Millennium Ecosystem Assessment

Bridging Scales and Epistemologies:
Linking Local Knowledge and Global Science
in Multi-Scale Assessments

Alexandria, Egypt
17th-20th March, 2003

The issue of Quality Assurance in Multi-criteria Analysis of sustainability: An overview of challenges

General Introduction to the topics dealt with in Panel 1 – Session 10.4

Description of Panel 1 – Session 10.4

1. Joint presentation by Giuseppe Munda, Mario Giampietro, Serafin Corral-Quintana: "Quality Assurance in Multi-Criteria Analyses of Sustainability"
An overview of the mix of technical and epistomological challenges entailed by Multi-Scale, Multi-Dimensional Analysis of Sustainability

2. Giuseppe Munda: Social-Multicriteria Evaluation (SMCE): Methodological Foundations and Operational Consequences

3. Mario Giampietro: Multi-Scale Integrated Analysis of Sustainability: A methodological tool to improve the quality of narratives

4. Serafin Corral-Quintana: Quality Assurance in Science for Governance: The case of the OGMIT Project

Objective of the talk is the making of the following points:

1. The issues of sustainability and governance pose new challenges to science
   1. **Technical incommensurability**
   2. **Social Incommensurability**
   3. **A large dose of uncertainty and genuine ignorance**

2. The predicament of Science for Governance
   1. **How to determine the quality of the problem structuring on the descriptive side (Multi-Scale Integrated Analysis - MSIA);**
   2. **How to determine the quality of the problem structuring on the normative side (Social Multi-Criteria Evaluation - SMCE);**

3. Quality Assurance requires a self-organizing process
   1. **The predicament associated with Post-Normal Science entails keeping separated descriptive from normative analysis**
   2. **Quality Assurance requires a continuous iteration between MSIA ←→SMCE**

PART 1.

The issues of sustainability and governance pose new challenges to science

Overview of useful concepts

Concepts (1)

Life is the interaction of Non-equivalent Observers

The ultimate wisdom of agro-ecology: the recycling of night-soil. Nutrients are going from plants to humans and back to plants . . .

Chinese ethnic fashion
by Qi Chunying

International fashion week
Beijing

Farmers' vision of the future for their daughters

Concepts (2)

The crisis of reductionism when dealing with evolution: Legitimate but contrasting policy suggestions

International Conference on World Food Security
SAGUF -Zurich, October 9 - 10, 1996

EXPERTS'SUGGESTIONS FOR IMPROVING THE SITUATION

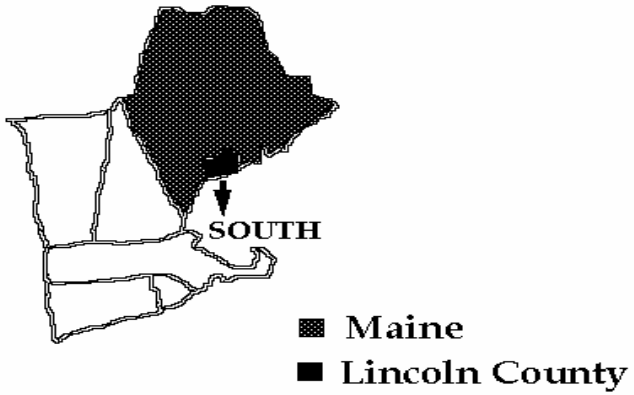
National Policy	
Keep prices of food commodities LOW	**I.F.P.R.I. - U.S. scientist**
Keep prices of food commodities HIGH	**Ag. Econ. - Prof. from Pakistan**
International Policy	
REDUCING imports from the South	**Wuppertal Inst. - German scientist**
INCREASING imports from the South	**Ag. Dev. - Prof. from Ghana**
Social Policy	
PRESERVING local cultural heritage	**NGO - Swiss Feminist**
FIGHTING local cultural heritage	**Sociologist - Prof. from India**

Concepts (3)

The epistemological “Achilles heel”: Bifurcations - logically independent definitions of system’s qualities

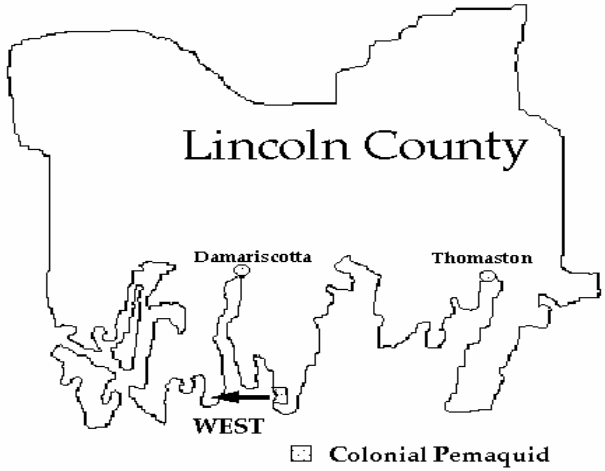
Hierarchical Levels:

Federation (whole country)/State



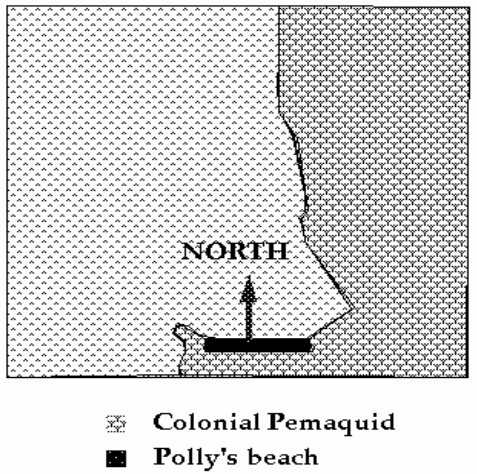
Hierarchical Levels:

State/County



Hierarchical Levels:

County/Village



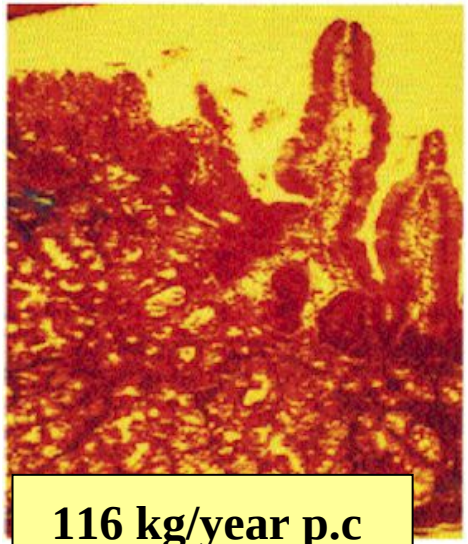
Hierarchical Levels:

Village/specific beach

Concepts (4)

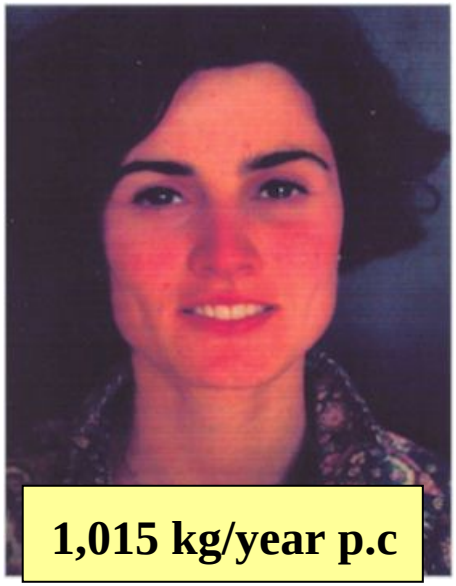
Non-reducibility of models due to non-equivalent descriptive domains: Technical incommensurability

Non-Equivalent descriptive domains = Non-reducible Models



116 kg/year p.c

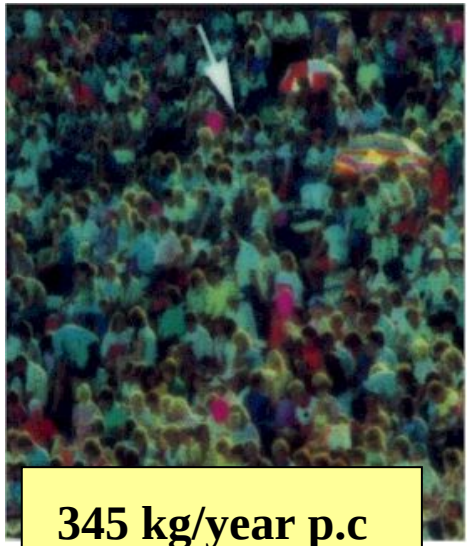
Different scale



1,015 kg/year p.c

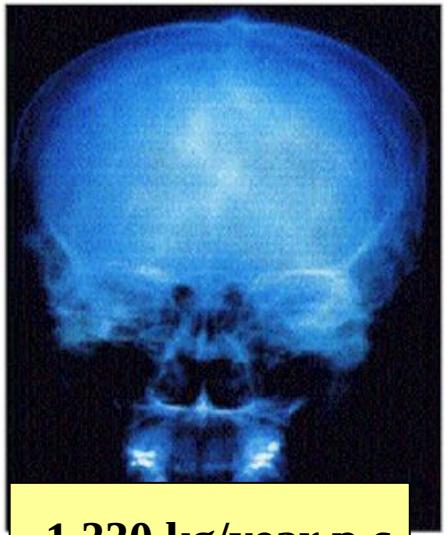
Assessment

U.S.grain consumption per capita per year



345 kg/year p.c

Different criteria of observation and scales



1,330 kg/year p.c

Concepts (5)

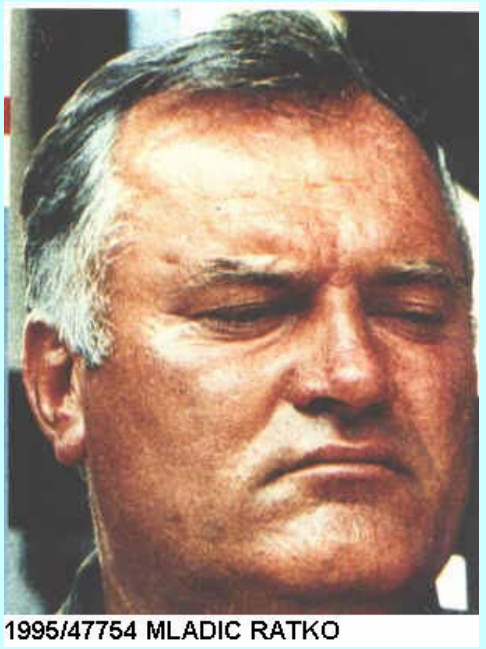
Non comparability due to heterogeneity of values: Social incommensurability

Wanted by Interpol

www.interpol.int/public/Wanted/notices/Data/1995/54/1995_47754.asp

1995

MLADIC, Ratko



1995/47754 MLADIC RATKO

Present family name: **MLADIC**
Forename: **RATKO**
Sex: MALE
Date of birth: 12 March 1943 (59 years old)
Place of birth: BOZINOVICI, Bosnia and Herzegovina
Language spoken: SERBO CROAT
Nationality: FORMER YUGOSLAVIA

Physical description

Height: 1.70 meter <-> 67 inches
Colour of eyes: BLUE
Distinguishing marks and characteristics: STOCKY BUILD, HIGHLY COLOURED COMPLEXION

Person may be dangerous.

Offences: ASSAULT , CRIMES AGAINST HUMANITY , CRIMES AGAINST LIFE AND HEALTH , GRAVE BREACHES OF THE 1949 GENEVA CONVENTIONS , MURDER , PLUNDER VIOLATIONS OF THE LAWS OR CUSTOMS OF WAR

Arrest Warrant Issued by: / INTL COURT THE HAGUE

Ratko MLADIC: a dangerous criminal in the Interpol web-site

Ratko MLADIC: a freedom-fighter in a calendar of a Serbian bakery

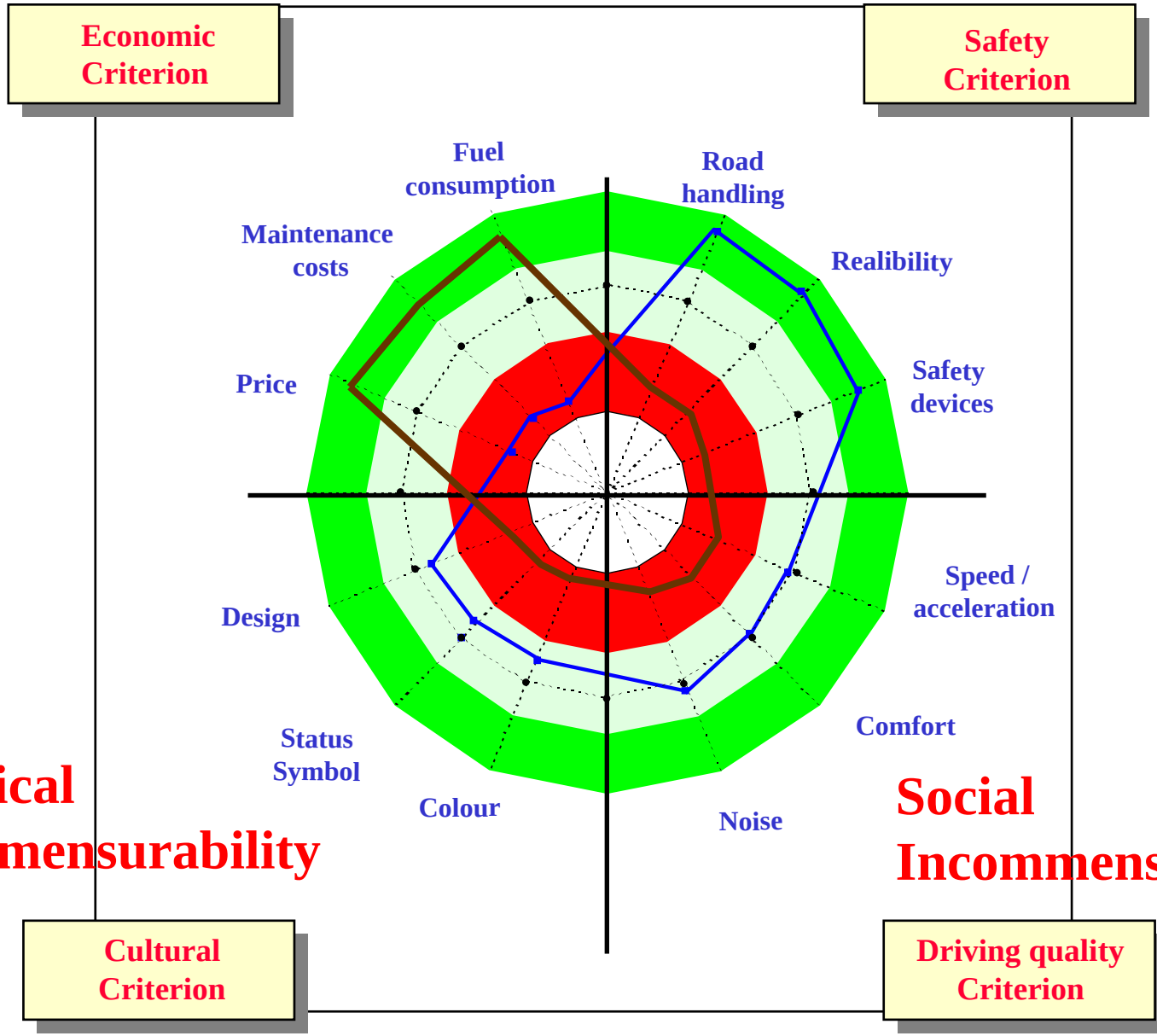
PART 2.

The predicament of Science for Governance: Theoretical and practical problems associated to Participatory Multi-Criteria Analysis

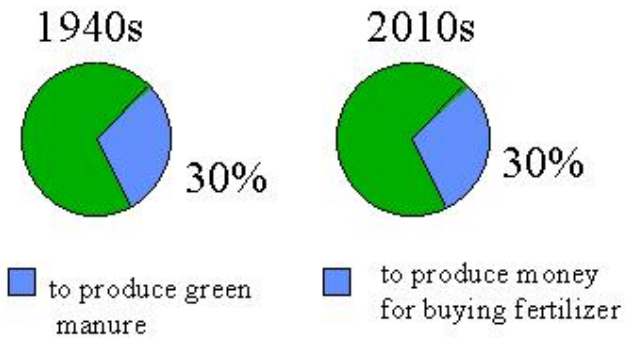
Concepts (1)

The challenge of Multi-Criteria Analysis: dealing with non reducible indicators and non comparable values

Multi-Criteria Analysis, when buying a car . . .

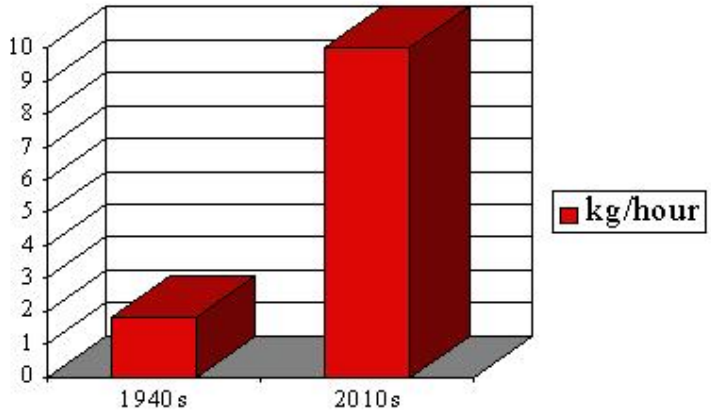


Different indicators that can be used to characterize historical trends in rice farming in China

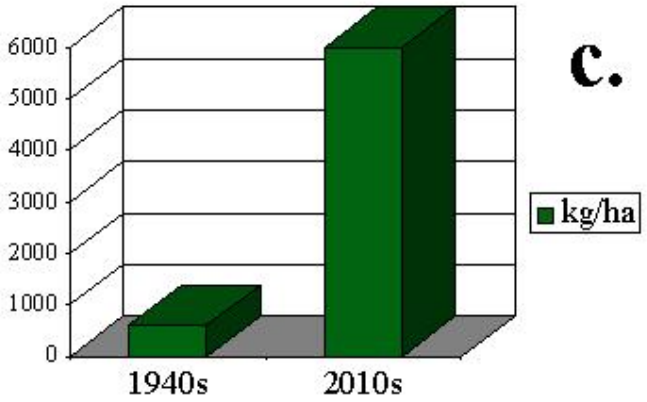


Profile of land allocation

a.



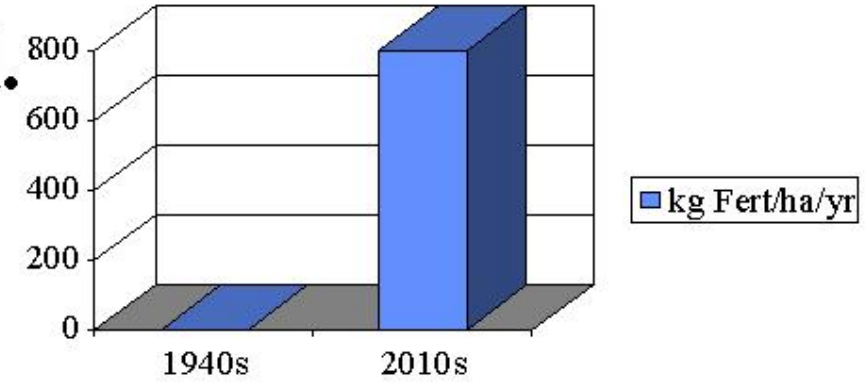
b. **Labor Productivity**



c.

Cropland productivity

d.



Environmental Loading

Concepts (2)

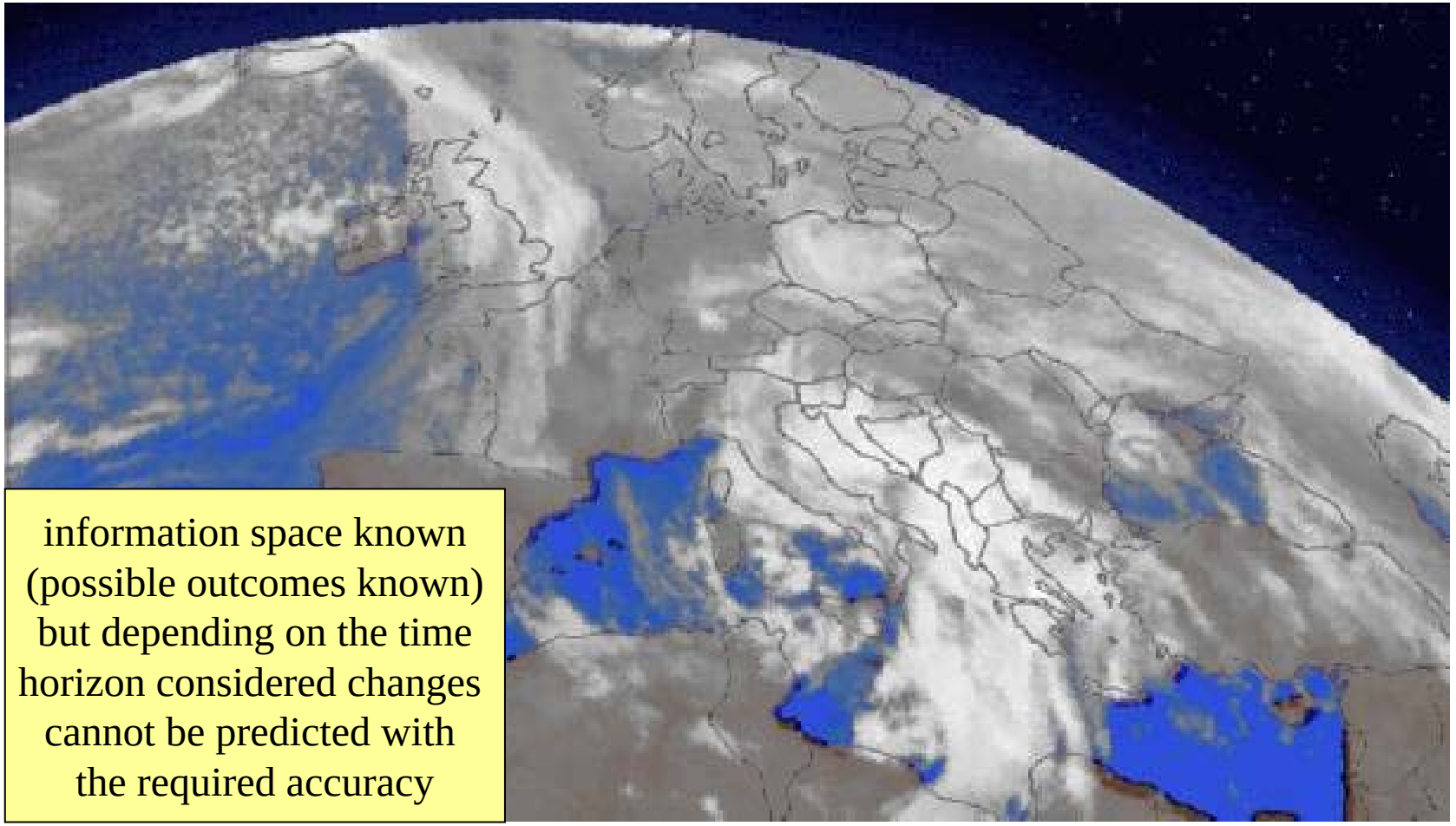
The challenge of Multi-Criteria Analysis: dealing with non reducible uncertainty

Purple Down desert, Australia

Guessing eclipses = Predictive power very high

information space known
associative context given
nothing changes in time

Prediction using probabilities = Conventional risk assessment



information space known (possible outcomes known) but depending on the time horizon considered changes cannot be predicted with the required accuracy

Nobody can predict the weather in Rome in 60 days . . .

Predictions facing indeterminacy = “the butterfly effect”

Alice wondering about the “DRINK-ME”bottle

IGNORANCE

It is not about being unable of guesstimating probabilities

Rather, it is about ignoring the relevant attributes that will matter for us in the future

IGNORANCE means not having the slightest idea of possible outcomes . . .

IGNORANCE MAY IMPLY TRAGIC CONSEQUENCES

Marie Curie born in 1867

She paved the way for nuclear physics and cancer therapy . . .

Nobel Prize in Physics in 1903

Nobel Prize in Chemistry 1911

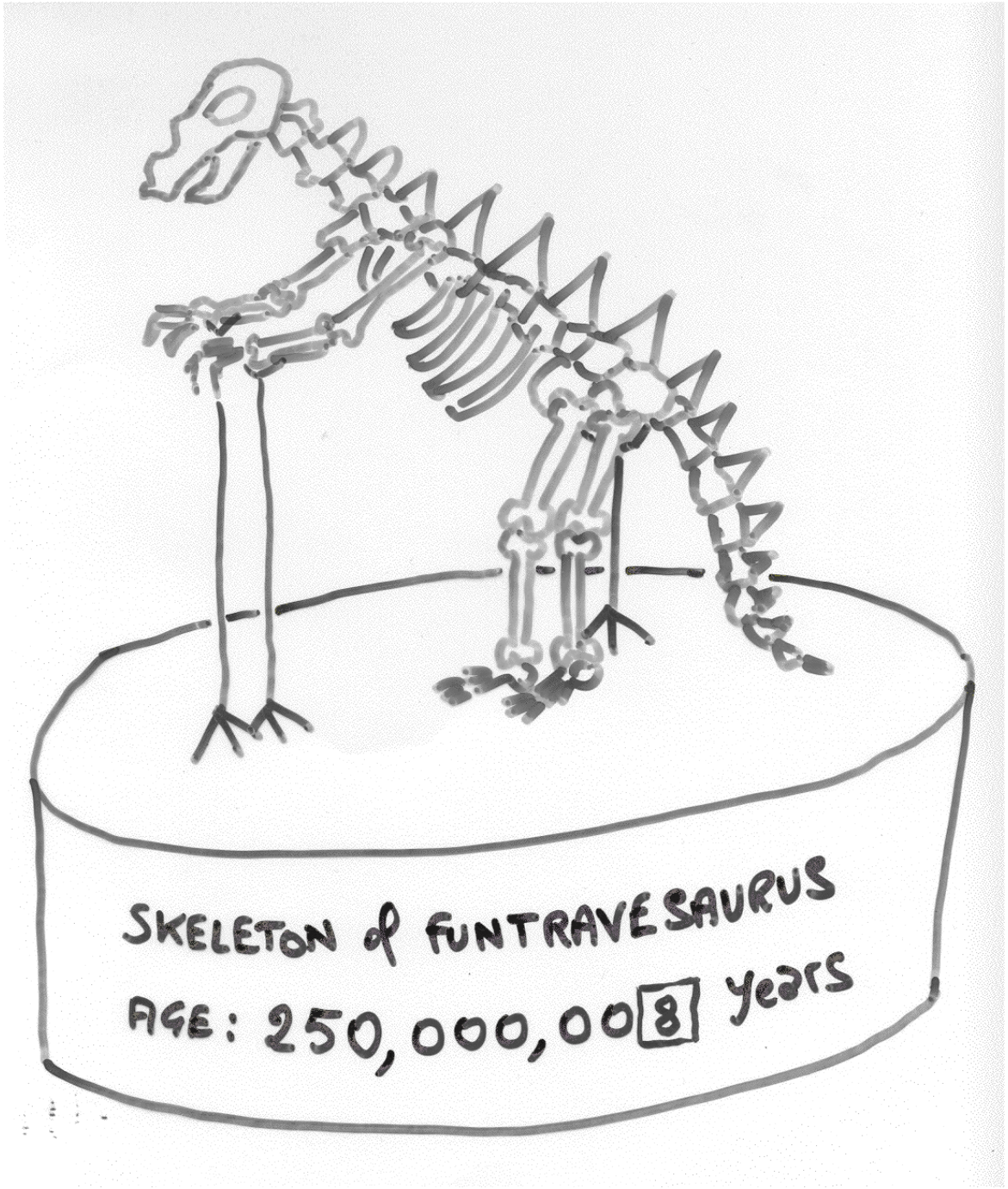
Died of leukaemia in 1934 ‘exhausted and almost blinded, her fingers burnt and stigmatised by “her” dear radium’ The same happened to her husband and her daughter . . .

FROM* A Nobel Prize pioneer at the Pantheon - *Florence Raynal

Concepts (3)

The challenge of Multi-Criteria Analysis: the limited power of formalization. As proved by Gödel, mathematics requires always a semantic check

"The proposition [1 + 1 = 2] is occasionally useful"
A.N. Whitehead and B. Russel - in Principia Mathematica



It is not sure that it is always possible to perform the sum
A + B = C

Recording the changes occurring to the population of a city after a wedding of two people (one of whom pregnant . . .)

Using the variable “number of households”

$1 + 1 = 1$

Using the variable “number of people”

$1 + 1 = 3$

Concepts (4)

The challenge of Multi-Criteria Analysis: The algorithmic approach for handling MCA is bound to fail

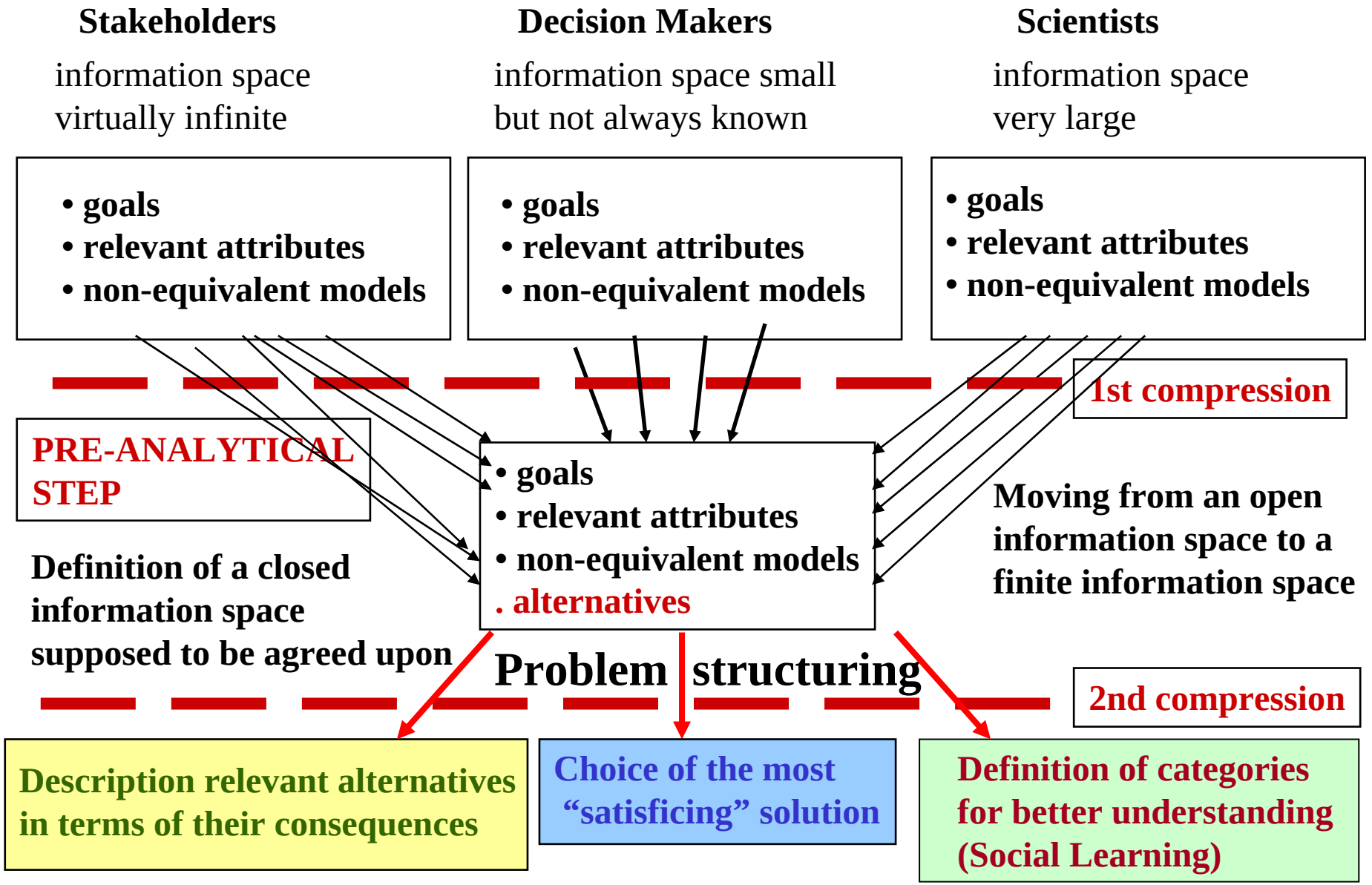
Integrated Assessment - the formalist perspective

Closing the information space into a formal problem structuring

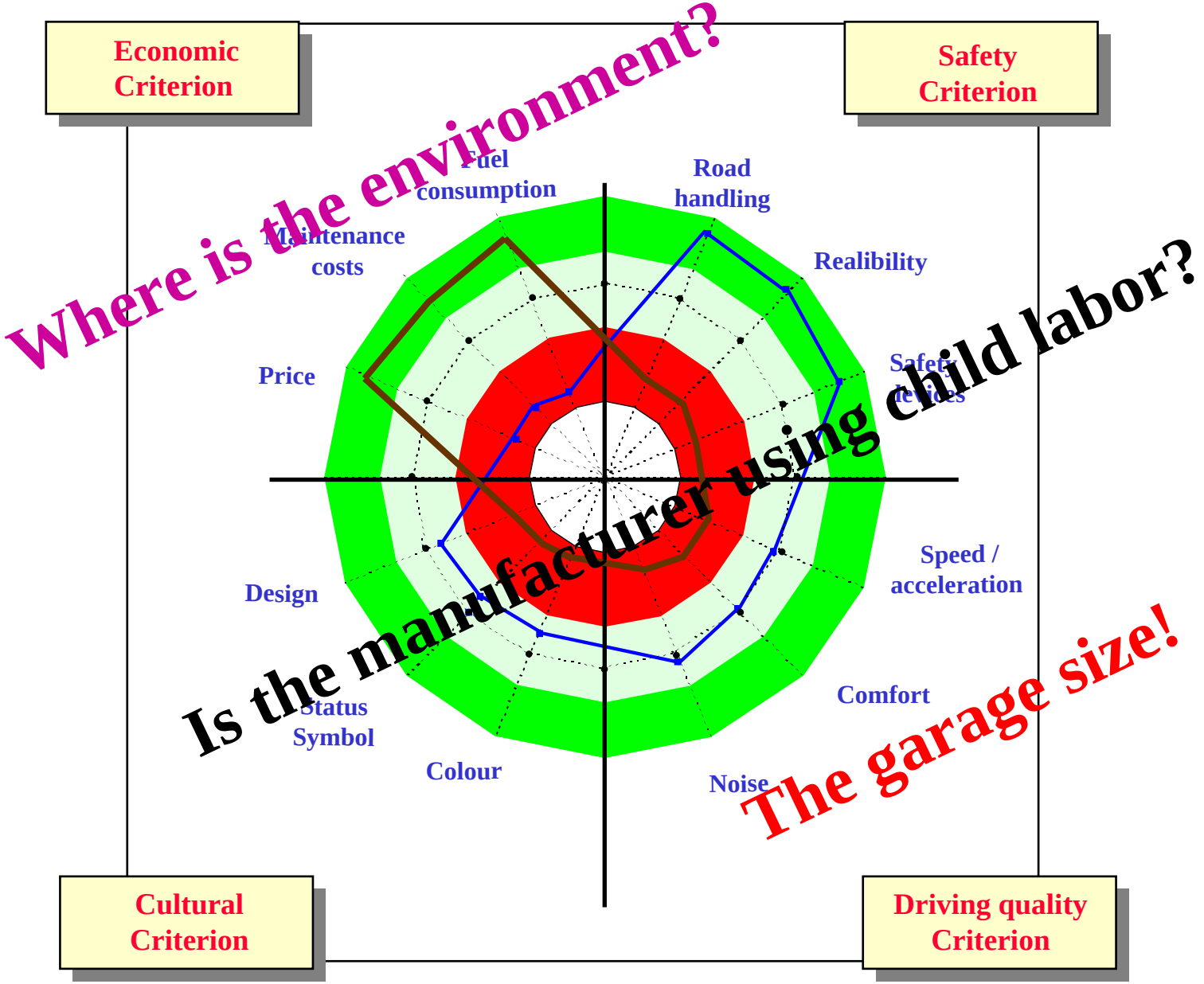
(computers can handle it . . .)

Criteria	Units	Alternatives: FORD Mondeo	HONDA Civic	VW Golf	NISSAN Micra
Fuel Consumption	US$	$a_{1\,1}$	$a_{1\,2}$	. . .	$a_{1\,4}$
Maintenance cost	US$	. . .	. . .	. . .	. . .
Price	US$			$a_{3\,3}$	
Road Handling	Index				
Reliability	Index	. . .	$a_{5\,2}$	. . .	. . .
Safety devices	Index				
Power	HP	$a_{7\,1}$			
Comfort	Index	. . .	. . .	. . .	. . .
Noise	db			$a_{9\,3}$	
Design	Index		$a_{10\,3}$		
Status Symbol	Index	. . .	. . .	. . .	. . .
Colour	Index	$a_{12\,1}$			$a_{12\,4}$

“Problem Structuring” as a “heroic” compression of the information space



Looking for the optimal set of criteria . . .



The “Copernican revolution” in the use of quantitative analyses in MCA: Using numbers to find useful narratives rather than optimal solutions

Multi-Criteria Impact Matrix of the performance of a car in relation to a given set of alternatives

Criteria	Units	Alternatives: FORD Mondeo	HONDA Civic	VW Golf	NISSAN Micra
Fuel Consumption	US$	$a_{1\,1}$	$a_{1\,2}$	. . .	$a_{1\,4}$
Maintenance cost	US$	. . .	. . .	. . .	. . .
Price	US$			$a_{3\,3}$	
Road Handling	Index				
Reliability	Index	. . .	$a_{5\,2}$	. . .	. . .
Safety devices	Index				
Power	HP	$a_{7\,1}$			
Comfort	Index	. . .	. . .	. . .	. . .
Noise	db			$a_{9\,3}$	
Design	Index		$a_{10\,3}$		
Status Symbol	Index	. . .	. . .	. . .	. . .
Colour	Index	$a_{12\,1}$			$a_{12\,4}$

“Multi-Criteria Evaluation” versus “Integrated Analysis”

Additional elements: Power relations, Conflict analysis, Institutional analysis

STAKEHOLDERS \ OPTIONS →	Ford Mondeo	VW Golf	Honda Civic	Nissan Micra	
Sandra (my wife)	Yes +	No	Yes/No	Yes ++	**Veto Power !!!**
Mario (me)	Yes +	Yes/No	No	Yes/No	**Relevant**
Olga (older daughter)	No	Yes/No	Yes ++	Yes ++	**Relevant only in fine tuning**
Sofia (younger daughter)	**It must be red**	**It must be red**	**It must be red**	**It must be red**	**Ignored, but what if...**

PART 3

Quality Assurance requires a Self-organizing process (social learning)

Integrated Analysis - definition # 1 (semantic)

Simultaneous appraisal of relevant qualities of the system under investigation in relation to a given goal.

==> individuation of the set of relevant issues which have to be considered in the problem structuring in relation to a shared perception of the reality

Integrated Analysis - definition # 2 (formal)

Studying non-equivalent typologies of relevant indicators
and constraints in relation to a pre-defined set of relevant goals.

e.g. technical feasibility, compatibility with cultural values,
economic viability, ecological compatibility, social acceptability.

This entails:
(1) understanding the mechanisms generating the relevant features and patterns by using in parallel non-reducible models;
(2) describing the effects of changes by using in parallel various indicators;
(3) gathering the relative data in an adequate time;

This activity requires a continuous quality check!

An epistemological analysis of the challenge implied by Multi-Criteria Analysis suggests the need of keeping separated:

*** descriptive tools --> discussion support**

MSIA = Multi-Scale Integrated Analysis

*** normative tools --> decision support**

SMCE = Societal Multi-Criteria Evaluation

Iterative process mixing quantitative and qualitative analyses resonating between MSIA ←→ SMCE for Quality Assurance