www.itim.unige.it/strategos

WWW.STRATEGOS.IT

Engineering Technologies for Strategy in Defense, Industry, Government & Homeland Security

Università di Genova

STRATEGOS

Strategic decision making in complex environments with the analytic hierarchy process (AHP)

Antonella PETRILLO
University of Napoli “Parthenope”

antonella.petrillo@uniparthenope.it

STRATEGOS
Engineering Technologies for Strategy in Defense, Industry, Government & Homeland Security

Università di Genova
www.strategos.it

University of Napoli "Parthenope"

Department of Engineering

STRATEGOS
Engineering Technologies for Strategy in Defense, Industry, Government & Homeland Security

Università di Genova
www.strategos.it

Research Activities

Multi Criteria Decision Analysis (MCDA)

I4.0 and Smart Manufacturing

Digitalization

Sustainability and Life Cycle Analysis (LCA)

Simulation & Modeling

Safety at workplace

AVIO
ADVANCED VISION INTO ORBIT

abbvie

Schneider Electric

ALSTOM

HITACHI
Inspire the Next

MBDA
MISSILE SYSTEMS

FCA
FIAT CHRYSLER AUTOMOBILES

ABB

RFI
RETE FERROVIARIA ITALIANA

STRATEGOS
Engineering Technologies for Strategy in Defense, Industry, Government & Homeland Security

Università di Genova
www.strategos.it

Research Activities

University of Pittsburgh
Prof. Thomas SAATY

KATZ
UNIVERSITY OF PITTSBURGH
JOSEPH M. KATZ
GRADUATE SCHOOL
OF BUSINESS

University of Pittsburgh
PITT BUSINESS | Joseph M. Katz Graduate School of Business

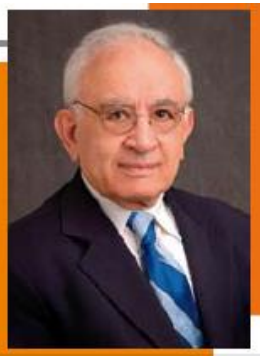
Research Activities

AHP Academy

ACTIVITIES

Particularly, the **AHP Academy** will promote events and offer tools for the diffusion of information regardings the field of decision making, such as:

- **international lectures;**
- **publications on Decision Making/AHP;**
- **training courses;**
- **scholarships.**



Honorary President
Thomas L. Saaty (born 1926 in Mosul, Iraq) is an American mathematician. He teaches in the Joseph M. Katz Graduate School of Business. He is the inventor, architect, and primary theoretician of the Analytic Hierarchy Process, a decision-making framework used for large-scale, multiparty, multi-criteria decision analysis, and of the Analytic Network Process, its generalization to decisions with dependence and feedback.

AHP Academy

The **AHP Academy** promotes the diffusion of the culture and methodologies of Decision Making, with particular reference to those based on **Analytic Hierachy Process**. The aim of the association is to support the development of studies, researches and applications within the Decision Making and the **AHP**, and to create a place to share experiences and results of the researches on decision making among researchers, experts, public and private institutions of around the whole world.

THE AIMS
The goals of **AHP Academy** are:

- Promote the spread of a culture of methodologies of Decision Making in the world, working for the sharing of experience and knowledge of among the members.
- Facilitate the exchange of experience and knowledge between the parties concerned with issues of Decision Making, including the identification of areas of interest and the prevailing development of partnerships.
- Promote a more effective dialogue between research and business, encouraging and promoting joint initiatives, support the university in identifying training needs and research priorities for the sector.
- Evolve as a center of expertise and collaborate with national and international associations involved in the standardization and certification of methods, criteria and tools for decision making, taking into account the quality system.

STRATEGOS
Engineering Technologies for Strategy in Defense, Industry, Government & Homeland Security

Università di Genova
www.strategos.it

Research Activities

AHP Academy

AHP Academy

STRATEGOS
Engineering Technologies for Strategy in Defense, Industry, Government & Homeland Security

Università di Genova
www.strategos.it

Research Activities

Decision Lens

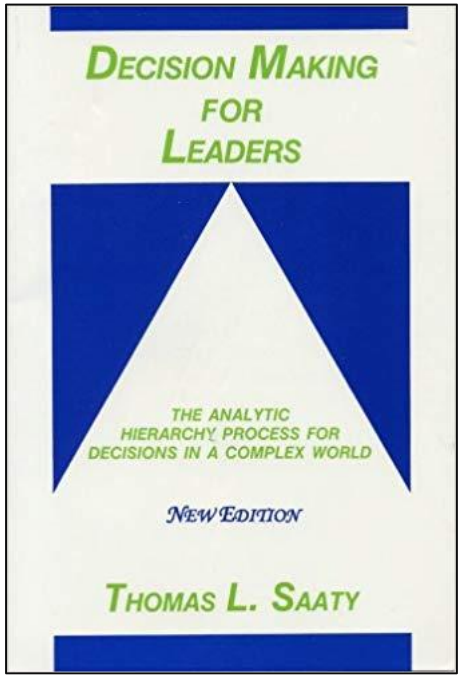
John & Daniel Saaty

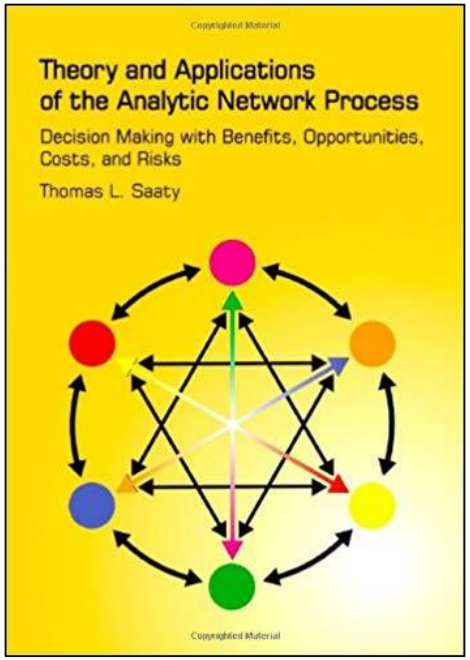
DECISION LENS

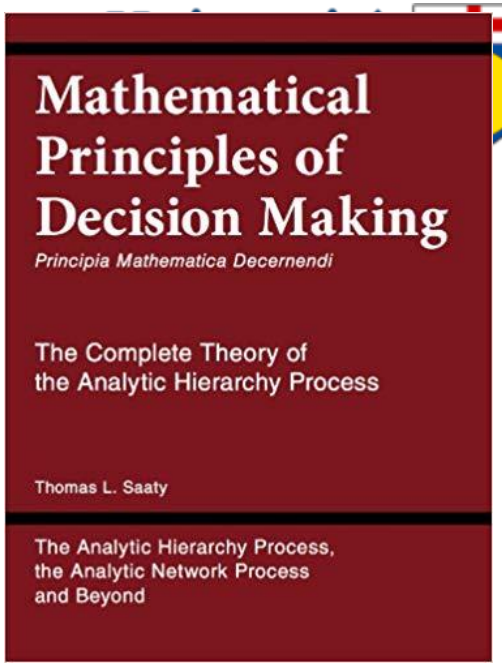
STRATEGOS
Engineering Technologies for Strategy in Defense, Industry, Government & Homeland Security

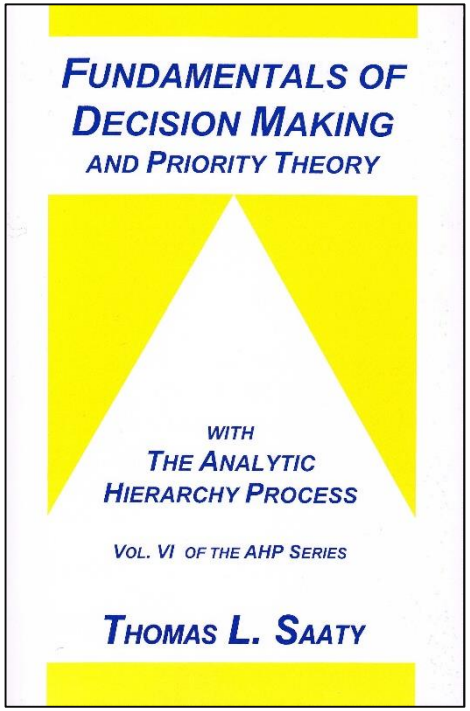
Research Activities

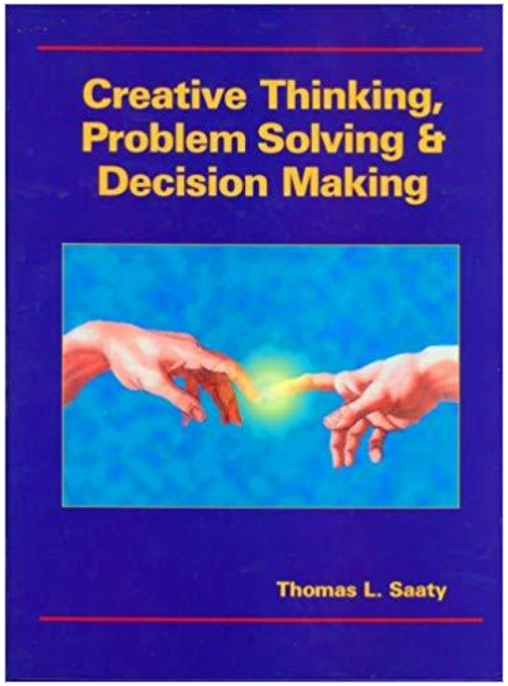
Some Publications









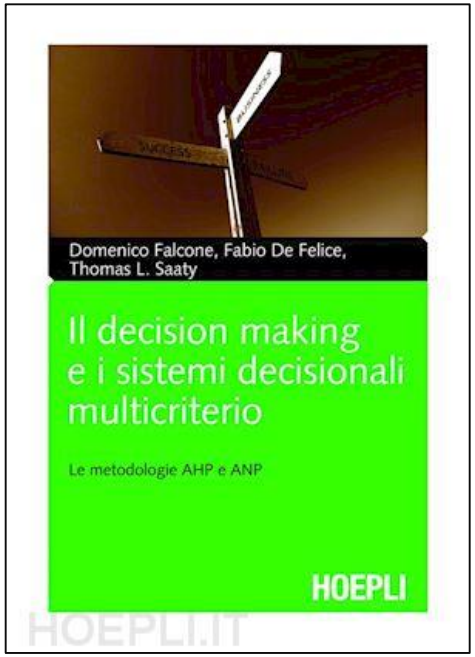


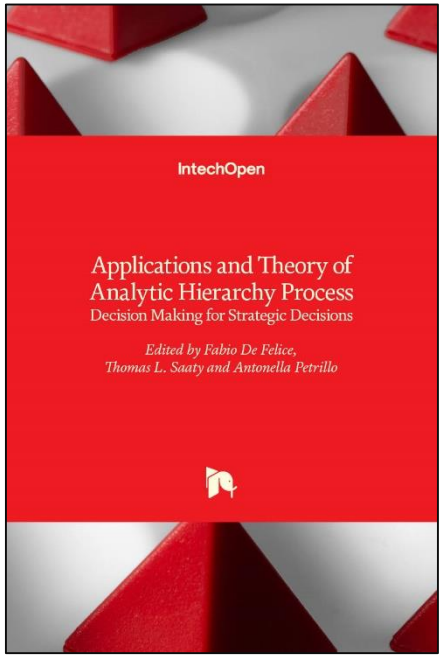
STRATEGOS
Engineering Technologies for Strategy in Defense, Industry, Government & Homeland Security

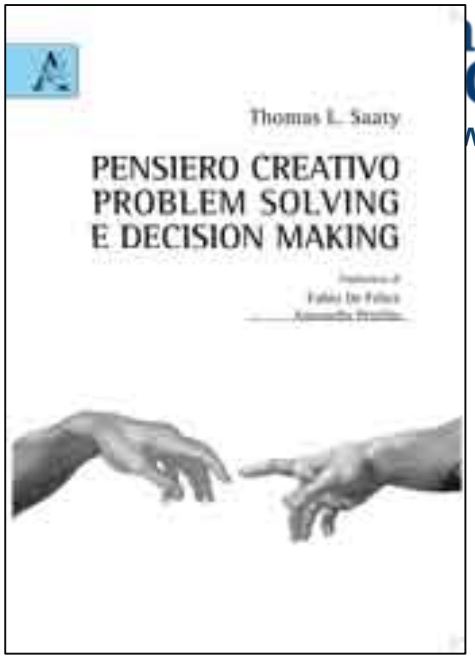
iversità Genova
w.strategos.it

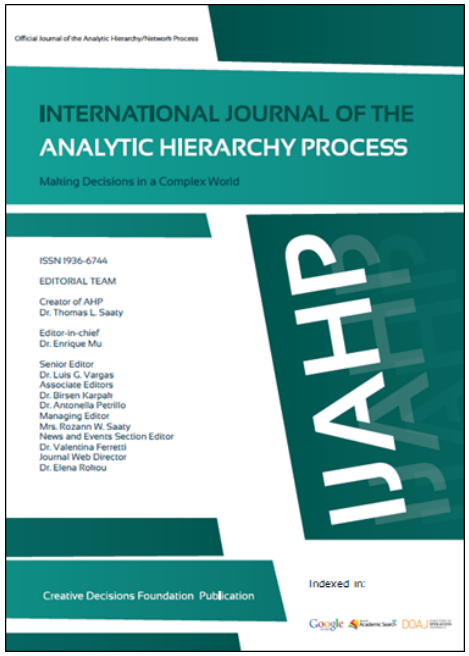
Research Activities

Some Publications









What is decision making?

Decision Making

Decision making today is a **science**.

People have **hard decisions** to make and they need help because many lives may be involved, **the survival of the business depends** on making the **right decision**, or because future success and diversification must survive competition and surprises presented by the future.

Decision Making

3 Kinds of Decisions

Instantaneous and personal like what **restaurant to eat** at and what kind of rice cereal to buy.

Personal but allowing a little time like which job to choose and what **house to buy** or car to drive.

Long term decisions and any decisions that involve **planning** and **resource allocation** and more significantly group decision making.

Decision Making

Our lives are the sum of our decisions, whether in business or in personal spheres.

Often, when we decide is as important as what we decide.

To be a person is to be a decision maker.

Thomas Saaty

Decision Making

Which career should I pursue?

Should I break up -- or get married?!

Where should I live?

Decision Making

Simple choices!?!? ..Simple decisions

Choice 1

Choice 2

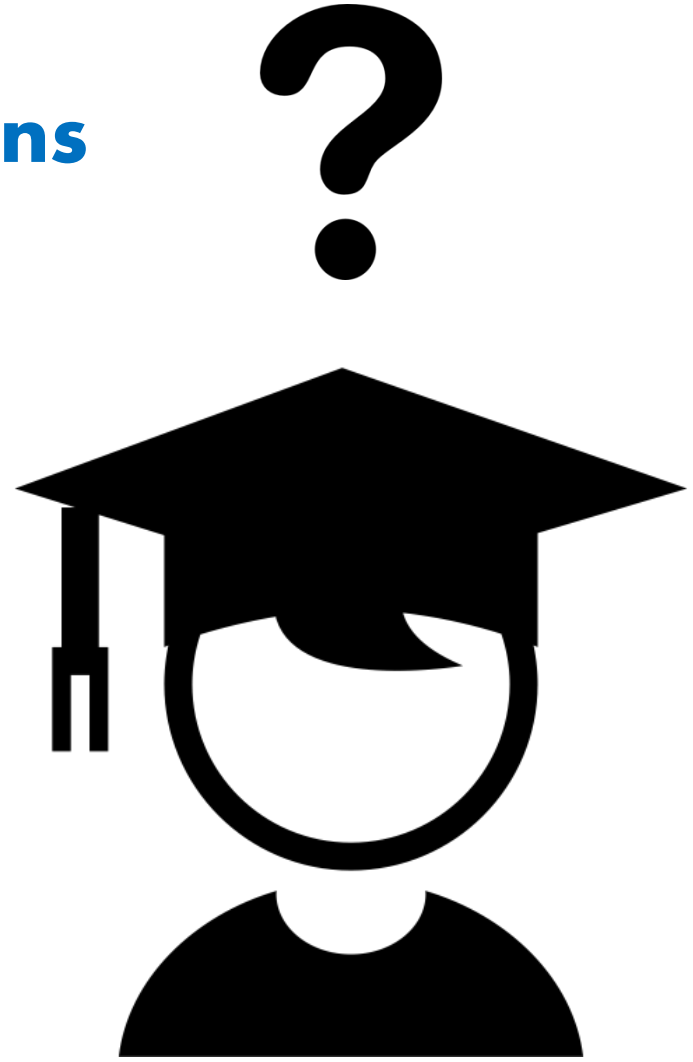
STRATEGOS
Engineering Technologies for Strategy in Defense, Industry, Government & Homeland Security

Università di Genova
www.strategos.it

Decision Making

Hard choices!?!?... Hard decisions

Choice 1



Choice 2

Decision Making

***Big decisions** like these can be agonizingly difficult.*

But that's because we think about them the wrong way!

Decision Making

… Hard Choices … How to make it!!!

Hard Choices are hard because there is no best option.

In an easy choice one alternative is better than the other.

In **hard choice** **one alternative is better in some ways**, the other alternative **is better in other ways** and neither is better than the other overall.

The alternatives must be equally good!

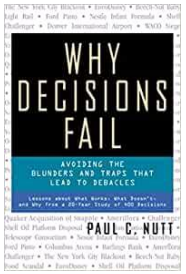
Why is it important to decide?

….and decide well

Decision Making

Importance of decision making process

- At least 50% of decisions should not be successful.
- 33% of decisions are never implemented .
- 50% of the decisions implemented is left after 2 years.
- 66% of decisions are based on methods used to failure.
- The decisions that use a high level of participation are successful in 80% of cases, but this occurs only 20% of the time.
- In practice, any error is unavoidable decision.

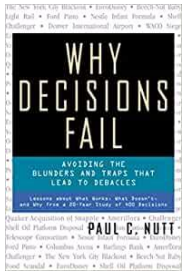


Source: Why Decisions Fail - Author Paul Nut - Publisher; Berret & Koehler 2002

Decision Making

Importance of decision making process

- 11 Million meetings in the U.S. per day
- Most professionals attend a total of 61.8 meetings per month
- Research indicates that over 50 percent of this meeting time is **wasted**
- Professionals **lose 31 hours per month** in unproductive meetings, or approximately four work days.



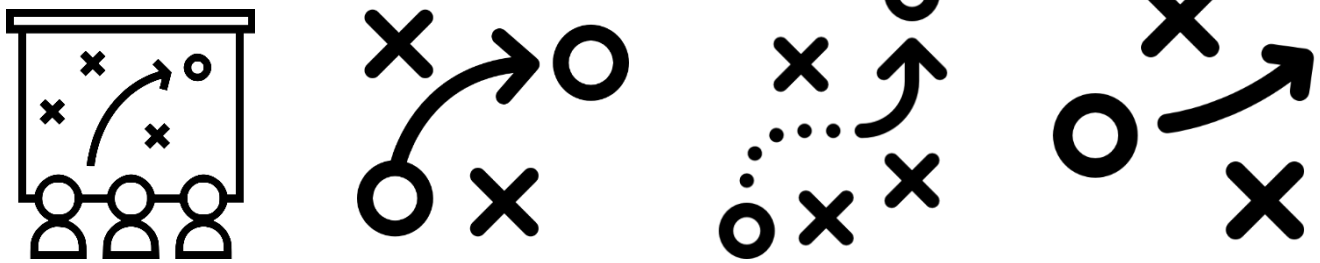
Source: Why Decisions Fail - Author Paul Nut - Publisher; Berret & Koehler 2002

Decision Making

Decision making is difficult enough…

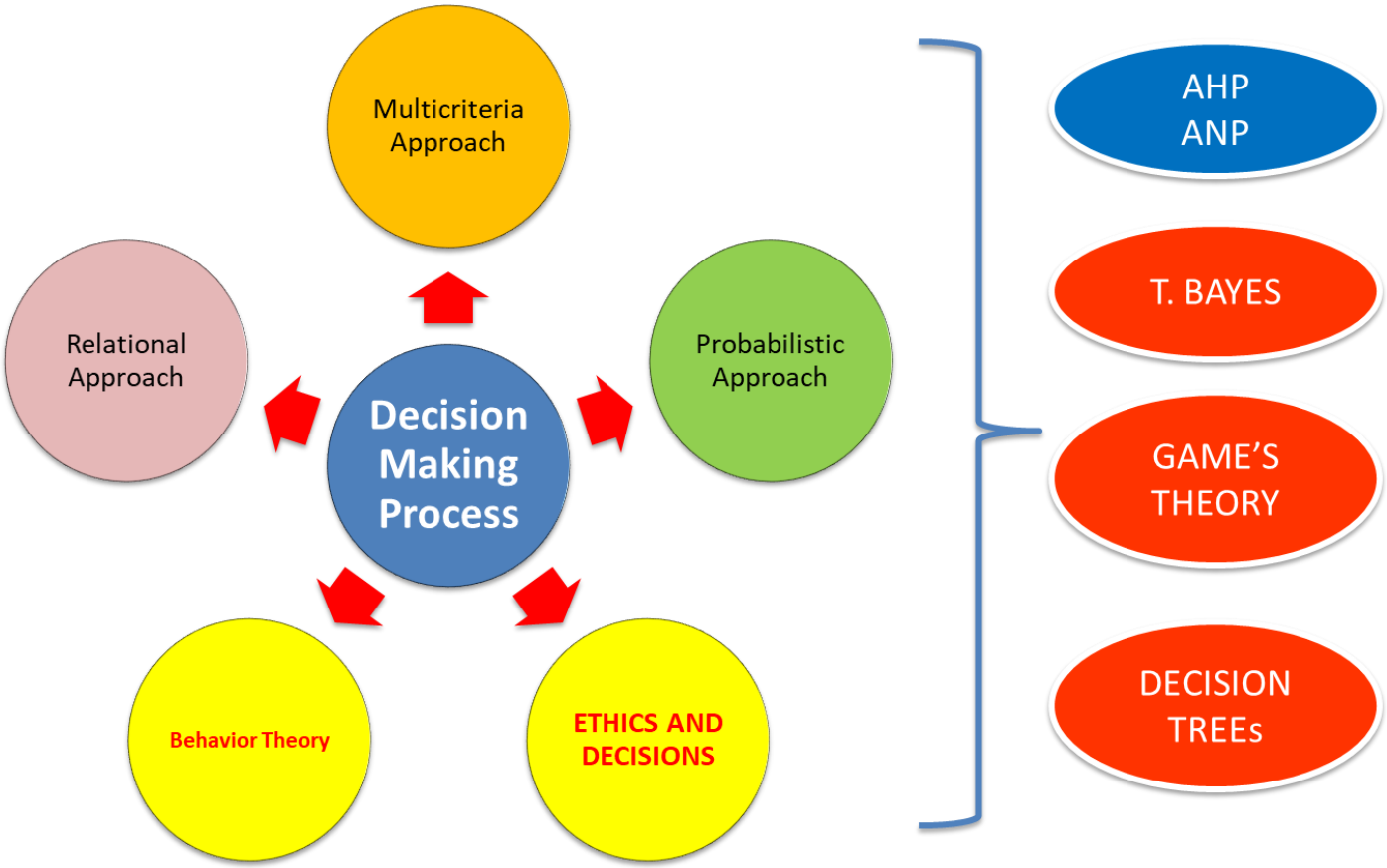
….It is necessary to develop strategies and measures to manage these risks!

***Of course*…..The success parameters for any project are** on time completion, within specific **budget** and with **requisite performance** (technical requirement).



Decision Making

To make a decision in complex systems

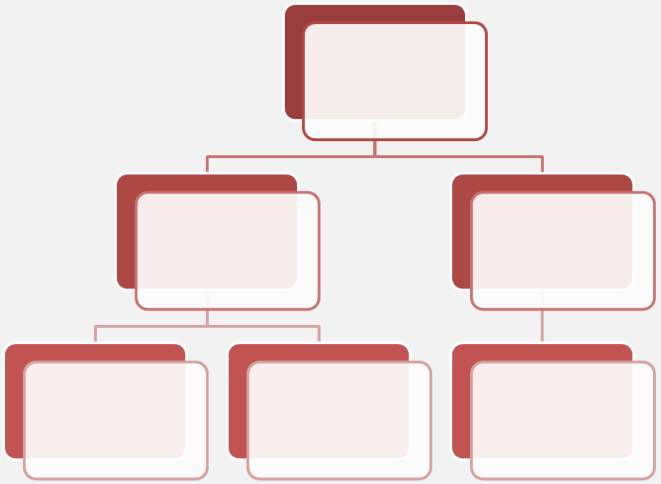


STRATEGOS
Engineering Technologies for Strategy in Defense, Industry, Government & Homeland Security

Università di Genova
www.strategos.it

Analytic Hierarchy Process

Introduction



Analytic hierarchy process

The analytic hierarchy process (AHP) is a structured technique for organizing and analyzing complex decisions, based on mathematics and psychology. It was developed by Thomas L. Saaty in the 1970s.

It represents the most accurate approach for quantifying the weights of criteria. Individual experts' experiences are utilized to estimate the relative magnitudes of factors through pair-wise comparisons.

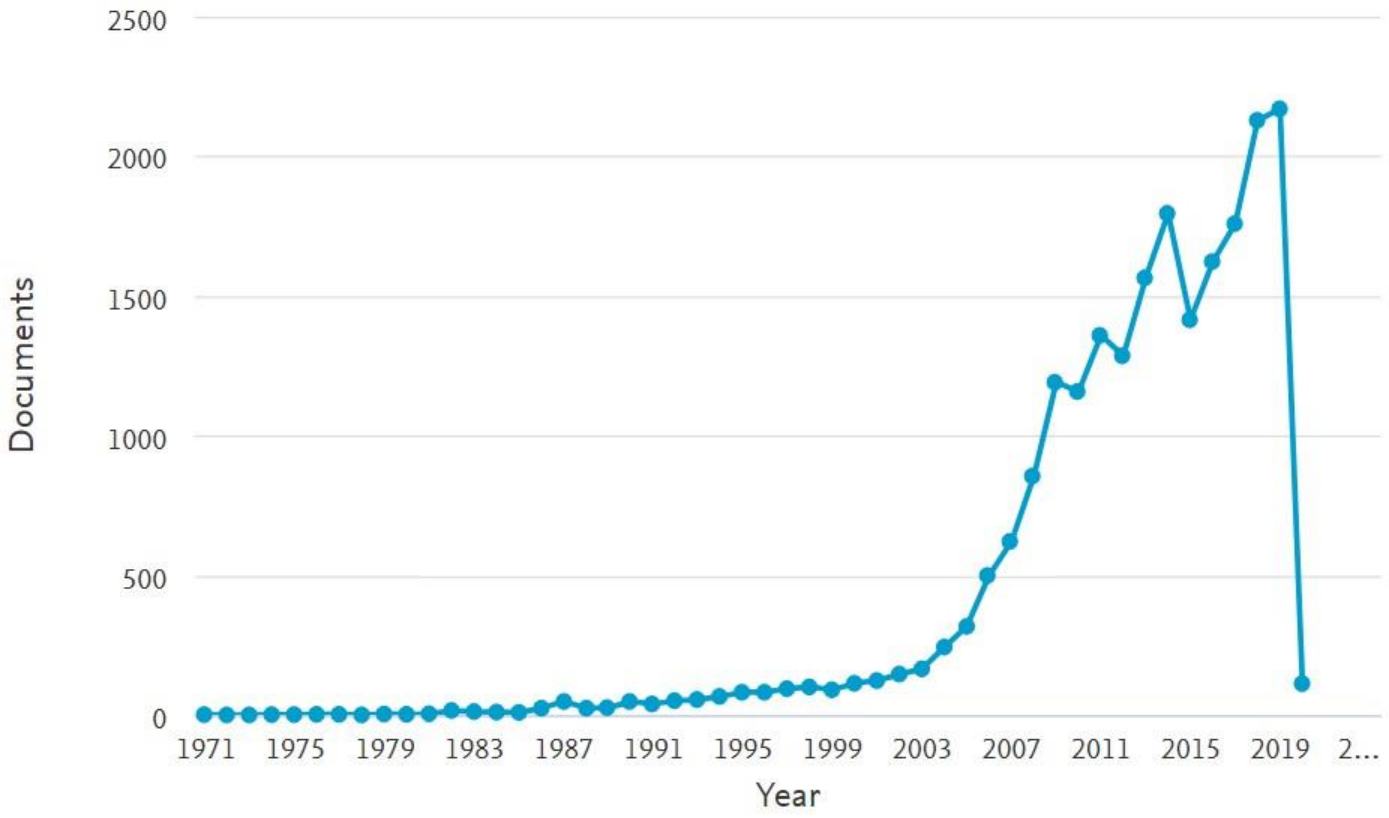
Scopus

Scopus

Scopus is a source-neutral abstract and citation database curated by independent subject matter experts. It places powerful discovery and analytics tools in the hands of researchers, librarians, institutional research managers and funders.

Scopus indexes content from 24,600 active titles and 5,000 publishers which is rigorously vetted and selected by an independent review board, and uses a rich underlying metadata architecture to connect people, published ideas and institutions.

Documents by year



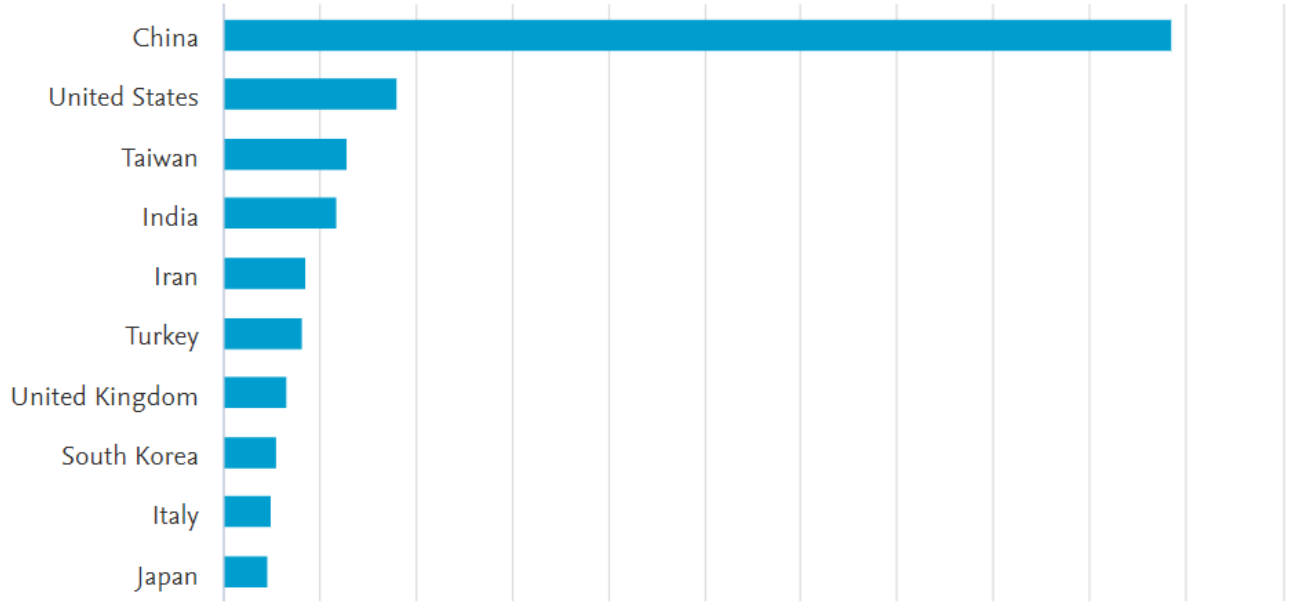
ELSEVIER Scopus®

21,535 document results

Select year range to analyze:
1971-20219

Boolean operator
TITLE-ABSTRACT-KEYWORDS

Documents by country



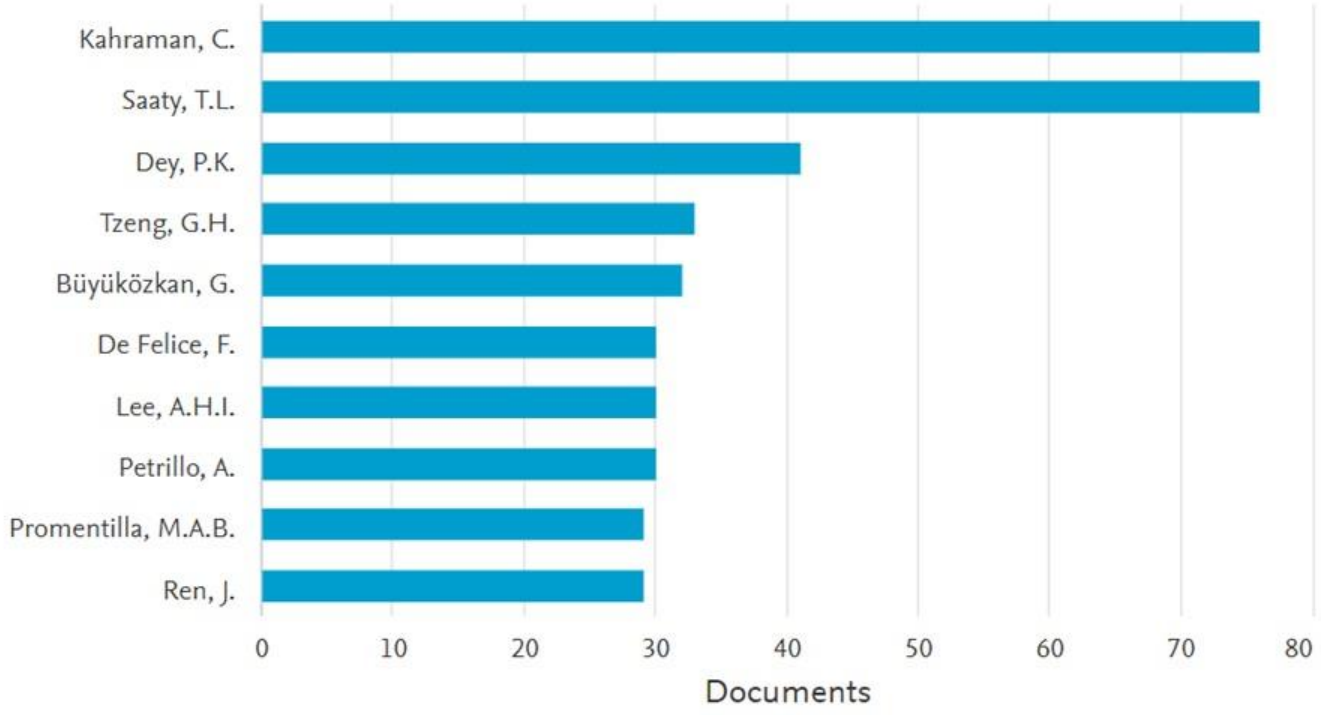
ELSEVIER Scopus®

21,535 document results

Select year range to analyze:
1971-20219

Boolean operator
TITLE-ABSTRACT-KEYWORDS

Documents by authors



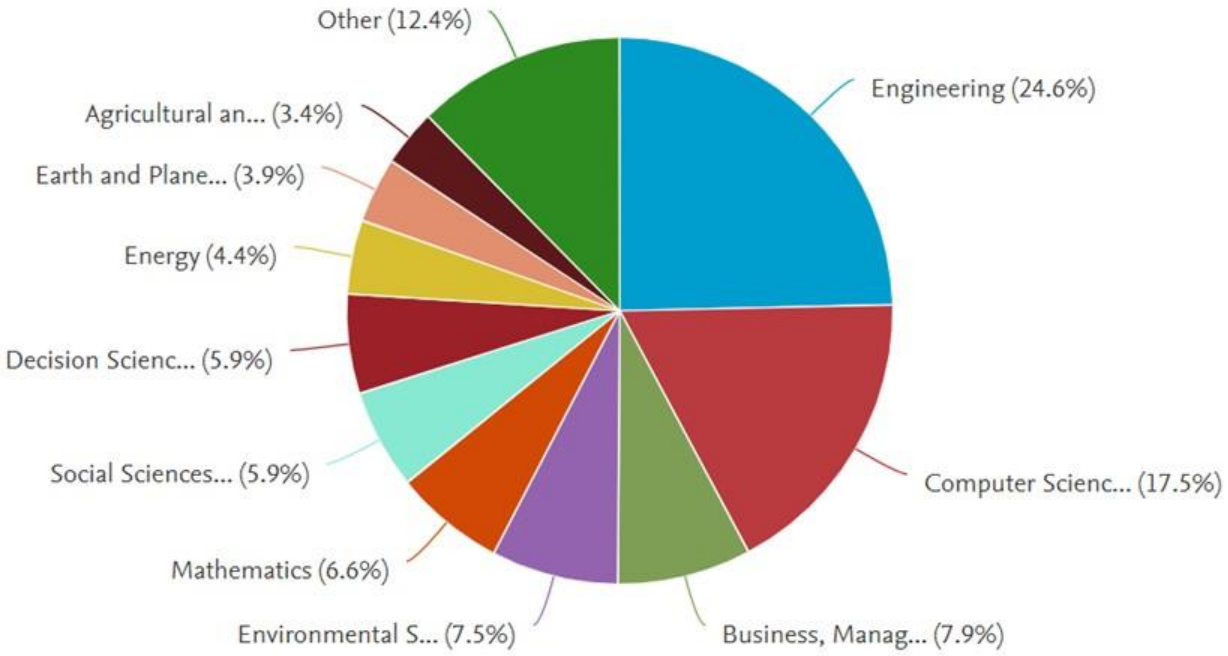
ELSEVIER Scopus®

21,535 document results

Select year range to analyze:
1971-20219

Boolean operator
TITLE-ABSTRACT-KEYWORDS

Documents by subject area



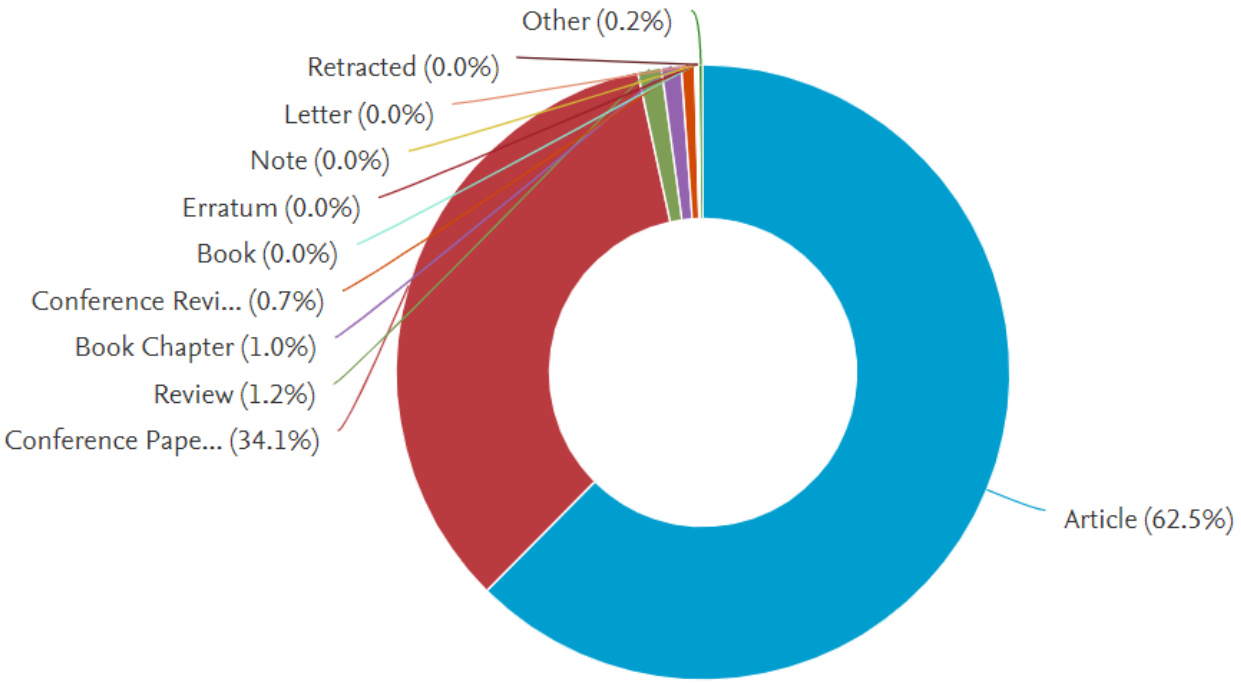
ELSEVIER Scopus®

21,535 document results

Select year range to analyze:
1971-20219

Boolean operator
TITLE-ABSTRACT-KEYWORDS

Documents by type



ELSEVIER Scopus®

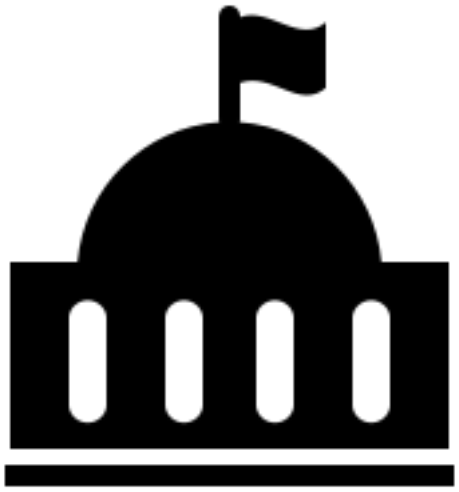
21,535 document results

Select year range to analyze:
1971-20219

Boolean operator
TITLE-ABSTRACT-KEYWORDS

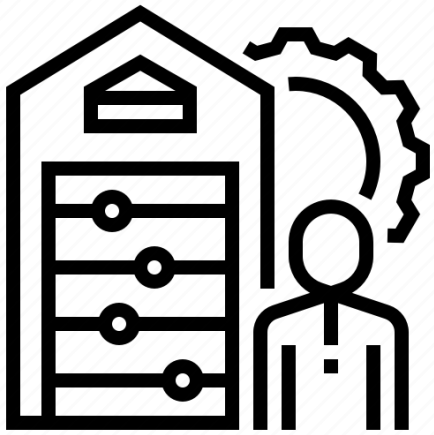
Who uses AHP?

Analytic Hierarchy Process



Federal

State & Local



Private Sector

Analytic Hierarchy Process

THE ORGANIZATION

A8-XP is the strategic planning division of the Air Force. It focuses on orchestrating their annual integration effort to **prioritize and allocate resources in their 30-year plan**.

THE PROBLEM

Their current process was not flexible enough to handle on-the-fly adjustments while still accounting for the long-term payout of the programs.

THE SOLUTION

The development of AHP model specifically related to decisions and longer-term, strategic planning choices. This framework made it easy to manipulate and update data, which helped them look at resource decisions across multiple time periods, both mid-term and long-term.

STRATEGOS
Engineering Technologies for Strategy in Defense, Industry, Government & Homeland Security

Università di Genova
www.strategos.it

Analytic Hierarchy Process

THE ORGANIZATION

Arizona Department of Transportation (ADOT). ADOT strategically prioritizes the investment strategy for over 160 projects in a typical Statewide Transportation Improvement Plan (STIP) cycle. The cycle usually lasts for 4 to 5 years and are accountable for around $1.2 billion of transportation funding, which is comprised of 7 different funding sources.

THE PROBLEM

ADOT needed to incorporate project performance into their planning process and provide a system-wide perspective during their planning decision process.

THE SOLUTION

The development of AHP model to improve their performance measures in place. This helped enable them to spend their budget with a direct correlation to expected performance and answer questions of what extra funding would yield.

STRATEGOS
Engineering Technologies for Strategy in Defense, Industry, Government & Homeland Security

Università di Genova
www.strategos.it

Analytic Hierarchy Process

mipaaf
ministero delle politiche agricole alimentari e forestali

UNIRE gente e cavalli

THE ORGANIZATION

Italian Ministry of Agricultural Policies is responsible for the elaboration and coordination of agricultural, forestry, agri-food policies as well as for fishing at national, European and international level, representing Italy in the European Union for the matters of competence.

THE PROBLEM

Identification of a “quality” model for Italian racecourse for the distribution of economic resources. Prioritizes the resources allocation strategy.

THE SOLUTION

The development of AHP model helped to define key factors to improve Italian racecourse performance. This helped them to allocate better their resources and to spend better their public budget.

Analytic Hierarchy Process

MBDA
MISSILE SYSTEMS

THE ORGANIZATION

MBDA is a world leader in missile systems offering a comprehensive international product range incorporating today's most advanced innovations.

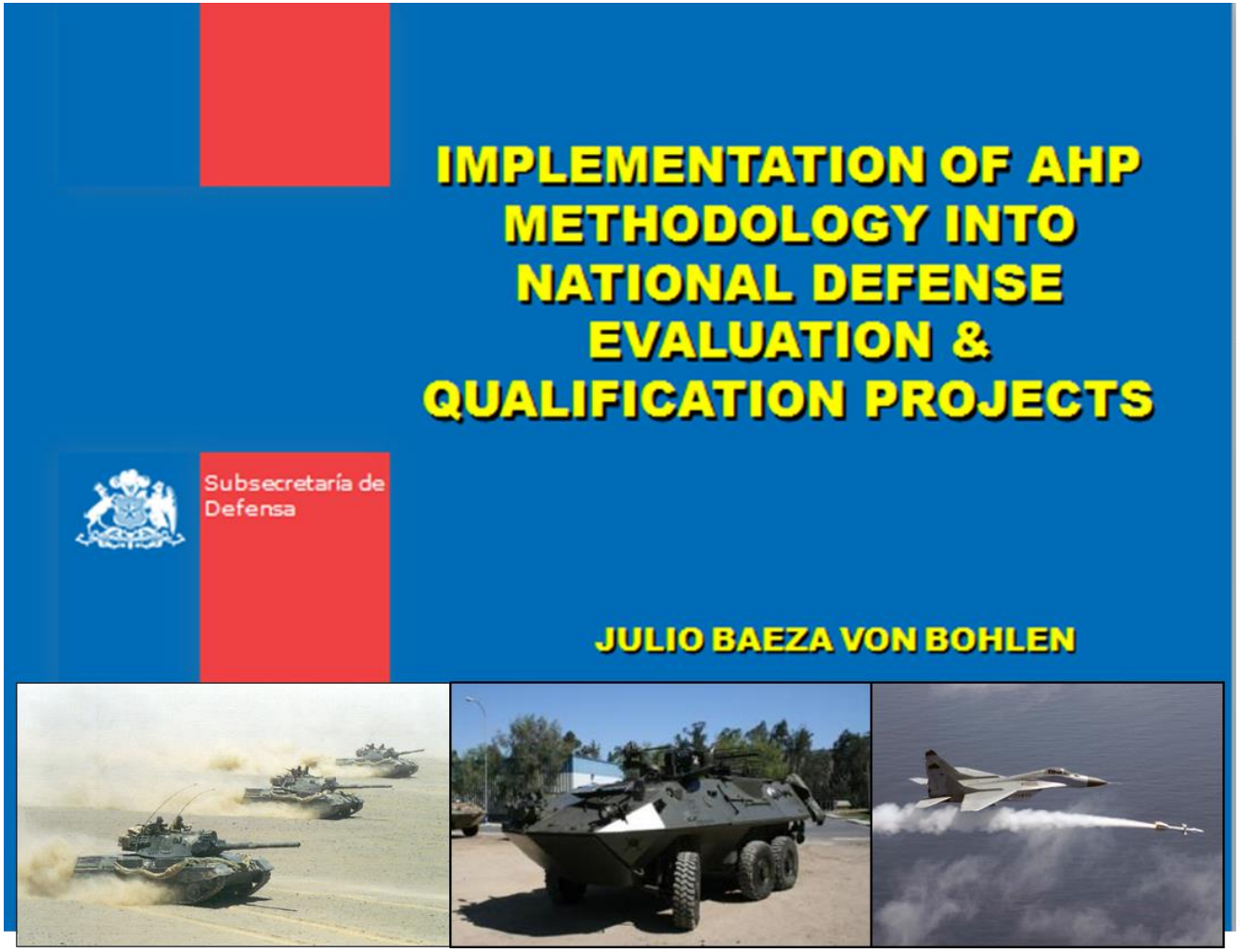
THE PROBLEM

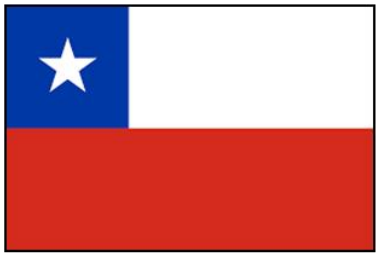
Train managers in decision making. For senior executives, managers for building high-performing teams and key decision makers.

THE SOLUTION

The “Decision-Making School” deals with planning and implementing top level training seminars for MBDA executives on various aspects of the theory of rational decisions.

Analytic Hierarchy Process





Why apply AHP?

Analytic Hierarchy Process

Most Decision Problems are Multicriteria

- Maximize profits
- Satisfy customer demands
- Maximize employee satisfaction
- Satisfy shareholders
- Minimize costs of production
- Satisfy government regulations
- Minimize taxes
- Maximize bonuses

Analytic Hierarchy Process

We need to prioritize both **tangible** and **intangible** criteria:

In most decisions, **intangibles** such as:

- political factors and
- social factors

take precedence over **tangibles** such as:

- economic factors and
- technical factors

Analytic Hierarchy Process

Just a little example to define **intangible elements**

…to **understand** that

Knowledge is Not in the Numbers!

Analytic Hierarchy Process

Isabel Garuti is an *environmental res*earcher whose father-in-law is a master chef in Santiago, Chile.

He owns a well-known **Italian restaurant** called **Valerio**. He is recognized as the best cook in Santiago. Isabel had eaten a favorite dish **risotto ai funghi**, rice with mushrooms, many times and **loved it** so much that she wanted to learn to cook it herself for her husband, Valerio's son, Claudio. So she armed herself with a pencil and paper, went to the restaurant and begged Valerio to spell out the details of the recipe in an easy way for her.

Analytic Hierarchy Process

Valerio can say, “Put more of this than of that, don’t stir so much,” and so on. That is how he cooks his meals - by following his instincts, not formalized logically and precisely.

BUT ISABEL could not replicate his dish!!??!!

The question is:

How does he synthesize what he knows?

Analytic Hierarchy Process

You don't need to know everything to get to the answer.

Analytic Hierarchy Process

It is not the **precision** of **measurement** on a particular factor that determines the validity of a decision, **but** the **importance** we attach to the factors involved.

How do we **assign importance** to all the factors and synthesize this diverse information to make the best decision**?**

Analytic Hierarchy Process

AHP allows to assign a **weight of importance** to each factors.

AHP allows to measure **intagibles elements** through expert's judgment.

AHP choose the "**best**" among several alternatives.

Differently from common optimization methods AHP uses derived measurements or subjective.

Subjectivity ≠ Arbitrariness

Analytic Hierarchy Process

- Initially, the **decision-making process** was studied as a **rational process** of analyzing a problem and seeking solution.
- However, in recent years it has become clear that **human beings** **are far from making in a rational way**, either as individual or as part of group.

Analytic Hierarchy Process

The increasing complexity of modern problems make it **extremely important to adopt a methodology** for making easy to use and understand.

The Analytic Hierarchy Process meets these requirements.

Analytic Hierarchy Process

- **Analytic:** Decompose the problem into its elementary components.
- **Hierarchy:** Design the decision problem in a hierarchical or network defining the goal, criteria and the sub-criteria
- **Process:** Process the data and evaluations in order to achieve the final result

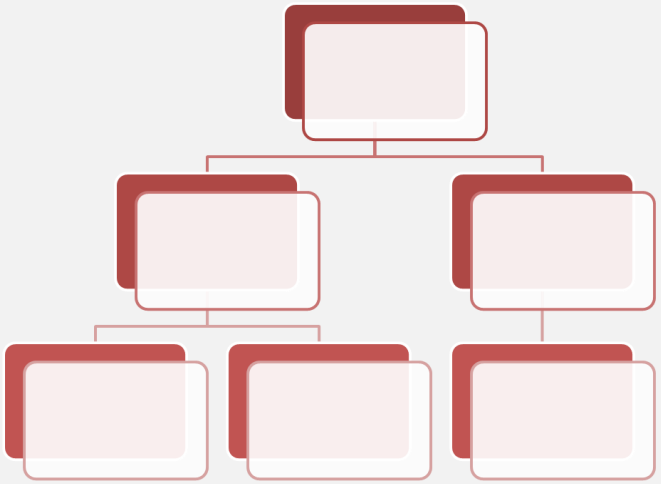
STRATEGOS
Engineering Technologies for Strategy in Defense, Industry, Government & Homeland Security

Università di Genova
www.strategos.it

Understanding the Analytic Hierarchy Process

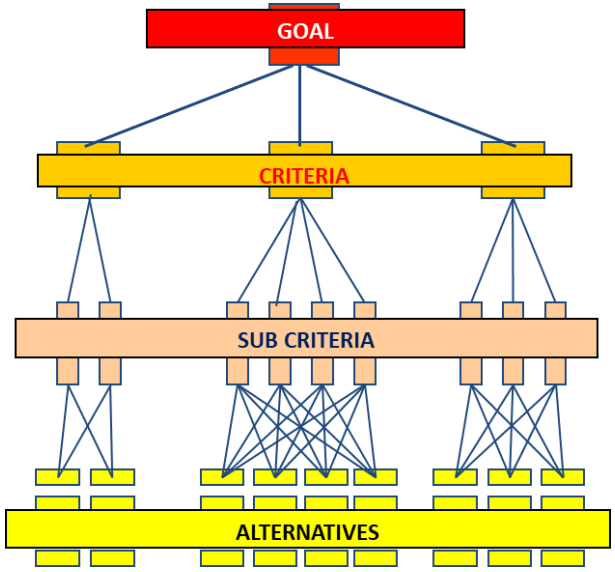
Basics

AHP model



Understanding the Analytic Hierarchy Process

Step#1: Develop a model for the decision: Break down the decision into a hierarchy of goals, criteria, and alternatives.



A hierarchy is an **efficient way** to organize complex systems. It is efficient both structurally, for representing a system, and functionally, for controlling and passing information down the system.

Unstructured problems are best grappled with in the systematic framework of a hierarchy or a feedback network.

Understanding the Analytic Hierarchy Process

Step#2: Derive priorities (weights) for the criteria: The **importance of criteria** are compared pairwise with respect of the **desired goal** to derive their weights.

We **then** check the **consistency of judgments**;
that is, a review of the judgments is done in order to esure a reasonable level of consistency in terms of proportionality and transitivity.

Analytic Hierarchy Process

Step#2: Derive priorities (weights) for the criteria:

In practice this means that a **pair of elements** in a level of the hierarchy **are compared** with respect to parent elements to which they relate in the level above.

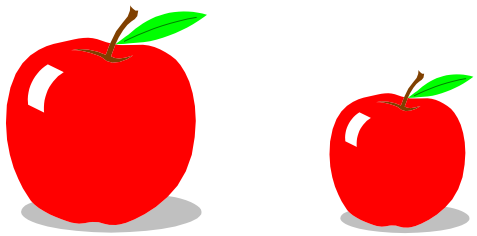
The question is how?

Analytic Hierarchy Process

Step#2: Derive priorities (weights) for the criteria:

If, for example, we are comparing **two apples** according to weight we ask:

- Which apple is bigger?
- How much bigger is the larger than the smaller apple?
  Use the smaller as the unit and estimate how many more times bigger is the larger one.
- The apples must be relatively close (homogeneous) if we hope to make an accurate estimate.



Understanding the Analytic Hierarchy Process

Step#3: Derive the local priorities (preferences) for the alternatives: Derive priorities for the alternatives with respect to each criterion. Check the consistency.

Step#4: Derive the Overal Priorities (Model Syntesis): All alternative priorities obtained are combined as a weighted sum – to take into account the weight of each criterion – to establish the overal priorities of the alternatives. The alternative with the highest overall priority consitutes the best choice.

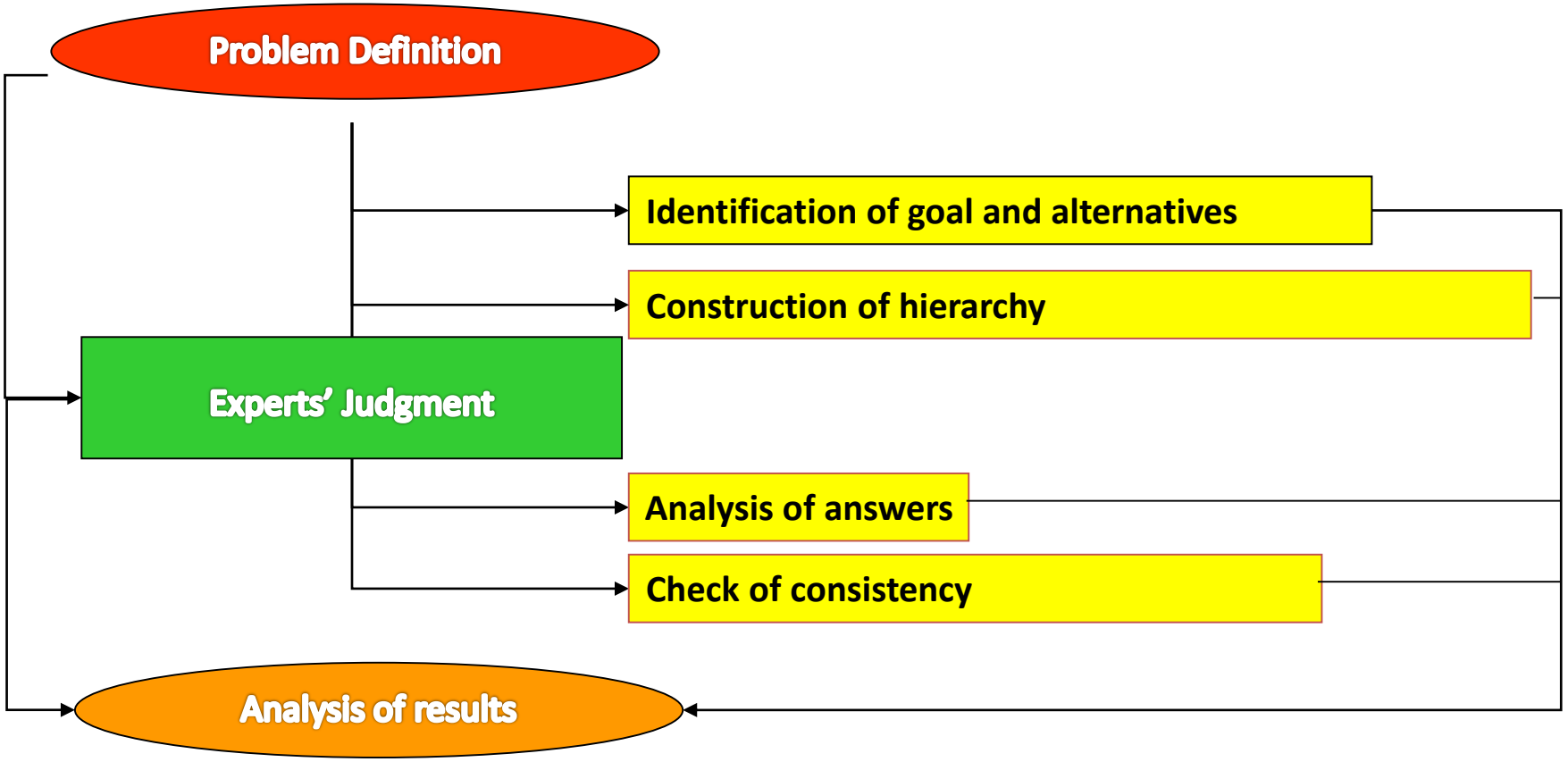
Understanding the Analytic Hierarchy Process

Step#5: Perform Sensitivity Analysis: A study of how changes in the weights of the criteria could effect the result os done to understand the rationale behind the obtained results.

Step#6: Making a Final Decision: Based on the synthesis results ad sensitivity analysis, a decision can be made.

Understanding the Analytic Hierarchy Process

AHP Logic Diagram



STRATEGOS
Engineering Technologies for Strategy in Defense, Industry, Government & Homeland Security

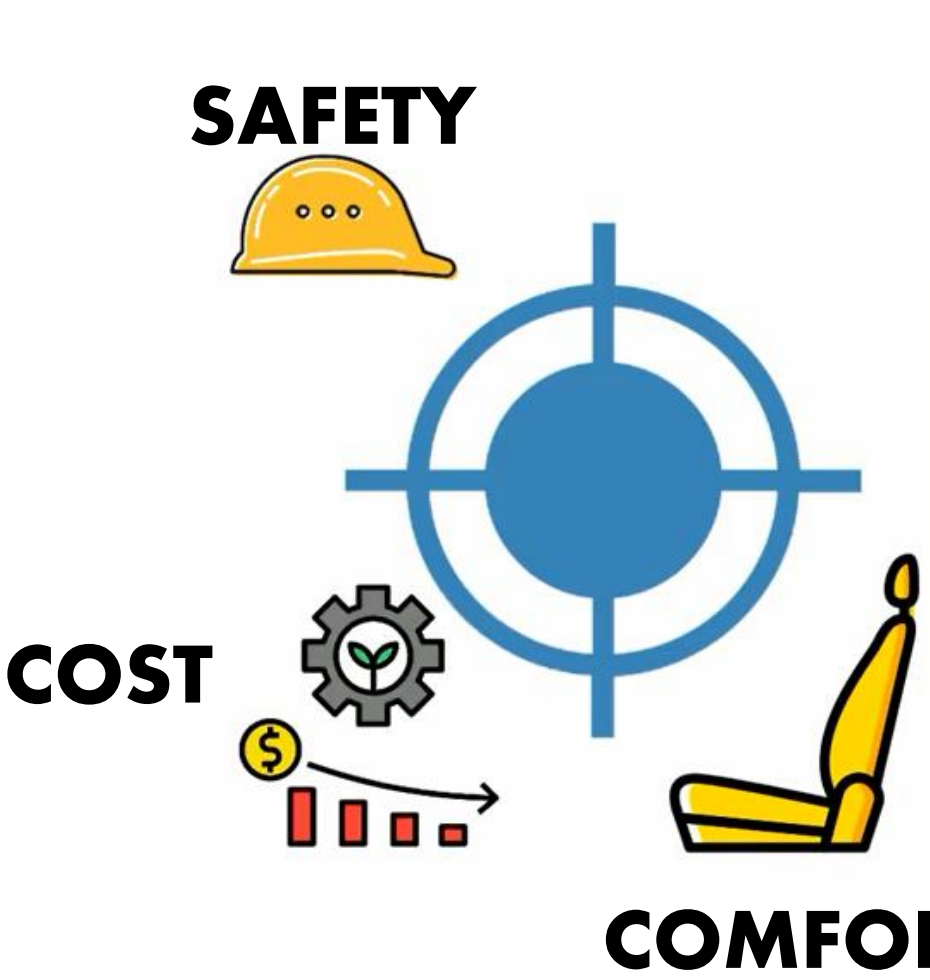
Università di Genova
www.strategos.it

Case Study 1

AHP Model:

Buying a car

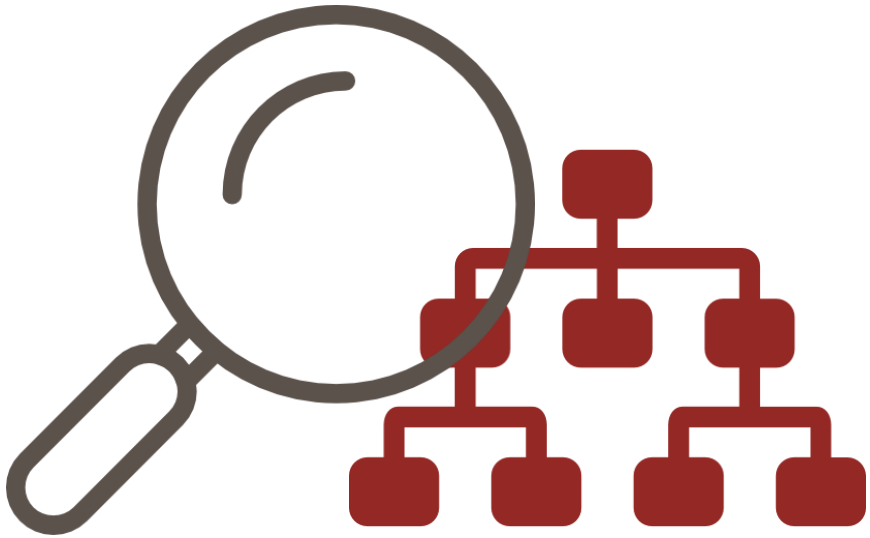
1. Developing a model



1. Developing a model

What are the Criteria?

What are the Alternatives?

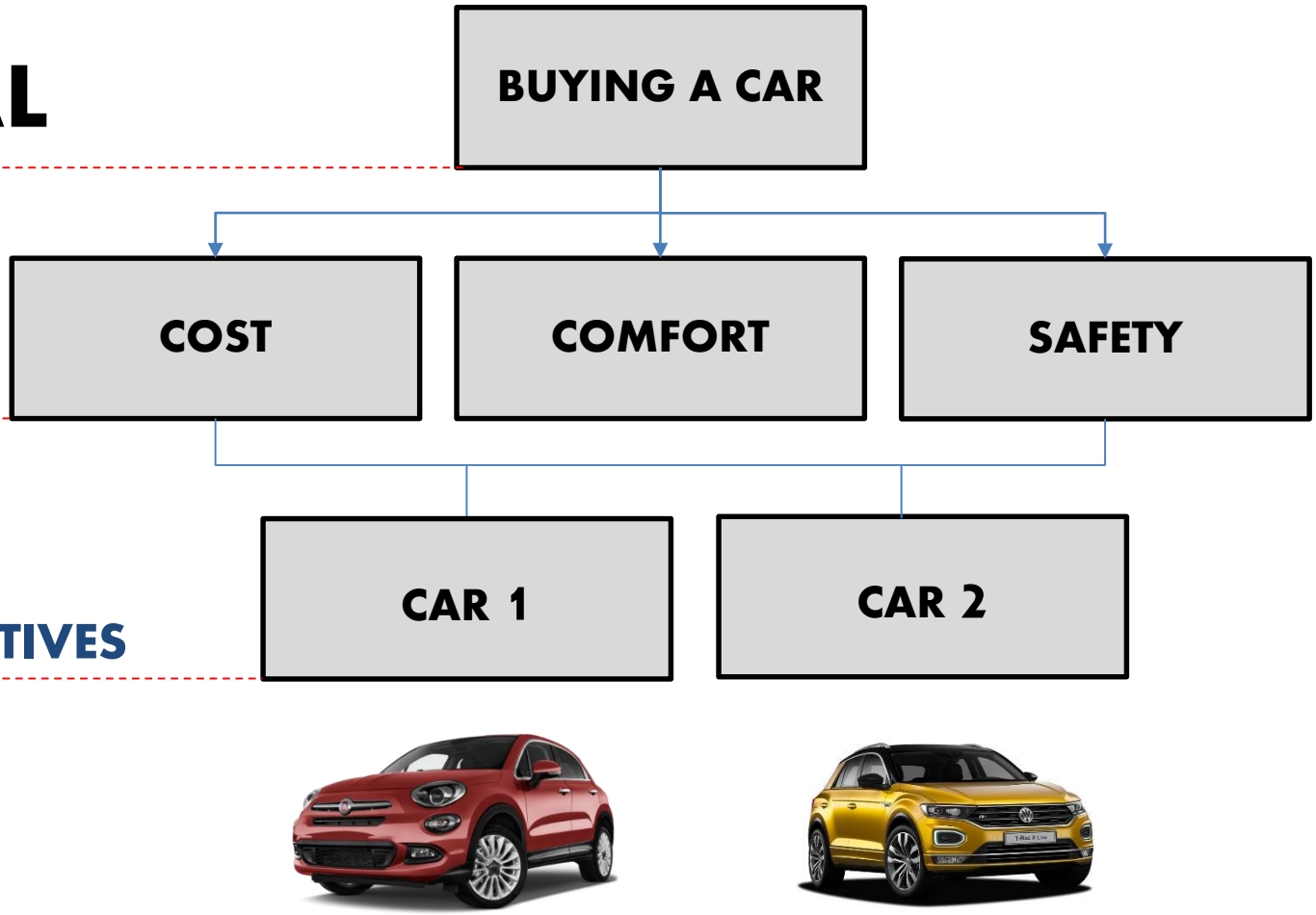


1. Developing a model

Level 1: **GOAL**

Level 2: **CRITERIA**

Level 3: **ALTERNATIVES**



2. Deriving Priorities (weights) for the Criteria

It is clear that **when buying** a car **not all criteria are equally important** in a given time.

For example,

- a student may give more importance to the **cost factor** rather than to comfort and safety;
- while a parent ma give more importance to the **safety factor** rather than to the others.

2. Deriving Priorities (weights) for the Criteria

Clearly, the importance or weight of each criterion will be different.

Because of this, we first are required to derive by pairwise comparisons the **relative priority** of each criterion with respect to each of the others using a numerical scale of comparison developed by

Prof. Saaty, the so-called **sematic scale of Saaty's**.

2. Deriving Priorities (weights) for the Criteria

Sematic scale of Saaty's

Numeric value	Verbal judgment
1	Equal importance
2, 3	Moderate importance of one over another
4, 5	Strong or essential importance
6, 7	Very strong or demonstrated importance
8, 9	Extreme importance

Use Reciprocals for Inverse Comparisons

2. Deriving Priorities (weights) for the Criteria

To perform the pairwise comparison you need to create a **comparison matrix** of the criteria involved in the decision.

Buying a car	COST	COMFORT	SAFETY
COST			
COMFORT			
SAFETY			

Cells in comparison matrices will have a value from the numeric scale to reflect **our relative preference** in each of the compared pairs.

2. Deriving Priorities (weights) for the Criteria

For example, if we consider that the **cost** is *very strongly more important* than the **comfort** factor, the cost-comfort factor comparison cell will contain the value 7.

Buying a car	COST	COMFORT	SAFETY
COST		7	
COMFORT			
SAFETY			

2. Deriving Priorities (weights) for the Criteria

Of course, the opposite comparison, the importance of comfort relative to the importance of cost, will yield the reciprocal of this value (comfort/cost = 1/7).

Buying a car	COST	COMFORT	SAFETY
COST		**7**	
COMFORT	**1/7**		
SAFETY			

2. Deriving Priorities (weights) for the Criteria

If we consider that the **cost** is *moderately more important* than safety, we will enter 3 in the cost-safety cell and the safety-cost cell will contain the reciprocal.

Buying a car	COST	COMFORT	SAFETY
COST		**7**	**3**
COMFORT	1/7		
SAFETY	**1/3**		

2. Deriving Priorities (weights) for the Criteria

Finally, if we feel that **safety** is *moderately more important* than **comfort**, the safety-comfort cell will contain the value 3 and the comfort-safety cell, will have the reciprocal 1/3.

Buying a car	COST	COMFORT	SAFETY
COST		**7**	3
COMFORT	1/7		**1/3**
SAFETY	1/3	**3**	

2. Deriving Priorities (weights) for the Criteria

Note that in comparison matrix when the importance of a criterion is compared with itself the input value is 1.

Pairwise comparison matrix with intensity judgment

Buying a car	COST	COMFORT	SAFETY
COST	**1**	7	3
COMFORT	1/7	**1**	1/3
SAFETY	1/3	3	**1**

2. Deriving Priorities (weights) for the Criteria

At this stage you can see on of the great advantages of the AHP:

- Its natural simplicity;
- Regardless of how many factors are involved in making the decision, the AHP method requires to compare a pair of elements at any time;
- It allows the inclusion of tangible variables (e.g., cost) as well **intangible ones** (e.g., comfort) as criteria in the decision.

2. Deriving Priorities (weights) for the Criteria

To calculate the priorities… weights for each criteria

Buying a car	COST	COMFORT	SAFETY	Product
COST	**1.000**	7.000	3.000	**21.00**
COMFORT	0.143	**1.000**	0.333	**0.048**
SAFETY	0.333	3	**1.000**	**1.000**

2. Deriving Priorities (weights) for the Criteria

To calculate the priorities… weights for each criteria

Buying a car	COST	COMFORT	SAFETY	Root3
COST	**1.000**	7.000	3.000	**2.758**
COMFORT	0.143	**1.000**	0.333	**0.362**
SAFETY	0.333	3	**1.000**	**1.000**

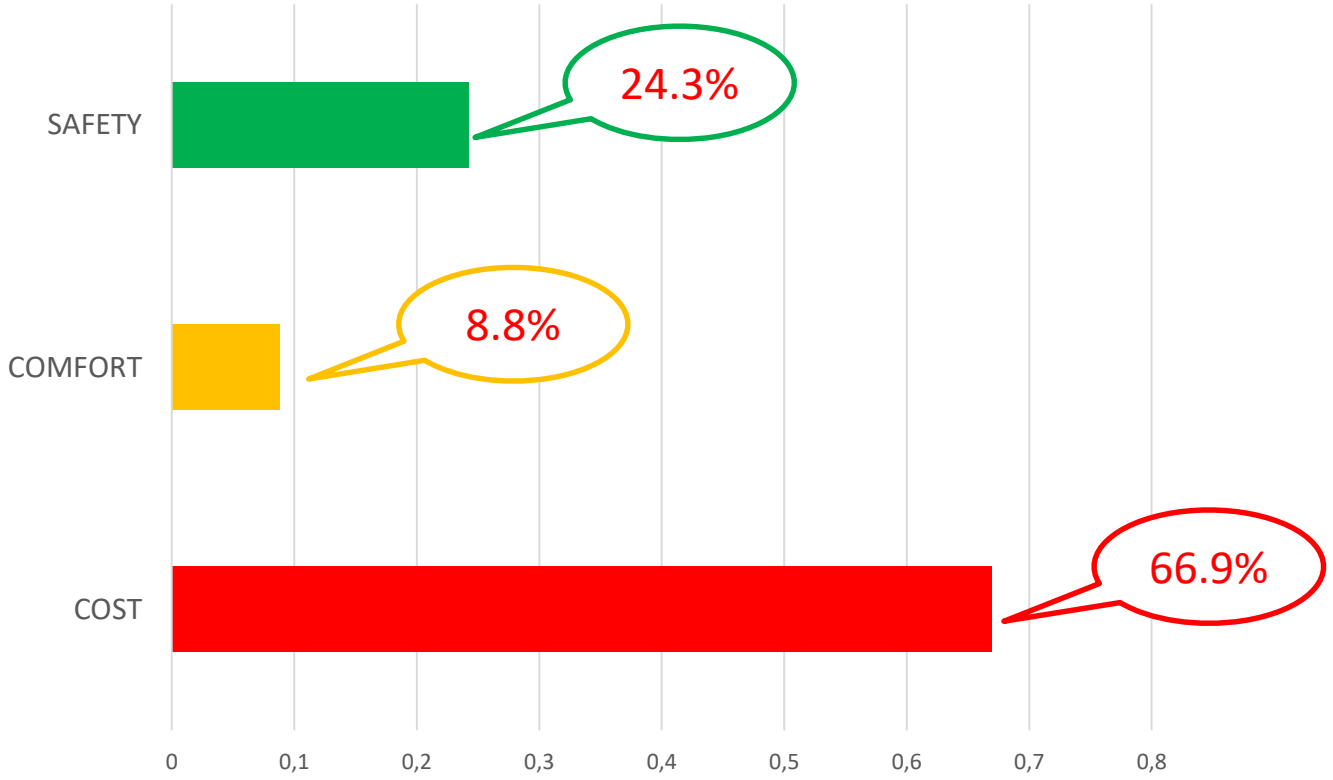
2. Deriving Priorities (weights) for the Criteria

To calculate the priorities… weights for each criteria

Buying a car	COST	COMFORT	SAFETY	Root3	Normalization
COST	**1.000**	7.000	3.000	2.758	0.669
COMFORT	0.143	**1.000**	0.333	0.362	0.087
SAFETY	0.333	3	**1.000**	1.000	0.242
				4.121	1

2. Deriving Priorities (weights) for the Criteria

The … weights for each criteria are:



2. Deriving Priorities (weights) for the Criteria

Consistency

Once judgments have been entered, it is necessary to **check that they are consistent**.

Since the numeric values are derived from subjective preferences of individuals, it is possible to avoid some inconsistency in the final matrix of judgments.

Because the world of experience is vast and we deal with it in pieces according to whatever goals concern us at the time, **our judgments can never be perfectly precise.**

2. Deriving Priorities (weights) for the Criteria

Consistency

The question is

How much inconsistency is acceptable?

For this purpose AHP calculates the Consistency Index (CI) of the matrix

$$CI = (\lambda max - n) / (n-1) < 10\%$$

Where n is the number of compared elements (in our example n = 3)

2. Deriving Priorities (weights) for the Criteria Consistency

Buying a car	COST	COMFORT	SAFETY	Root3	Normalization	Coeff	λmax Eigenvalue
COST	**1.000**	7.000	3.000	2.758	0.669	1	0.988
COMFORT	0.143	**1.000**	0.333	0.362	0.087	0.1313	0.967
SAFETY	0.333	3	**1.000**	1.000	0.242	0.362	1.051
Sum	1.476	11	4.333	4.121	1		3.007

For example:

For COST (2.75)* (1.476)/tot (4.12) = 1,004 (Eigenvalue)

CI = (3.007 – 3) / (3-1) = 0.004

Since the value is less than 0.10, we can assume that our judgments matrix is **resasonable consistent.**

3. Deriving Local Priorities (preferences) for the Alternatives

Our third step consists of deriving the **relative priorities** (preferences) **of the alternatives with respect of each criterion**.
In our case are cost, comfort, and safety.

In our example we have only **2 alternatives** CAR1 and CAR 2 and we have **3 criteria**.
This means that there will be **3 comparison matrices** corresponding to the following three comparisions:

- With respect of the cost criterion: Compare CAR 1 with CAR 2
- With respect of the comfort criterion: Compare CAR 1 with CAR 2
- With respect of the safety criterion: Compare CAR 1 with CAR 2

3. Deriving Local Priorities (preferences) for the Alternatives

With respect of the cost criterion which alternative is preferable? CAR 1 or CAR 2?

Let us assume that we prefer **very strongly** the CAR 1 over the CAR 2

COST	CAR 1	CAR 2
CAR 1	**1**	7
CAR 2	1/7	**1**

▶ C.I. = 0

▶ Priority:

- 0.875 for CAR 1 = 87.5%
- 0.125 for CAR 2 = 12.5%

3. Deriving Local Priorities (preferences) for the Alternatives

With respect of the comfort criterion which alternative is preferable? CAR 1 or CAR 2?

Let us assume that we prefer **strongly** the CAR 2 over the CAR 1

COMFORT	CAR 1	CAR 2
CAR 1	**1**	1/5
CAR 2	5	**1**

▶ C.I. = 0

▶ Priority:
0.833 for CAR 2 = 83,3%
0.167 for CAR 1 = 16,7%

3. Deriving Local Priorities (preferences) for the Alternatives

With respect of the safety criterion which alternative is preferable? CAR 1 or CAR 2?

Let us assume that we prefer **extremely** the CAR 2 over the CAR 1

COMFORT	CAR 1	CAR 2
CAR 1	**1**	1/9
CAR 2	9	**1**

▶ C.I. = 0

▶ Priority:
0.90 for CAR 2 = 90%
0.10 for CAR 1 = 10%

3. Deriving Local Priorities (preferences) for the Alternatives

We can **summarize** the results indicating that:

1. if our only criterion were **cost**, CAR 1 would be our best option (priority 0.875);
2. if our only criterion were **comfort** our best option would be the CAR 2 (priority 0.833);
3. if our sole purchase criteria were **safety** our best option would be the CAR 2 (priority 0.90)

- COST = 87,5% for CAR 1
- COMFORT = 83,3% for CAR 2
- SAFETY = 90% for CAR 2

4. Derive Overall Priorities (Model Synthesis)

Final RESULT

	COST	COMFORT	SAFETY	Overall priority
Criteria weights	*0.669*	*0.088*	*0.243*	
CAR 1	0.875	0.167	0.100	**0.146**
CAR 2	0.125	0.833	0.900	**0.853**

CAR 1 = **14.6%**

CAR 2 = 85.3%

5. Sensitivity Analysis

It is useful to perform a "**what-if**" analysis to see how the final results would have a change if the **weights** of the **criteria** would have been **different**.

Sensitivity analysis allows us to understand **how robust** is our **original decision**.

To perform a sensitivity analysis it is necessary to **make changes to the weights** of the criterion and see how the change the overall priority.

5. Sensitivity Analysis

Scenario 1: all criteria same weight

	COST	COMFORT	SAFETY	Overall priority
Criteria weights	*0.333*	*0.333*	*0.333*	
CAR 1	0.875	0.167	0.100	**0.130**
CAR 2	0.125	0.833	0.900	**0.869**

CAR 2 = 86.9%

5. Sensitivity Analysis

Scenario 2: cost weight leading

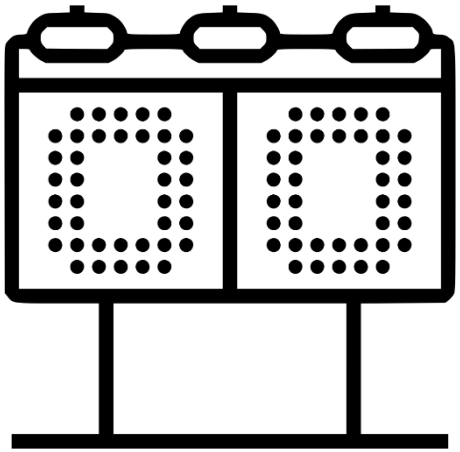
	COST	COMFORT	SAFETY	Overall priority
Criteria weights	*0.500*	*0.250*	*0.250*	
CAR 1	0.875	0.167	0.100	**0.129**
CAR 2	0.125	0.833	0.900	**0.435**

CAR 2 = 43.5%

6. Final Decision

The model is **rather robust** since CAR 2 is the best choice even when changing scenarios!

We can analyze different possible scenarios of interest to understand in which cases the best original choice is no longer so.



STRATEGOS
Engineering Technologies for Strategy in Defense, Industry, Government & Homeland Security

Università di Genova
www.strategos.it

Case Study 2

AHP Model:

Buying a car

Using Superdecision

By Creative Decisions Foundation
4922 Ellsworth Avenue
Pittsburgh, PA 15213
Phone: 412-621-6546
Fax: 412-681-4510

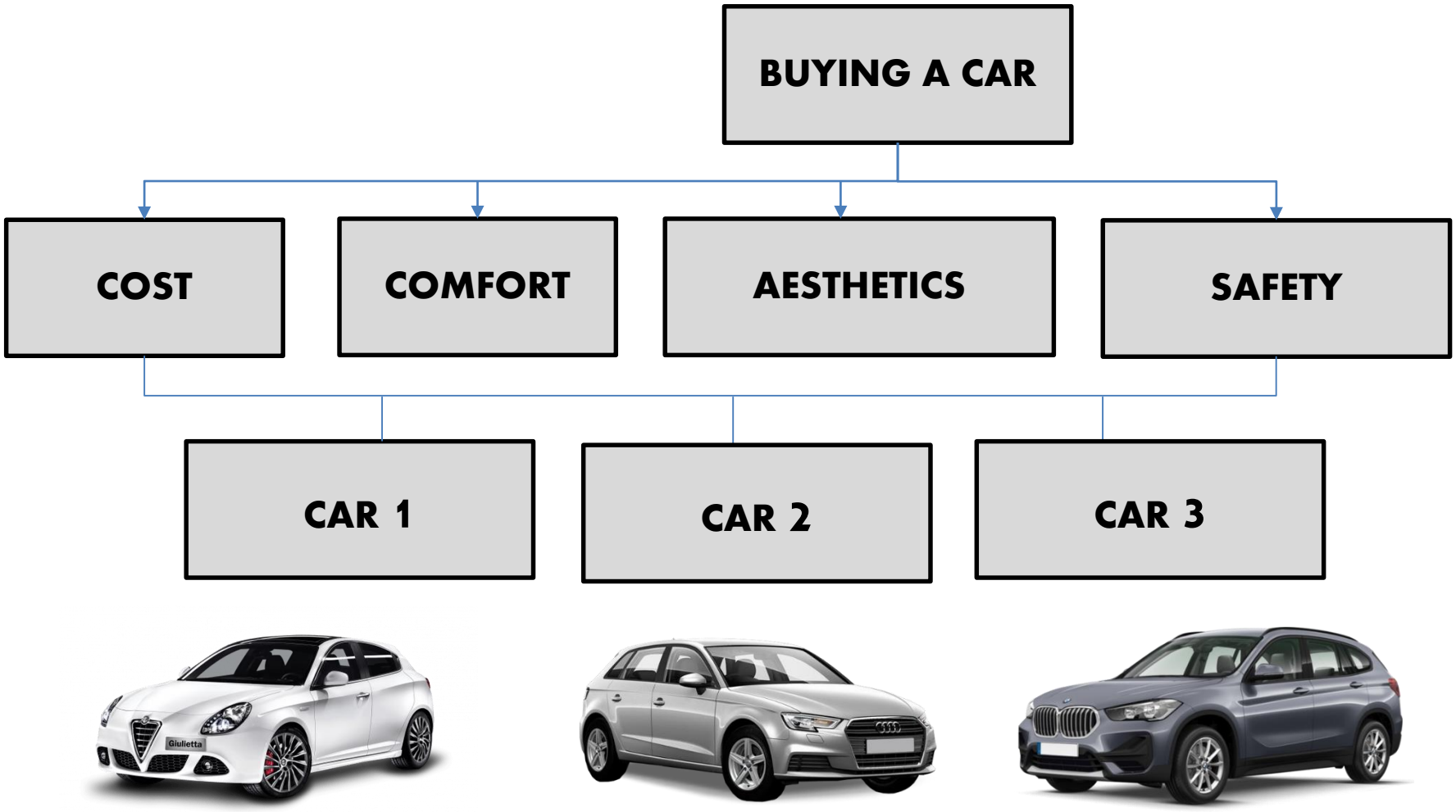
Case Study 2

ALFA ROMEO

Audi

BMW

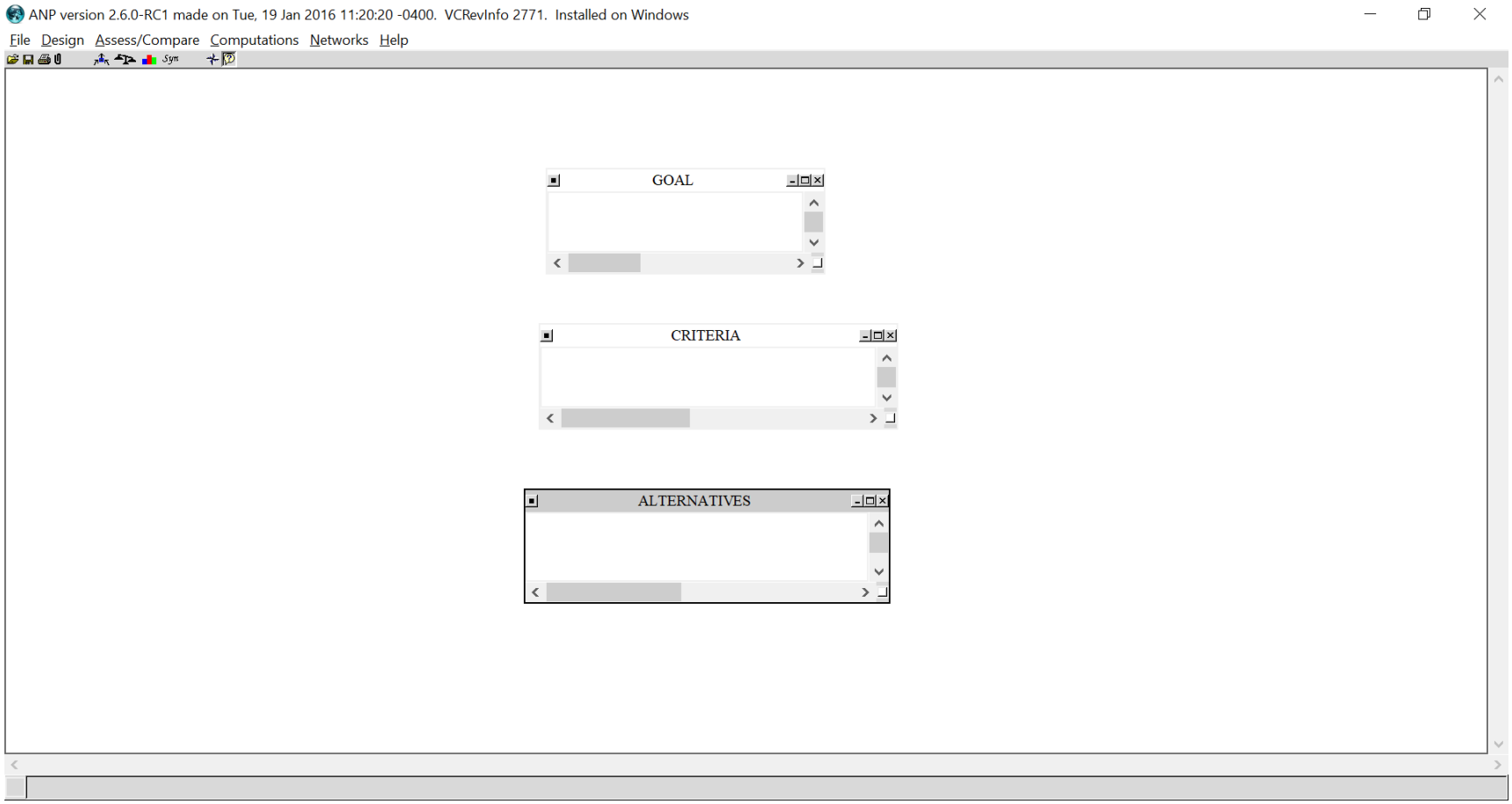
1. Developing a Model



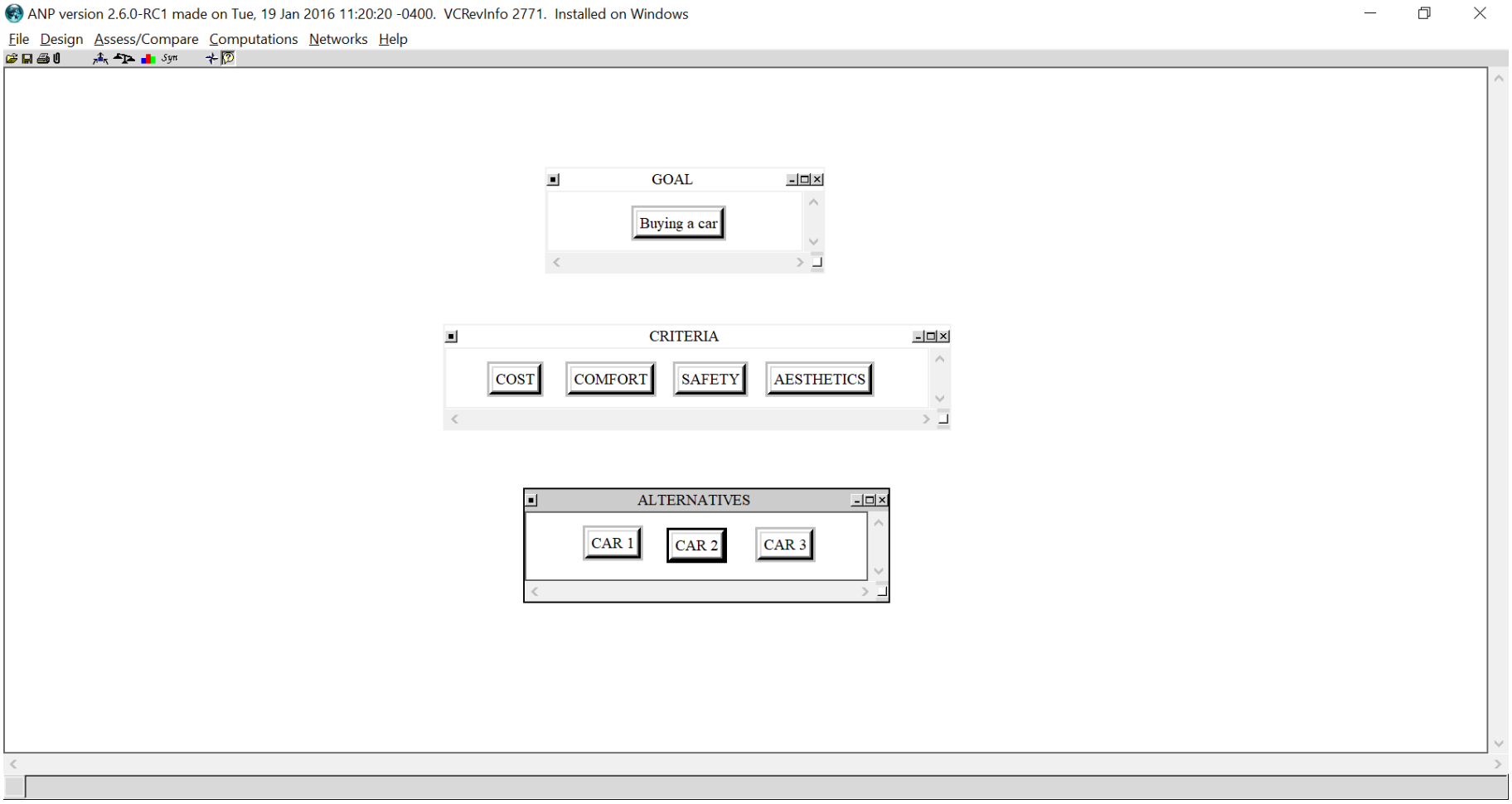
1. Developing a Model

	AESTHETIC/ Prestige	COMFORT	COST	SAFETY
	Excellent	Medium	22.500,00 EUR	Medium
	Good	Excellent	26.700,00 EUR	Excellent
	Medium	Good	28.200,00 EUR	Good

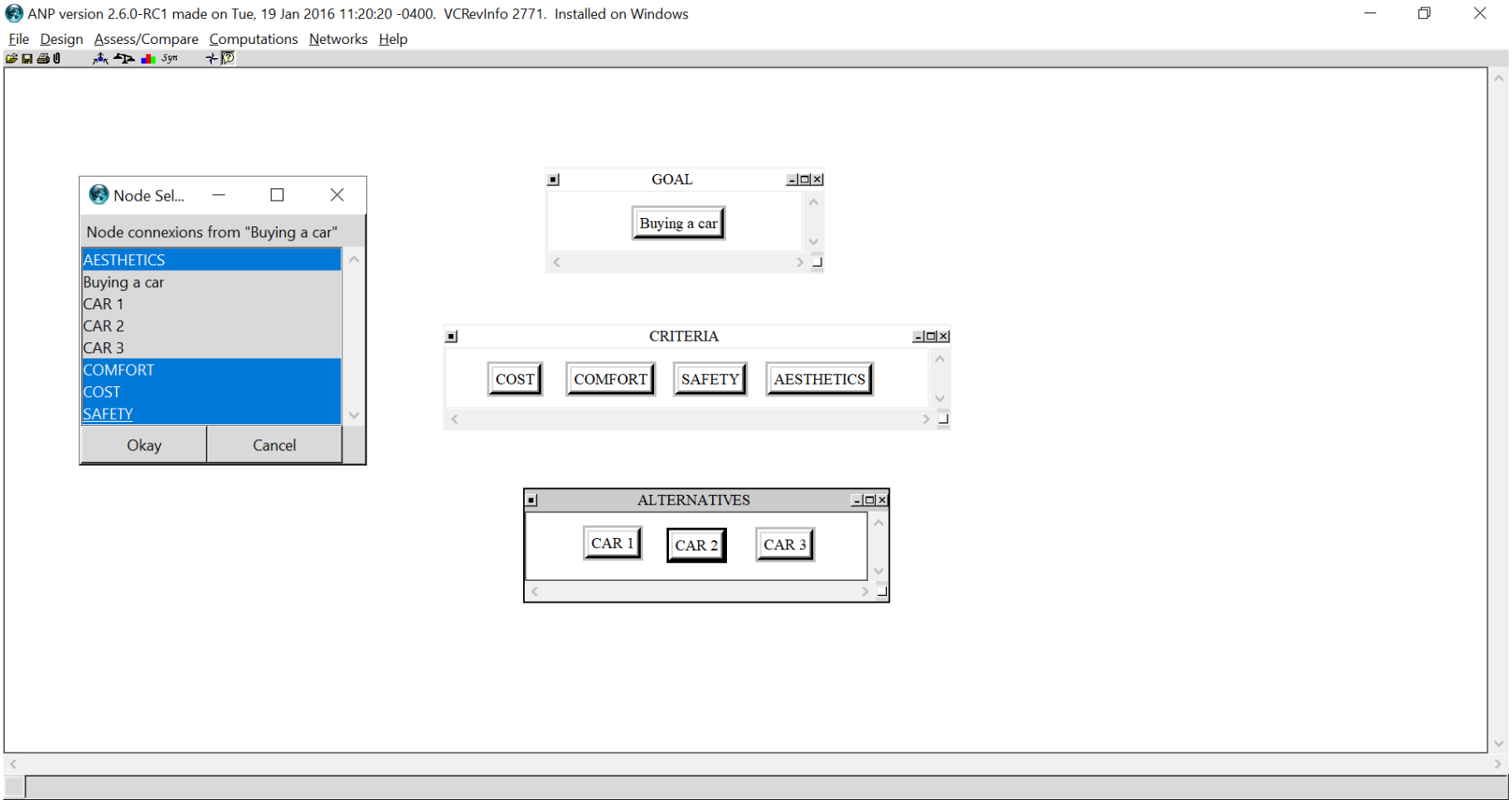
1. Developing a Model



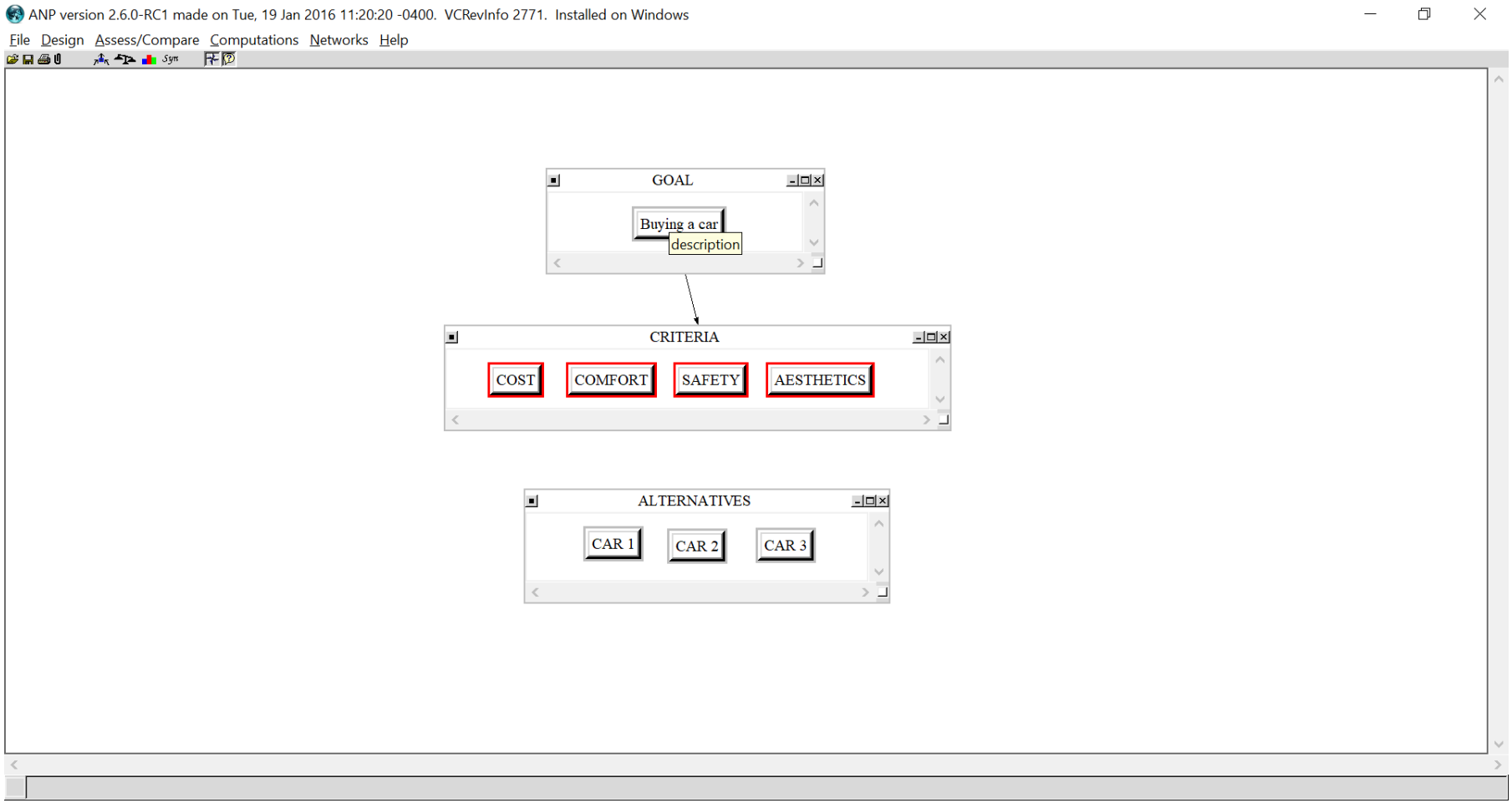
1. Developing a Model



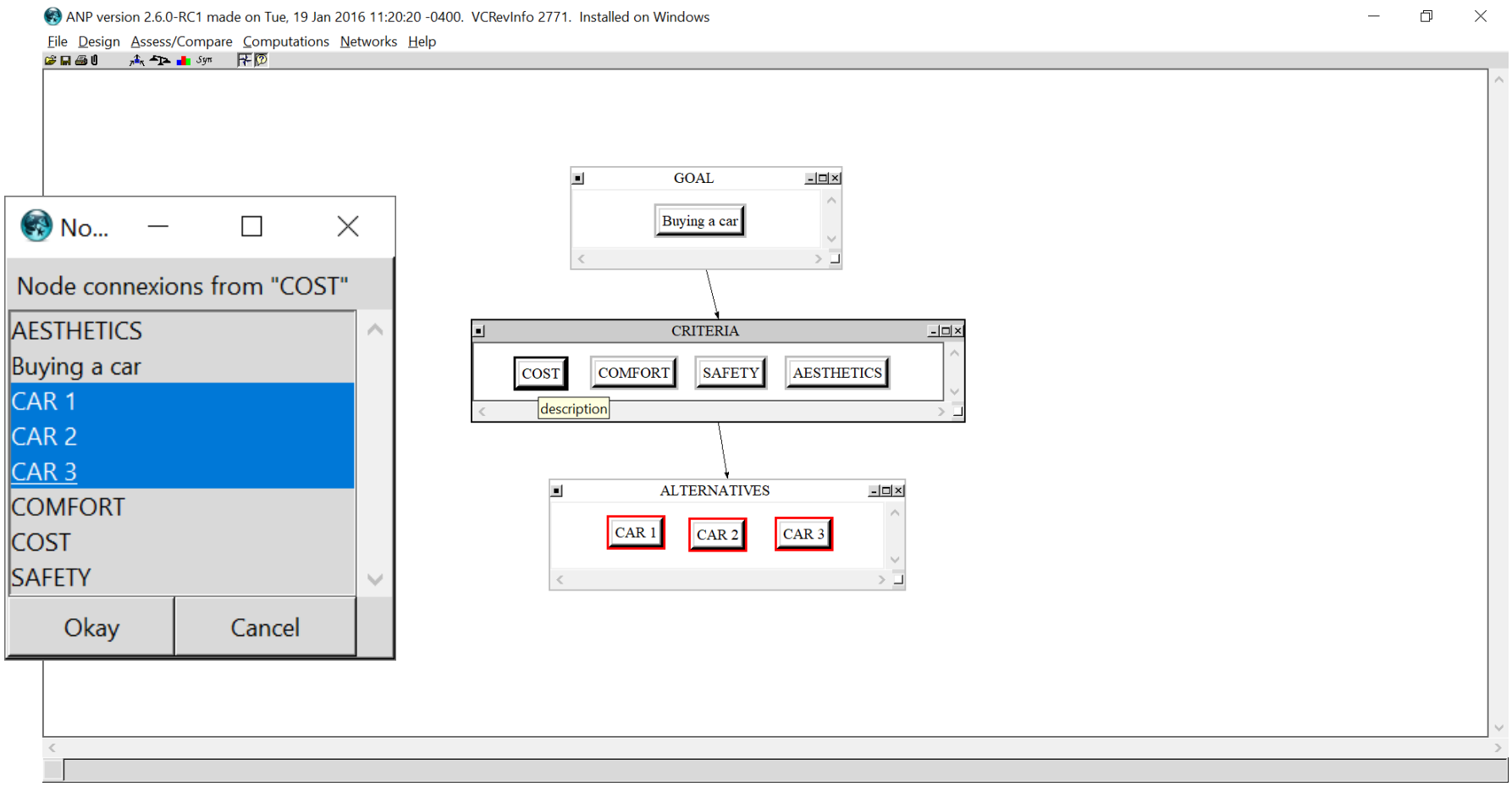
1. Developing a Model



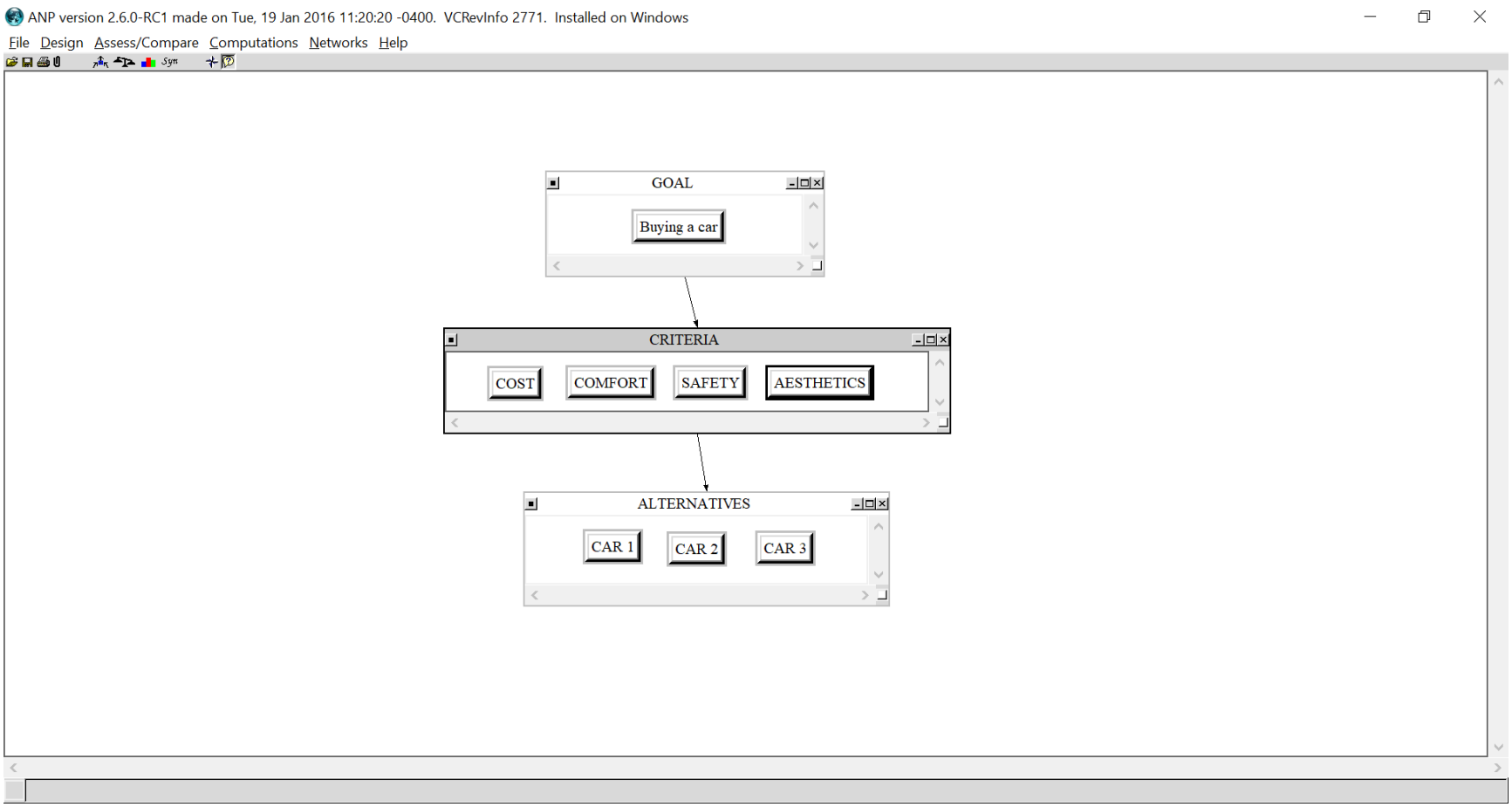
1. Developing a Model



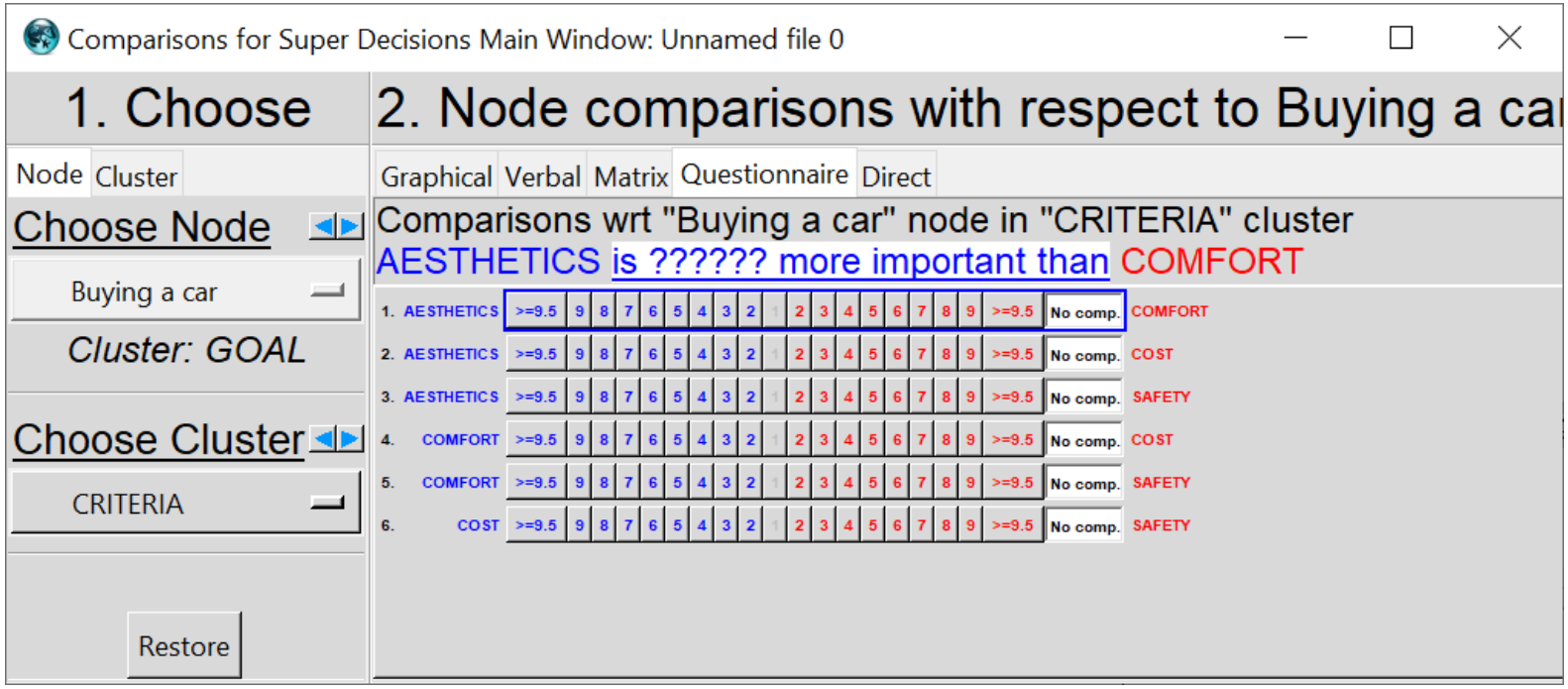
1. Developing a Model



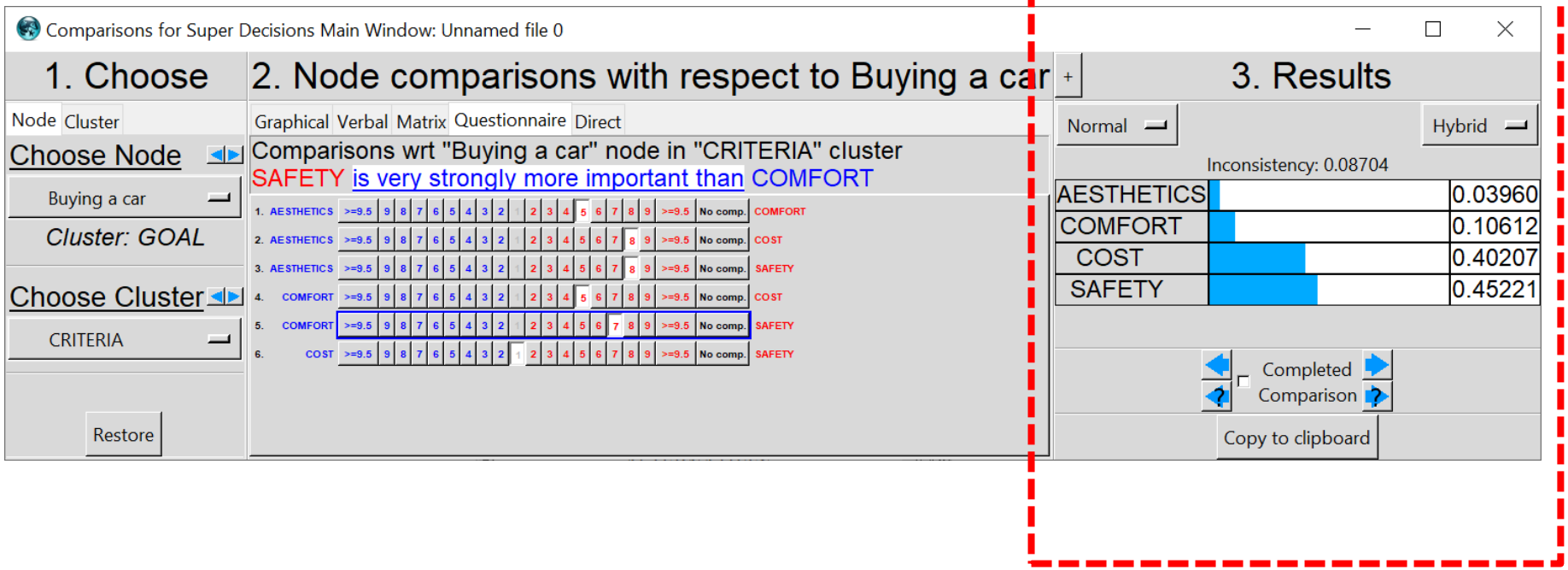
1. Developing a Model



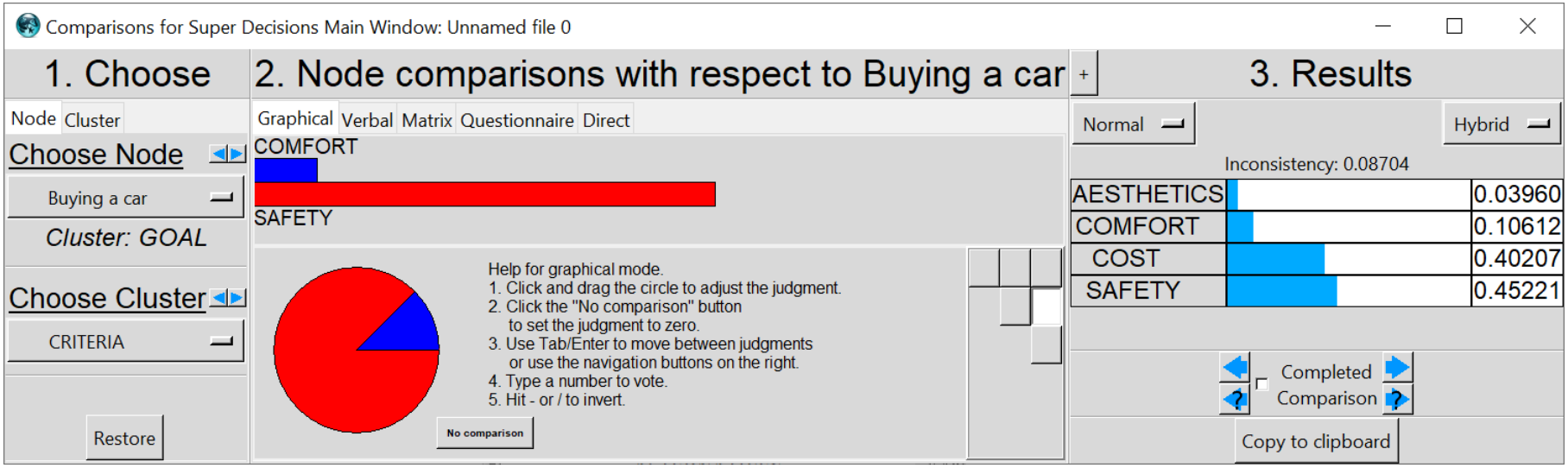
2. Deriving Priorities (weights) for Criteria



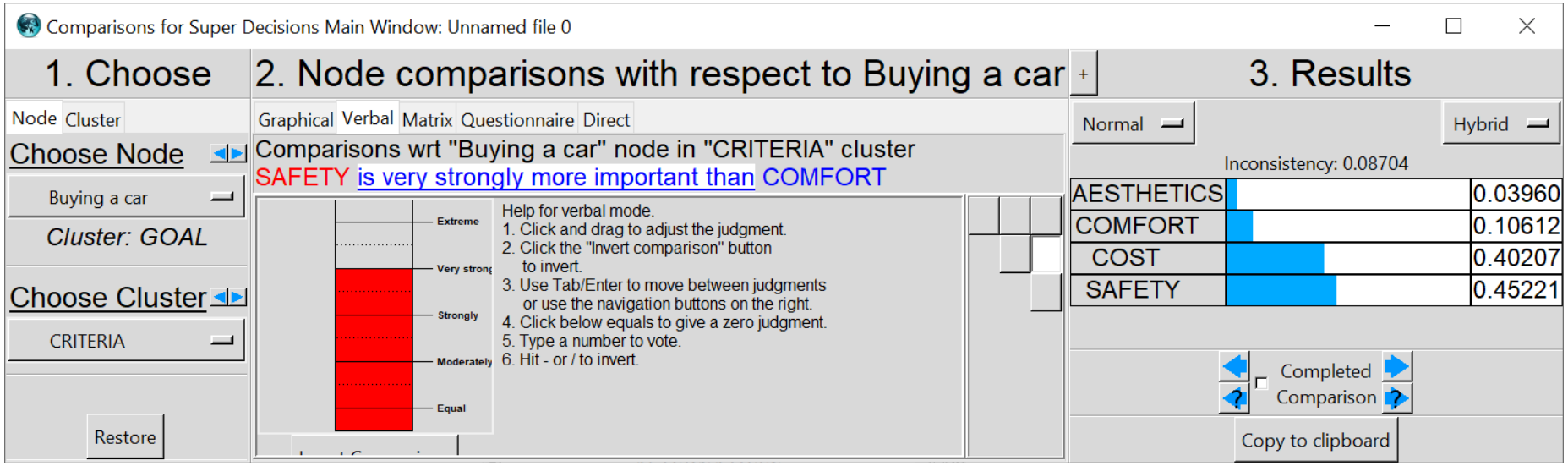
2. Deriving Priorities (weights) for Criteria



2. Deriving Priorities (weights) for Criteria

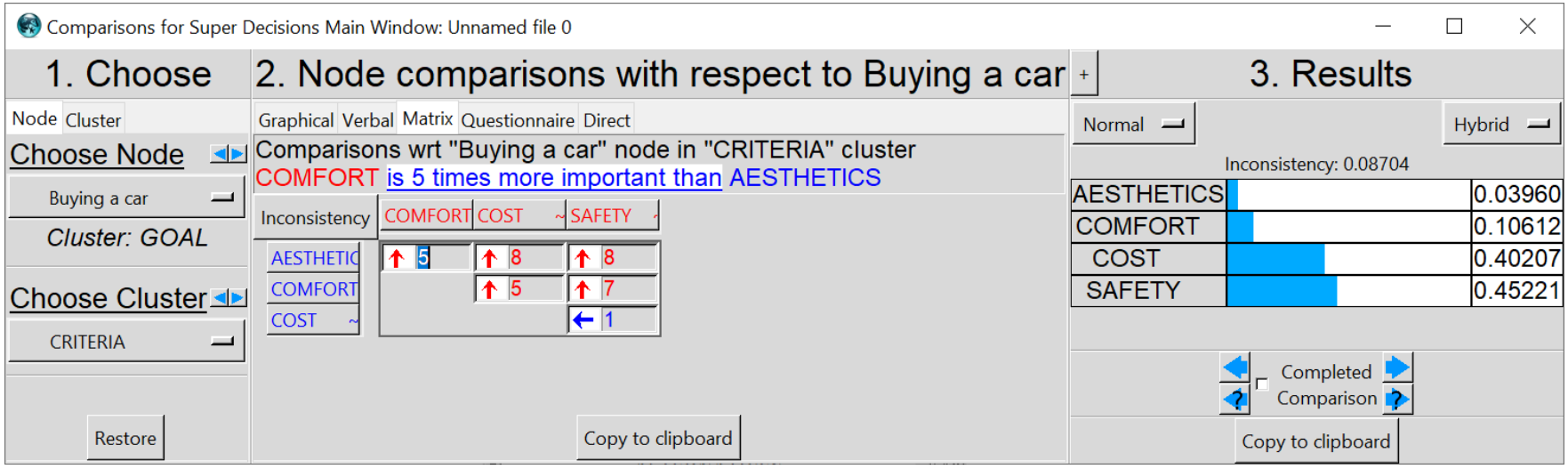


2. Deriving Priorities (weights) for Criteria



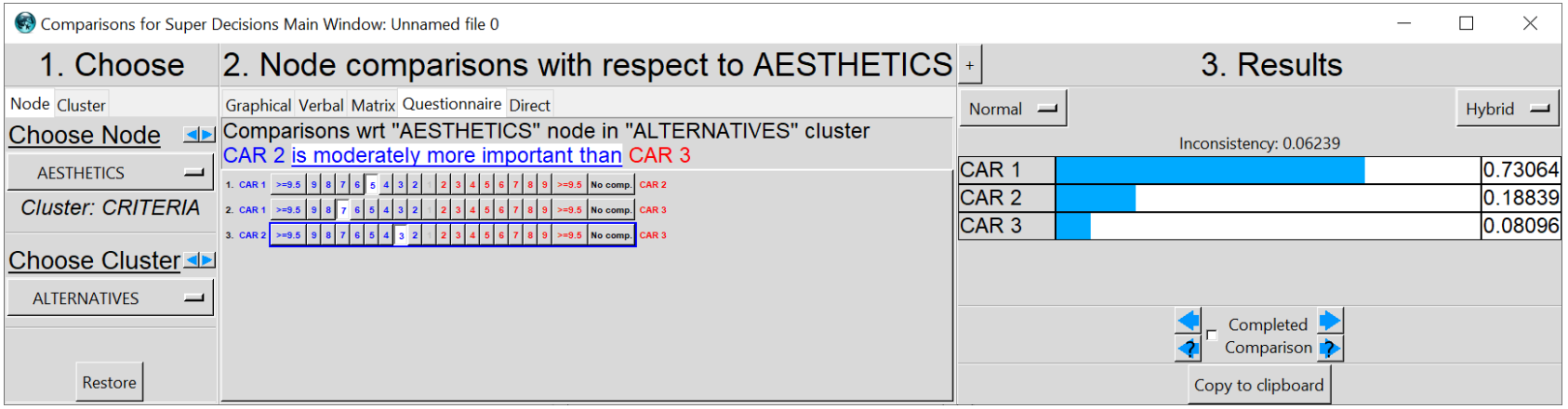
2. Deriving Priorities (weights) for Criteria Consistency

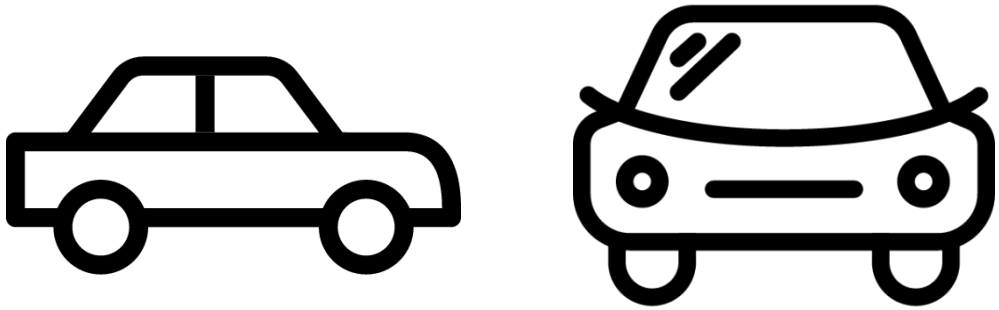
- Click on the **Inconsistency button** (at top left corner of matrix)
- Choose Basic **Inconsistency Report**; the first cell
- Left-click on either the Current or **Best Value** cell to return to the matrix and input a new value . You can use the suggested value to improve the final CI.



3. Deriving Local Priorities (preferences) for the Alternatives

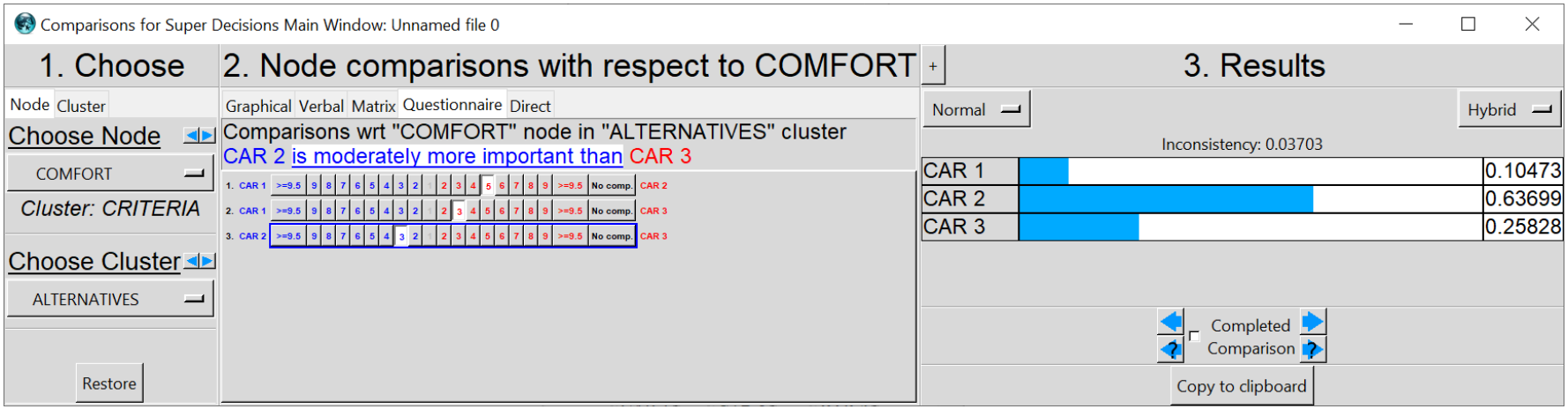
AESTHETIC Criteria

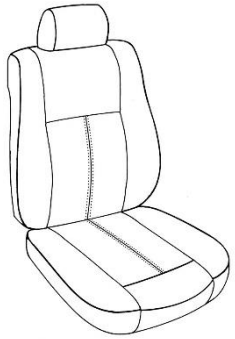


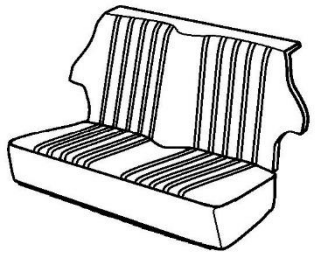


3. Deriving Local Priorities (preferences) for the Alternatives

COMFORT Criteria

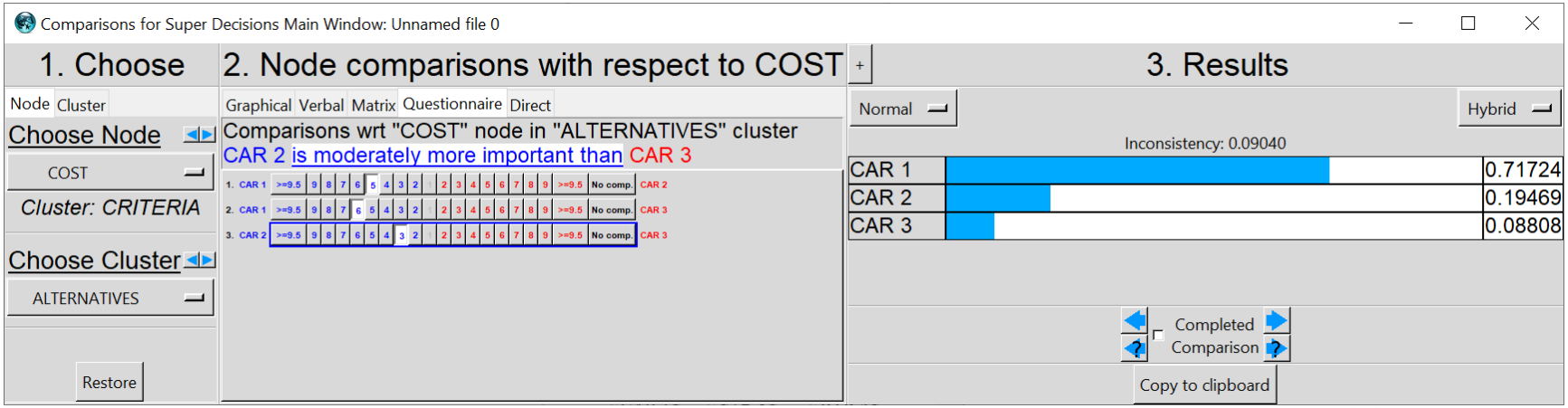






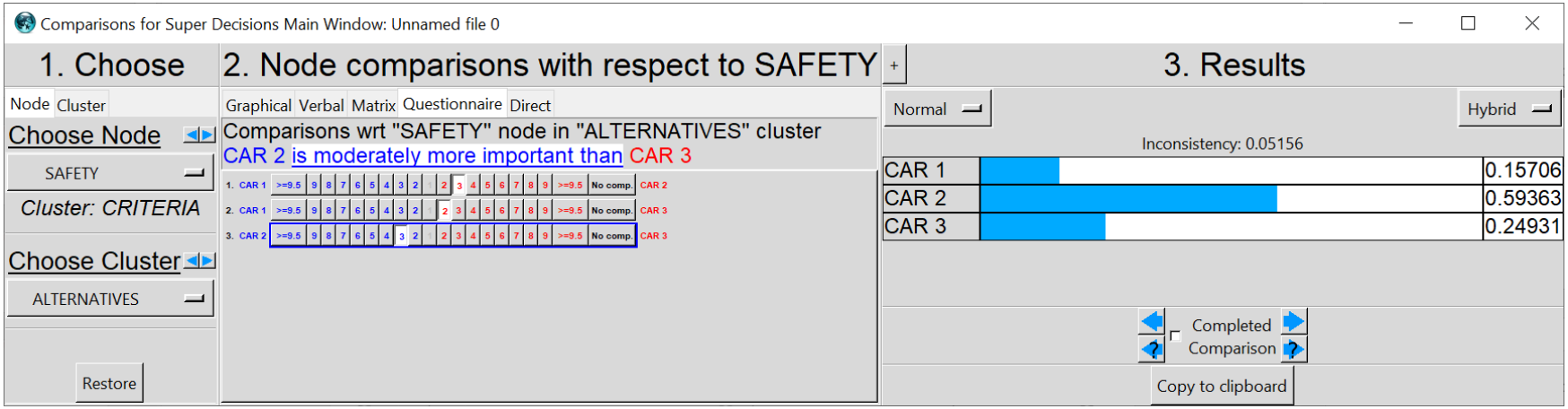
3. Deriving Local Priorities (preferences) for the Alternatives

COST Criteria



3. Deriving Local Priorities (preferences) for the Alternatives

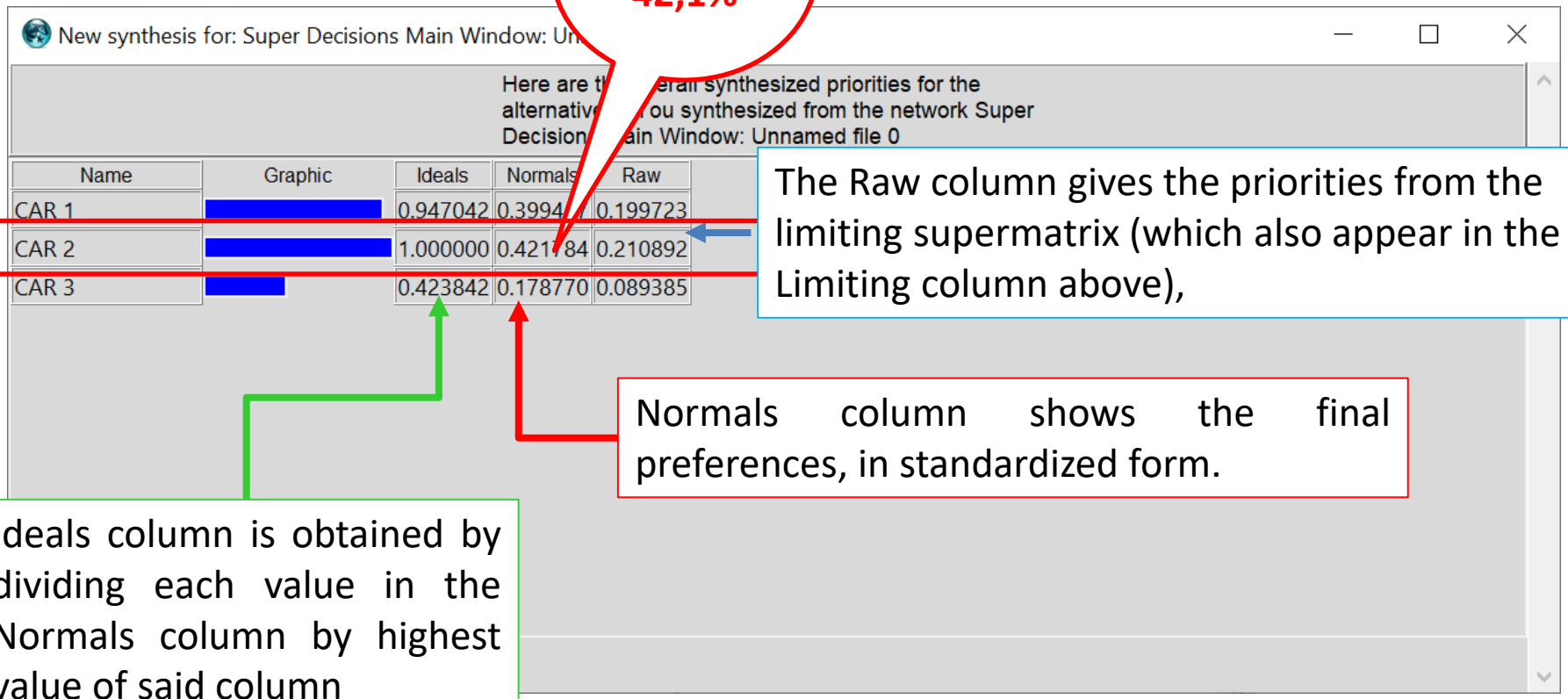
SAFETY Criteria



4. Deriving Overall Priorities (Model Synthesis)

Final RESULTS

CAR2: 42,1%



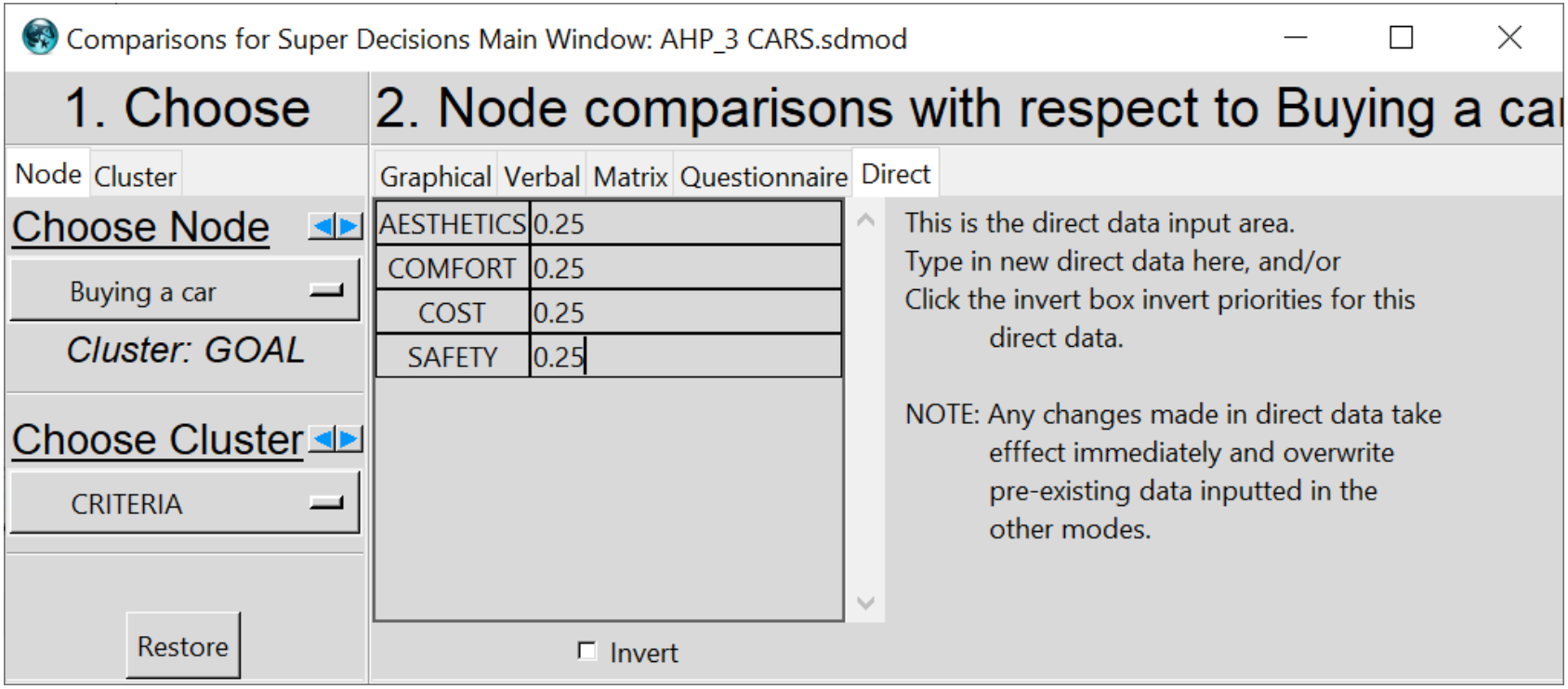
The Raw column gives the priorities from the limiting supermatrix (which also appear in the Limiting column above),

Normals column shows the final preferences, in standardized form.

Ideals column is obtained by dividing each value in the Normals column by highest value of said column

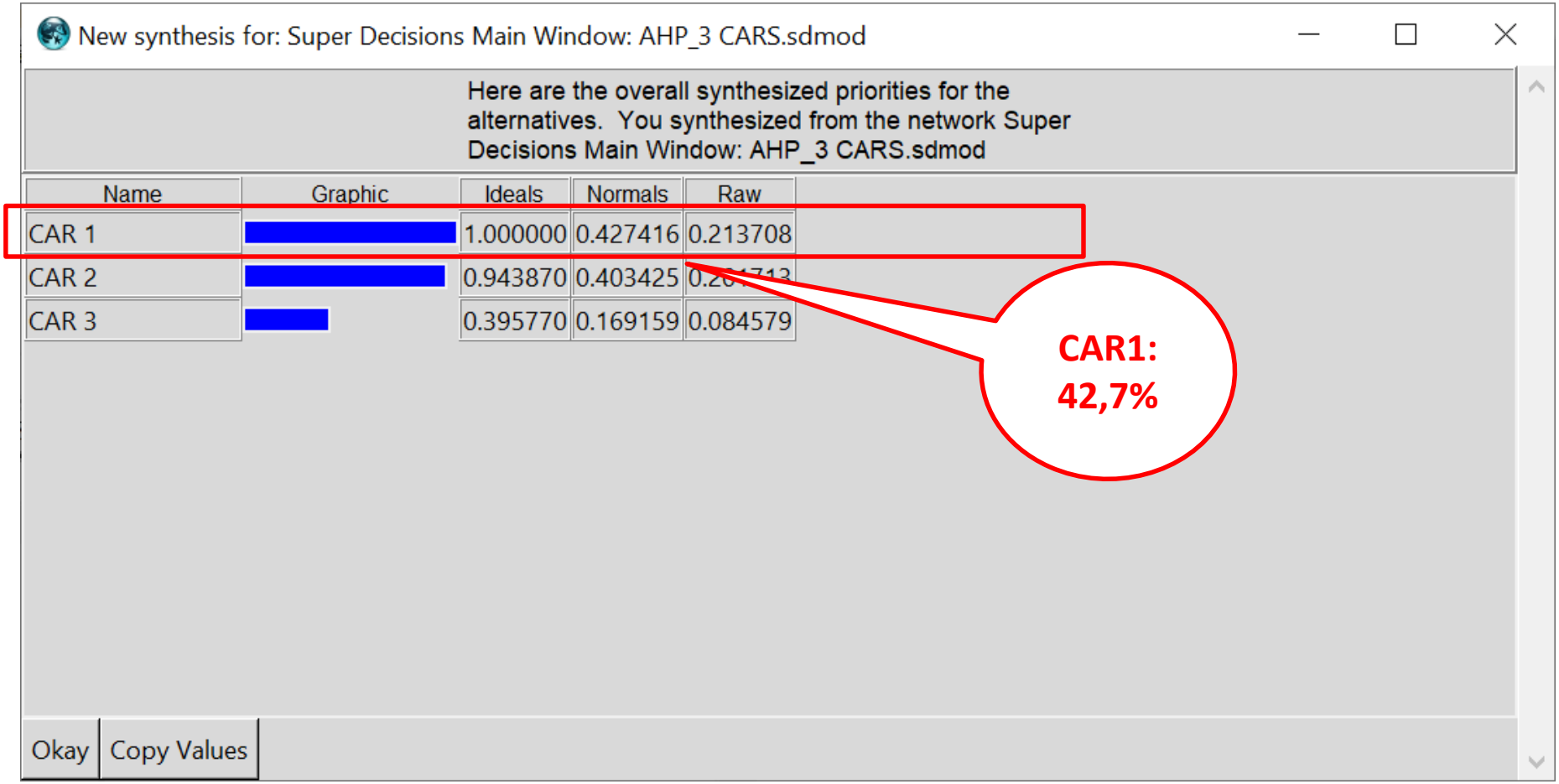
5. Sensitivity Analysis

Scenario 1: all criteria same weight



5. Sensitivity Analysis

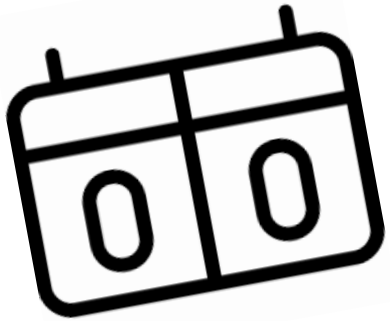
Scenario 1: all criteria same weight

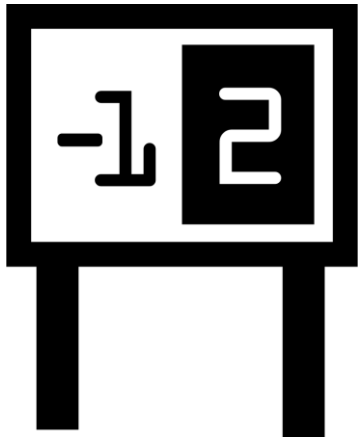


6. Final Decision

If all criteria have the same weight the best choice becomes CAR 1, but just a little.
It means that model is quite robust.

We can analyze different possible scenarios of interest to understand in which cases the best original choice is no longer so.





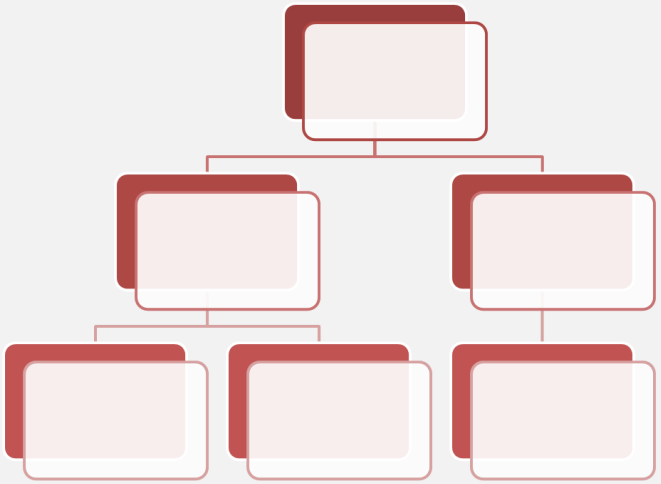
STRATEGOS
Engineering Technologies for Strategy in Defense, Industry, Government & Homeland Security

Università di Genova
www.strategos.it

Understanding the Analytic Hierarchy Process

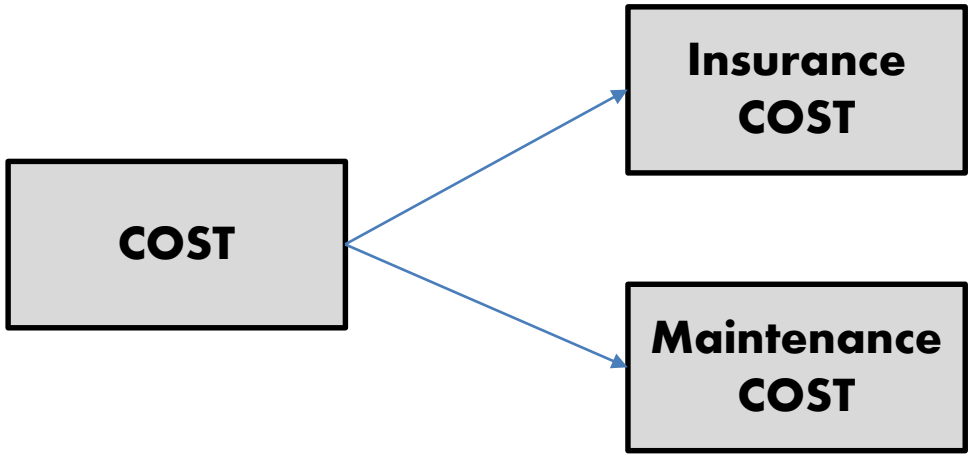
Intermediate

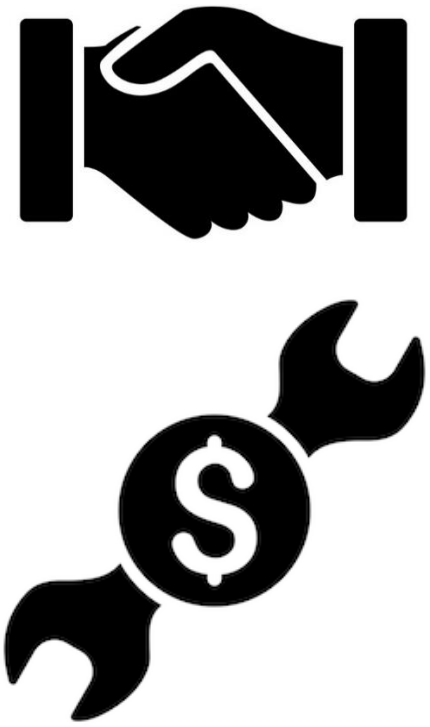
AHP model with sub-criteria



AHP model with sub-criteria

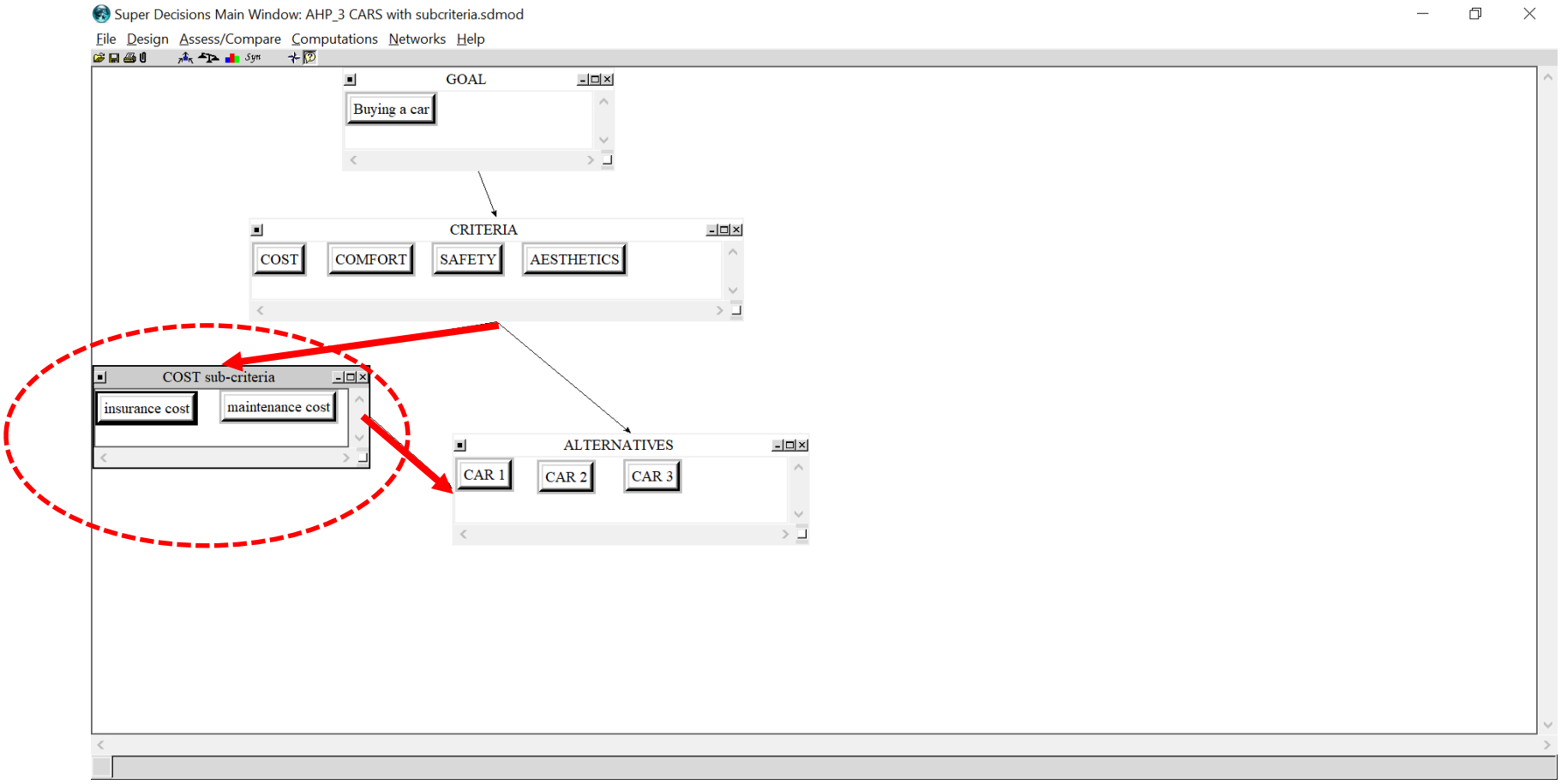
How to modify the model?





AHP model with sub-criteria

How to modify the model?

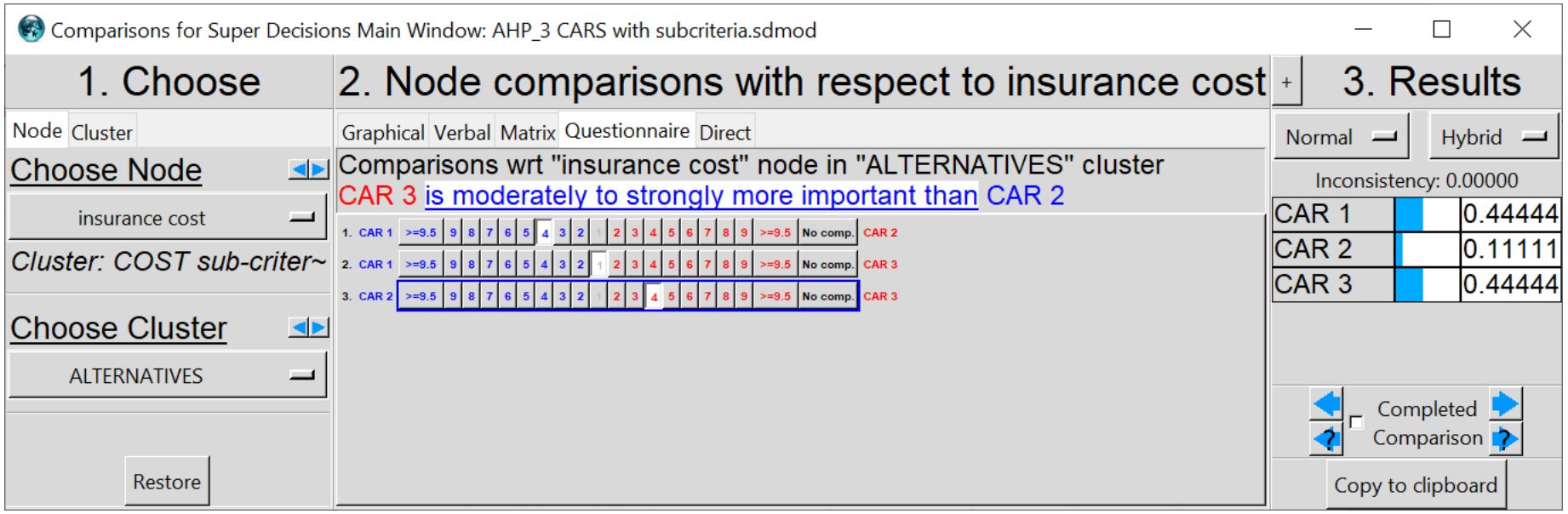


How to modify the model?

	AESTHETIC/ Prestige	COMFORT	COST		SAFETY
			Insurance	Mainten.	
	Excellent	Medium	22.500,00 EUR		Medium
			500,00	300,00	
	Good	Excellent	26.700,00 EUR		Excellent
			550,00	350,00	
	Medium	Good	28.200,00 EUR		Good
			500,00	400,00	

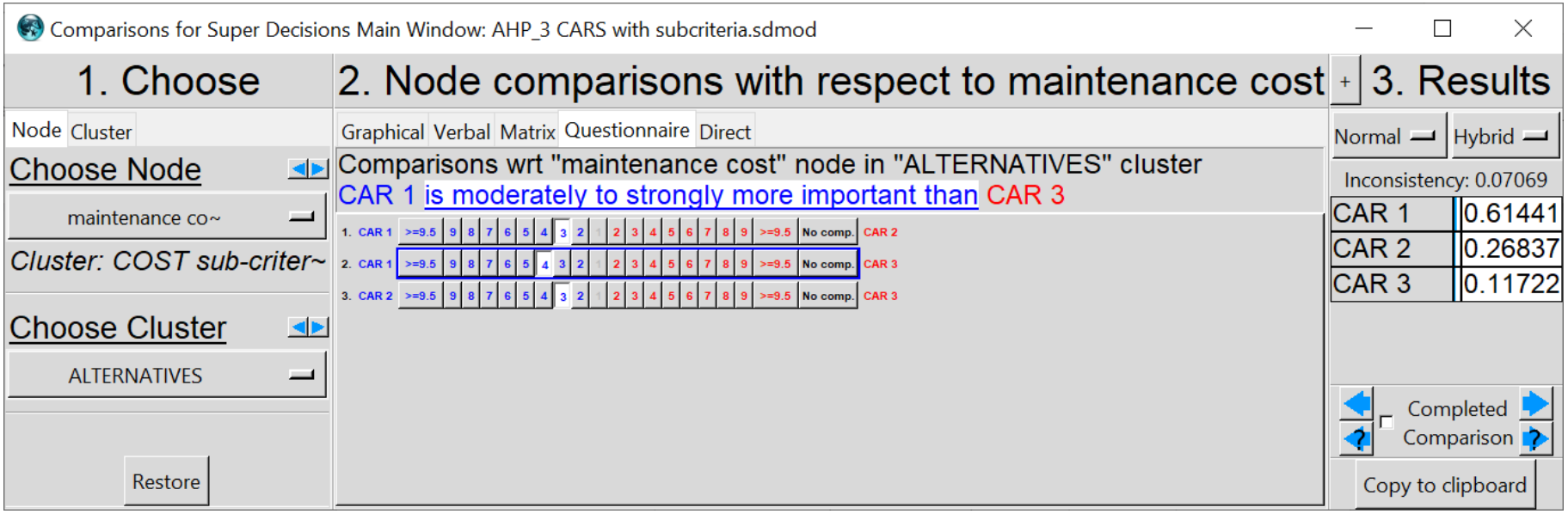
How to modify the model?

1 new matrix for insurance cost



How to modify the model?

1 new matrix for maintenance cost



How to modify the model?

In **summary**, the procedure to insert sub-criteria to a specific criterion (e.g., cost) consist of:

- Create sub-criteria cluster for the specific criterion;
- Create the **sub-criteria nodes**;
- **Connect the criterion node to the alternatives**;
- Compare pairwise the sub-criteria to obtain the relative sub-criteria weights;
- Compare the alternatives with respect to these sub-criteria.

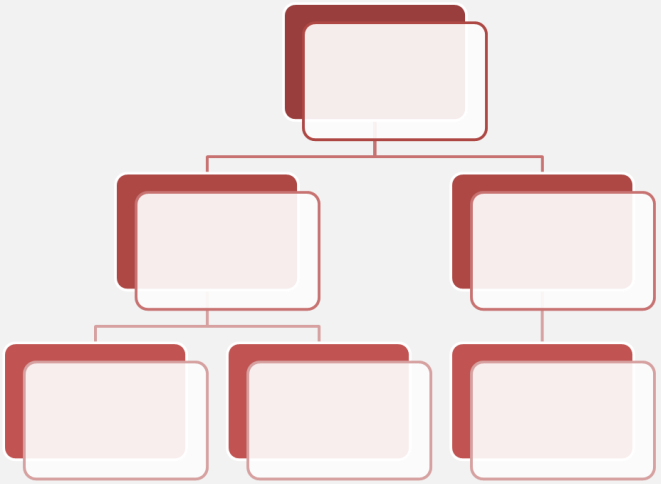
STRATEGOS
Engineering Technologies for Strategy in Defense, Industry, Government & Homeland Security

Università di Genova
www.strategos.it

Understanding the Analytic Hierarchy Process

Intermediate

AHP Absolute Model (or Rating Model)



Absolute model or called Rating Model

- Sometimes there is a **large number of alternatives** to consider. For example, in the case of **evaluating employees** for promotion, it would not be unusual to have to evaluate 30 or more.
- This would make a **pairwise comparison very difficult** due to the excessive number of required comparisons.
- A similar situation occurs when you are constantly adding or removing alternatives.

A pairwise comparison requires a repetitive comparative process.

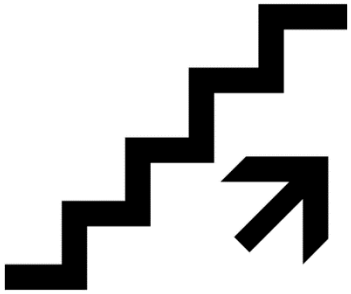
This process is tedious!

Absolute model or called Rating Model

To resolve these two situations ratings model have been developed by Prof. Saaty.

In an Absolute model a **hierarchy is developed** in the usual way down to the level of criteria or sub-criteria.

The criteria or sub-criteria are further subdivided into a **level for intensities**.



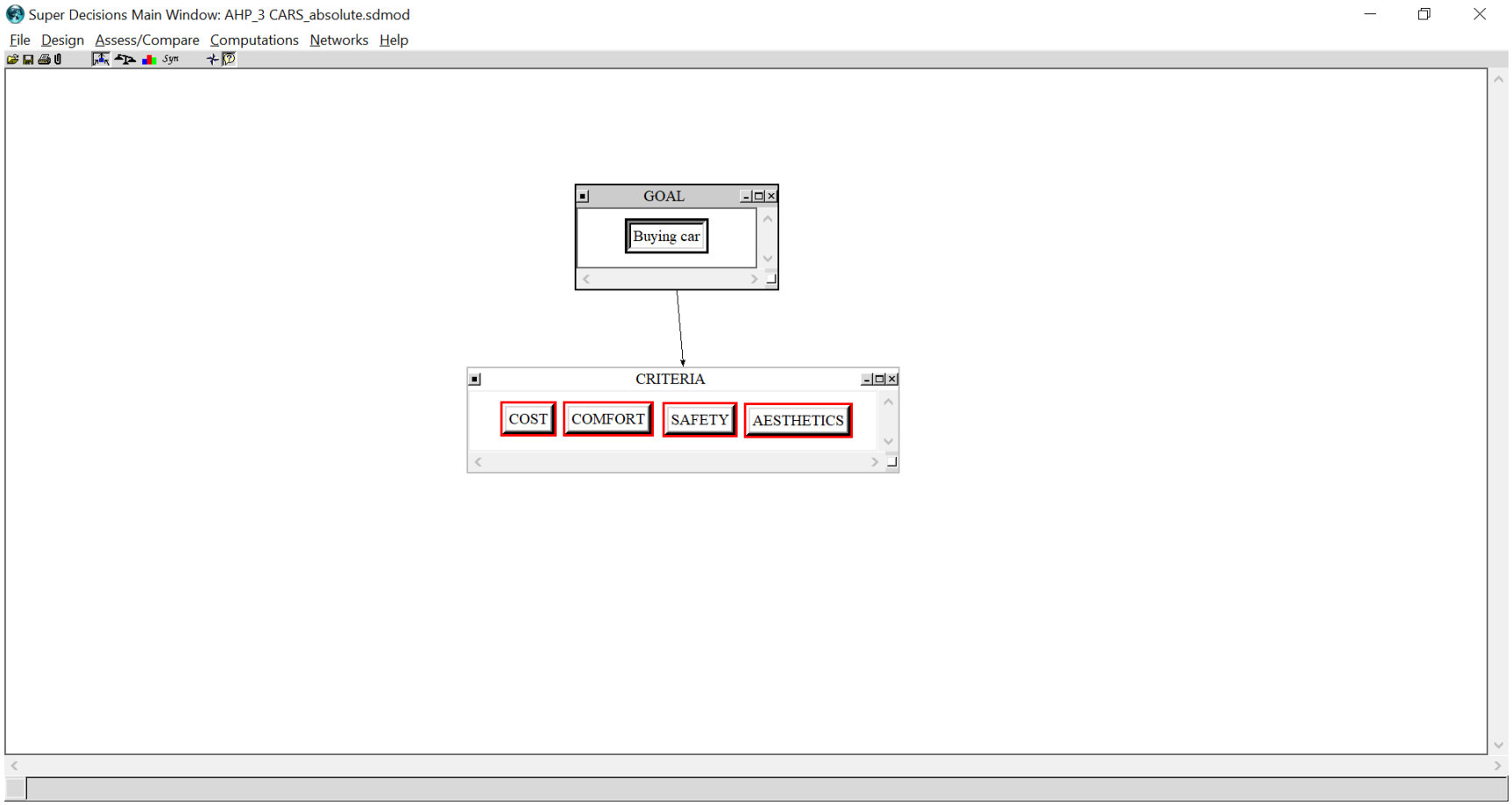
Absolute model or called Rating Model

An intensity may be expressed as a **numerical range** of values if the criterion is measurable or in qualitative terms.

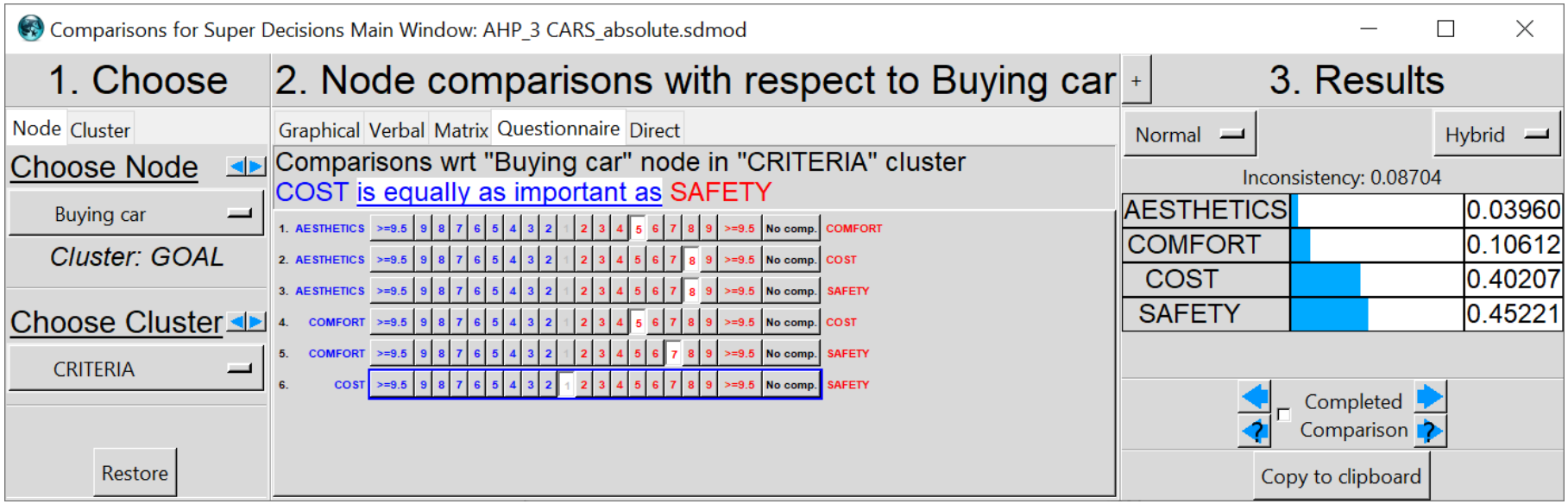
For example, if we have a class and we would like to rank students according to their performance in mathematics, the mathematics ranking might be:

1. excellent, good, average, below average, poor
2. or using the usual school terminology A, B, C, D, and E
3. or a third way is to use numerical ranges 93-100, 85-95, 75-85, 60-75, below 60

How to build the model?



Absolute model



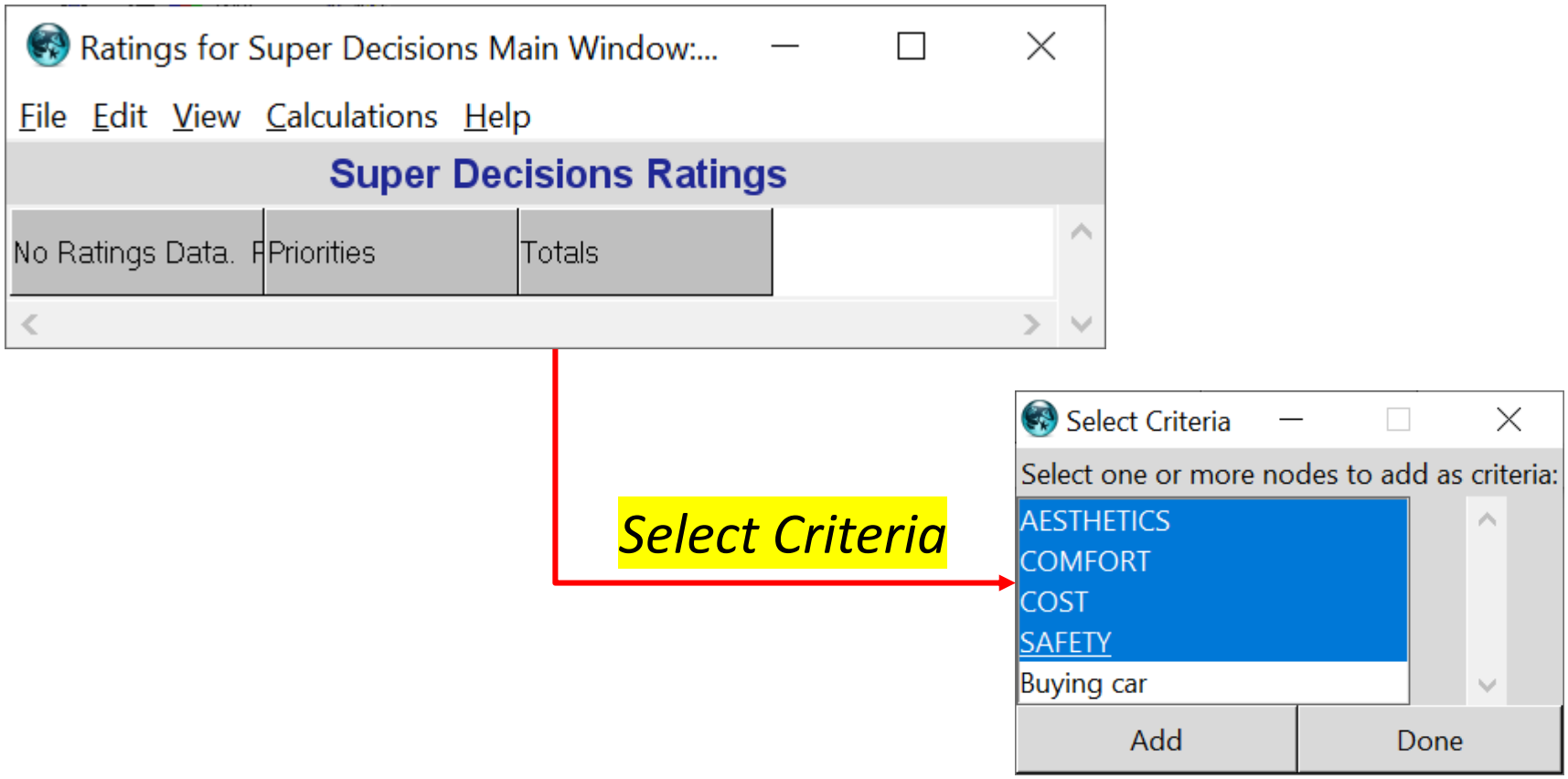
How to build the model?

In ratings models, the **evaluation of the alternatives** is **NOT** done via pairwise comparison but by **rating them** with respect to each criterion separately.

For this purpose, we need to **create a ratings scale** for each criterion.

How to build the model?

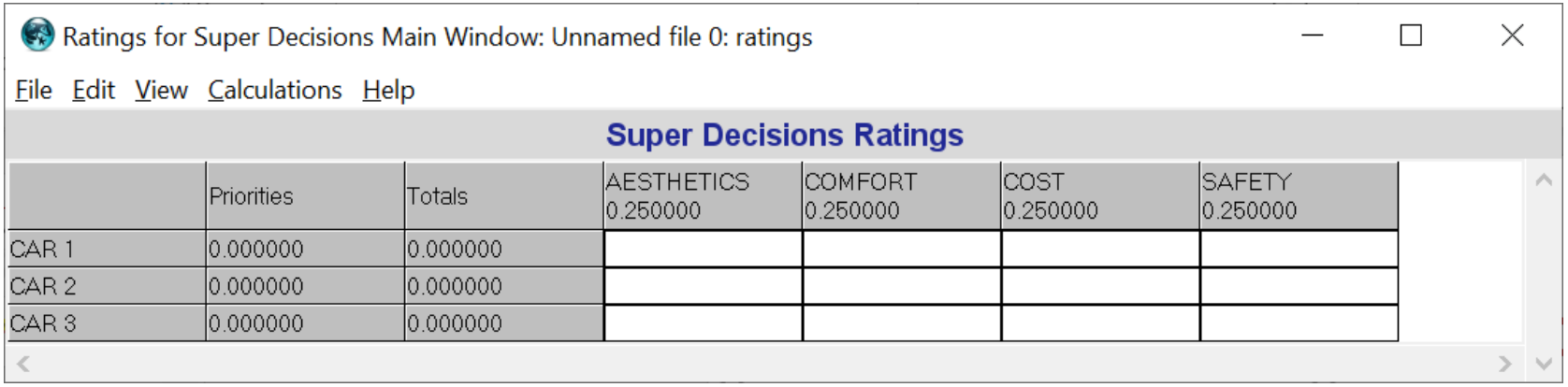
Select ***Design>Ratings*** to open the Ratings screen where the Alternatives will be evaluated.



How to build the model?

We need to add the **alternatives**.

For this we select ***Edit/Alternatives/New*** and proceed to enter the name of the first alternative.



	Priorities	Totals	AESTHETICS 0.250000	COMFORT 0.250000	COST 0.250000	SAFETY 0.250000
CAR 1	0.000000	0.000000				
CAR 2	0.000000	0.000000				
CAR 3	0.000000	0.000000				

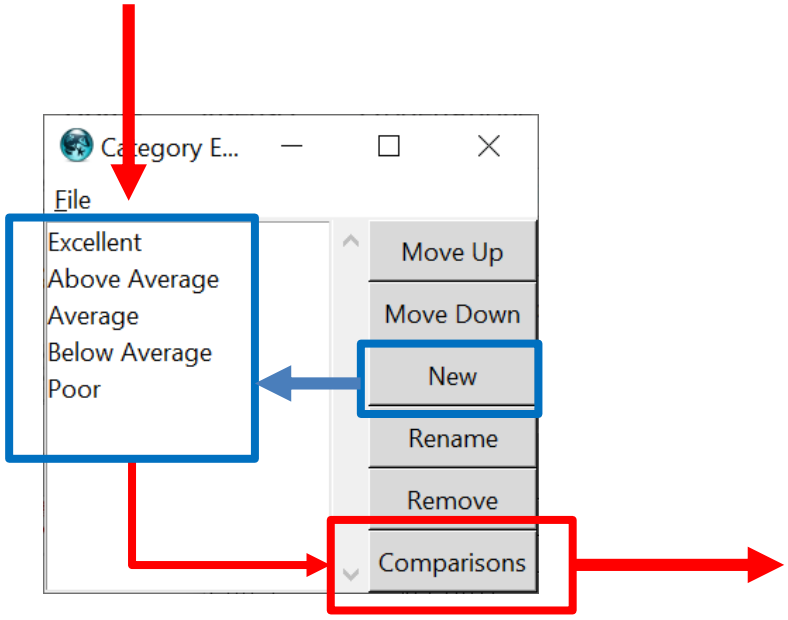
How to build the model?

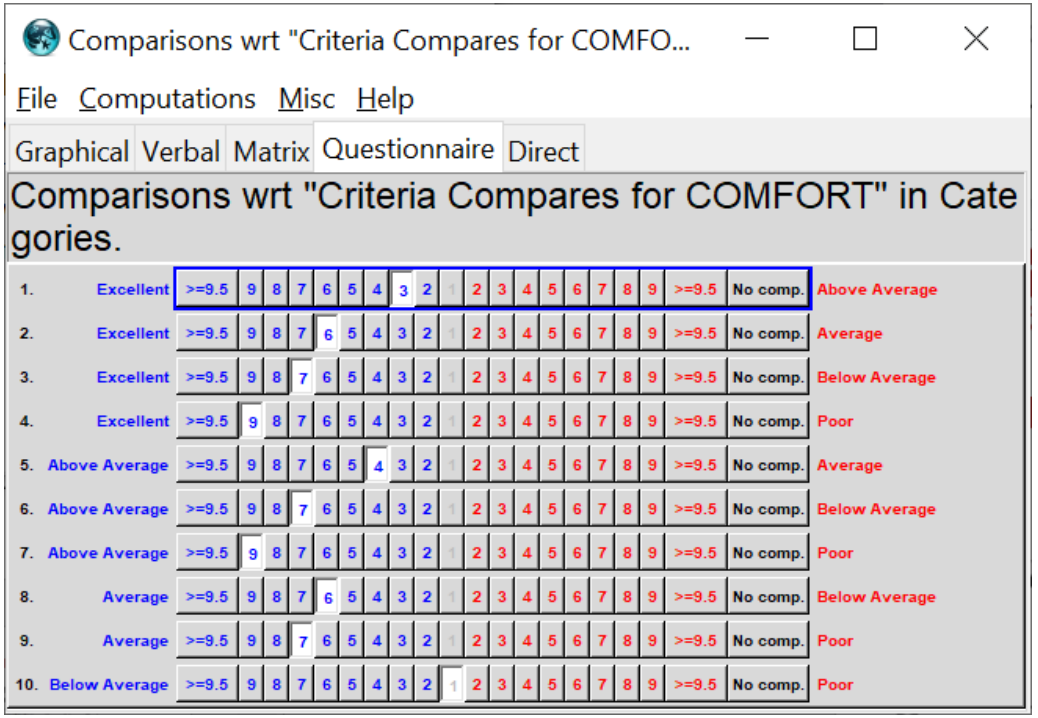
Now you must create a **rating scale** for each criterion.

For this select ***Edit/Criteria/Edit Categories*** and select

Comfort… *Aesthetic*….*Cost*…Safety…and click **OK**.

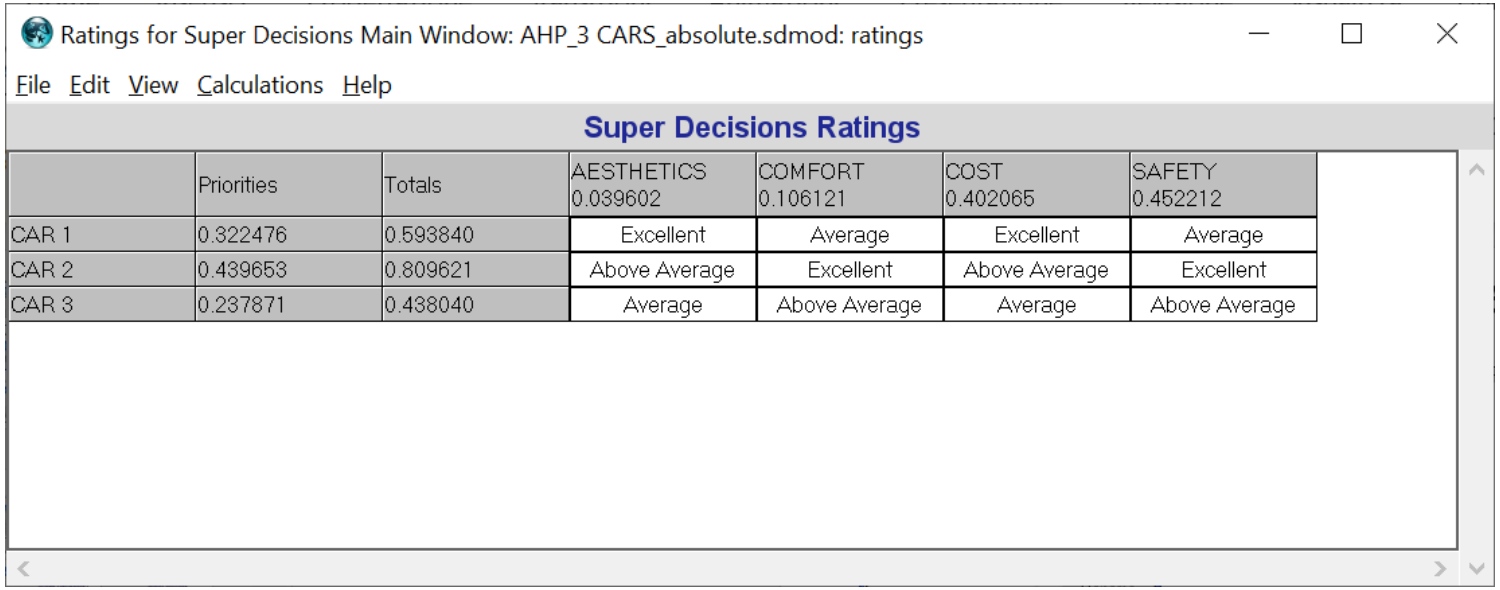
Add the **ratings/comparisons**





How to build the model?

Now you must evaluate alternatives using the ratings model


Ratings for Super Decisions Main Window: AHP_3 CARS_absolute.sdmod: ratings

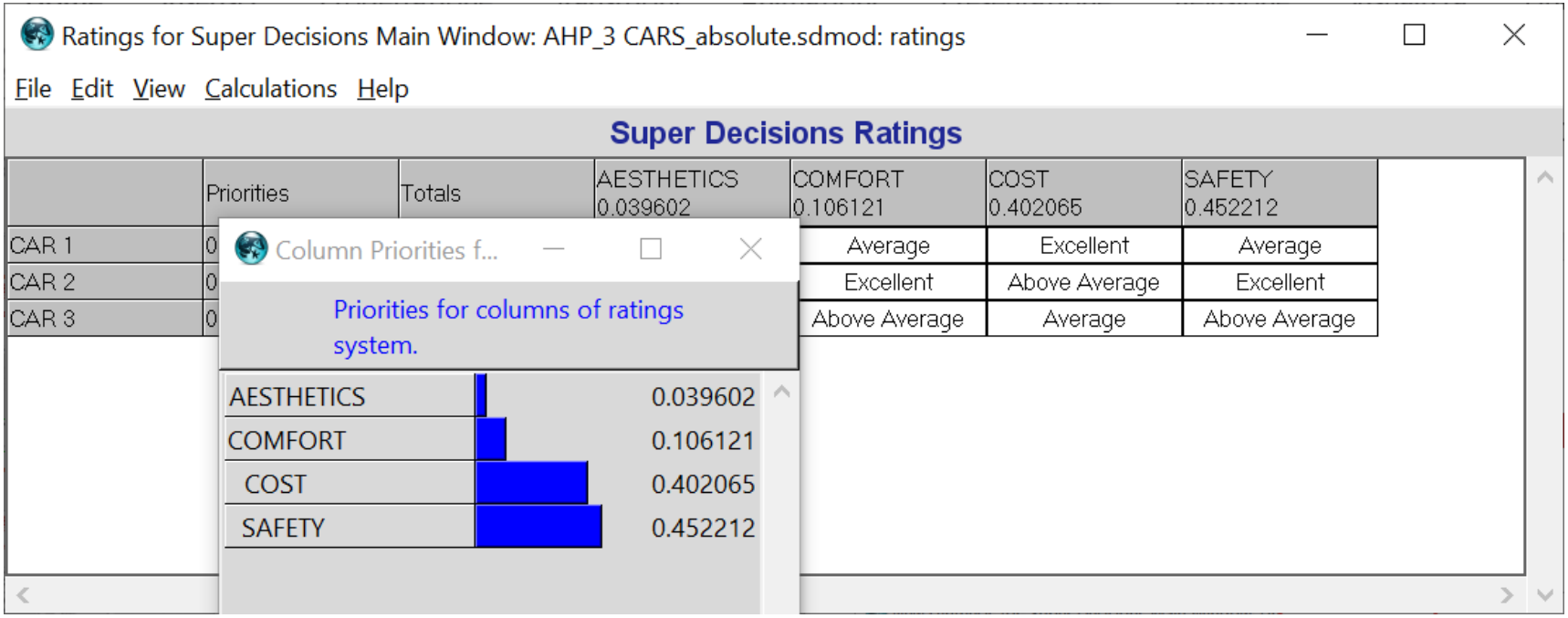
File Edit View Calculations Help

Super Decisions Ratings

	Priorities	Totals	AESTHETICS 0.039602	COMFORT 0.106121	COST 0.402065	SAFETY 0.452212
CAR 1	0.322476	0.593840	Excellent	Average	Excellent	Average
CAR 2	0.439653	0.809621	Above Average	Excellent	Above Average	Excellent
CAR 3	0.237871	0.438040	Average	Above Average	Average	Above Average

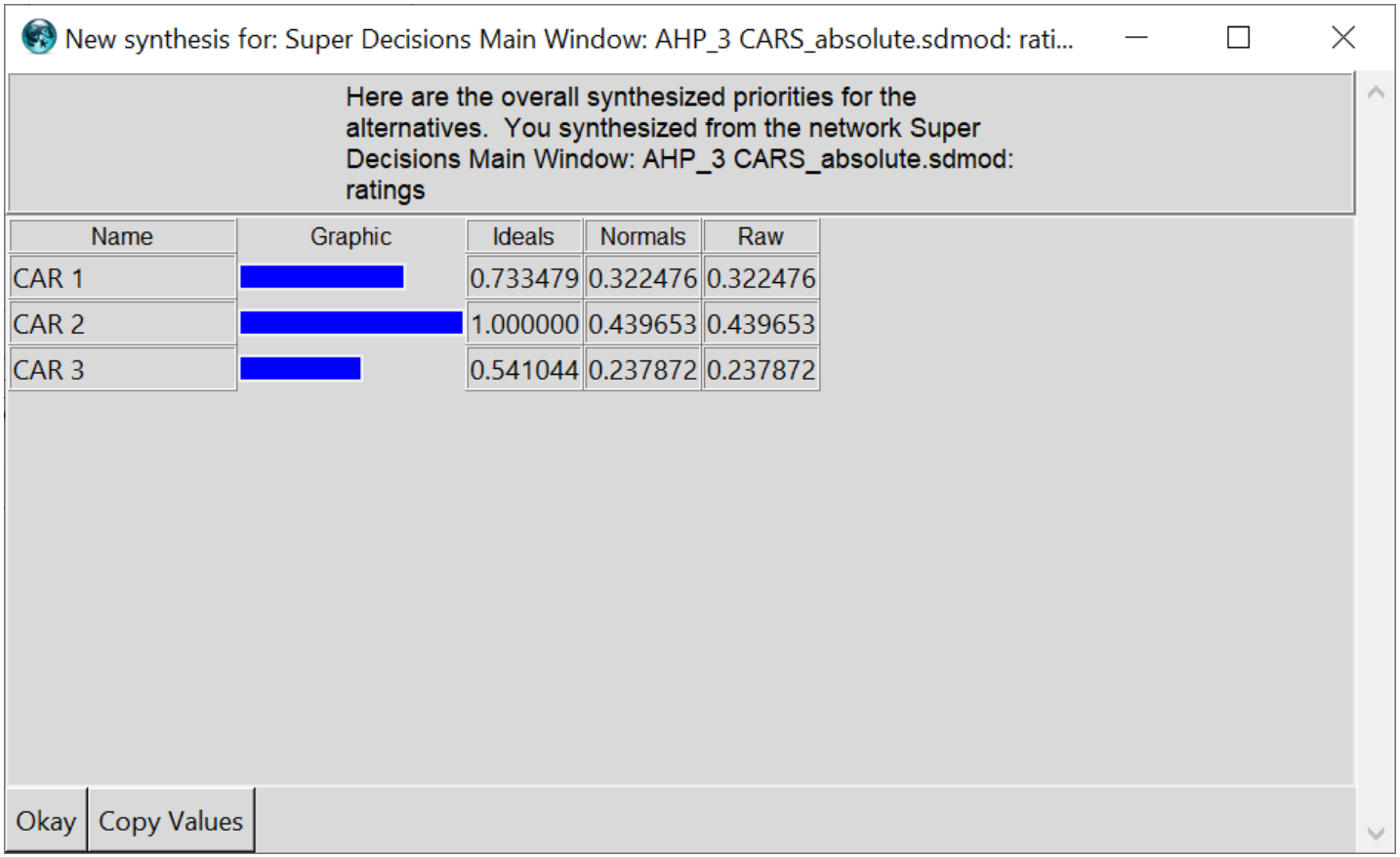
How to build the model?

Rating scale values for comfort.



How to build the model?

Final Results



Name	Graphic	Ideals	Normals	Raw
CAR 1		0.733479	0.322476	0.322476
CAR 2		1.000000	0.439653	0.439653
CAR 3		0.541044	0.237872	0.237872

STRATEGOS
Engineering Technologies for Strategy in Defense, Industry, Government & Homeland Security

Università di Genova
www.strategos.it

Case Study 3

Absolute AHP Model: a case study for employee performance evaluation

Absolute model

Methodological approach

- **Step 1:** Identify the criteria, subcriteria for evaluation and put them into the AHP hierarchy.
- **Step 2:** Build the hierarchy (AHP Model)
- **Step 3:** Calculate the weights of the decision criteria by the relative measurement of AHP, i.e., construct the pairwise comparison matrix
- **Step 4:** Divide each subcriterion into several intensities or grades. Set priorities on the intensities by comparing them pairwise under each subcriterion. Multiply these priorities by the priority of the parent subcriterion.
- **Step 5:** Take one alternative at a time and measure its/his/her performance intensity under each subcriterion.

Absolute model

Problem Statement

The aim of the model is to evaluate employees performances based upon **6 criteria**:

- C1: quantity/quality of the work
- C2: planning/organization
- C3: initiative/commitment
- C4: teamwork/cooperation
- C5: communication
- C6: external factors

Absolute model

Step 1: Criteria and Subcriteria

Quality/Quantity of work (C1)

This criterion includes completion of tasks in a thorough, accurate and timely manner that **achieve expected results**. Subcriteria are:

- Complete tasks (C11)
- Concern for goals (C12)
- Multiple assignments (C13)

Planning/organization (C2)

Planning for usage of organization's limited resources and organizing himself/herself to carry out the activities. Subcriteria are:

- Clear objectives (C21)
- Identify resources (C22)
- Seek guidance (C23)

Absolute model

Step 1: Criteria and Subcriteria

Initiative/commitment (C3)

This criterion evaluates **individual responsibility** when performing duties. Subcriteria are:

- Demonstrated commitment as a responsible person (C31)
- Minimal supervision (C32)
- Meets expectations (C33)

Teamwork/cooperation (C4)

This includes maintaining **harmonious and effective work relationships** with coworkers. Subcriteria are:

- Harmonious work (C41)
- Adapts to changes (C42)
- Share information resources (C43)

Absolute model

Step 1: Criteria and Subcriteria

Communication (C5)

This is concerned about how effectively the employee **conveys information** and ideas both orally and in writing. Subcriteria are:

- Conveys information/idea (C51)
- Conflict resolution (C52)
- Seeks clarification (C53)

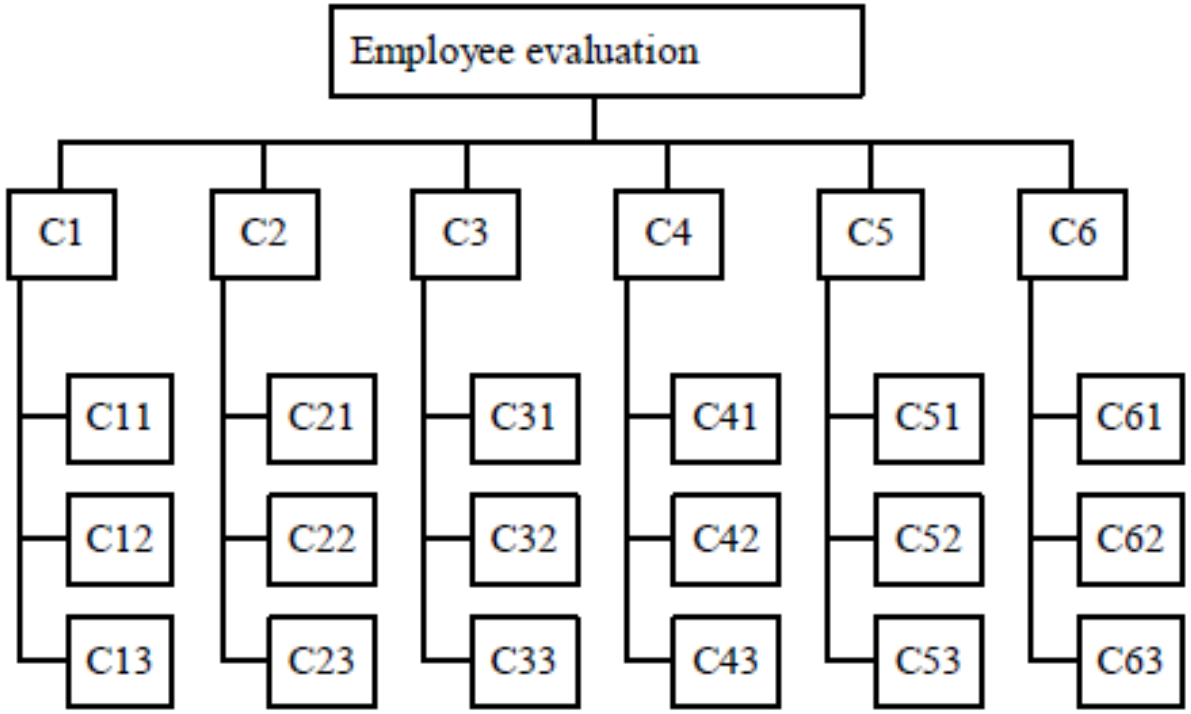
External factors (C6)

This is about the ability to contribute **to greater society** in several ways. Subcriteria are:

- Contribution to society (C61)
- Involvement at the non organizational activities (C62)
- Promotes the company (C63)

Absolute model

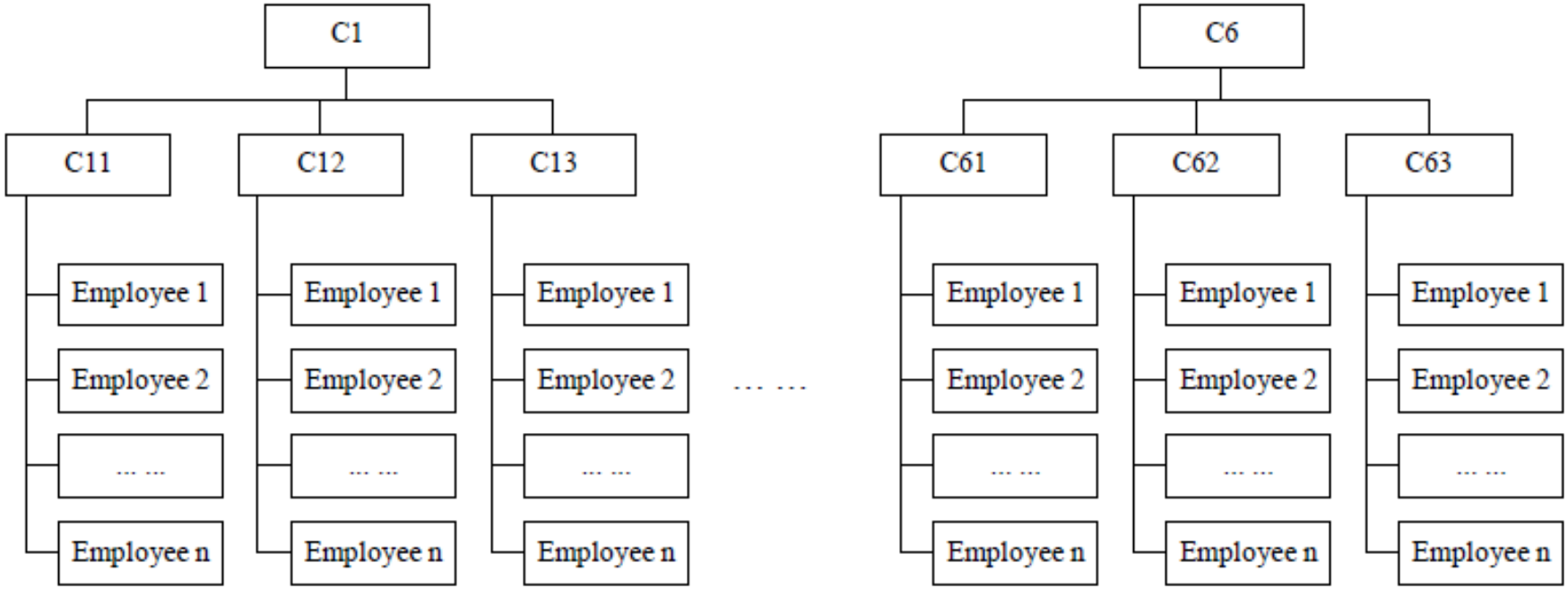
Step 2: Hierarchy (AHP Model)



The Hierarchy of the Criteria and Subcriteria of the Evaluation Process

Absolute model

Step 2: Hierarchy (AHP Model)



The Partial Hierarchy Consisting of the Employees

Absolute model

Step 3: Pairwise comparision for Criteria

	C_1	C_2	C_3	C_4	C_5	C_6	Weights
C_1	1	8	6	7	4	7	0.480
C_2		1	7	6	4	7	0.240
C_3			1	7	5	6	0.135
C_4				1	6	8	0.077
C_5					1	8	0.049
C_6						1	0.019
CR=0.40							

Absolute model

Step 3: Pairwise comparision for Sub Criteria

C_1	C_{11}	C_{12}	C_{13}	Wts.
C_{11}	1	8	9	0.804
C_{12}		1	2	0.122
C_{13}			1	0.074
CR=0.04				

C_2	C_{21}	C_{22}	C_{23}	Wts.
C_{21}	1	4	8	0.699
C_{22}		1	5	0.237
C_{23}			1	0.064
CR=0.09				

C_3	C_{31}	C_{32}	C_{33}	Wts.
C_{31}	1	8	9	0.804
C_{32}		1	2	0.122
C_{33}			1	0.074
CR=0.04				

C_4	C_{41}	C_{42}	C_{43}	Wts.
C_{41}	1	3	8	0.653
C_{42}		1	6	0.285
C_{43}			1	0.062
CR=0.07				

C_5	C_{51}	C_{52}	C_{53}	Wts.
C_{51}	1	8	8	0.796
C_{52}		1	2	0.125
C_{53}			1	0.079
CR=0.05				

C_6	C_{61}	C_{62}	C_{63}	Wts.
C_{61}	1	8	9	0.798
C_{62}		1	3	0.138
C_{63}			1	0.064
CR=0.10				

Absolute model

Step 4: Divide each subcriterion into several intensities

Excellent (E)
Good (G)
Average (A)
Satisfactory (S)
Poor (P)

Absolute model

Step 4: Comparision matrix for Intensities

The pairwise comparison matrix for the intensities namely, excellent (E), good (G), average (A), satisfactory (S), and poor (P) is the following:

	E	G	A	S	P	Weights
E	1	3	5	6	8	0.501
G		1	3	5	6	0.262
A			1	3	5	0.133
S				1	3	0.067
P					1	0.036
CR=0.06						

Absolute model

Step 5: Performance Rating of 25 Employees

25 Employee's name

Empl.	C_1			C_2			C_3			C_4			C_5			C_6		
	C_{11}	C_{12}	C_{13}	C_{21}	C_{22}	C_{23}	C_{31}	C_{32}	C_{33}	C_{41}	C_{42}	C_{43}	C_{51}	C_{52}	C_{53}	C_{61}	C_{62}	C_{63}
AAD	G	S	G	E	A	A	G	S	G	G	S	S	G	P	G	G	S	G
ABA	E	P	G	E	S	A	E	P	G	G	S	S	G	S	G	G	S	G
AGS	E	P	G	G	A	S	E	P	G	G	S	S	G	P	G	G	S	G
BA	G	S	G	G	S	A	G	G	G	G	A	S	A	S	A	A	S	G
BA	E	P	E	G	S	A	E	P	E	E	A	S	A	S	A	A	S	G
BB	E	P	G	A	S	A	E	P	G	G	S	S	A	S	A	A	S	G
BK	E	P	G	A	S	A	E	P	G	G	A	S	A	P	A	A	S	G
CI	G	P	G	E	S	A	G	P	G	G	S	S	G	P	G	G	S	G
CPD	G	P	G	G	S	S	G	P	G	G	A	S	G	P	G	G	S	G
DA	G	S	E	G	S	S	G	S	E	E	S	A	G	S	G	G	S	G
DD	E	P	E	E	S	A	E	P	E	E	A	S	E	S	E	E	S	G
FA	E	P	E	G	S	S	E	P	E	E	A	S	G	S	G	G	A	E
FF	E	P	E	G	A	A	E	P	E	E	A	S	G	P	G	G	S	G
FH	E	S	G	E	A	S	E	S	G	G	A	S	G	P	G	G	S	G
GB	E	S	S	G	A	S	E	S	G	G	S	S	G	S	G	G	S	G
HA	G	S	S	E	A	S	G	S	G	G	A	S	G	S	G	G	S	G
HB	E	S	E	G	A	S	E	S	E	E	A	S	G	S	G	G	S	G
HH	E	S	S	G	A	S	E	S	G	G	S	S	G	S	G	G	S	G
JS	G	P	E	E	S	S	G	P	E	E	A	S	E	P	E	G	S	G
KN	E	P	E	G	S	S	E	P	E	E	A	S	G	P	G	G	S	G
LHA	E	S	G	G	A	A	E	S	G	G	A	S	G	S	G	G	S	G
MAB	G	P	G	E	G	A	G	P	G	G	A	S	G	S	G	G	S	G
MK	E	P	E	G	A	A	E	P	E	E	A	S	G	P	G	G	S	G
NANF	E	P	E	G	S	A	E	P	E	E	A	S	G	S	G	G	S	G
NH	E	S	E	E	A	S	E	S	E	E	S	S	E	S	E	E	S	G

Absolute model

Step 5: Overall Weights and Ranking of the 25 Employees

Priorities

			0,3861	0,0585	0,0354	0,1675	0,0568	0,0154	0,1087	0,0165	0,0100	0,0501	0,0219	0,0048	0,0394	0,0062	0,0039	0,0150	0,0026	0,0012
	TOTALS	PRIORITIES	C11	C12	C13	C21	C22	C23	C31	C32	C33	C41	C42	C43	C51	C52	C53	C61	C62	C63
AAD	0,5408	0,0327	0,5226	0,1347	0,5226	1,0000	0,2661	0,2661	0,5226	0,1347	0,5226	0,5226	0,1347	0,1347	0,5226	0,0724	0,5226	0,5226	0,1347	0,5226
ABA	0,7653	0,0463	1,0000	0,0724	0,5226	1,0000	0,1347	0,2661	1,0000	0,0724	0,5226	0,5226	0,1347	0,1347	0,5226	0,1347	0,5226	0,5226	0,1347	0,5226
AGS	0,6904	0,0417	1,0000	0,0724	0,5226	0,5226	0,2661	0,1347	1,0000	0,0724	0,5226	0,5226	0,1347	0,1347	0,5226	0,0724	0,5226	0,5226	0,1347	0,5226
BA	0,4480	0,0271	0,5226	0,1347	0,5226	0,5226	0,1347	0,2661	0,5226	0,5226	0,5226	0,5226	0,1347	0,1347	0,2661	0,1347	0,2661	0,2661	0,1347	0,5226
BB	0,6274	0,0379	1,0000	0,0724	0,5226	0,2661	0,1347	0,2661	1,0000	0,0724	0,5226	0,5226	0,1347	0,1347	0,2661	0,1347	0,2661	0,2661	0,1347	0,5226
BK	0,6299	0,0381	1,0000	0,0724	0,5226	0,2661	0,1347	0,2661	1,0000	0,0724	0,5226	0,5226	0,2661	0,1347	0,2661	0,0724	0,2661	0,2661	0,1347	0,5226
CI	0,5286	0,0320	0,5226	0,0724	0,5226	1,0000	0,1347	0,2661	0,5226	0,0724	0,5226	0,5226	0,1347	0,1347	0,5226	0,0724	0,5226	0,5226	0,1347	0,5226
CPD	0,4485	0,0272	0,5226	0,0724	0,5226	0,5226	0,1347	0,1347	0,5226	0,0724	0,5226	0,5226	0,2661	0,1347	0,5226	0,0724	0,5226	0,5226	0,1347	0,5226
DA	0,4979	0,0301	0,5226	0,1347	1,0000	0,5226	0,1347	0,1347	0,5226	0,1347	1,0000	1,0000	0,1347	0,2661	0,5226	0,1347	0,5226	0,5226	0,1347	0,5226
DD	0,8416	0,0509	1,0000	0,0724	1,0000	1,0000	0,1347	0,2661	1,0000	0,0724	1,0000	1,0000	0,2661	0,1347	1,0000	0,1347	1,0000	1,0000	0,1347	0,5226
FA	0,7327	0,0443	1,0000	0,0724	1,0000	0,5226	0,1347	0,1347	1,0000	0,0724	1,0000	1,0000	0,2661	0,1347	0,5226	0,1347	0,5226	0,5226	0,2661	1,0000
FF	0,7409	0,0448	1,0000	0,0724	1,0000	0,5226	0,2661	0,2661	1,0000	0,0724	1,0000	1,0000	0,2661	0,1347	0,5226	0,0724	0,5226	0,5226	0,1347	0,5226
FH	0,7835	0,0474	1,0000	0,1347	0,5226	1,0000	0,2661	0,1347	1,0000	0,1347	0,5226	0,5226	0,5226	0,1347	0,5226	0,0724	0,5226	0,5226	0,1347	0,5226
GB	0,6817	0,0412	1,0000	0,1347	0,1347	0,5226	0,2661	0,1347	1,0000	0,1347	0,5226	0,5226	0,1347	0,1347	0,5226	0,1347	0,5226	0,5226	0,1347	0,5226
HA	0,5283	0,0319	0,5226	0,1347	0,1347	1,0000	0,2661	0,1347	0,5226	0,1347	0,5226	0,5226	0,2661	0,1347	0,5226	0,1347	0,5226	0,5226	0,1347	0,5226
HB	0,7439	0,0450	1,0000	0,1347	1,0000	0,5226	0,2661	0,1347	1,0000	0,1347	1,0000	1,0000	0,2661	0,1347	0,5226	0,1347	0,5226	0,5226	0,1347	0,5226
HH	0,6894	0,0417	1,0000	0,2661	0,1347	0,5226	0,2661	0,1347	1,0000	0,1347	0,5226	0,5226	0,1347	0,1347	0,5226	0,1347	0,5226	0,5226	0,1347	0,5226
JS	0,5958	0,0360	0,5226	0,0724	1,0000	1,0000	0,1347	0,1347	0,5226	0,0724	1,0000	1,0000	0,2661	0,1347	1,0000	0,0724	1,0000	0,5226	0,1347	0,5226
KN	0,7314	0,0442	1,0000	0,0724	1,0000	0,5226	0,1347	0,1347	1,0000	0,0724	1,0000	1,0000	0,2661	0,1347	0,5226	0,0724	0,5226	0,5226	0,1347	0,5226
LHA	0,7003	0,0423	1,0000	0,1347	0,5226	0,5226	0,2661	0,2661	1,0000	0,1347	0,5226	0,5226	0,2661	0,1347	0,5226	0,1347	0,5226	0,5226	0,1347	0,5226
MAB	0,5396	0,0335	0,5226	0,0724	0,5226	1,0000	0,5226	0,2661	0,5226	0,0724	0,5226	0,5226	0,2661	0,1347	0,5226	0,1347	0,5226	0,5226	0,1347	0,5226
MK	0,7409	0,0448	1,0000	0,0724	1,0000	0,5226	0,2661	0,2661	1,0000	0,0724	1,0000	1,0000	0,2661	0,1347	0,5226	0,0724	0,5226	0,5226	0,1347	0,5226
NANF	0,7338	0,0444	1,0000	0,0724	1,0000	0,5226	0,1347	0,2661	1,0000	0,0724	1,0000	1,0000	0,2661	0,1347	0,5226	0,1347	0,5226	0,5226	0,1347	0,5226
NH	0,8488	0,0513	1,0000	0,1347	1,0000	1,0000	0,2661	0,1347	1,0000	0,1347	1,0000	1,0000	0,1347	0,1347	1,0000	0,1347	1,0000	1,0000	0,1347	0,5226
AB	0,7188	0,0435	1,0000	0,0724	1,0000	0,5226	0,1347	0,2661	1,0000	0,0724	1,0000	1,0000	0,2661	0,1347	0,2661	0,1347	0,2661	0,2661	0,1347	0,5226

Absolute model

Step 5: Overall Weights and Ranking of the 25 Employees

	PRIORITIES		PRIORITIES
AAD	0,0327	GB	0,0412
ABA	0,0463	HA	0,0319
AGS	0,0417	HB	0,0450
BA	0,0271	HH	0,0417
BB	0,0379	JS	0,0360
BK	0,0381	KN	0,0442
CI	0,0320	LHA	0,0423
CPD	0,0272	MAB	0,0335
DA	0,0301	MK	0,0448
DD	0,0509	NANF	0,0444
FA	0,0443	NH	0,0513
FF	0,0448	AB	0,0435
FH	0,0474		

STRATEGOS
Engineering Technologies for Strategy in Defense, Industry, Government & Homeland Security

Università di Genova
www.strategos.it

Case Study 4

AHP Model: supplier selection

Case Study 4

	Cost	Lead Time	Quality
SUPPLIER 1	100	2 days	GOOD
SUPPLIER 2	80	5 days	GOOD
SUPPLIER 3	120	3 days	EXCELLENT

Conclusion

The Analytic Hierarchy Process (AHP) is the Method of Prioritization

1. AHP captures priorities from paired comparison judgments of the
2. elements of the decision with respect to each of their parent criteria.
3. Paired comparison judgments can be arranged in a matrix.
4. Priorities are derived from the matrix as its principal eigenvector, which defines a ratio scale.
5. Thus, the eigenvector is an intrinsic concept of a correct prioritization process. It also allows for the measurement of inconsistency in judgment.
6. Priorities derived this way satisfy the property of a ratio scale just like pounds and yards do.

Conclusion

WHY IS AHP EASY TO USE?

- It does not take for granted the measurements on scales, but asks that scale values be interpreted according to the objectives of the problem.
- It relies on elaborate hierarchic structures to represent decision problems and is able to handle problems of risk, conflict, and prediction.

Conclusions

WHY THE AHP IS POWERFUL IN CORPORATE PLANNING

1. Breaks down criteria into manage-able components.
2. Leads a group into making a specific decision for consensus or tradeoff.
3. Provides opportunity to examine disagreements and stimulate discussion and opinion.

Scientific & Technical References

- Thomas L. Saaty Fundamentals of Decision Making and Priority Theory With the Analytic Hierarchy Process. Ed. RWS Publications, 2000.
- Enrique Mu, Milagros Pereyra-Rojas, Practical Decision Making: An Introduction to the Analytic Hierarchy Process (AHP) Using Super Decisions V2. Ed. Springer, 2017.
- Fabio De Felice, Thomas L. Saaty and Antonella Petrillo. Applications and Theory of Analytic Hierarchy Process - Decision Making for Strategic Decisions. Ed. InTECH. ISBN: 978-953-51-2561-7
- The SUPERDECISIONS software for decision making with the Analytic Hierarchy Process (AHP) and the Analytic Network Process (ANP).

Teacher References

Antonella PETRILLO
University of Napoli Parthenope
Isola C4, CDN
80143 Napoli (Italy)
antonella.petrillo@uniparthenope.it