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iDEAL - DEcision support for Adaptation pLan

Priority Axis:Safety and resilience
Specific objective:2.1 - Improve the climate change monitoring and planning of adaptation measures tackling specific effects, in the cooperation area

WP4 SETTING UP OF A DECISION SUPPORT SYSTEM AS SUPPORT TO CLIMATE CHANGE ADAPTATION PLANNING
Activity 2 Setting up a DSS as support to CC adaptation planning

Decision Support System

FINAL Version
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Coordinator:
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Partners involved:
LP - IRENA – Istrian Regional Energy Agency
PP1 - MUNICIPALITY OF PESARO
PP3 - MUNICIPALITY OF MISANO ADRIATICO
PP4 - CITY OF DUBROVNIK DEVELOPMENT AGENCY DURA
PP5 - REGIONAL NATURAL PARK “COASTAL DUNES FROM TORRE CANNE TO TORRE SAN LEONARDO”

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1. Introduction

The prevention, or at least reduction of most diffuse effects of climate change affecting Italy-Croatia regions, should be supported by a public sector better organized in the field of data and information available and their integrated elaboration. Climate change adaptation, together with mitigation, is a long-term effort that requires alternative-makers with a Decision Support System enabling informed and knowledge-based decisions.

Starting from these assumptions, iDEAL capitalize the DSS developed by IUAV University of Venice within TERRE project (South-East Europe, 2012-2014). The DSS developed in TERRE project was a system based on a multi-criteria decision analysis (MCDA), where alternative actions were evaluated and classified through common and weighted indicators. Namely, indicators were shared between decisionmakers of pilot cities, which expressed their priorities by assignment of weights. Thus, maintaining such methodology and logic, it was easy to capitalize on the DSS of TERRE and adapt it in a specific way for supporting Climate Adaptation Plans.

It was necessary to redefine scenarios, objectives, and criteria following new decision-makers' priorities and suggestions, but DSS structure is maintained to support decision-makers during the decision-making process, from alternatives creation and evaluation to their ranking and selection. Thus, the main function of DSS is to assess alternatives climate adaptation plan in order to support decisions towards climate-proof city/area based on key sustainability and adaptation measures components. More specifically, developed DSS can integrate environmental-climate observations with socio-economic issues, to allow decision-makers (end-users) to evaluate several actions contained in its climate adaptation planning alternatives based on their own subjective objectives. In this way, climate adaptation strategies are proposed based on a quantitative and qualitative assessment of climate analysis and assessed considering decision-makers' objectives and priorities.

In addition, the territorial vulnerability of climate impacts is assessed and localized using new technology. The output of this process will lead to indicators and geographical information which define the state of climate risk and will be incorporated into DSS. This system was improved using Geographic Information System (GIS) since climate adaptation is based on spatial processes.

2. DSS: definition and methodology

In this section, first, it will explain some important definitions useful in order to understand the DSS approach, its process and also its implementation. Second, it will be shown the DSS methodology. Quickly, it will be exposed to the theories used for this DSS development.

2.1 Definitions

The language, used into the DSS and in some parts of this document, is a technical language. Thus, in order to avoid misunderstanding and confusion, it is basic to share this "technical language", especially, in a complex context like the iDEAL is. For these reasons some important definitions are given:

ALTERNATIVE (or OPTION): Potential solutions (strategies/actions/projects/plants) that can be undertaken by the decisionmaker (PP) in order to solve his problem. The set of alternatives must consider all the possible problem's solutions.

CRITERION: Principle by which the alternatives must be assessed, (a criterion is a preference model) a SUBCRITERION is one characteristic (that can be measured by a specific unit of measure) of the criterion by which alternatives must be assessed.

DECISION: Conscious and irrevocable act/process, which allocates resources (scarce), aimed at achieving a particular and defined goal.

DECISION AIDING PROCESS: Decision process that involves at least two actors: a client, who himself is involved to at least one decision-making process (the one generating the concern for which the aid is requested) and the analyst who is expected to provide the decision support. This particular process aims to establish a shared representation of the client's problem, using the analyst's methodological knowledge, a representation enabling to undertake an action towards the problem solution.

DECISION-MAKER: Who makes the final decisions.

DECISION-MAKING PROCESS: Process of evaluation of the problem situation, considering alternatives, assessing them through some criteria, making choices, and following it up with the necessary actions.

DECISION SUPPORT SYSTEM (DSS): The Decision Support System is an approach or a methodology able to support the decision-making process. The DSS is intended to introduce elements of

rationality in the decisionmaking process, making it transparent, reproducible and allowing the stakeholder's participation.

EVALUATION MODEL: Organization of the available data and information in a way that it will be possible to obtain a formal answer to the problem. Such an organization can assess the different alternatives and rank/rate them.

FRAMEWORK: General context on which are collected all the needed information and data to solve the problem.

GOAL: Problem solution, what the implementation of the alternatives aims to achieve.

OBJECTIVE: Part of a problem solution, a specific result that an alternative aim to achieve. More objectives achieved are necessary to achieve a goal. [If goals are about the big picture, then objectives are all about tactics. Mechanically, tactics are action plans to get from where you are to where you want to be. A goal defines the direction and destination, but the road to get there is accomplished by a series of objectives]

PREFERENCE: Stakeholders' attitude towards a set of objects (criteria and sub-criteria).

STAKEHOLDERS: all the actors involved in the decision-making process (each type of involvement). The decisionmaker is a stakeholder.

2.2 Used Methodology

It is used as the theoretical foundation the "Decision Theory" and "Decision Aiding Theory" principles, in order to structure iDEAL DSS. In decision theory and decision aiding theory, the sciences on which are based and developed decision support systems, decisions are results of a "process". This process is seen as a set of cognitive activities enabling to go from a problem, i.e. a state of the world perceived as unsatisfactory, to its solution, i.e. a state of the world perceived as satisfactory, if any exist (problem-solving strategy). In this perspective, considering the decision not just an act of choice, but something more complex as a process, the DSS could be defined as a system/approach/method to support the decision-maker into the whole process. The DSS goal is to introduce elements of rationality into the decision process, in order to make it transparent, and also in order to make replicable and legitimate all its phases. In

scientific literature, the “decision aiding process” can be described and characterized by four phases and artifacts fig. 2.1:

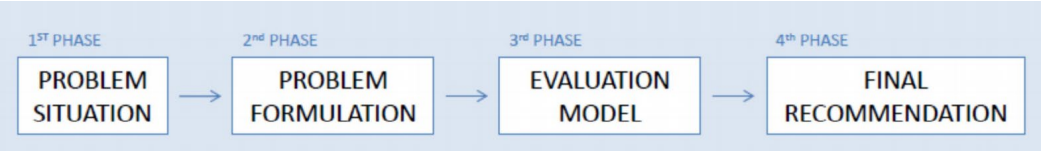

Fig. 1 Decision aiding process

The “problem situation” is the first phase where the problem is recognized and a set of preliminary information is collected. Usually, it is the result of an effort aimed at replying to questions of the type:

- *Who has a problem?*
- *Why is this problem?*
- *Who decides on this problem?*
- *Who is going to pay for the consequences of a decision?*

The “problem formulation” is a crucial moment of the process, since the entire problem's information is collected and the real problem with its complexity is transformed into a formal and abstract problem. In this phase, important decisions are made in order to reduce the problem complexity. The “evaluation model” is built in order to assess the alternatives solutions of the challenge. The model is built considering the potential alternatives, the decision-maker/stakeholders’ preferences, which are made explicit through the selected criteria and sub criteria, their weigh and their units of measure. The “final recommendation” represents the return to reality. At this moment the formal result is translated from a formal and abstract language to the current and understandable language. The IDEAL’s DSS was constructed following this methodology, principles, and phases. It means that it is possible to recognize four different phases into the DSS process and it means that the DSS result must be translated and adapted to the real context and situation.

3. Proposed indicators

Aspect	Indicator	Unit of measurement
A. Environmental	Soil coastal erosion	m2
	Soil drought	m2
	Impermeability ratio	m2
	Flooding area	m2
	Collected rain water	m3/year
	Reused water	m3/year
	Water consumption	m3/year
	Habitat maintenance	m2
	Uhi reduction	c°
	Energy use reduction	%
B. Social	People who will benefit from the actions n. Of people)	n. Of people
	Most vulnerable people who will benefit from the actions	n. Of people
	New job created by the actions	n. Of job
	Km - upgraded infrastructure	km
	New infrastructure	km
C. Economic	Implementation cost	€
	Management cost	€
	Revenues	€
	Revenues distribution	n. Of actors
	Enterprises supported	n. Of enterprises
	New enterprises	n. Of enterprises
	Traditional crops	ton/year
D. Legal, institutional and perceptional	Legal feasibility	low-medium-high
	Required permits	n. Of permits
	Procedural time	days
	Life time	days
	Peple acceptability	low-medium-high
	Political acceptability	low-medium-high

Selected indicators by the Municipality of Vrsar

A. Environmental	*Flooding area*	*m2*
B. Social	*People who will benefit from the actions*	*n°*
	New Infrastructure	*Km*
C. Economic	*Implementation cost*	*€*
D. Legal, institutional and perceptional	*People acceptability*	*low-medium-high*
	Political acceptability	*low-medium-high*

Selected indicators by the Municipality of Dubrovnik

A. Environmental	*Flooding area*	*m2*
	Uhi reduction	*c°*
	Energy use reduction	*%*
B. Social	*People who will benefit from the actions*	*n°*
D. Legal, institutional and perceptional	*People acceptability*	*low-medium-high*
	Political acceptability	*low-medium-high*

Selected indicators by the Dune Costiere Park

A. Environmental	*Soil coastal erosion*	*m2*
	Soil drought	*m2*
	Habitat maintenance	*m2*
B. Social	*New job created by the actions*	*n°*
	New infrastructure	*Km*
C. Economic	*Implementation cost*	*€*
	Enterprises supported	*n°*
	Traditional crops	*ton/year*
	People acceptability	*low-medium-high*

D. Legal, institutional and perceptional		
	Political acceptability	*low-medium-high*

Selected indicators by the Municipality of Pesaro

A. Environmental	*Soil coastal erosion*	*m2*
	Re-used water	m3/year
	Water consumption	m3/year
	Habitat maintenance	*m2*
	Uhi reduction	% tree canopy density
	Energy use reduction	Mwh/year
B. Social	*People who will benefit from the actions*	*n°*
C. Economic	*Implementation cost*	*€*
	Management cost	*low-medium-high*
D. Legal, institutional and perceptional	*People acceptability*	*low-medium-high*
	Political acceptability	*low-medium-high*

Selected indicators by the Municipality of Misano

A. Environmental	*Impermeability ratio*	*m2*
	Collected rain water	m3/year
	Water consumption	m3/year
	Habitat maintenance	*m2*
	Uhi reduction	C°
B. Social	*People who will benefit from the actions*	*n°*
C. Economic	*Km – upgraded infrastructure*	*Km*
	Implementation cost	*€*
D. Legal, institutional and perceptional	*Legal feasibility*	*low-medium-high*
	Procedural time	*days*

3. iDEAL Decision Support System

ACTION N°:	Title				Localization:
OBJECTIVES					
name	*weight (b)*	*result*	*funz*	*name*	*unit of measure*
A. Environmental aspect	0,2	unacceptable	0	A. 1 Soil coastal erosion	m2
				A. 2 Soil drought	m2
				A. 3 Impermeability ratio	m2
				A. 4 Flooding area	m2
				A. 5 Collected rain water	m3/year
				A. 6 Reused water	m3/year
				A. 7 Water consumption	m3/year
				A. 8 Habitat maintenance	m2
				A. 9 Uhi reduction	c°
				A. 10 Energy use reduction	%
B. Social Aspect	0,2	acceptable	0,5	B. 1 People who will benefit from the actions n. Of pe	n. Of people
				B. 2 Most vulnerable people who will benefit from th	n. Of people
				B. 3 New job created by the actions	n. Of job
				B. 4 Km - upgraded infrastructure	km
				B. 5 New infrastructure	km
C. Economic Aspect	0,2	good	1	C. 1 Implementation cost	€
				C. 2 Management cost	€
				C. 3 Revenues	€
				C. 4 Revenues distribution	n. Of actors
				C. 5 Enterprises supported	n. Of enterprises
				C. 6 New enterprises	n. Of enterprises
				C. 7 Traditional crops	ton/year
D. Legal, institutional and perceptional aspects	0,2	good	1	D. 1 Legal feasibility	low-medium-high
				D. 2 Required permits	n. Of permits
				D. 3 Procedural time	days
				D. 4 Life time	days
				D. 5 Peple acceptability	low-medium-high
				D. 6 Political acceptability	low-medium-high
Adaptation, Mitigation and Resilienc	0,2	good	1	E. 1 The target of the Action is an area exposed to a C	Vulnerable/Not Vulner

Ir. Hexagon/Sectio			Result:	good	Function	1
CRITERIA						
function	*hreshold Mir*	*threshold Max*	*weight (a)*	*data*	*result*	*funz*
to min / to max	1	10	0,1	0	unacceptable	0
to min / to max	1	10	0,1	0	unacceptable	0
to min / to max	1	10	0,1	0	unacceptable	0
to min / to max	1	10	0,1	0	unacceptable	0
to min / to max	1	10	0,1	0	unacceptable	0
to min / to max	1	10	0,1	0	unacceptable	0
to min / to max	1	10	0,1	0	unacceptable	0
to min / to max	1	10	0,1	0	unacceptable	0
to min / to max	1	10	0,1	0	unacceptable	0
to min / to max	1	10	0,1	0	unacceptable	0
to min / to max	1	10	0,1	10	good	1
to min / to max	1	10	0,1	10	good	1
to min / to max	1	10	0,1	10	good	1
to min / to max	1	10	0,1	10	good	1
to min / to max	1	10	0,1	10	good	1
to min / to max	1	10	0,1	10	good	1
to min / to max	1	10	0,1	10	good	1
to min / to max	1	10	0,1	10	good	1
to min / to max	1	10	0,1	10	good	1
to min / to max	1	10	0,1	10	good	1
to min / to max	1	10	0,1	10	good	1
to min / to max	1	10	0,1	10	good	1
to min / to max	1	10	0,1	10	good	1
to min / to max	1	10	0,1	10	good	1
to min / to max	1	10	0,1	10	good	1
to min / to max	1	10	0,1	10	good	1
to min / to max	1	10	0,1	10	good	1
to min / to max	1	10	0,1	10	good	1
yes/no	Not Vulnerab	Vulnerable	1	Vulnerable	good	1

4. Process limitations

In the meeting held in Venice on February 20th / 2019, it was decided, by mutual agreement among all the Partners, to directly evaluate the single actions and not potential versions of the Climate adaptation plan. This made it possible to evaluate the quality of the individual actions concerning specific and considered areas such as:

- Environmental aspect
- Social aspects
- Economic aspects
- Legal, institutional and perception aspects

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