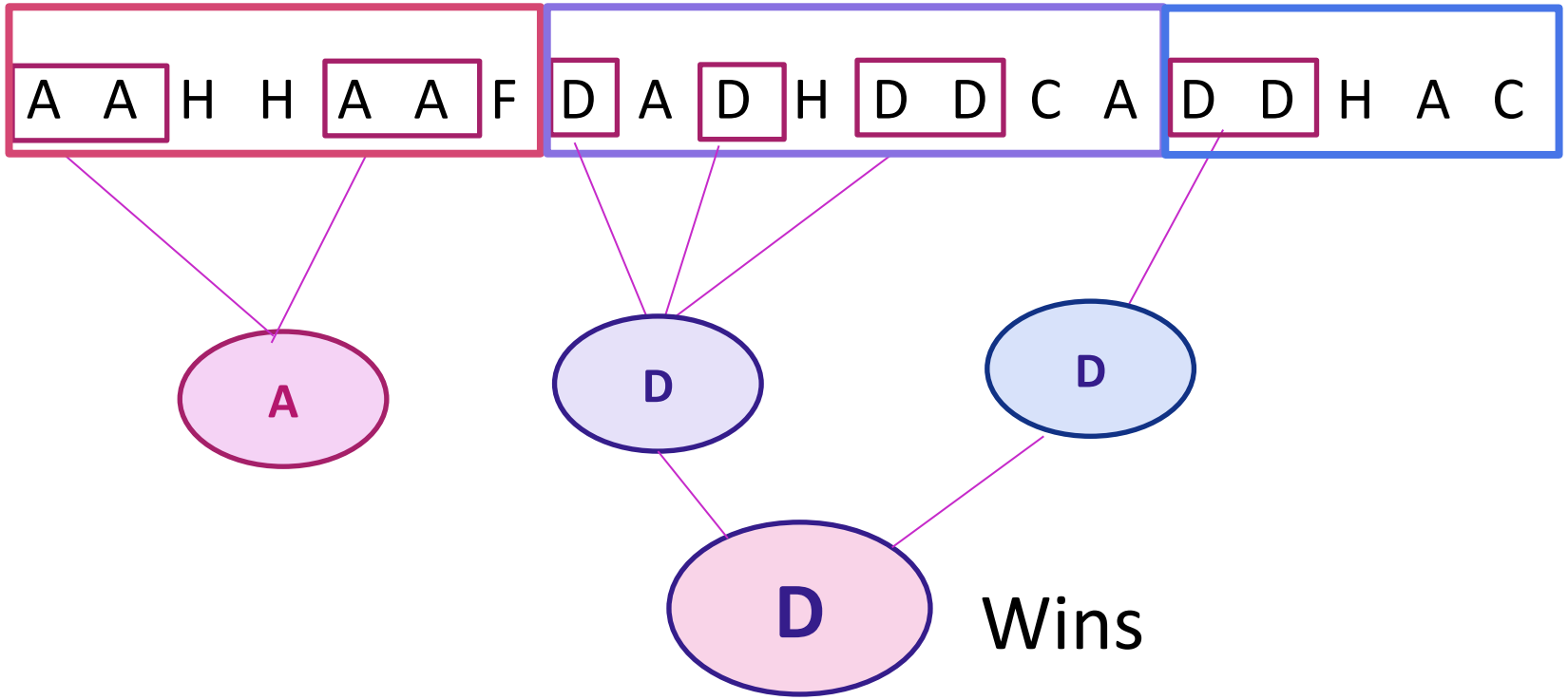
Select from 10 candidates (A to J) with 20 voters
How?
One head one vote



Single criterion multiple DM

Electoral College:

Voters are subdivided by geographical area



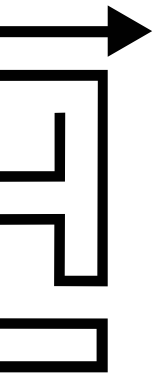
Single criterion multiple DM

OTHER METHODS

BORDA COUNT (Jean-Charles de Borda, 1733 – 1799)

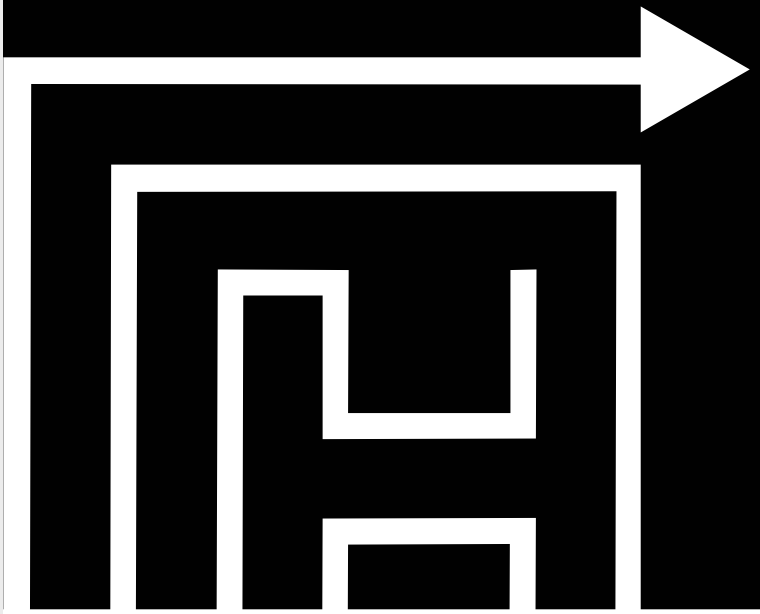
- Each voter ranks N candidates
- A score is associated to each position in ranking
- Scores are summed to select the winner

CONDORCET METHOD (Marie Jean Antoine Nicolas de Caritat Marquis de Condorcet, 1743 – 1794)



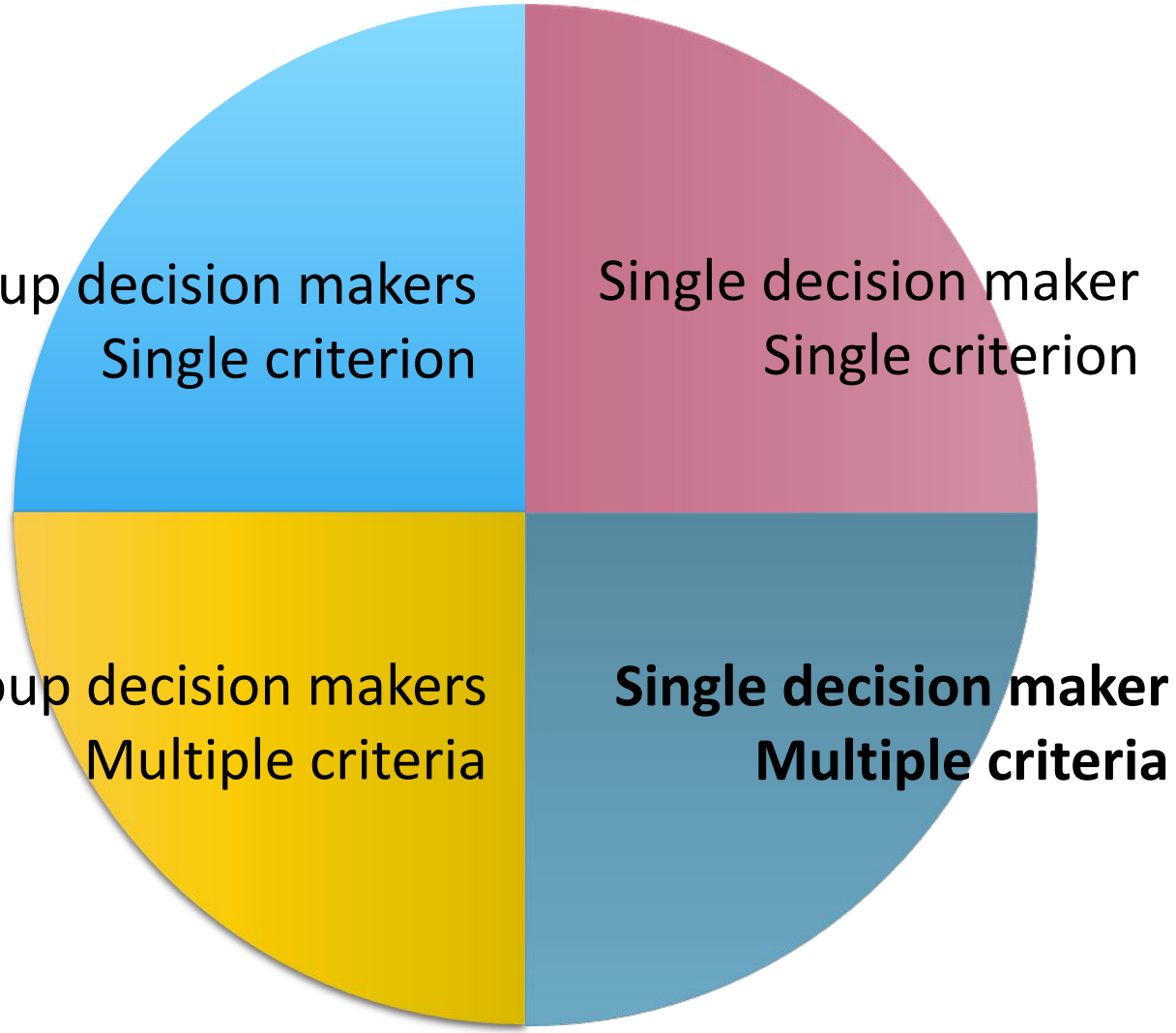
- Voters ranks the list of candidates in order of preference (ranked ballot)
- The count is conducted by pitting every candidate against every other candidate in a series of hypothetical one-on-one contests
- When all possible pairings of candidates have been considered, if one candidate beats every other candidate in these contests then they are declared the “Condorcet winner”
- If there’s not a “Condorcet winner” a ballot is needed

04



DECISION PROCESSES: Multiple criteria

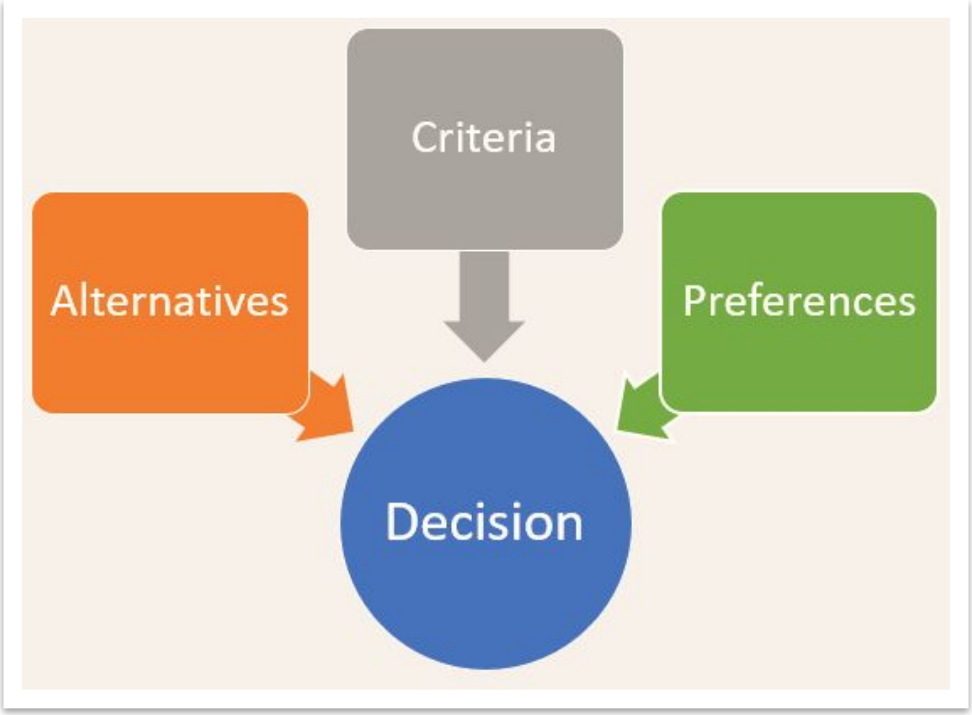
Four kinds of Decision processes



Multiple criteria single DM

Multiple Criteria Decision Analysis

Methodologies to aid decisions when multiple criteria are involved



Multiple Criteria single DM

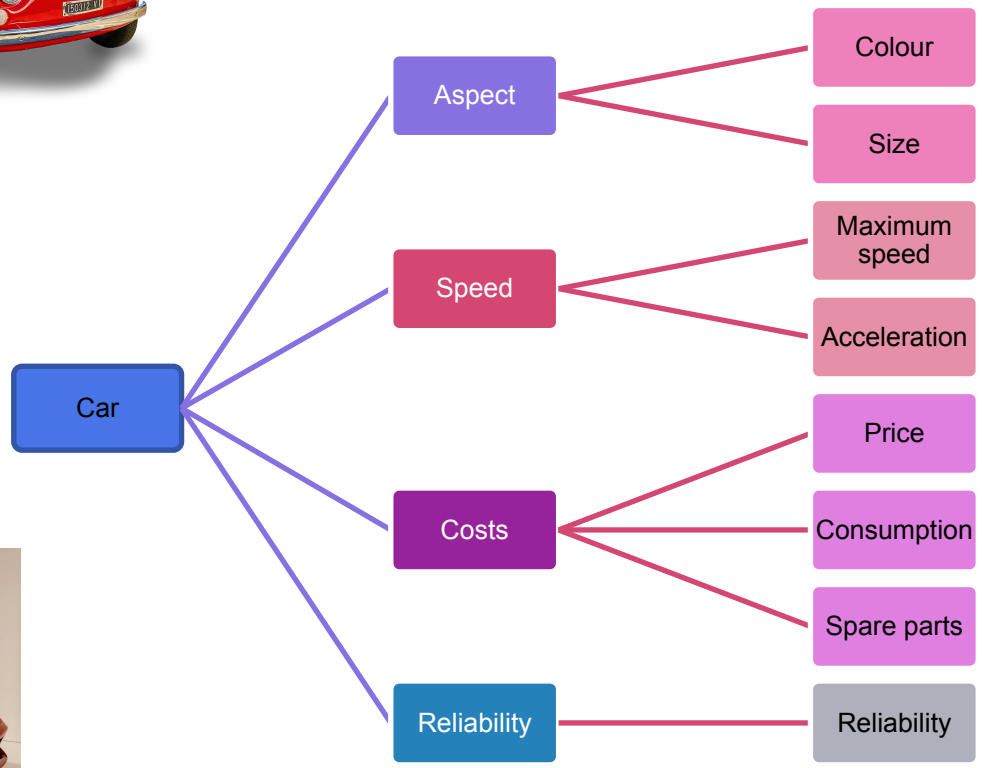
«Buy a car» example




	Colour	Size	Maximum speed	Acceleration	Price	Consumption	Spare parts	Reliability
Fiat 500	white	small	80 km/h	-	5k€	16 km/lt	cheap	low
Beetle	blue	medium	130 km/h	50 sec	8k€	15 km/lt	cheap	medium
Minivan	yellow	big	100 km/h	120 sec	20k€	13 km/lt	cheap	medium
Ferrari	red	medium	280 km/h	6 sec	200k€	2 km/lt	expensive	high

Multiple criteria single DM

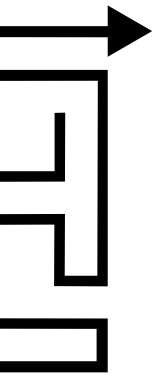
Criteria organization



Multiple criteria single DM

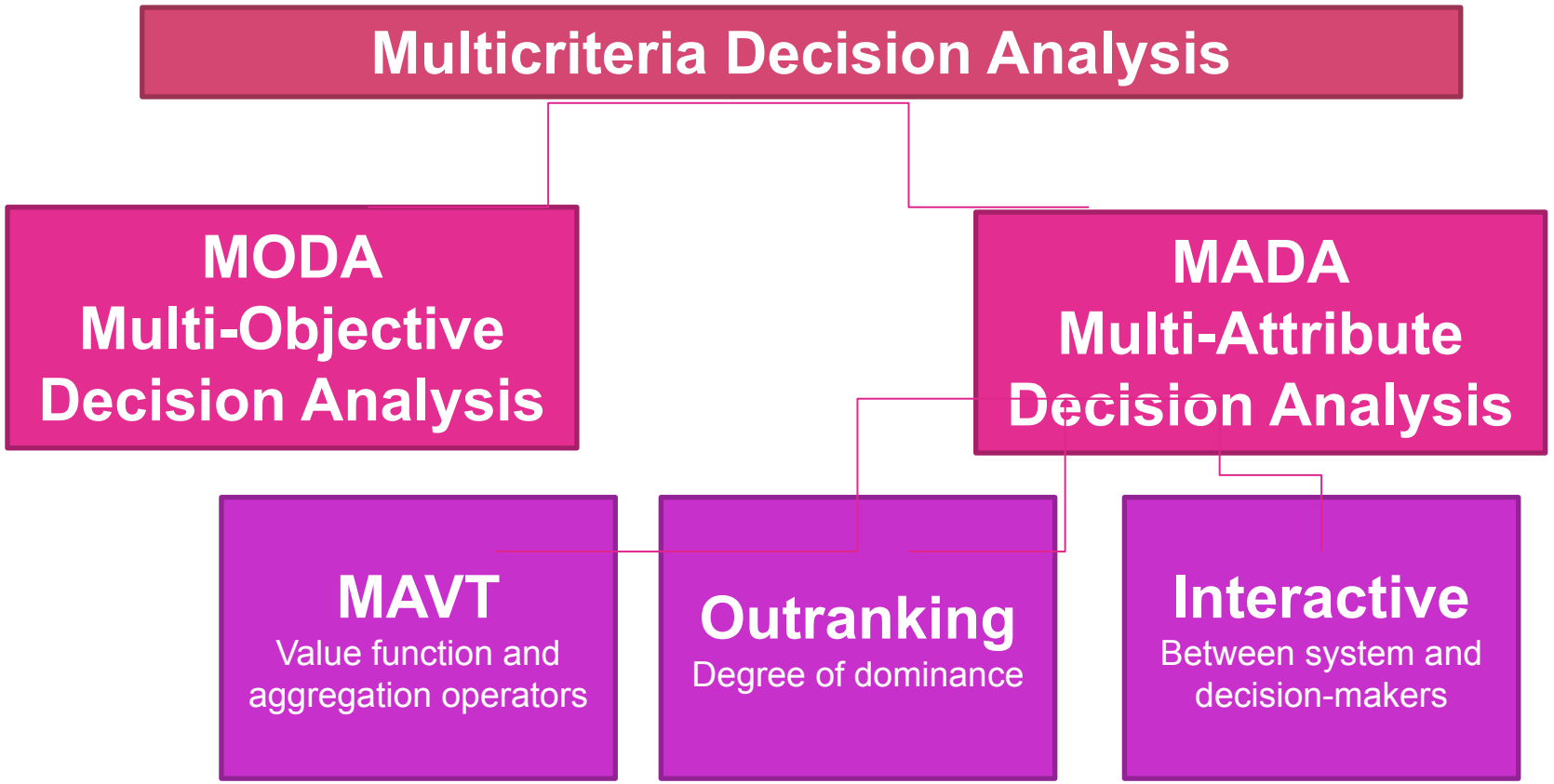
Measurement scales

- **Nominal scale**: nominal scale datum is equal to some particular value or to count the number of occurrences of each value → Colour (Red, blue, white…)
- **Ordinal scale**: ordinal data can be ranked but differences between two ordinal values cannot be quantified → Size (Big, average, small…)
  → Reliability (Hig, medium, low…)
- **Interval scale**: differences can be quantified but there is no natural zero
  → Maximum speed (Km/hours)
  → Consumption (Km/Liter)
- **Ratio scale**: differences can be quantified and ratio is meaningful because there is a natural zero → Price (Euros)

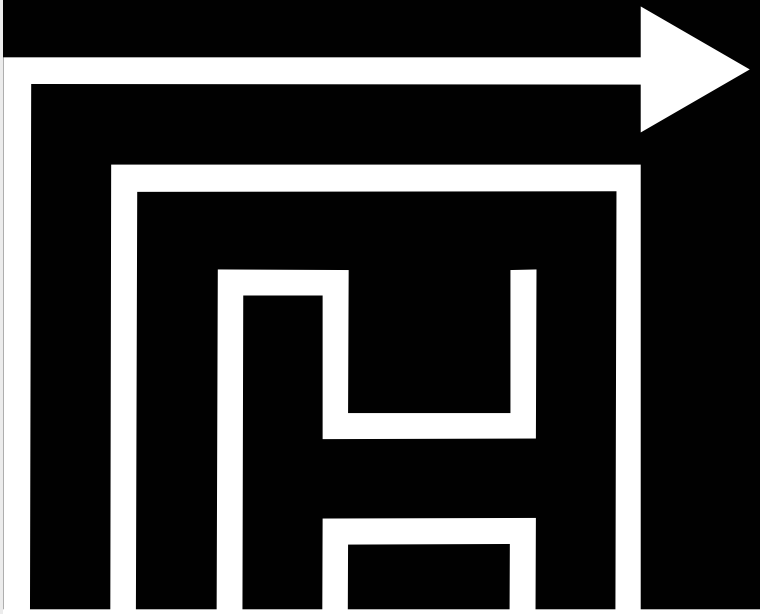


Multiple criteria single DM

Different measurements scales are **not comparable: how to aggregate** them in order to rank alternatives?



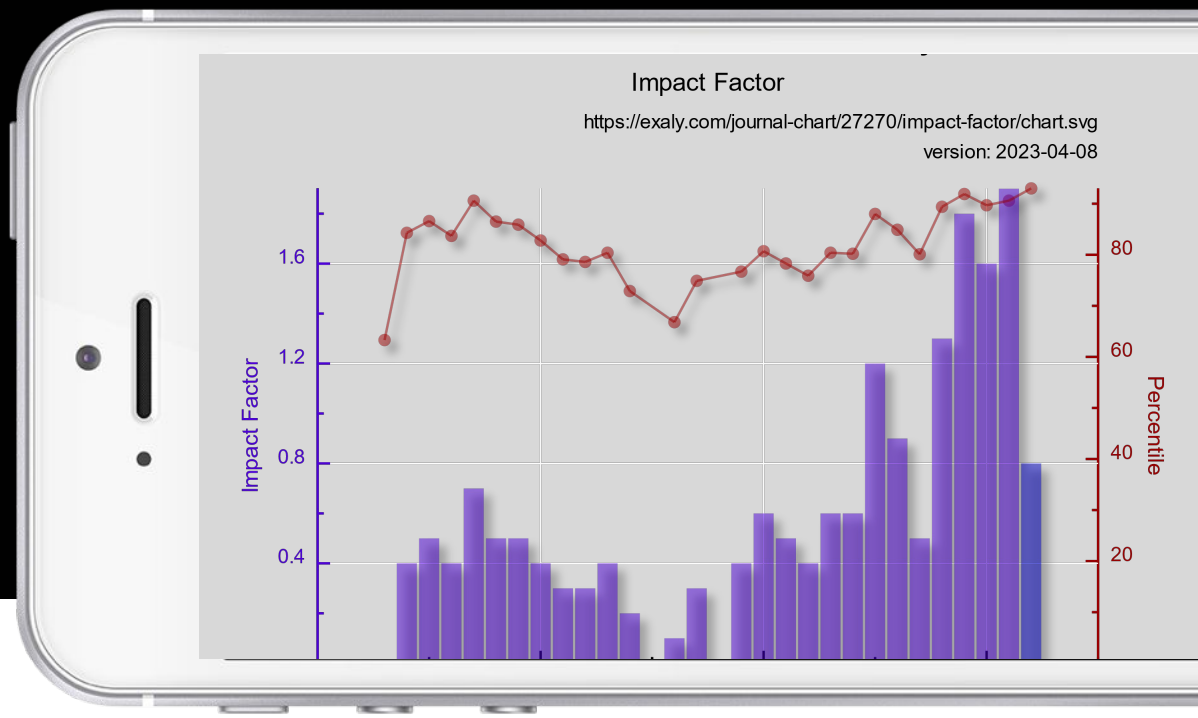
05



Multiple-Criteria Decision Analysis MCDA

MCDA

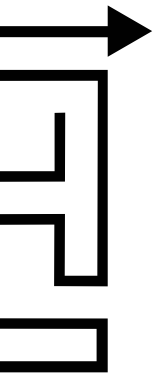
Multi-Criteria Decision Analysis (MCDA), also known as Multi-Criteria Decision-Making (MCDM), is about making decisions when multiple criteria (or objectives) need to be considered together in order to rank or choose between alternatives.



MCDA applications

Some examples of **MCDA applications** in different fields (business, nonprofits, government, health, education…):

- The local/central government which wants to prioritize its spending
- The health facility that must prioritize patients for access to clinical trial
- The HR department of a company that must shortlist job applicants
- program
- The NGO that needs to select projects or investments for funding
- The University which draw up a students ranking for scholarships
- The person who is choosing a new car (or smartphone, or house…)

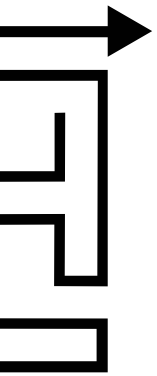


MCDA Softwares

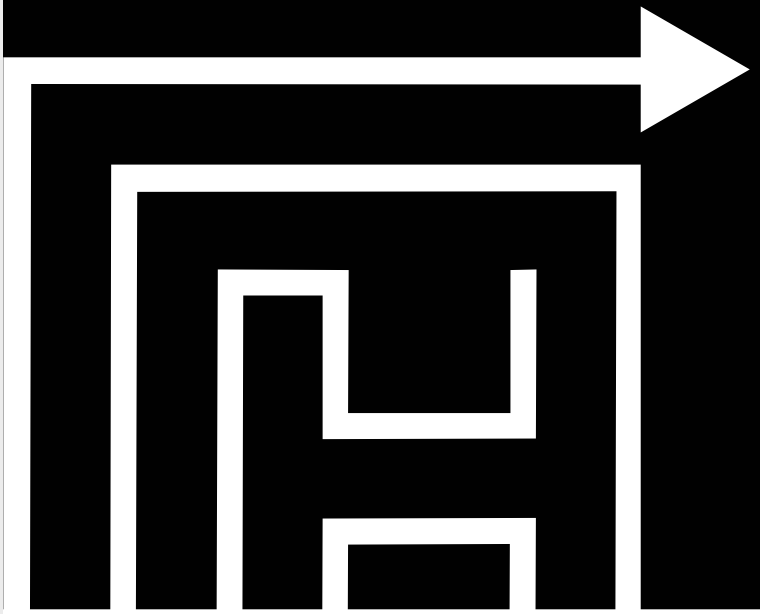
Multi-Criteria Decision Analysis is supported by **specialized software** which frees "the facilitator/analyst and decision-maker from the technical implementation details, allowing them to focus on the fundamental value judgments" (Belton & Stewart 2002, p. 345).

MCDA softwares are useful (and sometimes essential) in particular:

- for applications involving **many different alternatives and criteria**
- when the methods for determining the weights on the criteria are technically sophisticated



06



DECISION SUPPORT SYSTEMS: an example

DSS APACHE Project

The **APACHE project (Active & intelligent PAckaging materials and display cases as a tool for preventive conservation of Cultural Heritage)** has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N. 814496 (https://www.apacheproject.eu/).

APACHE aims to find a solution to the long-term preservation questions raised by billions of objects collected in museum, library and archive storages by developing:

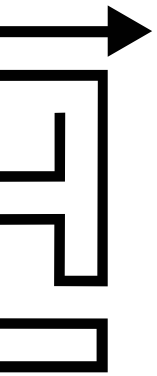
- multi-scale modelling to predict Cultural Heritage degradation;
- new generation of active and intelligent storage crates, archive boxes and display cases to improve storage and exhibition;
- collaborative decision-making tools for preventive maintenance.

DSS APACHE Project

The **Decision Support System** developed by GreenDecision s.r.l. in the **APACHE project** is a freely available web application created to help **museum curators** maintain a clear view of their art objects, the materials they are made of and the sensors associated with them.

The Apache Decision Support System (DSS), specifically tailored to tangible, movable and indoor cultural heritage, allows users to assess the conservation status of their artifacts and to **discover and rank the most suitable preventive measures to be applied**.

The tool aims to support **preventive conservation decision making** for cultural heritage collections, through providing basic information concerning the behaviour of a limited number of common materials found in heritage objects, in relation to four well-known sources of environmental deterioration (temperature, relative humidity, light and airborne pollutants).



Apache DSS by GreenDecision s.r.l.

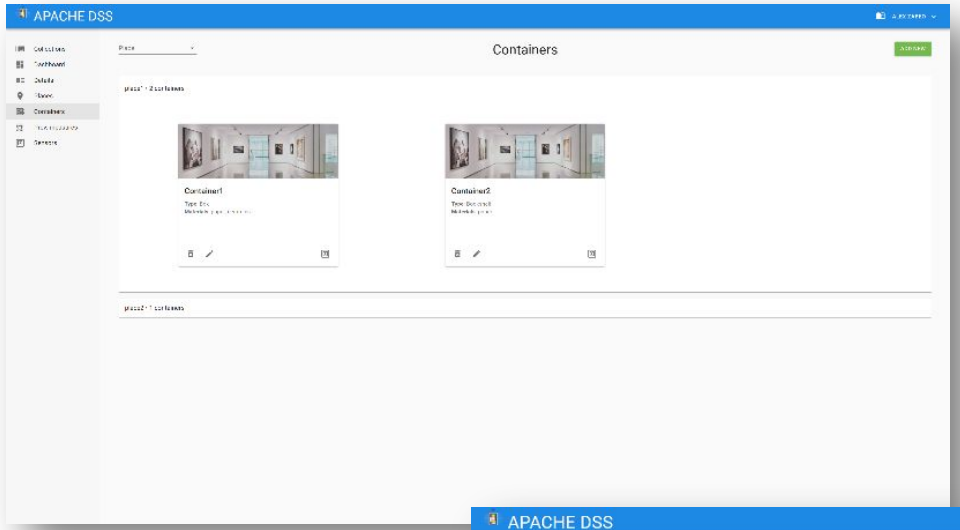
https://apachedss.greendecision.eu/

Extensive guidelines on materials and agents of deterioration

Sensors' data collection

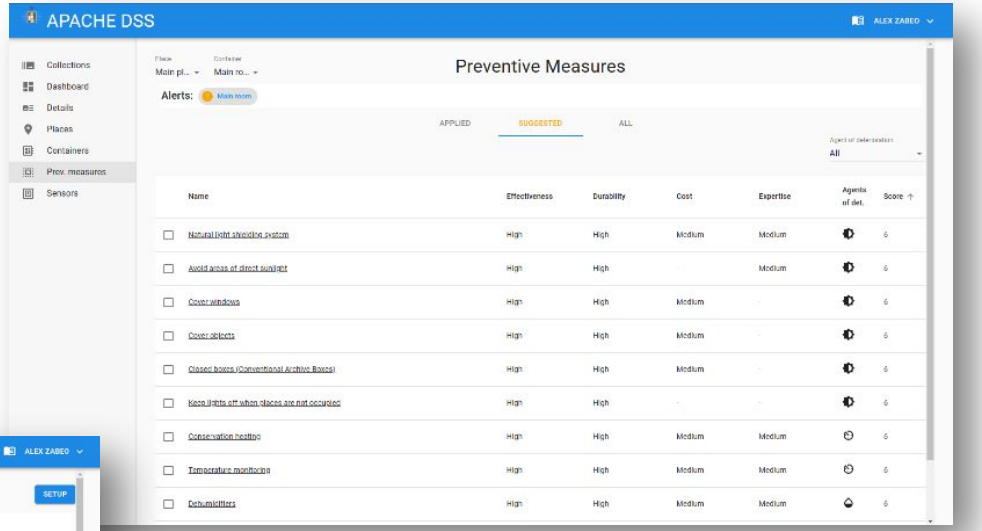
Preventive measures repository and suggestions

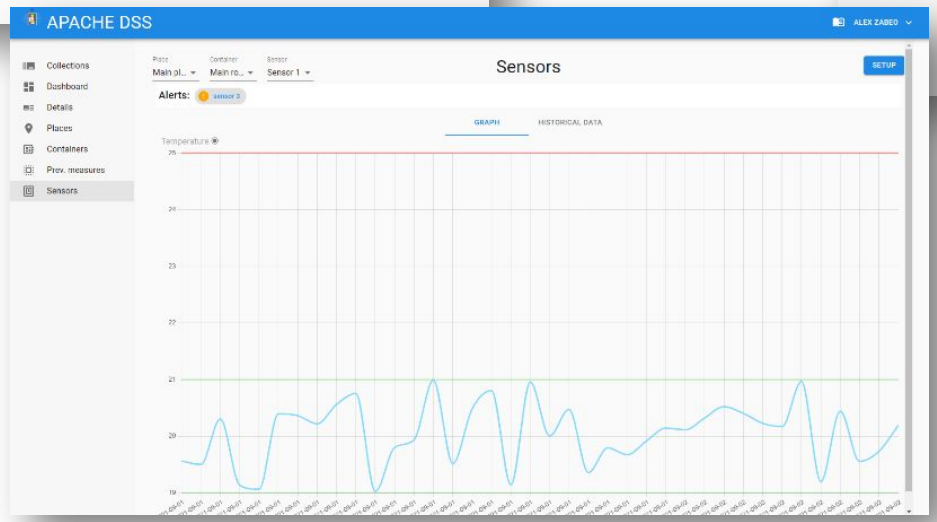
Apache DSS by GreenDecision s.r.l.



Organize data

Select preventive measures

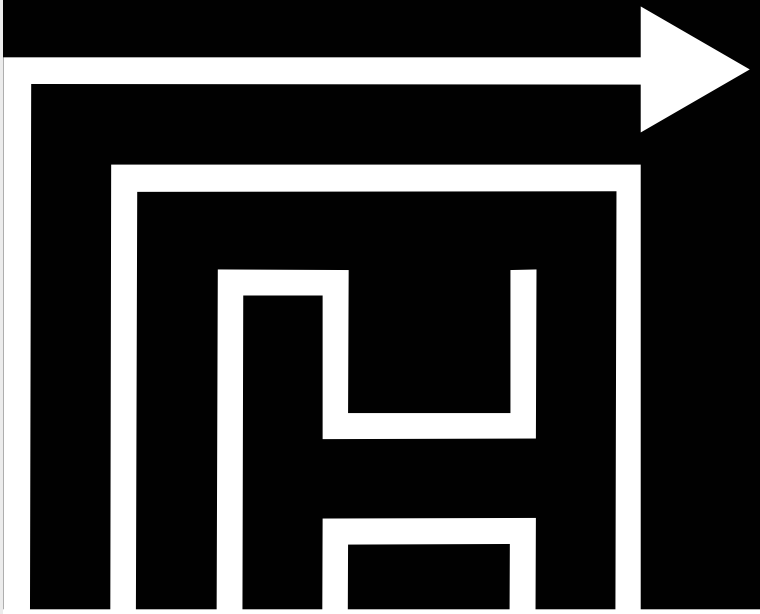




Store and check sensors' readings

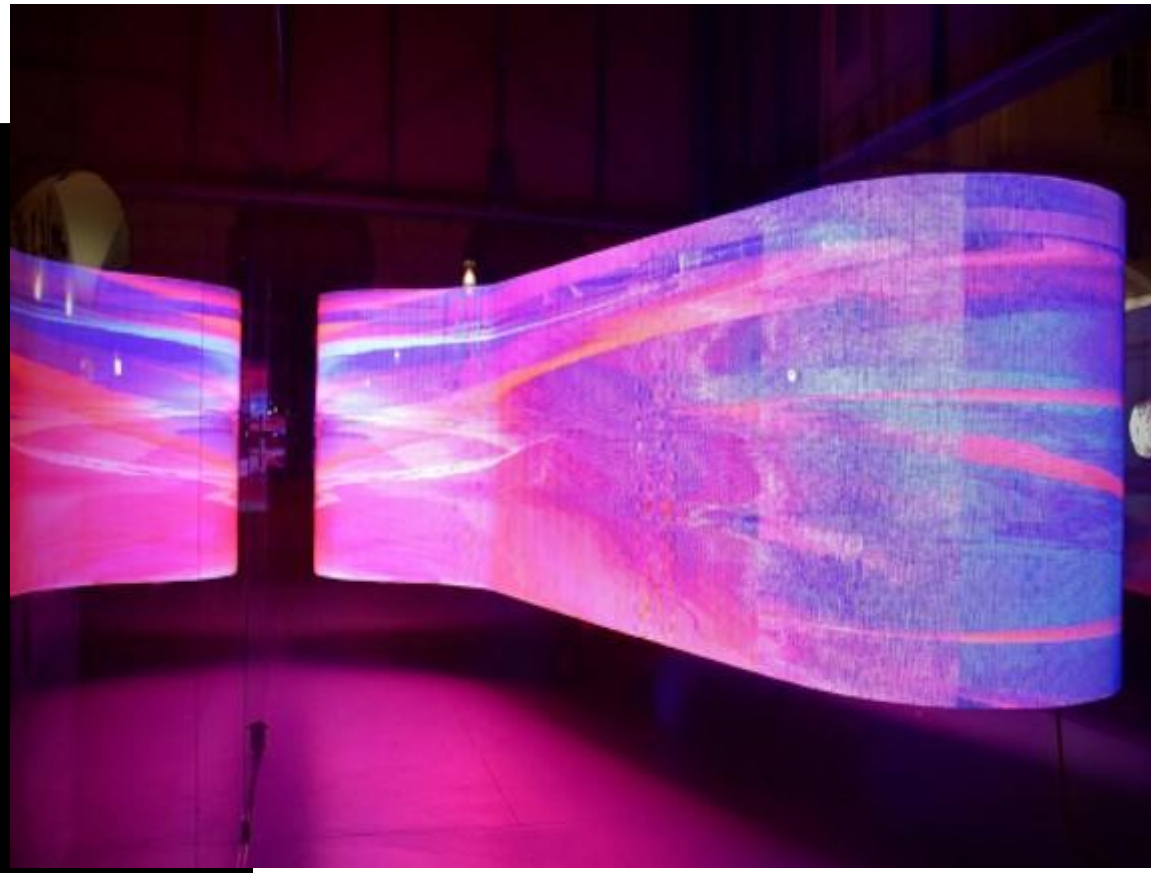
CULTURAL HERITAGE **2.0**

07



FURTHER READINGS

- Multiple Criteria Decision Methods and Applications (1985)
- Readings in Multiple Criteria Decision Aid (1990)
- Multicriteria Decision-Aid (1992)
- Multiple Criteria Decision Analysis: State of the Art Surveys (2005)
- Trends in Multiple Criteria Decision Analysis (2010)



CULTURAL HERITAGE 2.0

CULTURAL HERITAGE 2.0

CULTURAL HERITAGE

www.culturalheritage.eu

Follow our journey

Ca' Foscari University of Venice

University Industry Innovation Network

UNIVERSITY OF COPENHAGEN

universität wien

momentum [educate + innovate]

bespoke

Co-funded by the Erasmus+ Programme of the European Union