About me

学习科研经历:

-2004 系统工程，大连理工大学
2004-2007 知识科学，北陆先端科学技术大学院大学
2007- IME，ASA 国际应用系统分析研究所

项目经验:

- ✓Energy efficiency and Risk Management in Public Buildings (EnRiMa)
- ✓New Energy Externalities Developments for Sustainability (NEEDS)
- ✓Web-based Emission Trading System
- ✓MCA-based Global Energy Assessment
- ✓Intuitive Decision Analysis support System (Prototype)
- ✓COE: Knowledge Management system, E-science Environments, Domain Knowledge Ontology Construction
- ✓大连建委评标系统

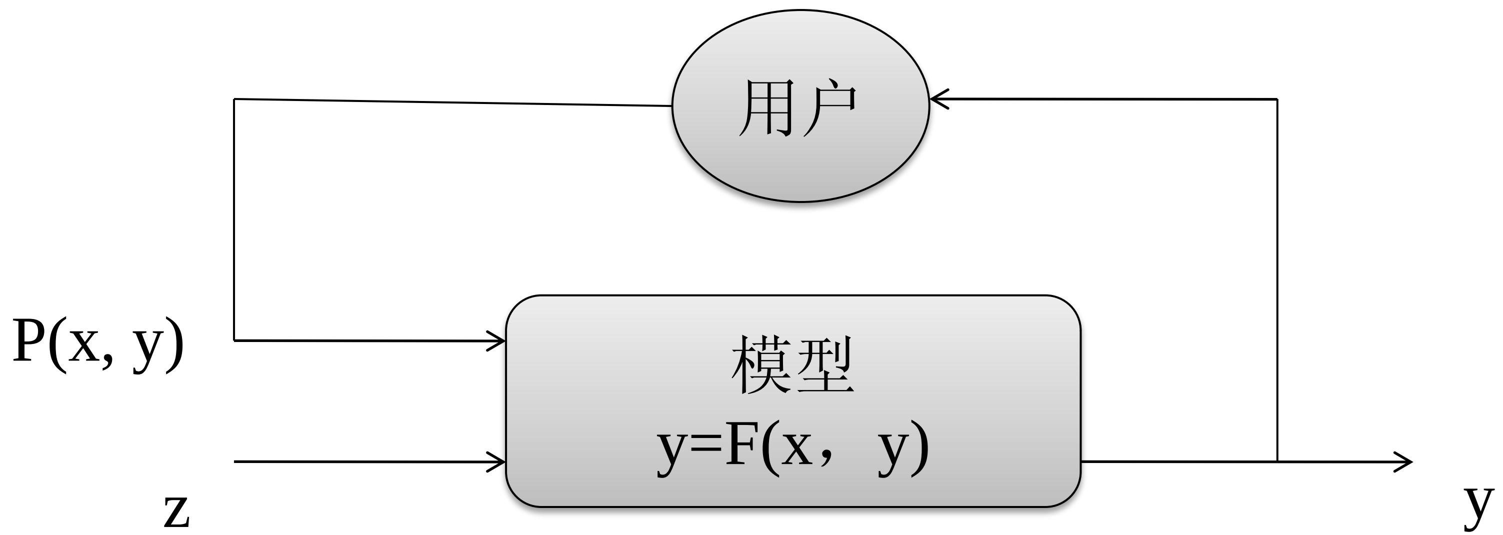
多准则分析及其应用系统
Multi-criteria Analysis and It's Application

Hongtao Ren

renh@iiasa.ac.at
International Institute for Applied Systems Analysis
A-2361 Laxenburg, Austria

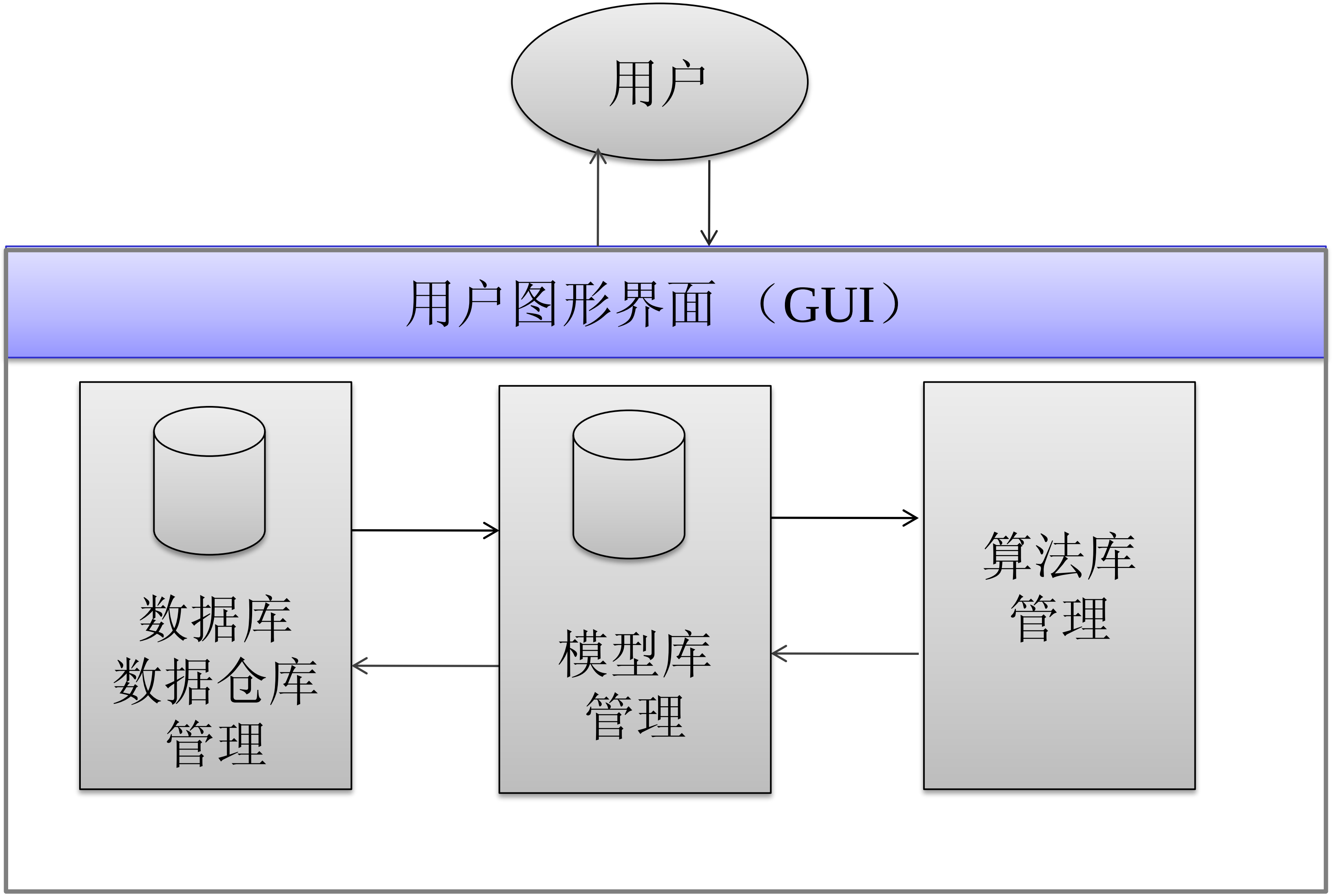
ECUST, 23-26 April, 2011

多准则分析数学模型框架:



x – 决策变量
z – 外部变量
y – 输出
P(x, y) –输入

多准则分析系统模块化结构:



Problem specification

多准则分析举例:

	price	fuel	safety	accel.
BMW	0	0	0.7	1
Honda	0.7	0.4	0	0.2
Toyota	1	0.8	0.3	0
VW	0.3	1	1	0.5

$$\boldsymbol{y_i} = \{price, \ldots\}, y_i \in J \qquad y_{ij} \in [0, 1], \qquad 1 - the\ best$$

$$x_i \in \{0, 1\}, \qquad i \in I = \{BMW, \ldots\}$$

$$\sum_{i \in I} x_i = 1$$

多准则问题:

$$\hat{x} = \underset{x \in X}{\operatorname{argmax}} \boldsymbol{F}(x)$$

- X – set of alternatives
- $\boldsymbol{F}$ – vector of criteria
- $\hat{x} \in X$ – *the best* alternative

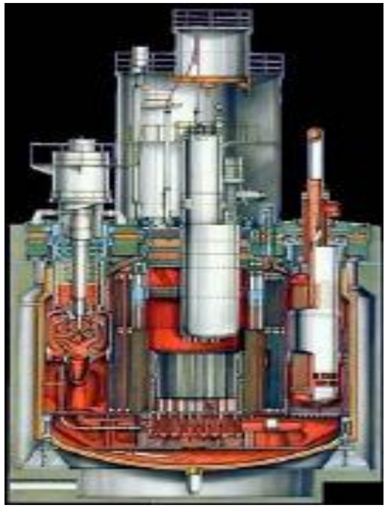
模型期望的输出:

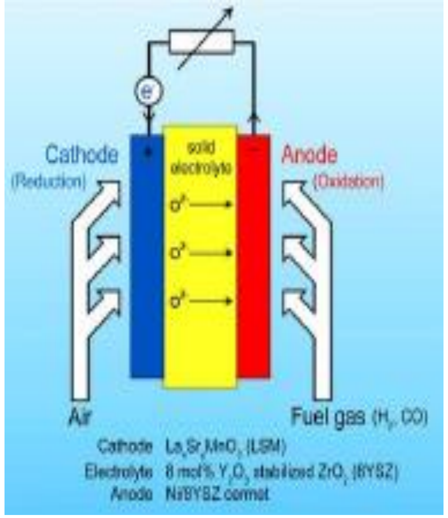
- clusters of good/bad alternatives
- sorting (ordered clusters) of alternatives
- (partial) ranking of alternatives

MCA applications and tools:

- MCA-NEEDS (EU project)
- MCA (general purpose, car, home， city selection, etc)
- 基于多准则的传统工艺品推荐系统,cooperation with JAIST
- MCA web-services
- 集成建模环境（ Integrated Modeling Environment ）
  MESSAGE 模型接口
  登月机器人步行决策

40 alternatives (technologies)





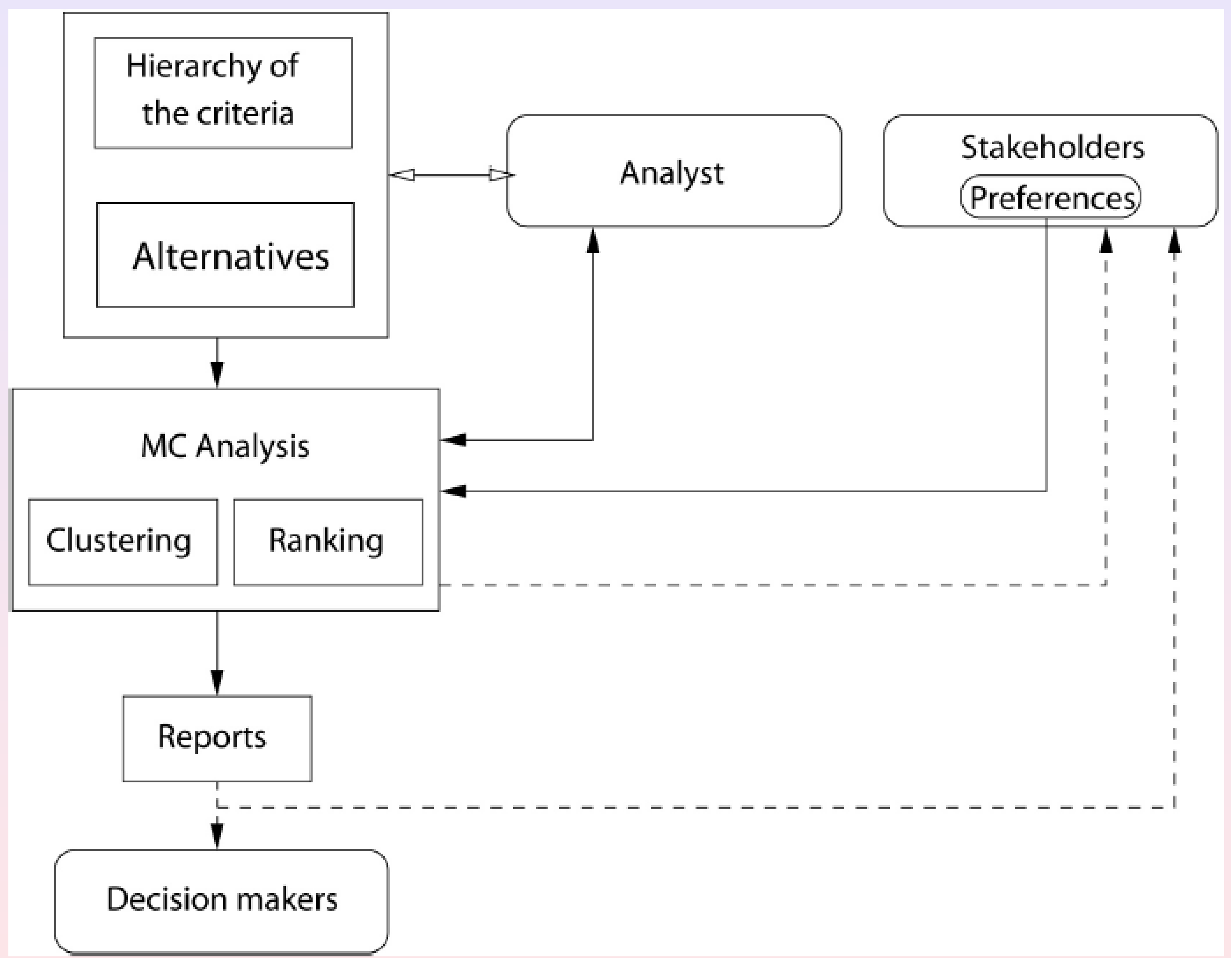

63 criteria *hierarchy*:

1	ENVIRONMENT	Environment related criteria Source: NEEDS Research Streams 1a & 2b, using Life Cycle Analysis (LCA)		
1.1	RESOURCES	Resource use (non-renewable)		
1.1.1	Energy	Energy resource use in whole life-cycle		
1.1.1.1	Fossil fuels	This criterion measures the total primary energy in the fossil resources used for the production of 1 kWh of electricity. It includes the total coal, natural gas and crude oil used for each complete technology chain. Note: Using coal fired technologies as an example; the total primary energy also includes the energy from oil used in transportation as well as from natural gas in the electricity mix used for mining and processing.	min	MJ/kWh
1.1.1.2	Uranium	This criterion quantifies the primary energy from uranium resources used to produce 1 kWh of electricity. It includes the total use of uranium for each complete electricity generation technology chain	min	MJ/kWh

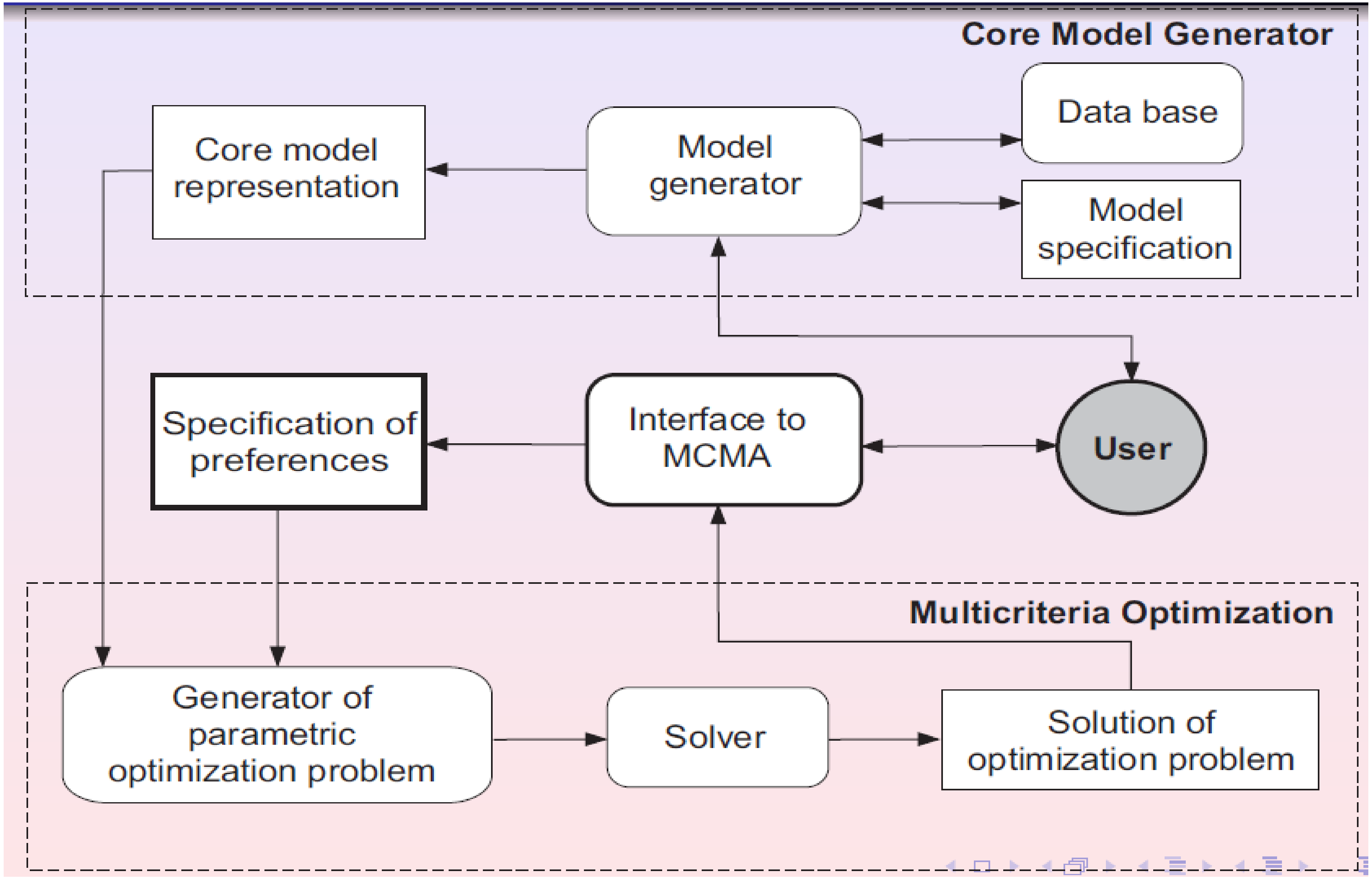
2	ECONOMY	Economy related criteria Source: NEEDS Research Stream 2b contributors for different technologies.		
2.1	CUSTOMERS	Economic effects on customers		
2.1.1.1	Generation cost (Gen. Cost)	This criterion gives the average generation cost per kilowatt-hour (kWh) for each technology, including the capital cost of the plant, (fuel), and operation and maintenance costs. It is the cost to the utility of generating electricity and not the end price that the customer must pay.	min	EUR/MWh
2.2	SOCIETY	Economic effects on society		

3	SOCIAL	Socially related criteria Source: NEEDS Research Stream 2b survey of social experts for most indicators (indicated by ordinal scale for units). Quantitative risk measures based on PSI risk database.		
3.1	SECURITY	Social Security		
3.1.1	Political continuity (Pol. Continuity)	Political continuity		
3.1.1.1	Secure supply	This criterion refers to the market concentration of energy suppliers in each primary energy sector that	min	Ordinal scale

Analysis of alternatives (simplified)



Structure of MC model analysis cycle



MCA-NEEDS issues

Technology:

- Diversified 3000+ users
- No browser plug-ins
- Intuitive, efficient, and robust Web-based interface

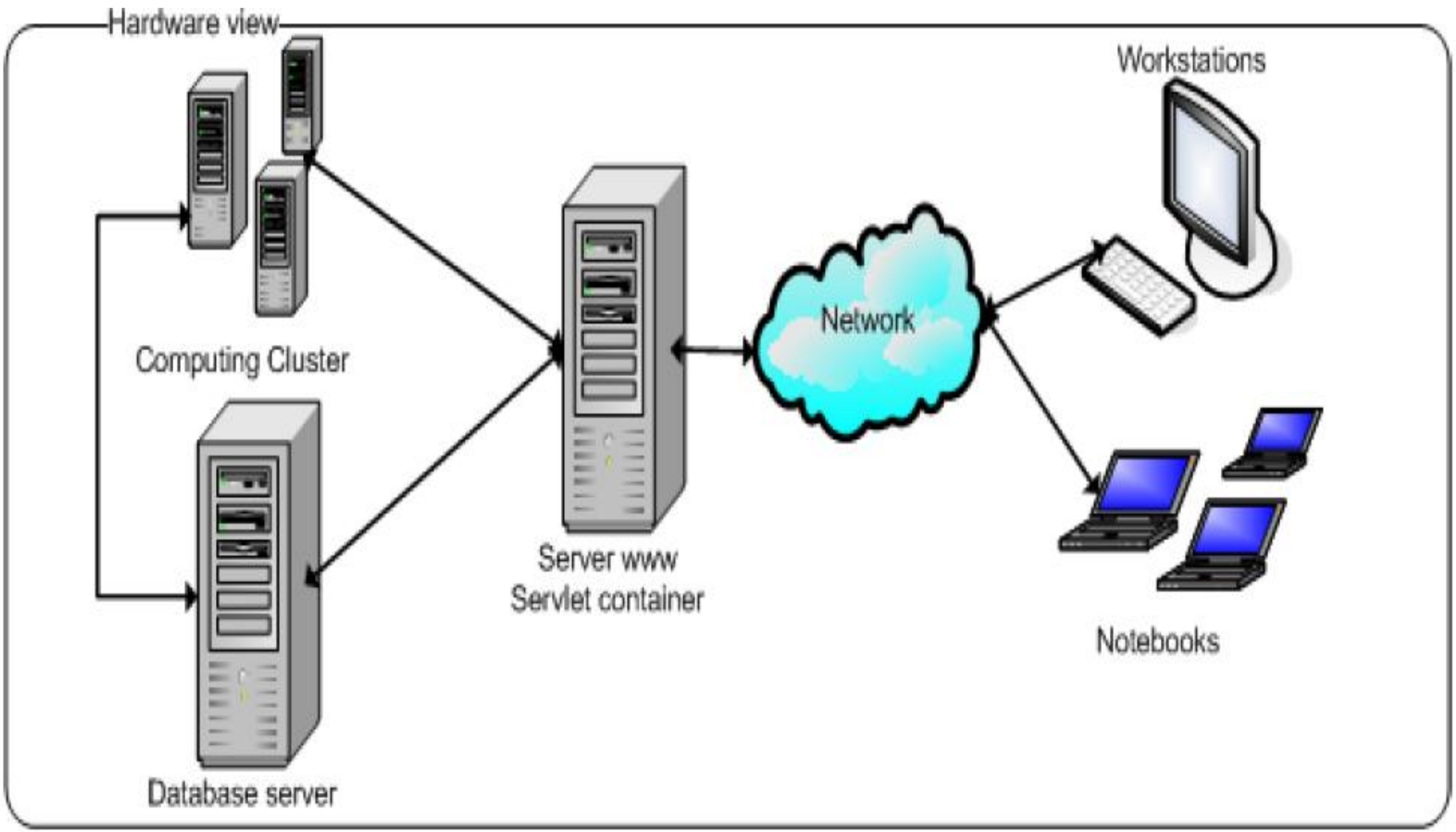
Policy:

- Diverse opinions of stakeholders
- Stakeholder preferences vs national regulations vs industry preferences

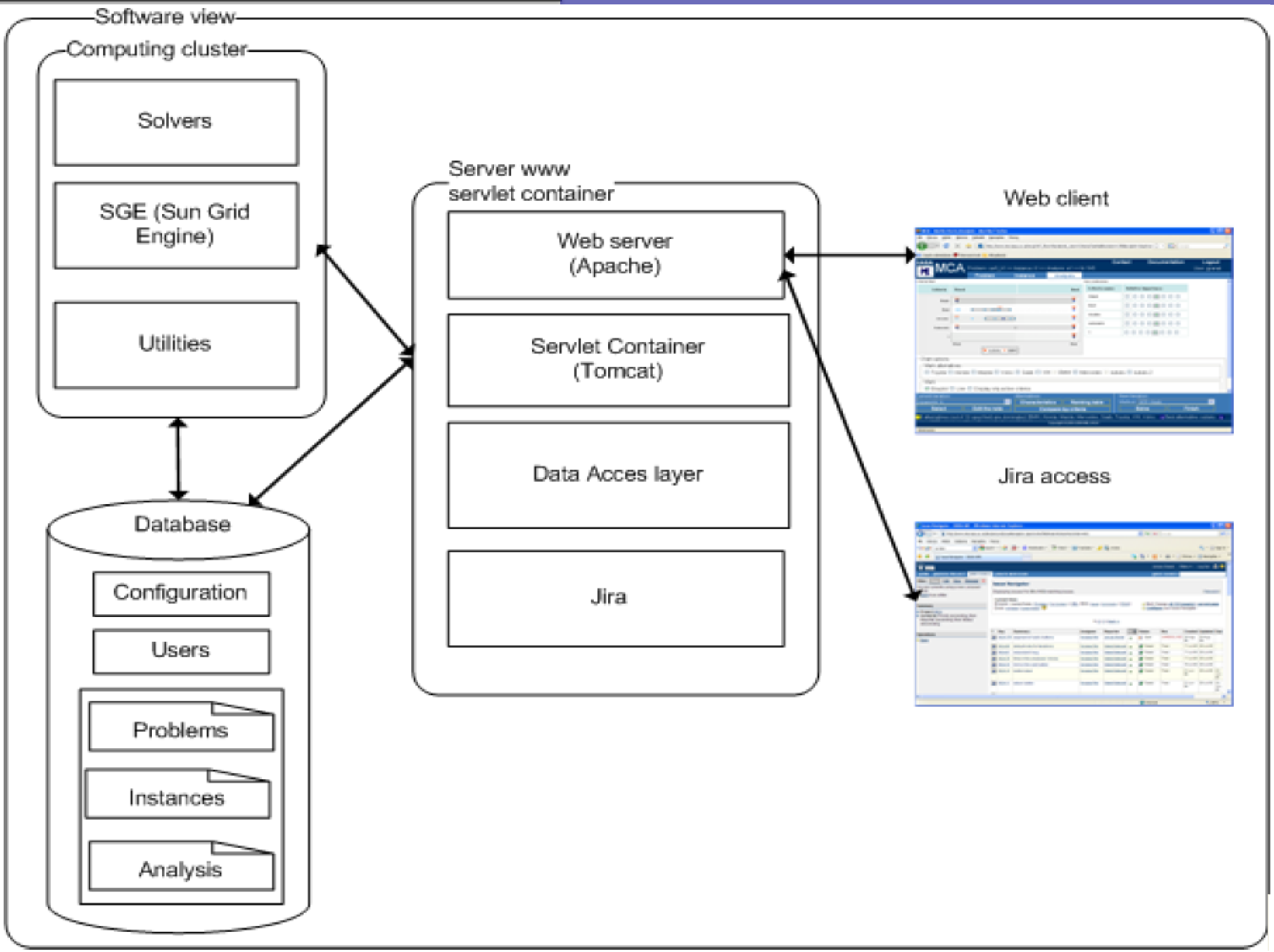
OR:

- Analysis of a set of discrete alternatives:
  up to 40 alternatives
  up to 63 criteria
- No known MC method is suitable for this problem

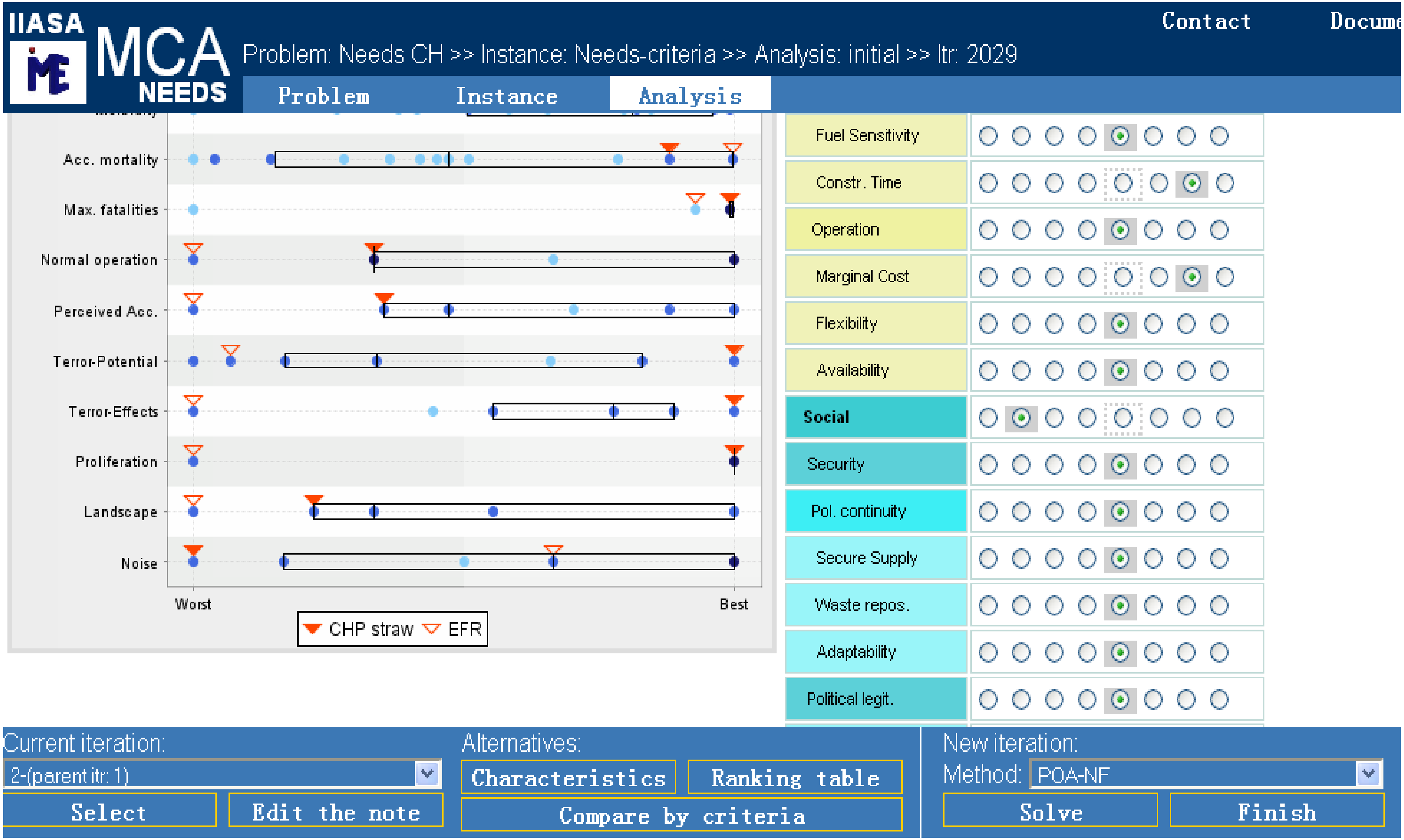
Architecture of MCA-NEEDS (1)



Architecture of MCA-NEEDS (2)



Screens of MCA-NEEDS



Technologies

- ✓ JDK7
- ✓ C++, PL solver
- ✓ Tomcat7
- ✓ Sun Grid Engine
- ✓ Springframework
- ✓ Axis2 Web services
- ✓ Jfreechart
- ✓ Hibernate
- ✓ Oracle10g
- ✓ Ajax

Layers:
- Java persistence layer
- Object-relational mapping abstraction layer
- Data access layer
- Services layer
- Process and integration layer
- Interfaces layer

Modules
- Problem
- Instance
- Analysis

Other MCA applications

MCA : general purpose, free access:

www.ime.iiasa.ac.at/mca/

MCA-DIS
www.ime.iiasa.ac.at/mca_dis/

Lessons from science-policy interactions:

- Much more demanding than pure science
- There is no golden key: modeling requires a combination of science, craft, art, experience
- Modeling for (interdisciplinary) knowledge integration and creation

A. Einstein:

Everything should be made as simple as possible, but not one bit simpler