

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 epistemological 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 \leftrightarrow 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

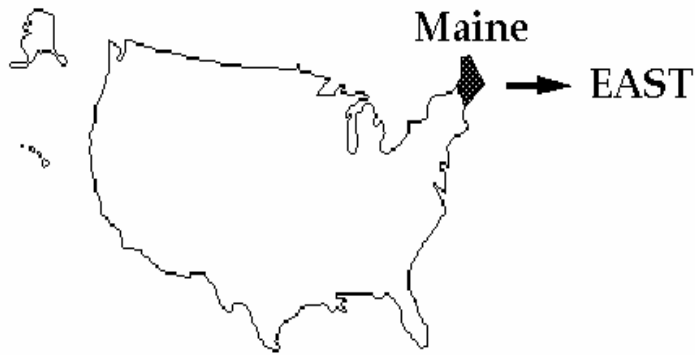
NGO - Swiss Feminist

FIGHTING local cultural heritage

Sociologist - Prof. from India

Concepts (3)

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



Hierarchical Levels:

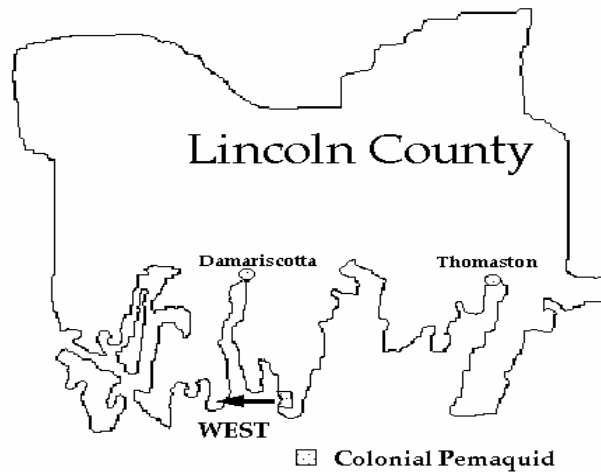
Federation (whole country)/State



■ Maine
 ■ Lincoln County

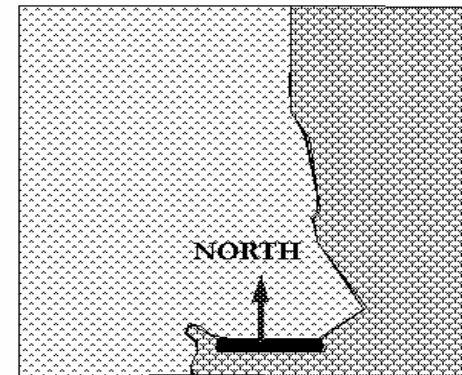
Hierarchical Levels:

State/County



Hierarchical Levels:

County/Village



■ Colonial Pemaquid
 ■ Polly's beach

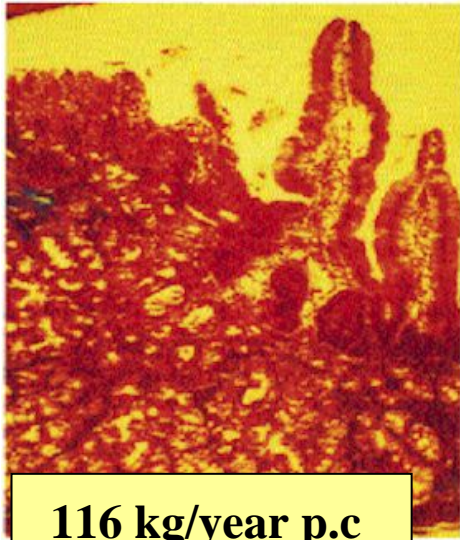
Hierarchical Levels:

Village/specific beach

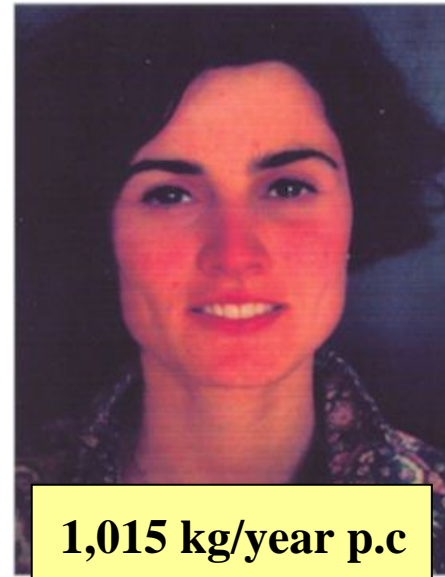
Concepts (4)

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

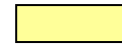
Non-Equivalent descriptive domains = Non-reducible Models



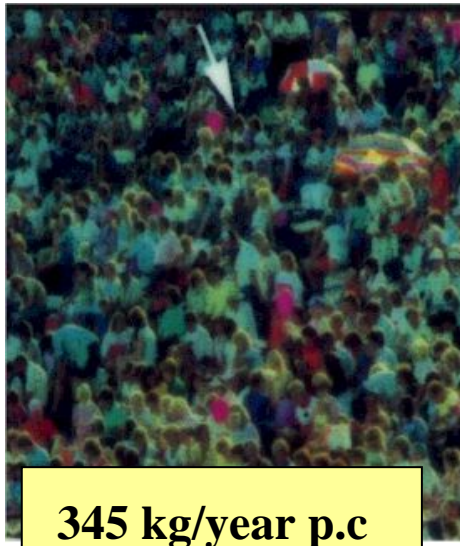
Different scale



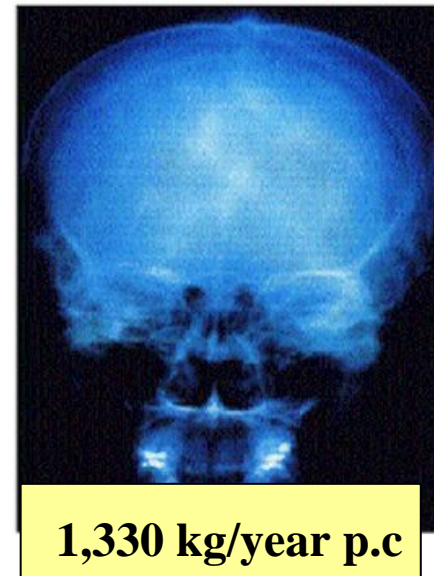
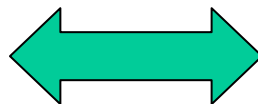
Assessment



U.S. grain consumption per capita per year



Different criteria of observation and scales



Concepts (5)

**Non comparability due to
heterogeneity of values:
Social incommensurability**



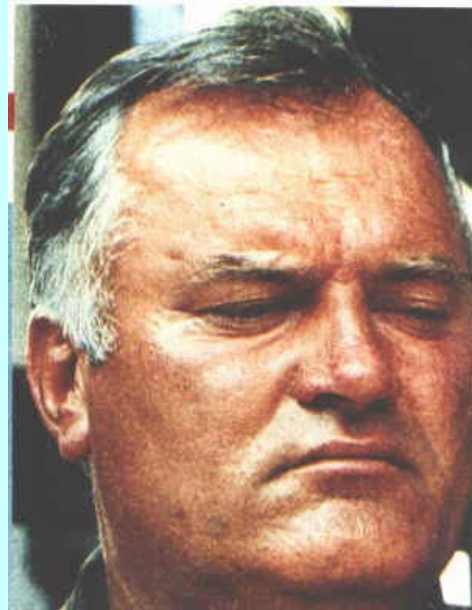
Wanted by Interpol

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

1995

MLADIC, Ratko

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**



1995/47754 MLADIC RATKO



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

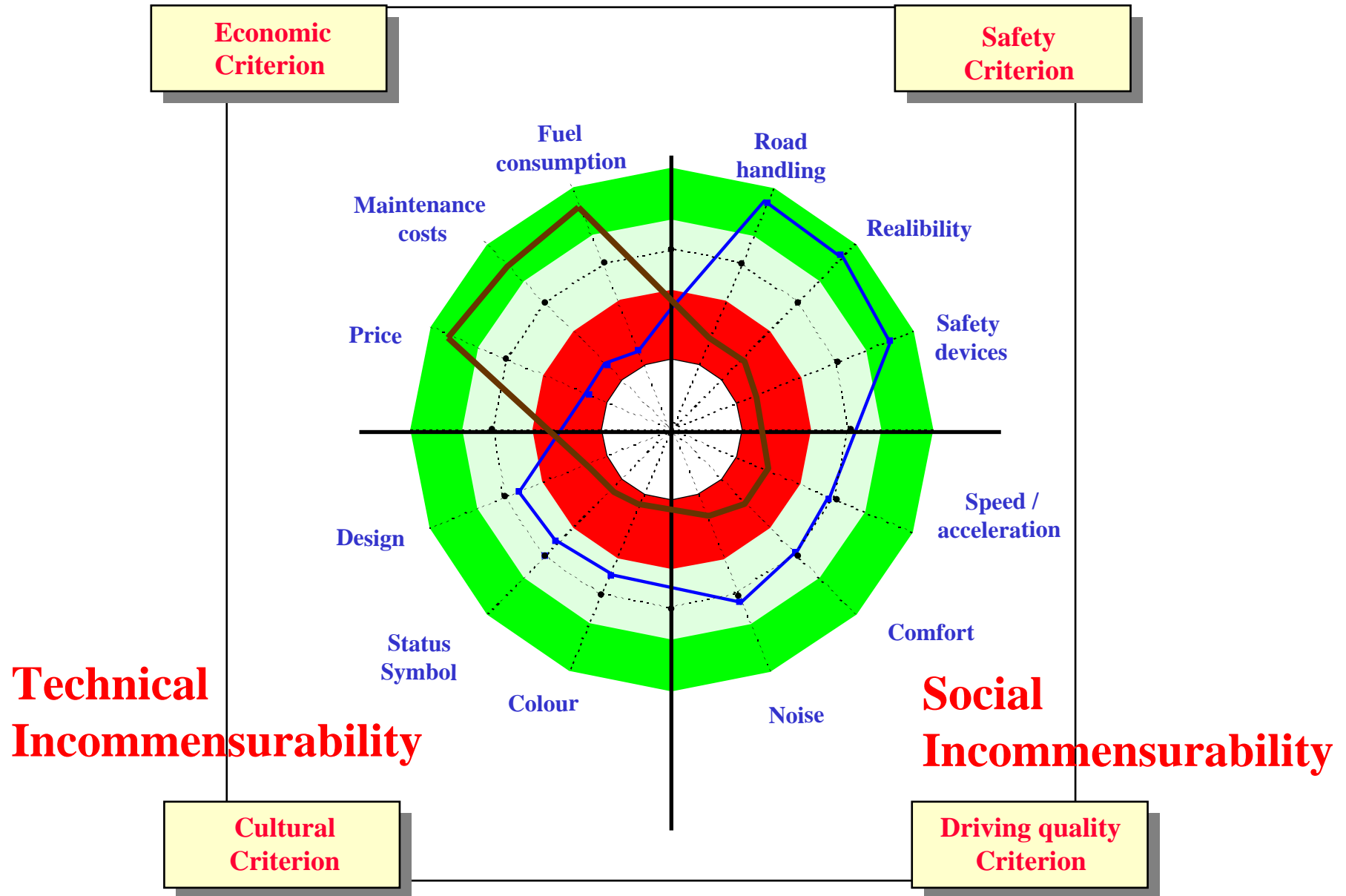
PART 2.

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

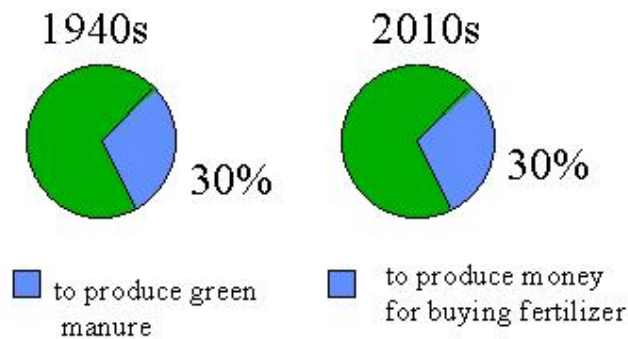
Concepts (1)

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

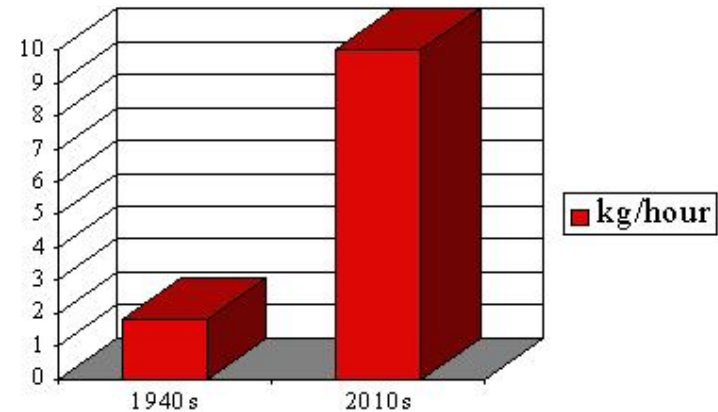
Multi-Criteria Analysis, when buying a car . . .



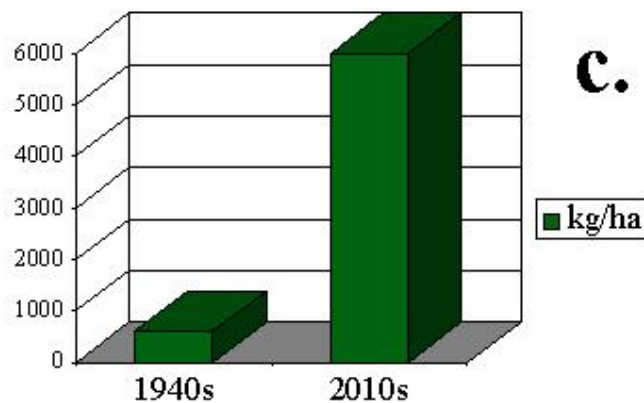
Different indicators that can be used to characterize historical trends in rice farming in China



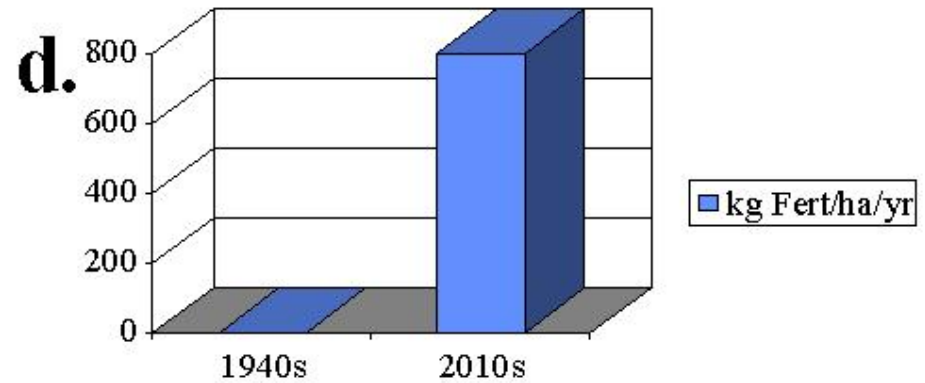
a. Profile of land allocation



b. Labor Productivity



c. Cropland productivity



d. Environmental Loading

Concepts (2)

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



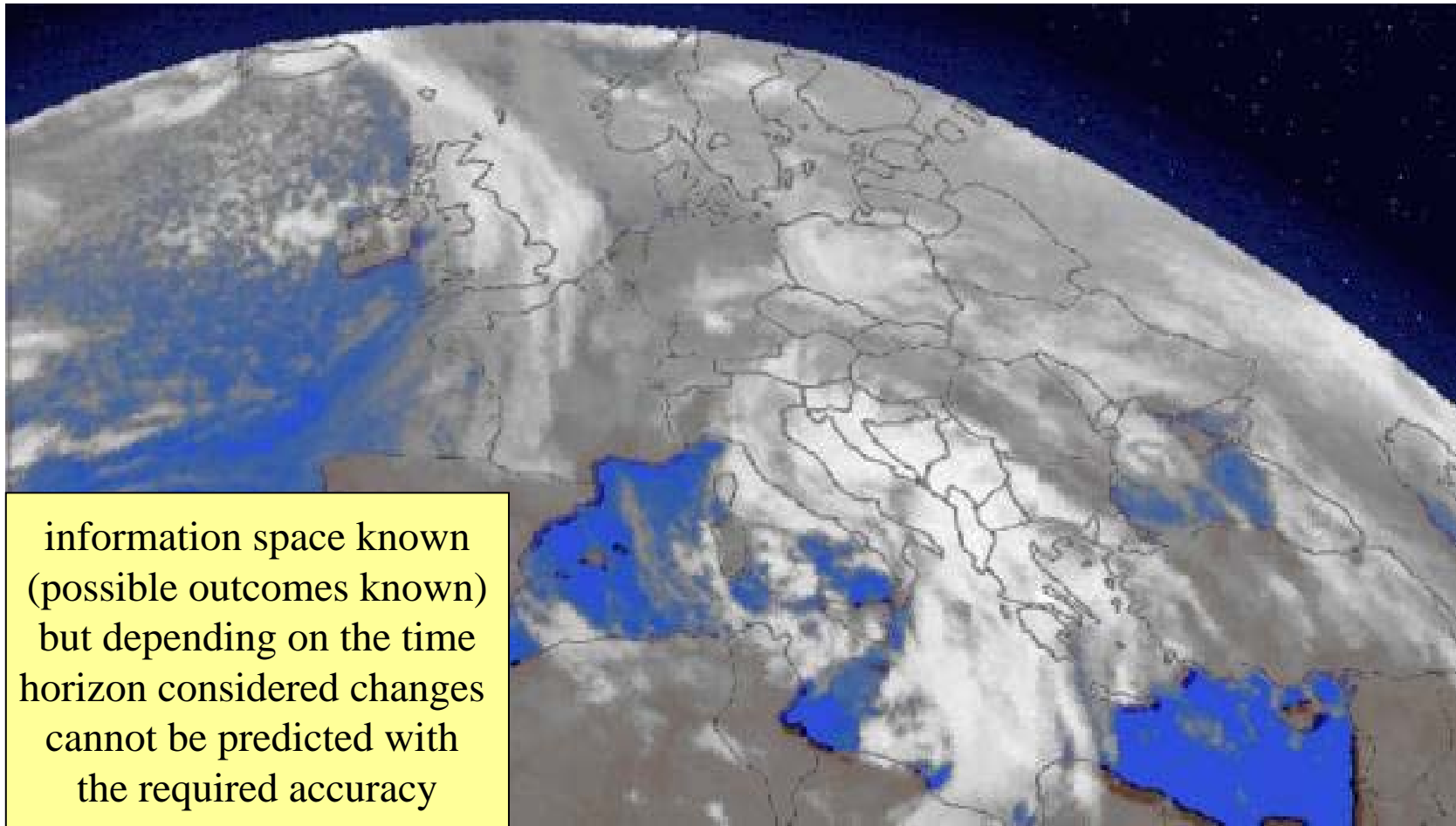
Purple Down desert, Australia

Guessing eclipses = Predictive power very high



information space known
associative context given
nothing changes in time

Prediction using probabilities = Conventional risk assessment



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

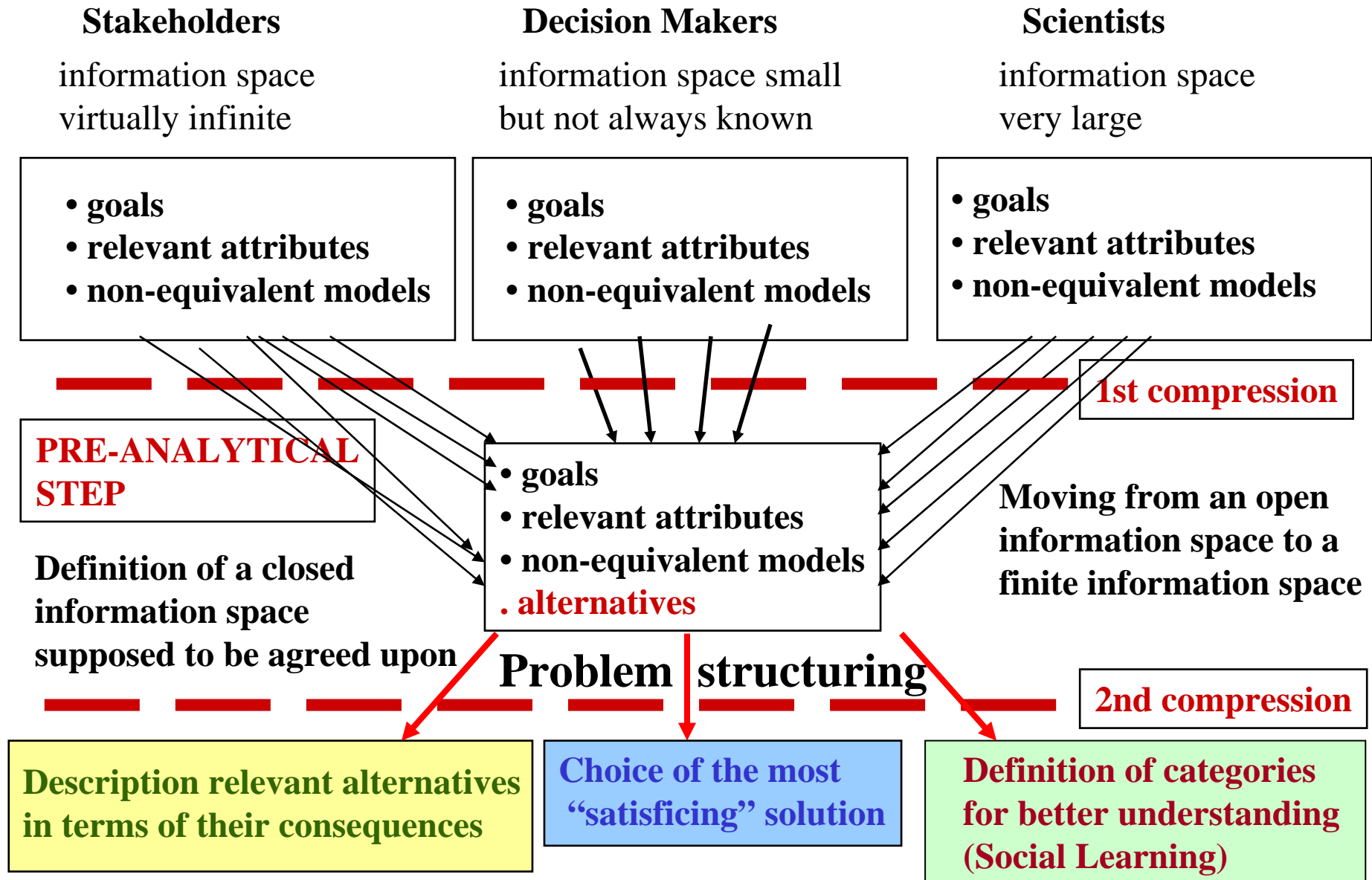
Closing the information space into a formal problem structuring

(computers can handle it ...)

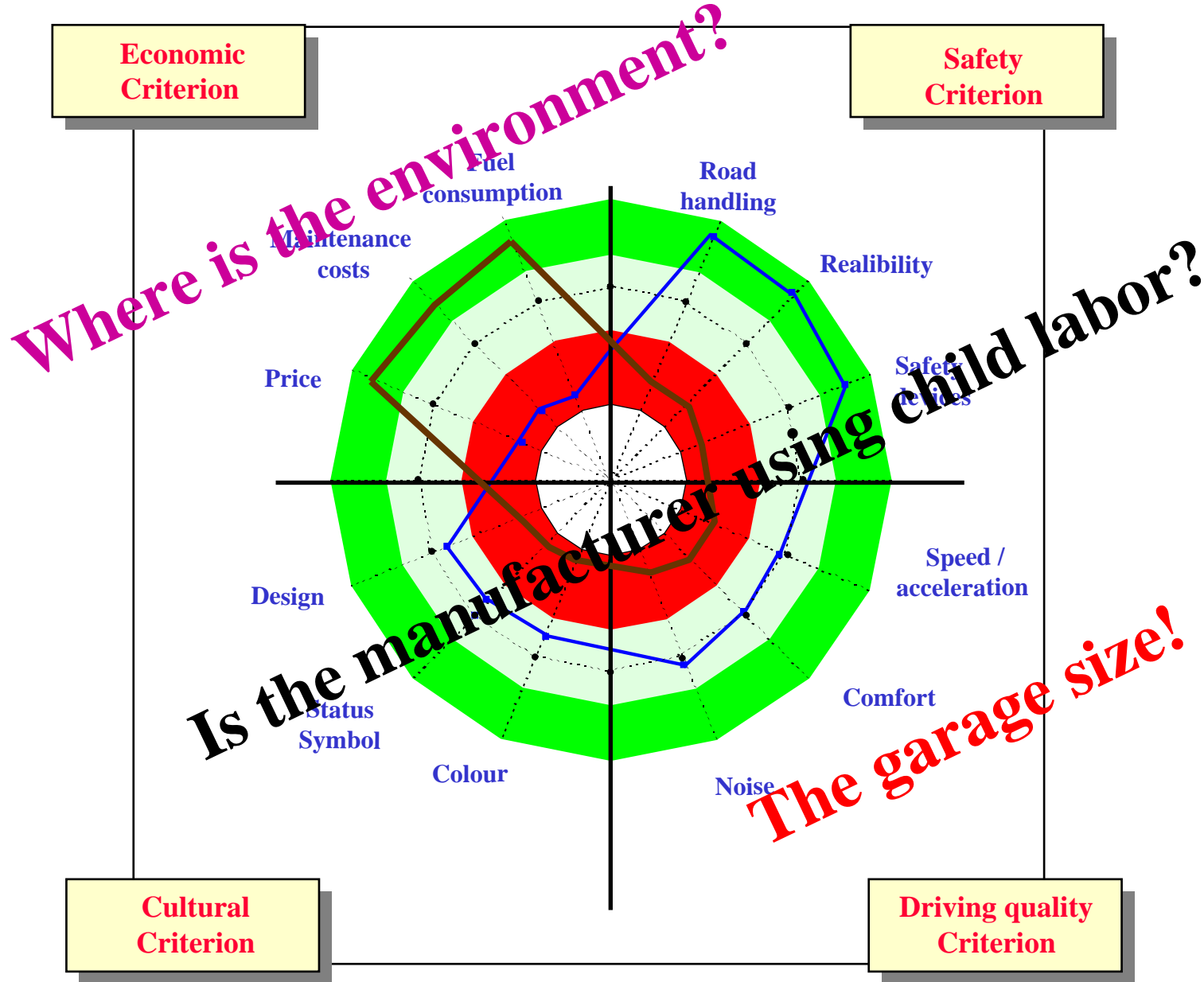
Alternatives

Criteria	Units	FORD Mondeo	HONDA Civic	VW Golf	NISSAN Micra
Fuel Consumption	US\$	a_{11}	a_{12}	...	a_{14}
Maintenance cost	US\$	...	...	...	...
Price	US\$			a_{33}	
Road Handling	Index				
Reliability	Index	...	a_{52}	...	...
Safety devices	Index				
Power	HP	a_{71}			
Comfort	Index	...	...	...	...
Noise	db			a_{93}	
Design	Index		a_{103}		
Status Symbol	Index	...	...	...	...
Colour	Index	a_{121}			a_{124}

“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_{11}	a_{12}	...	a_{14}
Maintenance cost	US\$	...	...	...	...
Price	US\$			a_{33}	
Road Handling	Index				
Reliability	Index	...	a_{52}	...	...
Safety devices	Index				
Power	HP	a_{71}			
Comfort	Index	...	...	...	...
Noise	db			a_{93}	
Design	Index		a_{103}		
Status Symbol	Index	...	...	...	...
Colour	Index	a_{121}			a_{124}

“Multi-Criteria Evaluation” versus “Integrated Analysis”

Additional elements: Power relations, Conflict analysis, Institutional analysis

		OPTIONS				
		Ford Mondeo	VW Golf	Honda Civic	Nissan Micra	
STAKEHOLDERS	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 \leftrightarrow SMCE for Quality Assurance

