

# MCMD

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# CRITERION

**Criteria** – plural of criterion

**Definition:** A quality or attribute of an alternative  
that is related to its desirability

# MAJOR CATEGORIES OF CRITERIA

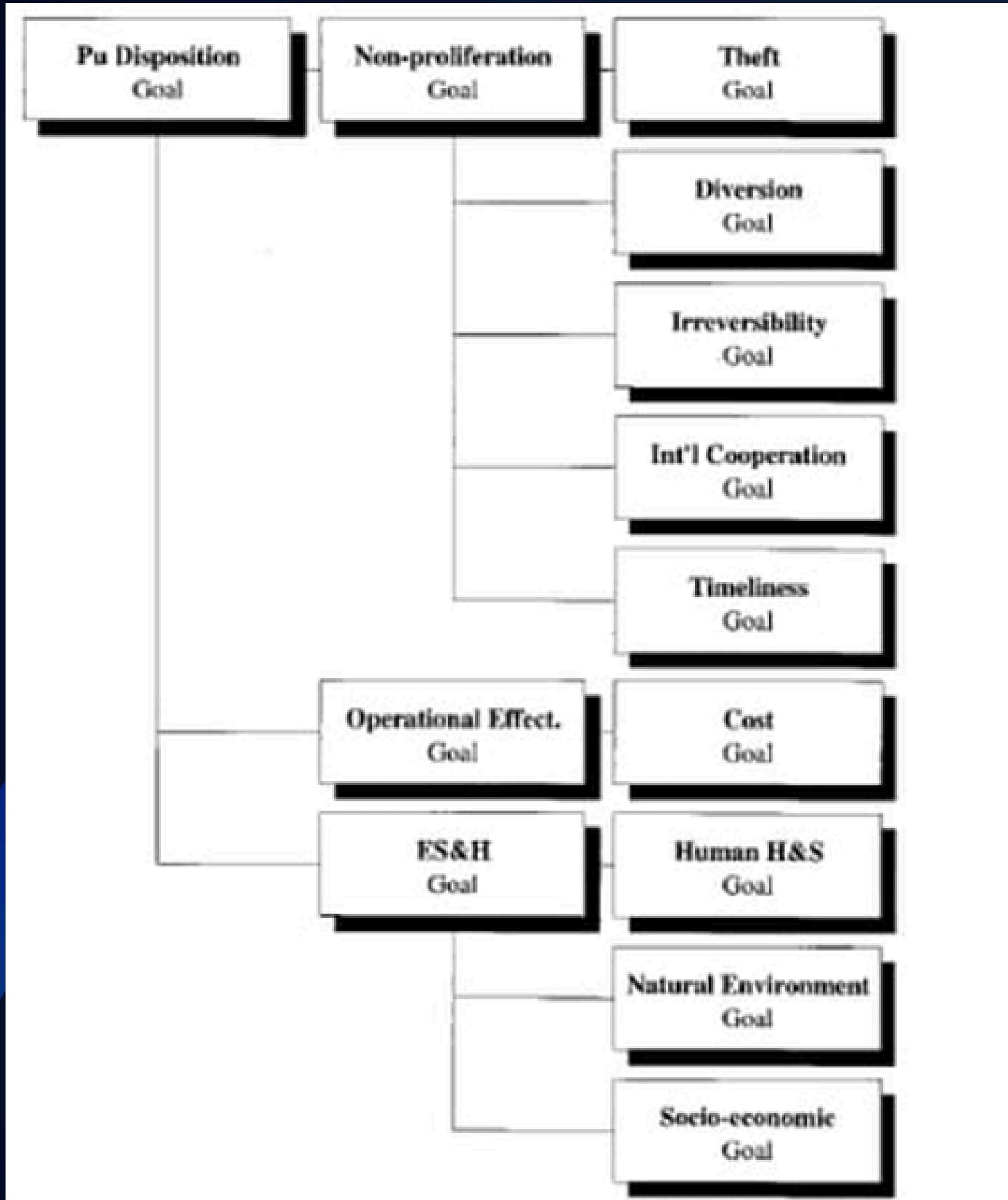


Fig 1: High Level objectives

# FORMAL ANALYSIS

Because criteria's are competing and trade offs among the criteria are difficult

# ALTERNATIVE

**Definition:** (of one or more things) available as another possibility.

A potential course of action

Ex: An item to be purchased

# DECISION

**Definition:** a conclusion or resolution reached after consideration.

Ex: Allocation of resource

# DECISION MAKING

- Decision making is the process of making choices by defining a decision, collecting facts, and evaluating alternative resolutions.
- Decision Making is preeminently a human function. We humans make several decisions knowingly or unknowingly everyday.
- Decision Making as a structured tool is a complex process of:
  1. Selecting criteria
  2. Determining alternatives
  3. Gathering, evaluating, and processing information.
  4. Producing and evaluating partial or immediate results.
  5. Reconsidering criteria, alternatives and information on the basis of achieved results.
  6. Repeating the process until an actionable outcome, i.e. a decision has been reached

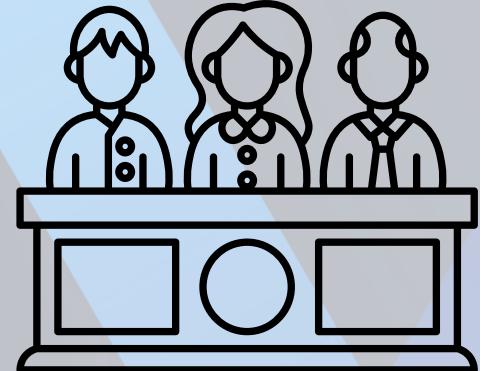
# DECISION MAKING

A school committee is tasked with allocating a fixed number of scholarships to students based on their performances on the subjects they are being taught e.g. mathematics, computer science, biology etc.

Decision problem is

- To rank all students from best to worst
- To select the top students as the scholarship recipients

Decision Maker



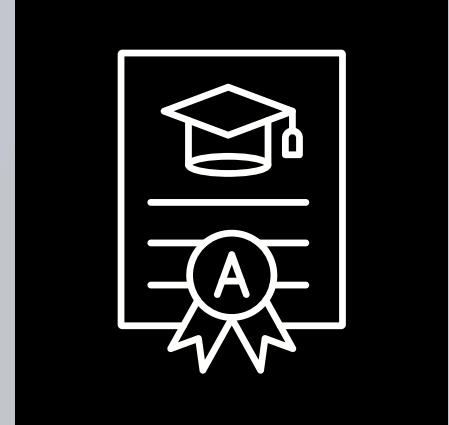
School Committee

Alternatives



Students

Criteria



Subject Performances

# SINGLE-CRITERIA DECISION PROBLEMS

**Example:** Choose least-cost airline ticket (All alternatives have same route, same schedule, same comfort)

# MULTIPLE-CRITERIA DECISION PROBLEMS

**Example:** Choose an airline ticket (All alternatives have different routes, types of airplane, costs etc.)

# MULTIPLE-CRITERIA DECISION PROBLEMS

- There is a choice- multi alternatives are possible
- Alternatives differ in more than one criterion
- Usually, the criteria are “competing” - i.e. no single alternative is best in every criterion

# TERMINOLOGY

- MCDM (multiple-criteria decision-making)
- MODM (multi-objective decision-making)
- MODA (multi-objective decision analysis)
- MAVT (multi-attribute value theory)
- MAPT (multi-attribute preference theory)
- MAUT (multi-attribute utility theory)

All address the problem of balancing multiple, competing criteria.

In many ways, they are all similar.

# WHY MCDM ANALYSIS?

- Criteria are competing and trade-offs are difficult to evaluate any other way.
- To balance multiple stakeholders' values.
- To improve communication.
- Analysis provides justification for decisions, and improves chances of acceptance of result.

# THINGS TO REMEMBER

There is no single right answer in MCDM analysis!!!

- Different decision-makers have different preference - legitimately.
- Subjective assessments are usually required in MCDM analysis.
- In general - the results (selected alternatives) may not be highly sensitive to subjective assessments.

# **STEPS IN A TYPICAL MCDM PROCESS**

1. Identify the problem
2. Formulate the problem
3. Construct the evaluation
4. Reach a final recommendation

# SUBSTEPS IN MCDM

## IDENTIFY THE PROBLEM

- Identify the stakeholders
- Identify the context of the problem
- Identify the objective of the decision and its respective properties

## FORMULATE THE PROBLEM

- Identify the decision alternatives and their criteria
- Identify the type of decision problem
- Managing Multiple DMs and their different perspectives

# SUBSTEPS IN MCDM

## CONSTRUCT THE EVALUATION MODEL

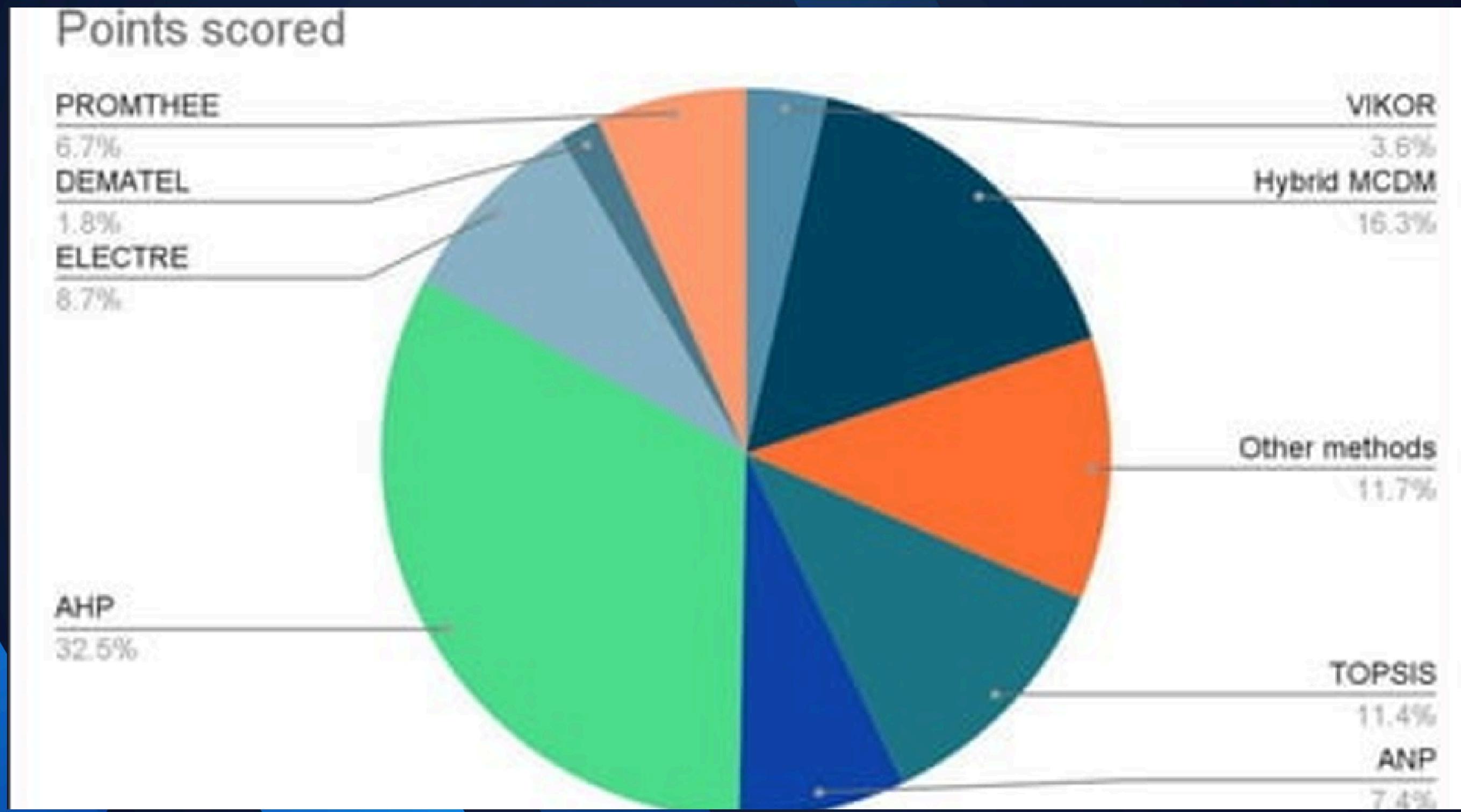
Choice of Mathematical Model and its Tuning

- To reflect the perspective of the DM A resolution method needs to be selected
- In order to provide a recommendation to the decision problem

## REACH A FINAL RECOMMENDATION

- Recommendation is presented to the DM
- Validates Recommendation
- Revisits previous steps in order to refine the solution
- Asks for additional supporting analysis

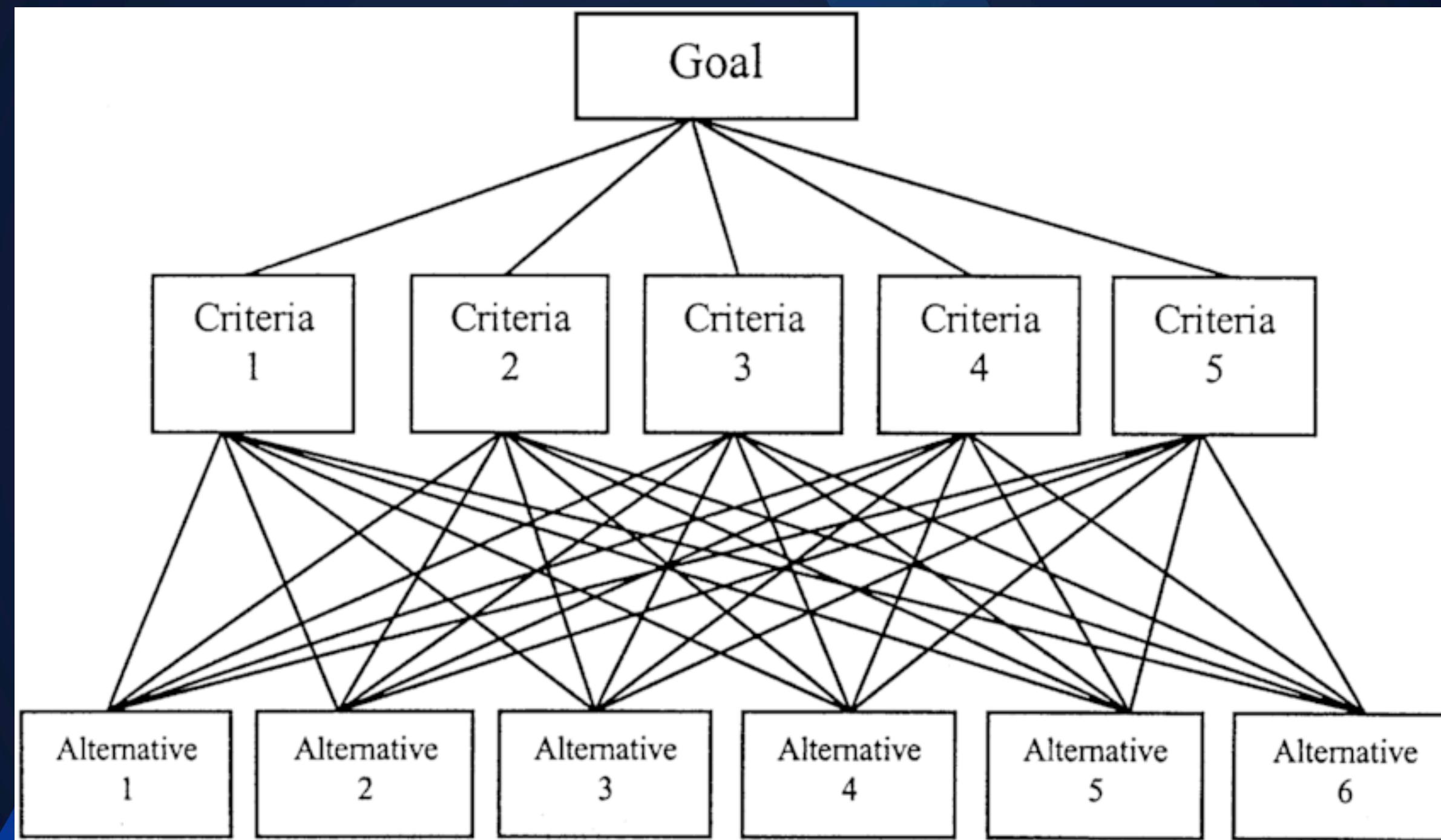
# PROPERTIES OF DIFFERENT MCDM MODELS



# **ANALYTICAL HERARCHU PROCESS (AHP)**

- 1.AHP method is the most famous MCDM method
- 2.The AHP method looks at the problem in three parts:
  - a.Goal
  - b.Criteria
  - c.Alternatives
- 3.AHP algorithm is basically composed of two steps:
  - a.Determining the relative weights of the decision criteria.
  - b.Determining the relative rankings (priorities) of alternatives.

# AHP



# AHP

	Color	Memory	Delivery
Color	1	3-1	½
Memory	3	1	1
Delivery	2	1	1

# THANK YOU