New frontiers for MCDA: from hundreds of indicators to structured models and processes of decision aiding

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Outline

MCDA interventions in the Intelligence phase of complex decision processes

The most frequent modeling approaches and their limits

An example

Problem situation

«Disaster resilience»

MCDA in the Intelligence phase of complex decision processes

A multicriteria approach and the use of MC methods can support the Intelligence phase of a decision process in complex situations

Some MCDA interventions

a difficult or impossible interaction with the decision makers

- Structuring some MC models to clarify problem and decision context and needs for knowledge/data acquisition
- Difficulties that are associated to the use of an MC method and result analysis of each method application to propose a new modeling approach or a better decision problem formulation

This "simulative" approach as a preliminary study

to reduce uncertainties about nature of the problems, values and attitudes of the involved actors, availability and/or need of knowledge, data and information; possible scenarios of problem evolution and choice of adequate parameters for the models

The most frequent modeling approaches

- Acquisition of the **experts' points of view**, in committees or in the literature (also when there are contradictions between their visions or their expertise is only apparently consistent with the context)
- Identification of **available data and indicators** (in general data that are quantitative or used as quantitative) and **their direct use as criteria** and not as dummy variables of the problem (in general a lot of criteria and in general criteria with names that are the names of the used indicators) dummy variables

The high number of criteria: the availability of not expensive data-indicators and, at the same time, the general belief that only a large amount of data-criteria produces information

Indicators as criteria and as meaning of the criteria in the model: in general the logical structure of the model is not considered essential because DM and stakeholders are not involved and the "visualization" and validation of the model with them is not possible

Disaster resilience: an example

"Resilience" as flexibility, adaptation, reaction, fronting ….

"*Resilience is something which we can grow in ourselves in our family, in our communities*" as the result of an education activity addressed to the **prevention** and **minimization of negative impacts/effects** (of adversities, natural events, disasters, …)
Resilience as the capacity of the administrators to face the risk of a catastrophe, their level of interest, time, resources and efforts devoted to it (the social life sphere)

ANDROID - Lifelong learning Programme to increase society's resilience to disasters of human and natural origin
http://www.disaster-resilience.net/
an Erasmus academic network - European Higher Education

Making Cities Resilient Campaign - UNISDR (the United Nations Office for Disaster Risk Reduction)

Associated Programme on Flood Management
c/o World Meteorological Organization

Increasing society's resilience to disasters of human and natural origin

Actions at different levels on several decision contexts and in relation to different problems

MC models and methods can create a shared vocabulary not only to decide but also to read and synthesize all the acquired elements, orient information acquisition and support problem definition, reduce complexity and uncertainty

Which elements may enable socio-cultural, politico-economic and natural systems to achieve greater resilience in the face of increasing threats from natural and human induced hazards?

Which attributes/criteria to describe, analyse and compare the capacity of cities or communities to address disaster risk?

How to inform, orient and aid policy and plan development?

U = intervention cost to generate resilience in a territorial system (e.g. flooding river resilience in a hydrographic system)

K = governmental financial support in order to improve resilience in the risky areas (towns or communities)

K is not enough to cover all the interventions and T = U – K is the cost to be financed by local taxation and shared among all the involved areas

How a central agency can assign to each involved town a specific part of the financial support to the resilience improvement? Could a ranking of the towns facilitate decision? Which are the main aspects to be analysed and used ?

Level of damage in each town of the territorial system, in the different public and private sectors

Level of virtuosity of each town (commitment and social capability to face the event and prevent its damages)

Connection between the cost to generate resilience and the total amount of damage from the last disaster ?

How a local agency can assign to each town a specific level of taxation in order to cover the costs of the resilience improvement? Could the assignment of each town to a specific category facilitate the decision? Which kind of category?

Taxation in relation to the damage in each town of the territorial system?

Duties and responsibilities, in relation to the natural structure of the area?

Duties and responsibilities, in relation to the actions that can be considered the damage causes or that are in relation to the nature and size of damage?

Capacity to address disaster risk: evaluation and comparison of cities

Criteria	Weights	Dimensions
CO2 emissions	0,12	
% urbanized area	0,04	
Electricity use	0,06	Environmental aspects
% differentiated waste	0,13	0,52
Drinkable water use	0,08	
Certified firms	0,09	
Demographic density	0,11	
Unemployed men	0,03	
Unemployed women	0,03	Socio economic aspects
Accidents in workplace	0,04	0,48
Territorial desirability	0,06	
Reaction time	0,08	
Firms/active population	0,06	
Spendable income	0,07	

Criteria		In relation to
CO2 emissions	decreasing	Contamination risk as a sign of limited environmental or risk awareness
% urbanized area	decreasing	Limits to the rainfall absorption (process responsible for damage)
Electricity domestic use	decreasing	Alternative energy use (environmental awareness)
% differentiated waste	increasing	Environmental awareness
Drinkable water use	decreasing	Safeguard of aquifer layers* (? industrial and/or agriculture picking up or other indicators)
Certified firms	increasing	Environmental awareness
Demographic density	decreasing	Anthropic impact on the environment
Unemployed men	decreasing	Anthropic impact on the environment
Unemployed women	decreasing	Progress in the social life
Accidents in workplace	decreasing	? Awareness of safety and risk*
Territorial desirability	increasing	Awareness of environment safeguard
Reaction time	increasing	Ratio active population /young+old population
Actives in firms/residents	decreasing	Resource consumption, waste creation
Spendable income	increasing	Citizen economic resources to prevent disasters*

Criteria	Prefer	In relation to
Electricity domestic use	decreasing	Environmental awareness if this is a sign of alternative energy use
% differentiated waste	increasing	Environmental awareness
Certified firms	increasing	Environmental awareness* (?)
Territorial desirability	increasing	Interest in environment safeguard
% urbanized area	decreasing	Limits to the rainfall absorption
Drinkable water use	decreasing	Safeguard of aquifer layers*
Demographic density	decreasing	Anthropic impact on the environment
Unemployed men	decreasing	Anthropic impact on the environment
Actives in firms/residents	decreasing	Resource consumption, waste creation
Unemployed women	decreasing?	Progress in the social life
Accidents in workplace	decreasing	Limited awareness of safety and risk
CO2 emissions	decreasing	Limited awareness of risk
Reaction time	increasing	Ratio active population /young+old population
Spendable income	increasing	Citizen economic resources to prevent disasters*

Capacity to address disaster risk: evaluation and comparison of cities

Main aspects	Aspects and Criteria
Social aspects	**Awareness and interest in environment safeguard** (territorial desirability, % differentiated waste or alternative energy use)
	Safety and risk awareness (Signs of the limited awareness such as CO2 emissions, accidents in the workplace, ….)
	Progress in the social life (working women, scholastic attendance, …)
Risky behaviour	**Resource consumption and waste creation** (actives in firms/residents), **limited rainfall absorption** (% urbanized area in the city plans), **limited safeguard of aquifer layers** (uncontrolled use of water), **anthropic impact on the environment** (cemented river banks)…
Opportune behaviour	**Disaster prevention** (naturalized river banks, education programs, ..), **reaction time** (ratio active population /young+old population, training programs), **spendable income** (public administration resources to prevent disasters) …

MC model to define the taxation levels

Main aspects	Aspects
Responsibilities of the disaster or its damage	Limited or wrong territory management
	Limited or wrong control on the production activities
	Legal and/or operational default
Prevention actions	Reaction capability in term of resource mobilization and action
	Sensibilization and information

Criteria, categories and parameters (scenarios of weights, veto thresholds, indifference and preference thresholds), and **guidelines** to facilitate modeling and use of methods in relation to different problem statements and decision contexts