

How people make decisions involving multiple objects

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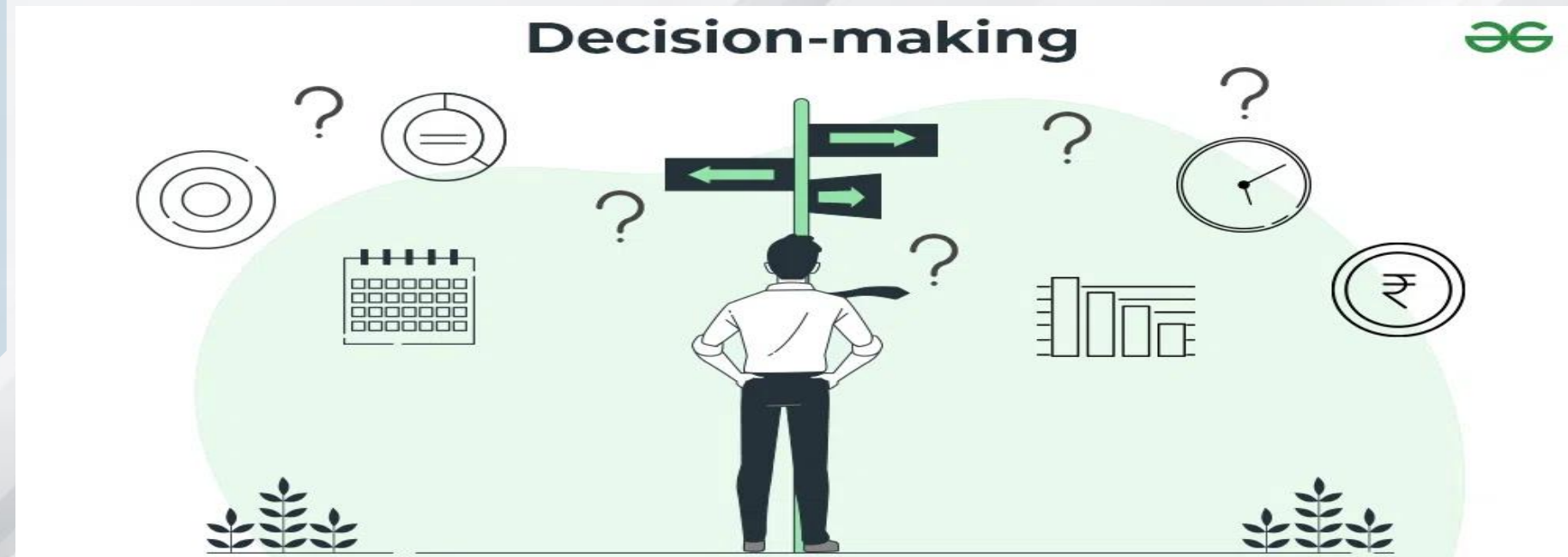
Lecture 2



Chapter
02

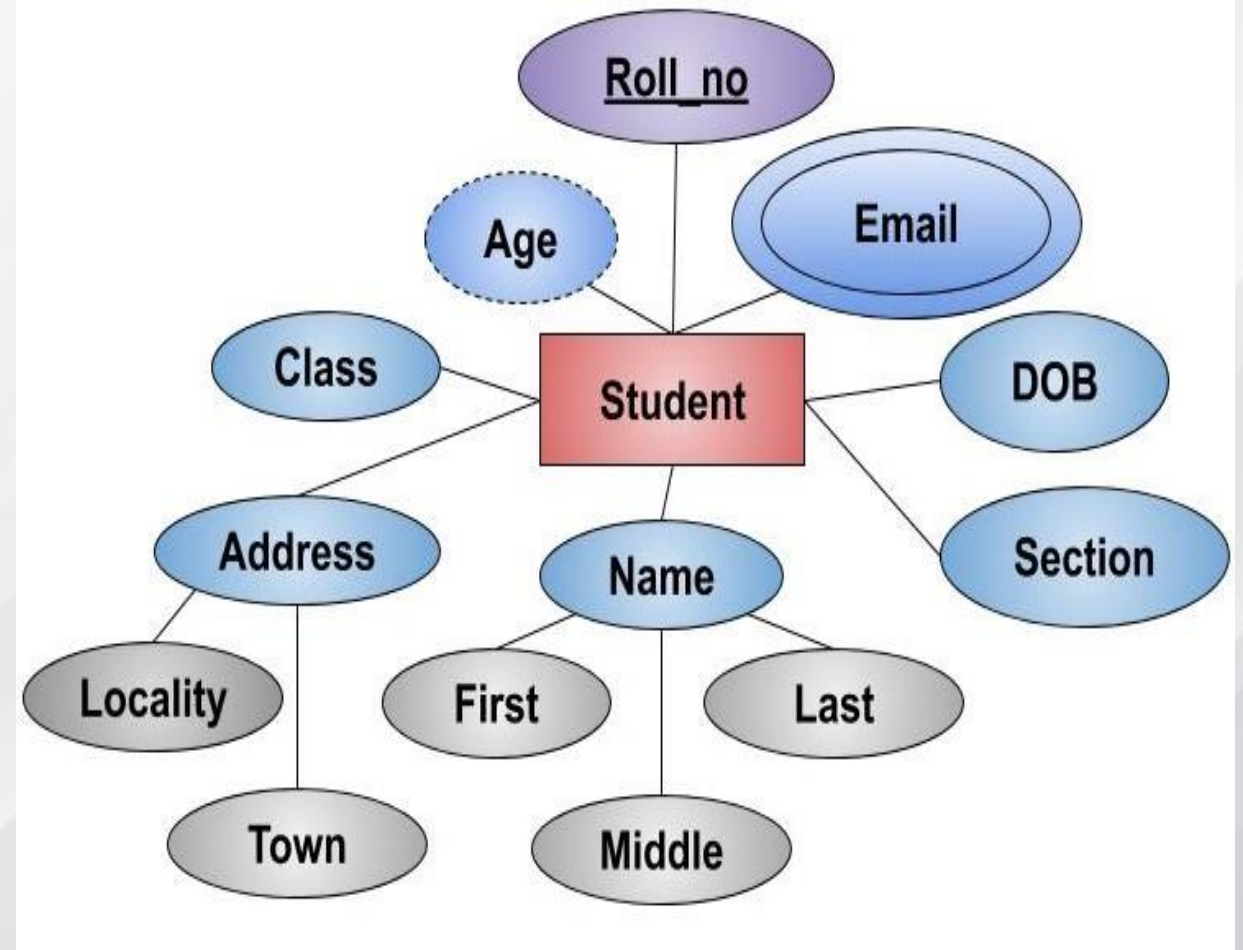
What are the methods of multi-criteria decision making?

Multi-criteria decision-making (MCDM) is one of the main decision-making problems which aims to determine the best alternative by considering more than one criterion in the selection process. MCDM has manifold tools and methods that can be applied in different fields from finance to engineering design.



What is difference between object and attribute?

An object is a **thing**. an attribute is a **characteristic of a thing**



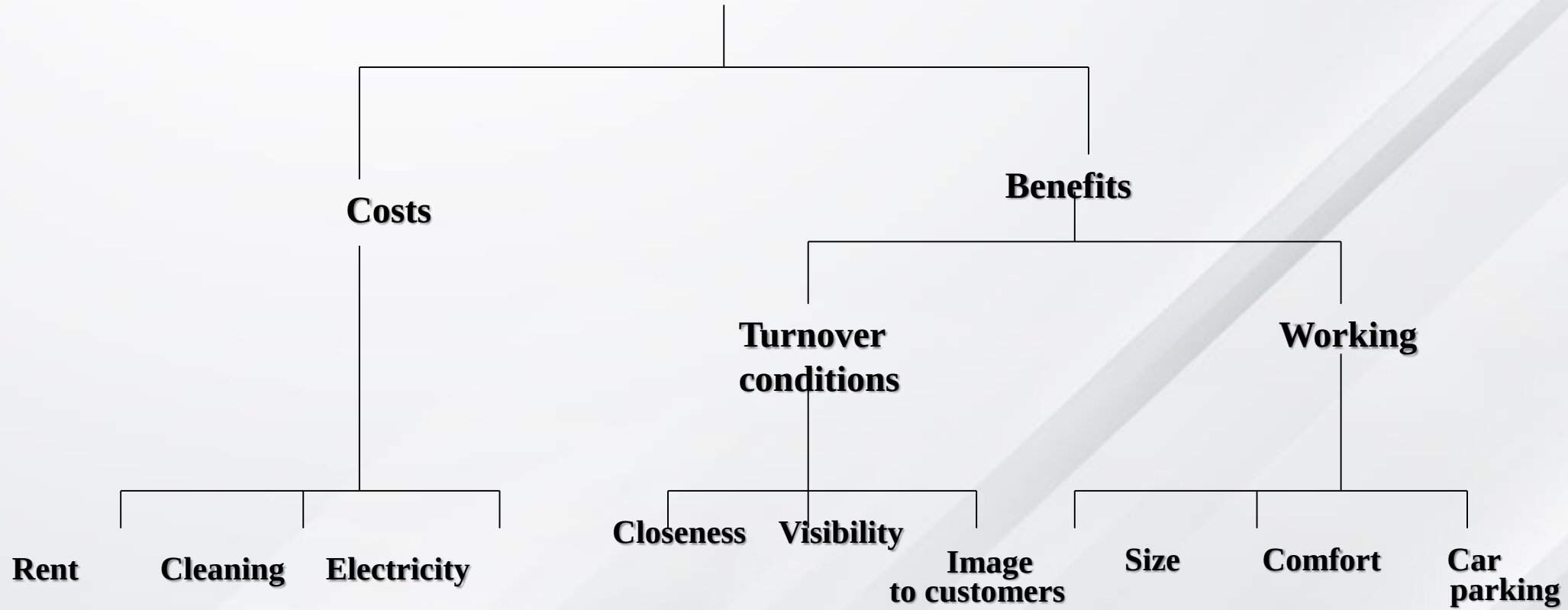
Objectives and Attributes

- An *objective* = an indication of preferred direction of movement. i.e. 'minimize' or 'maximize'.
- An *attribute* is used to measure performance in relation to an objective.

Main Stages of SMART Decision

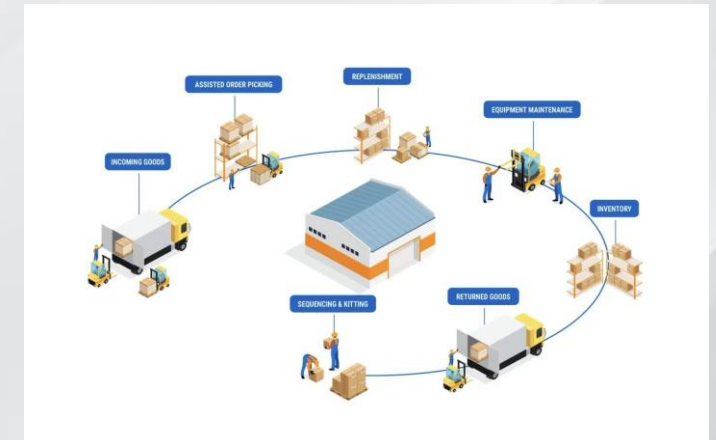
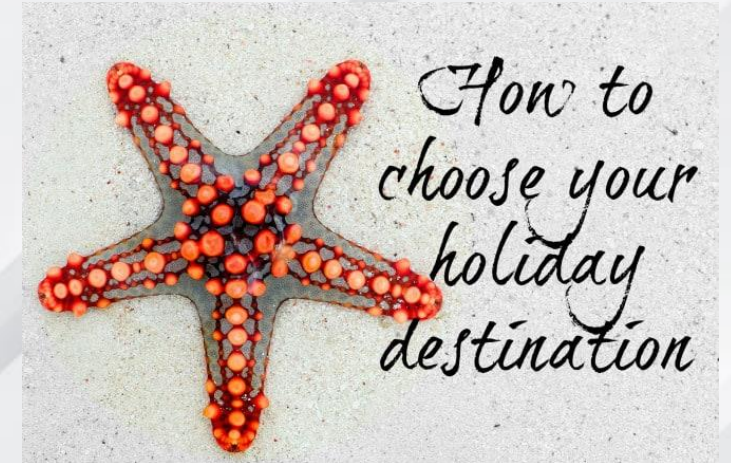
- 1 Identify decision maker(s)
- 2 Identify alternative courses of action
- 3 Identify the relevant attributes
- 4 Assess the performance of the alternatives on each attribute
- 5 Determine a weight for each attribute
- 6 For each alternative, take a weighted average of the values assigned to that alternative
- 7 Make a provisional decision
- 8 Perform sensitivity analysis

Value Tree



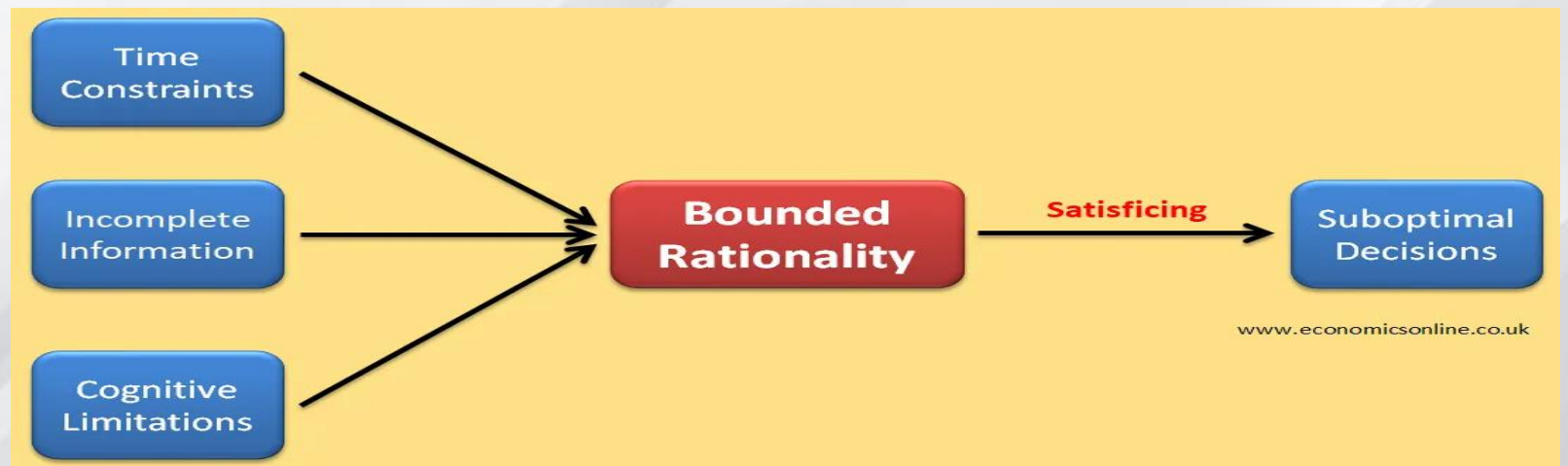
Examples of decisions involving multiple objectives & Attribute

- Choosing a holiday
 - ✓ liveliest nightlife
 - ✓ least crowded beaches
 - ✓ most sunshine
 - ✓ most modern hotels
 - ✓ lowest cost
- Choosing a company to supply goods
 - ✓ best after-sales service
 - ✓ fastest delivery time
 - ✓ lowest prices
 - ✓ best reputation for reliability



Bounded rationality

- The limitations of the human mind mean that people use “approximate methods” to deal with most decision problems
- As a result they seek to identify *satisfactory*, rather than optimal, courses of action.
- These approximate methods, or rules of thumb, are often referred to as “*heuristics*”



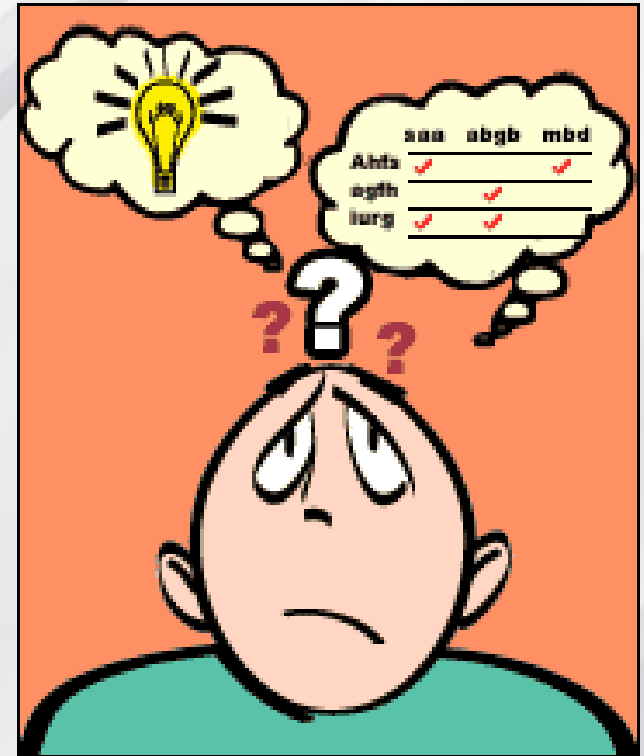
Heuristics

- These heuristics are often well adapted to the structure of people's knowledge of the environment
- Quick ways of making decisions, which people use, especially when time is limited, have been referred to as “*fast and frugal heuristics*”



Compensatory vs non compensatory strategies

- ✓ Compensatory strategy -poor performance on some attributes is compensated by good performance on others
 - Not the case in a non-compensatory strategy.
- ✓ Compensatory strategies involve more cognitive effort.



Compensatory vs non compensatory strategies

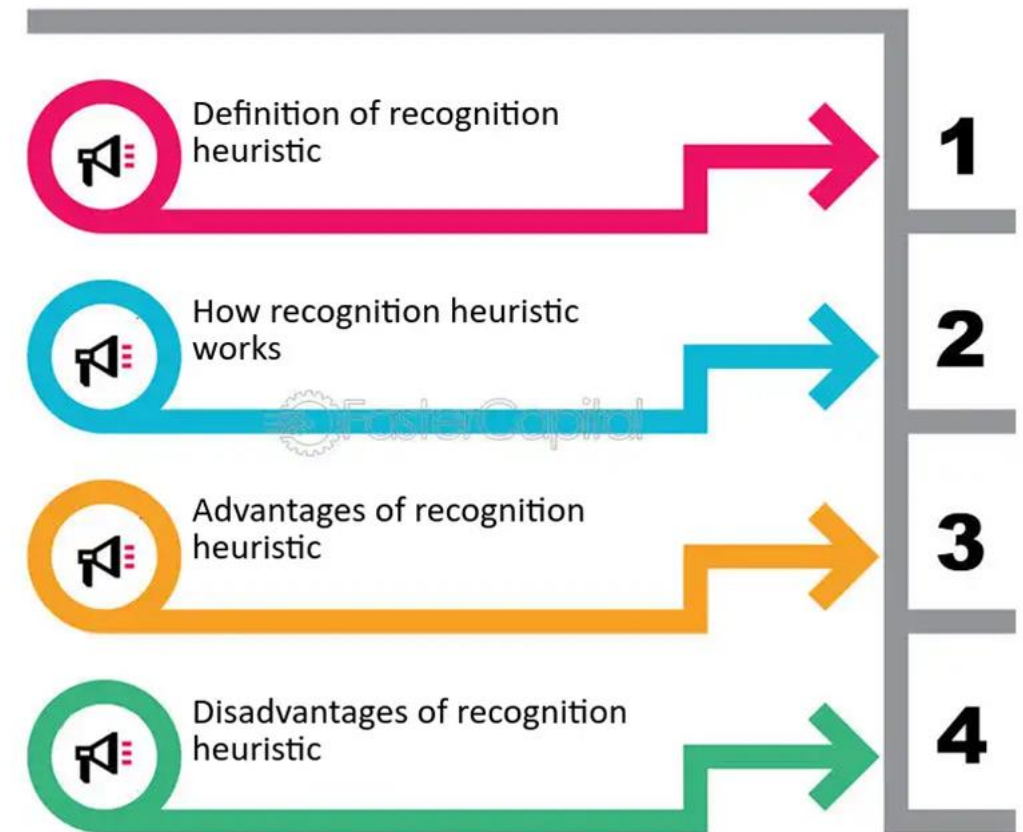
In the compensatory model, the consumer arrives at a choice by considering all of the attributes of a product or service (or benefits from a product or service) and by mentally trading off the alternative's perceived weaknesses on one or more attributes with its perceived strengths on other attributes.

A non compensatory decision-making strategy eliminates alternatives that do not meet a particular criterion. A compensatory decision-making strategy weighs the positive and negative attributes of the considered alternatives and allows for positive attributes to compensate for the negative ones

The Recognition heuristic

- Used where people have to choose between two options.
- If one is recognized and the other is not, the recognized option is chosen
- Works well in environments where quality is associated with ease of recognition

Recognition Heuristic



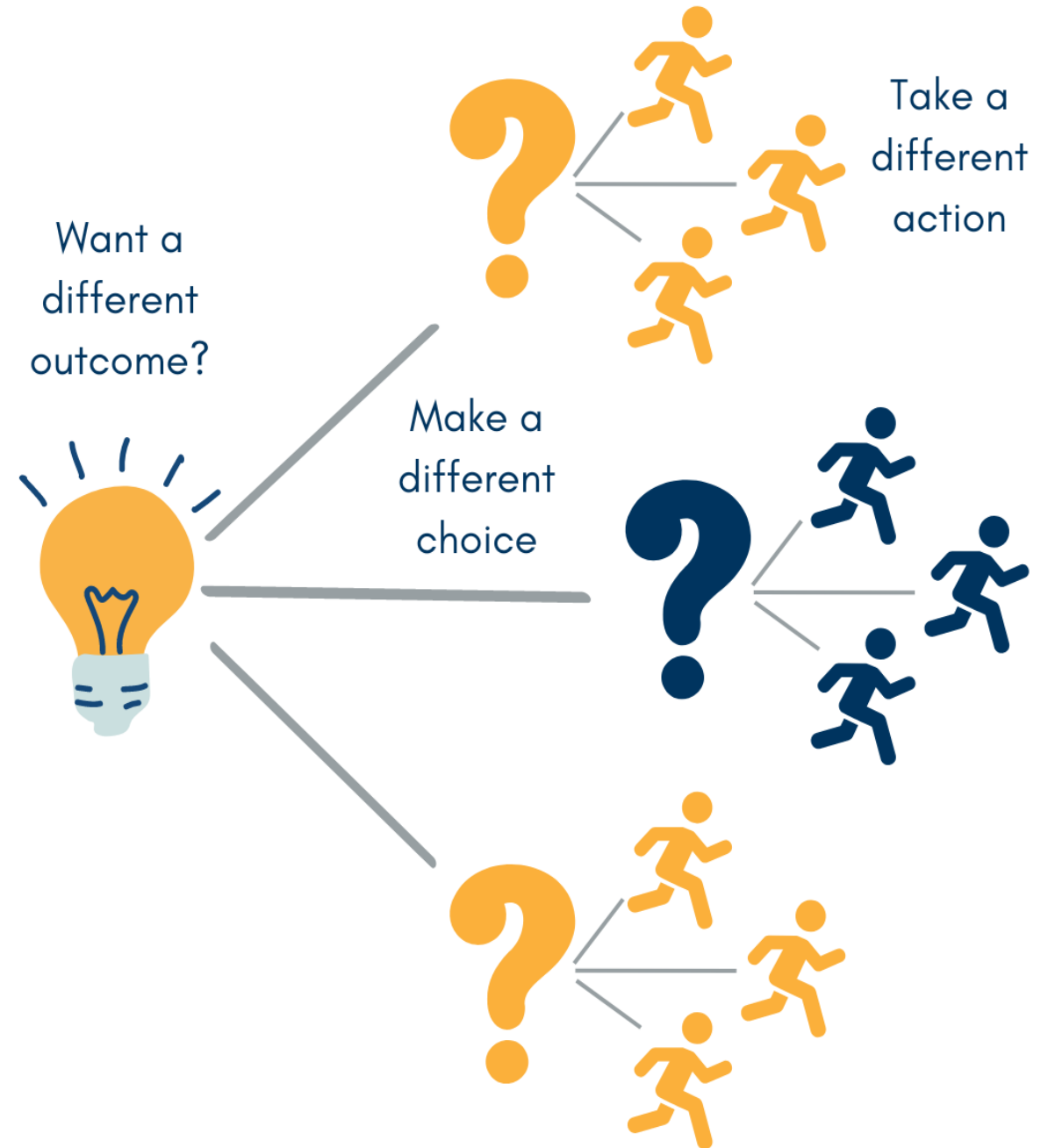
The Minimalist strategy

- First apply recognition heuristic,
- If *neither* option is recognized, simply guess which is the best option.
- If *both* options are recognized, pick at random one of the attributes of the two options and choose best performer on this attribute
- If both perform equally well on this attribute, pick a 2nd attribute at random, and so on..



Take the last

- Same as minimalist heuristic except that people use attribute that enabled them to choose last time when they had a similar choice
- If both options are equally good on this attribute, choose the attribute that worked the time before, and so on.
- If none of the previously used attributes works, a random attribute will be tried.



The Lexicographic strategy

- Used where attributes can be ranked in order of importance.
- Involves identifying most important attribute and selecting option which is best on that attribute (e.g. choose cheapest option)
- In there's a 'tie' on the most important attribute, choose the option which performs best on the 2nd most important attribute, and so on.

Lexicographic Method

Lets take an example in which DM has to select a car out of 4 possible options in the market.



Attributes	Price (In lakhs)	Fuel Efficiency(K m/Lit	Comfort	Looks
Car1	4	15	Good	Average
Car2	8	16	Good	Good
Car3	10	17	Excellent	Excellent
Car4	3.5	16	Average	Average

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The Buyer Decision Process



Example...

‘If the price difference between brands is less than 50 cents choose the higher quality product, otherwise choose the cheaper brand.’

<i>Brand</i>	<i>Price</i>	<i>Quality</i>
A	\$3.00	Low
B	\$3.60	High
C	\$3.40	Medium

A is preferred to B

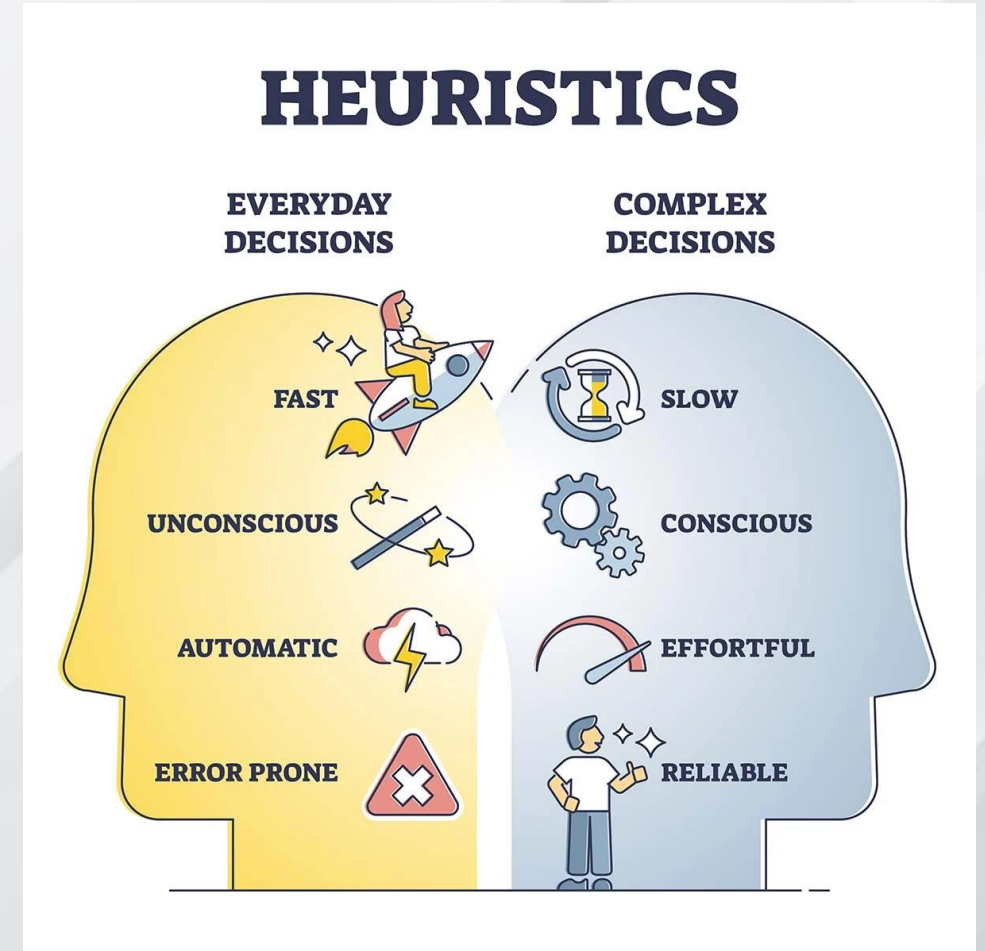
B is preferred to C

But:

C is preferred to A

Elimination by aspects (EBA)

- The most important attribute is identified and a performance cut-off point is established.
- Any alternative falling below this point is eliminated.
- The “Elimination by aspects” (eba) heuristic is used to choose among a given set of products during a sequential process: at each stage, consumers eliminate the products which do not possess a particular attribute, until only one good remains.



Example: Choosing a computer system

Aspect 1: £45m price limit

Aspect 2: Delivery time < 40 months

Aspect 3: Must have training course provided

System	Price (£m)	Del time (mths)	Course?
A	60	55	No
B	32	35	No
C	44	59	Yes
D	70	68	Yes
E	25	67	Yes
F	44	38	Yes

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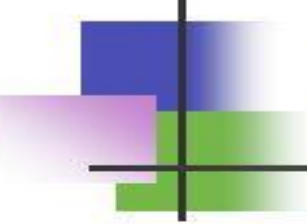
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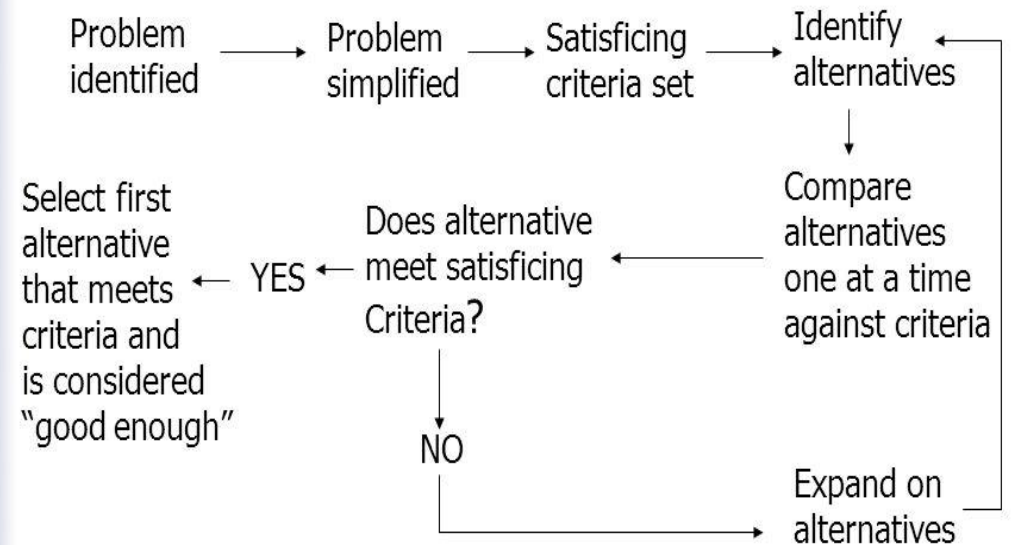
Strengths & limitations of EBA

- Easy to apply
- Involves no complicated computations
- Easy to explain and justify to others
- Fails to ensure that the alternatives retained are superior to those which are eliminated - this arises because the strategy is *non-compensatory*.

Sequential decision making: Satisficing

- Used where alternatives become available sequentially
- Search process stops when an alternative is found which is *satisfactory* in that its attributes' performances all exceed aspiration levels
- These aspiration levels themselves adjust gradually in the light of alternatives already examined.

The Satisficing Model



Some consequences of reason-based choice

- Decisions framed as “choose which to select...” can lead to different choices to those framed as “choose which to reject”
- Irrelevant alternatives can influence choice
- Attributes can be rejected if they have weakly favorable or irrelevant attributes



Example of reason-based choice

Candidate A

Average written communication skills

Satisfactory absenteeism record

Average computing skills

Reasonable inter-personal skills

Average level of numeracy

Average telephone skills

Candidate B

Excellent written communication skills

Very good absenteeism record

Excellent computer skills

Awkward when dealing with others

Poor level of numeracy

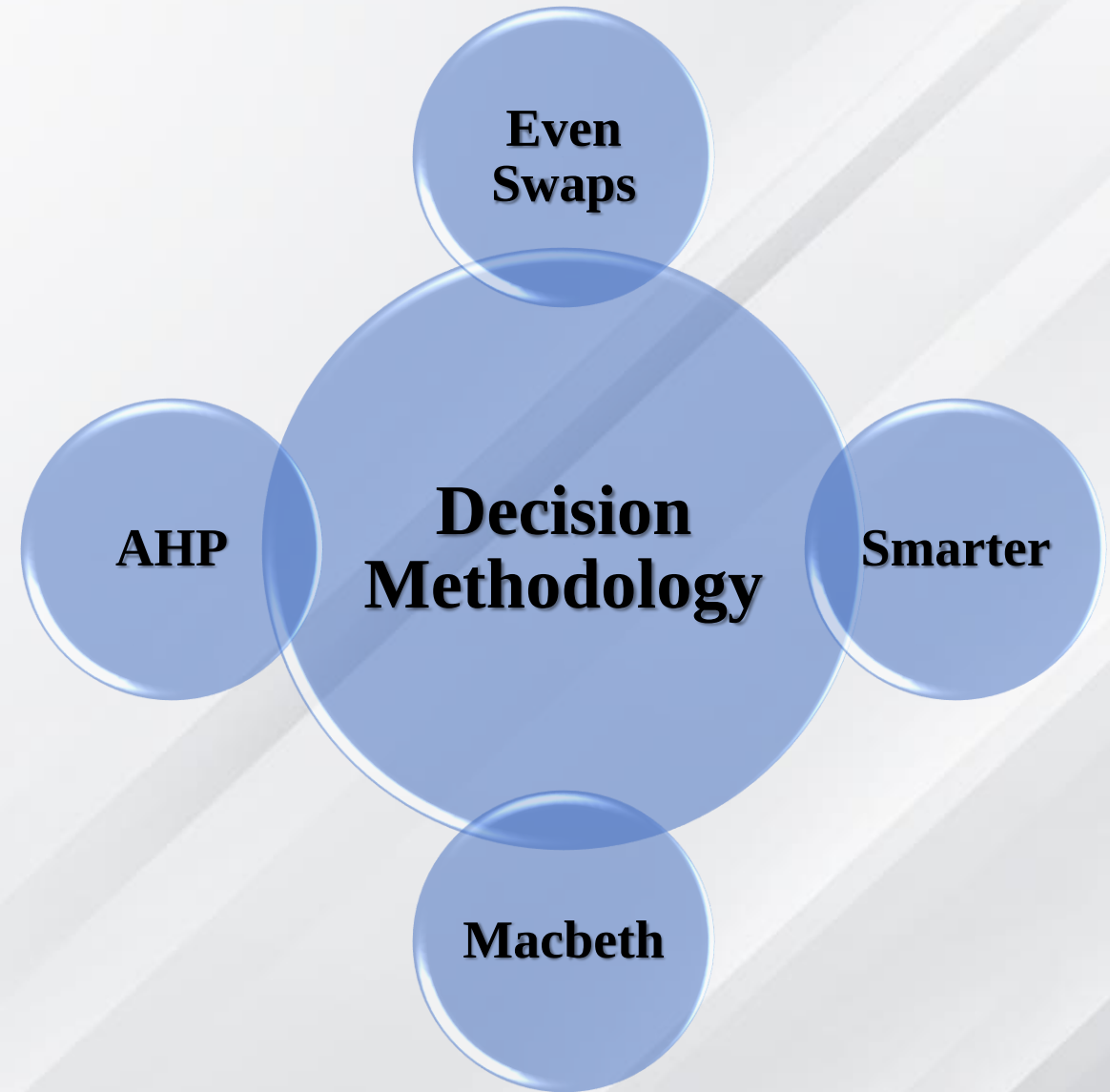
Poor telephone skills



Factors that affect how people make choices

- Time available to make decision
- Effort that a given strategy will involve
- Decision maker's knowledge about the environment
- Importance of making an accurate decision
- Whether or not the choice has to be justified to others
- Desire to minimize conflict (e.g. conflicts between the pros and cons of the alternatives).

Four alternatives of Mythologies in Decision Making



1- SMARTER

- Simple Multi attribute Rating Technique Exploiting Ranks
- Value functions are usually assumed to be linear
- Weights for attributes are estimated from the decision maker's ranking of the swings

Making Smarter Choices



Advantages of SMARTER

1. Easier judgments are required and these may be more accurate
2. Less time consuming than SMART
3. ROC (Return on Capital) weights may provide good approximations to the weights that would have been obtained using SMART

Disadvantages of SMARTER

1. It may encourage superficial analysis of a problem
2. Less transparent than SMART
3. Ratio of ROC - Return on Capital weights between the most and least important attributes may be too high

Rank Order Capital (ROC) weights

For example, if there are 4 items, the item ranked

- the first will be weighted $(1 + 1/2 + 1/3 + 1/4) / 4 = 0.52$,
- the second will be weighted $(1/2 + 1/3 + 1/4) / 4 = 0.27$,
- the third $(1/3 + 1/4) / 4 = 0.15$,
- the last $(1/4) / 4 = 0.06$.

A rank order scale's scores are weighted scores in which items selected first receive a higher value than the next ones in the list. This value is exponential and depends on the number of selections in your rank order scale. In your reports the percentage of all of these values (compared to the total) is shown.

Even-Swaps

1. an even swap increases the value of an alternative in terms of one objective while decreasing its value by an equivalent amount in terms of another objective.
2. Avoids the need to estimate swing weights
2. Exploits the fact that, when all options perform equally on an attribute, that attribute is not relevant to the decision



Even-Swaps example

Supplier Location	Annual Purchase Cost (\$)	Average Delivery Time (days)	Average % Defective	After-Sales Service
Canada	140000	3	2	Med
Mexico	80000	4	4	Good
Japan	190000	5	6	Med
South Korea	90000	5	3	Good
China	70000	8	5	Med
India	75000	7	4	Poor

Relative strengths of Even-Swaps

1. Avoids need to assign scores to measure the performance of the alternatives on each attribute
2. Avoids need to determine swing weights.
3. Even Swaps may be closer to a natural decision process than SMART

you can methodically reduce the number of objectives you need to consider until a clear choice emerges.

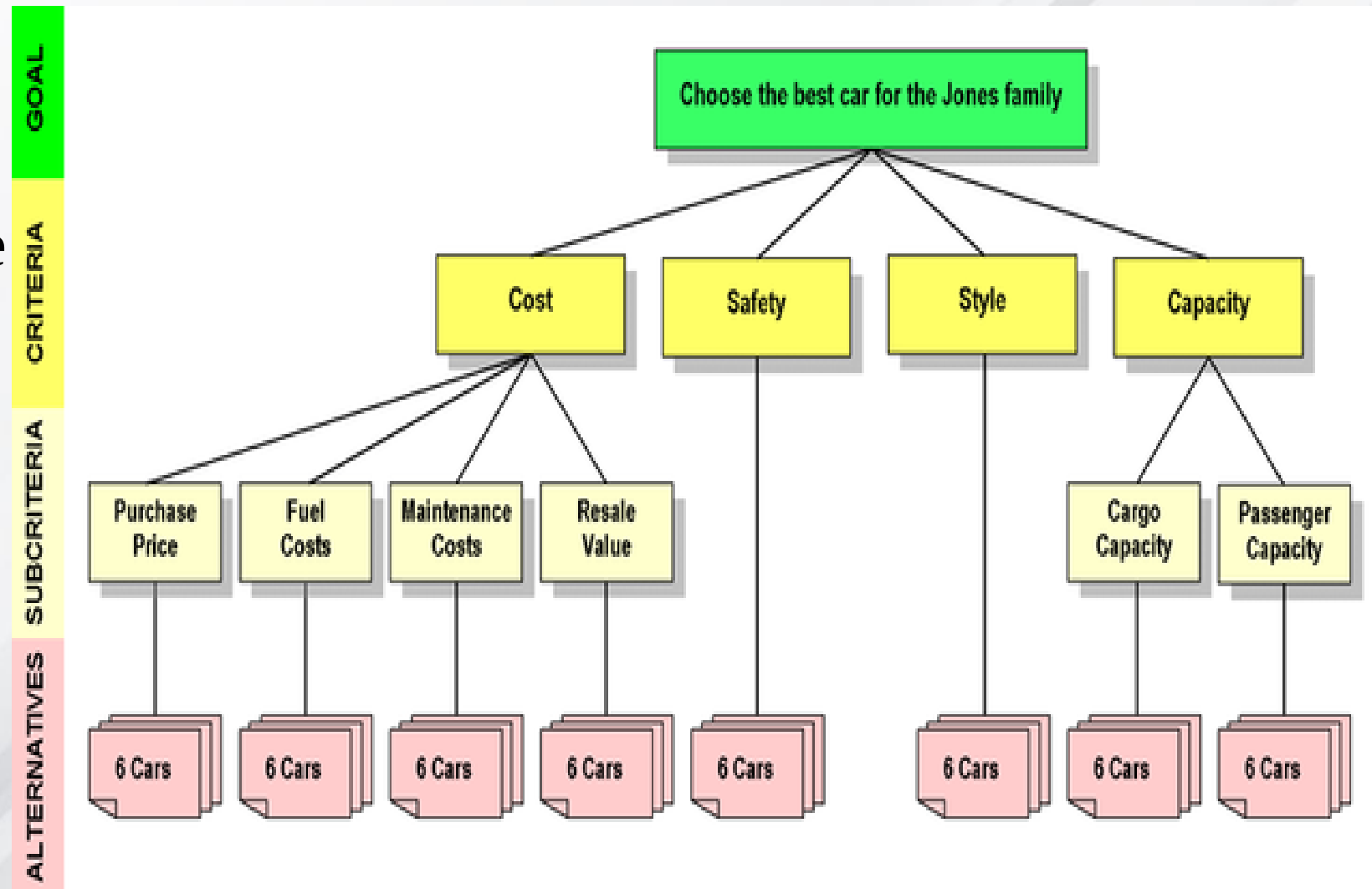
Relative limitations of Even-Swaps

1. It needs practice –new users may find it difficult
2. Output of process is less informative than SMART.
3. It may not have a neutral effect on choice

Because none of the remaining alternatives are dominated, each will have some advantages and some disadvantages relative to each of the others

The Analytic Hierarchy Process (AHP)

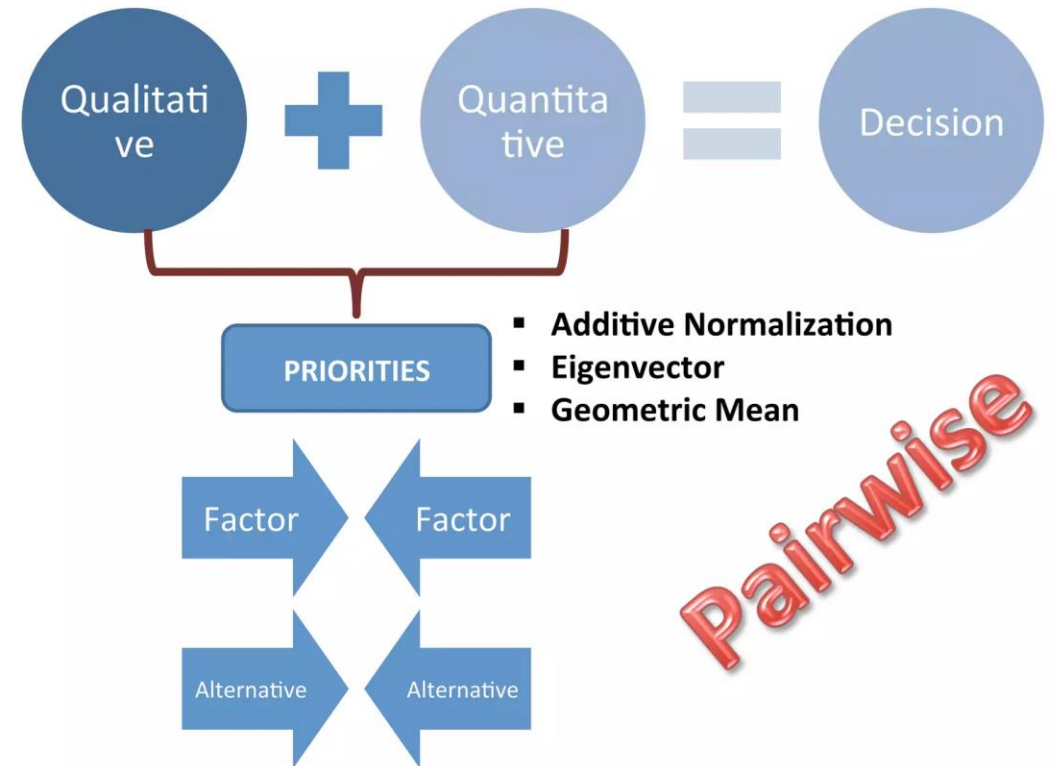
- Involves pairwise comparisons
- Comparisons can be made using verbal scales rather than numeric scales
- Provides automatic checks on the consistency of judgments



Overview of the AHP

1. Set up decision hierarchy
2. Make pairwise comparisons of attributes & alternatives
3. Transform comparisons into weights & check consistency
4. Use weights to obtain scores for options
5. Carry out sensitivity analysis

WHAT IS AHP?



ADVANTAGES AND DISADVANTAGES

ADVANTAGES

- **Straightforward and convenient**
- **Simplicity by using pairwise comparisons**
- **Consistency in evaluation**
- **Versatility**

DISADVANTAGES

- **Subjective Evaluation**
 - **Conversion from verbal to numeric scale**
 - **Inconsistencies imposed by 1 to 9 scale**
 - **Conflict between decision maker**
 - **Decision maker capacity**





Thank You