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DeCyDe: an integrated and participatory method to support Local Authorities in improving their waste management policies and practices

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Abstract:

Purpose: DeCyDe is a practical decision support method that can be implemented to have a measure, a "number", to understand the size or the scale of a state/condition, especially in cases where everything is subjective or difficult to quantify. When talking about decision support, the important questions are "who are the Decision Makers" and "what are their competences"[1]. If a sophisticated and complex to users decision support system, aims to support decision makers who do not have high academic competences, then it should be expected that the system will not be used. This is the most common problem of the Decision Support Systems, which results in decision makers who increasingly rely on their intuition and judgment and even interests.

Method: DeCyDe incorporates principles from multi-criteria analysis, from public policies approaches[2], from vocational training structures (eg LitusGo structure) and even basic logic principles from Fuzzy theory (the theory of graded concepts, where everything is a matter of degree). It is a spreadsheet oriented decision support method including a flexible and easy to use tool.

Results: DeCyDe is a framework that supports the decision makers and the stakeholders to understand and justify the main issues that are involved in the process of decision and the trade-offs between different decision alternatives.

Conclusions: The DeCyDe approach is in line with the trend of public policies to move from a purely conceptual and theoretical view to a more pragmatic approach, based on empirical evidence.

1. Structure of the DeCyDe method:

DeCyDe is structured in three preparatory, self-contained and interrelated steps and in a final stage where the actual decision support work is done. The preparatory steps are self-contained because they can be used per se, each step giving specific results. They are interrelated since if put together they lead to the final stage, where the decision is supported. However, the first step, the data base, is necessary for the consistent development of the other steps:

1.1 Step1: The Data Base

Usually a major problem in decision making is the lack of consistent data or the low quality of existing data. The Data Base of DeCyDe is built specifically and dedicated for every case that the method is implemented, taking into account the above mentioned data problems. This step forms actually the baseline work, the

product of the identification of the problem and the gap analysis of the needs and the parameters that are involved in the specific decision process. The Data Base provides with the set of "core" data that are needed in order to guarantee the unbiased character of the results of the decision process. It is very usual that the decision makers believe something which is not the reality but rather their perception. This set of core data is organized in a way that supports the decision makers to picture the real image of the existing situation and understand the problem through numbers.

1.2 Step 2: set of criteria/ parameters

This is the part of the method where each case under examination, is structured and modeled. Step 2 of DeCyDe consists of two parts:

Part 1: Address the multiple dimensions and/or perspectives of each case. It is important to define the key set of criteria/parameters that are involved in the decision making process. This is achieved through a participatory process[5], where the experts/consultants suggest a rather big set of parameters/criteria which is the result of their research. The decision makers and stakeholder are asked to go through them during dedicated structured meetings/ workshops, discuss and decide on the "core" set that is going to be implemented in order to support their decision. This is a highly participatory process that incorporates a simple approach, i.e. the availability of data, the definition of the problem and the perception of the decision makers and the stakeholders. It is important to have a robust baseline study, a good set of data (the result of step 1) and a trained facilitator/expert who is not imposing decisions, but supports the process and has a good knowledge of the examined case, of the data and of local/ case specific characteristics. It has to be clear and provide the decision actors with the reasoning that the aim is to solve the problem, to get a concrete result to support the decision to be made than to attempt to model a system mathematically.

Part 2: "Score" the criteria/parameters. The scoring of each criterion/parameter is achieved through given ranges of values. The "scoring through ranges" approach converts state-of-the-coast indicators into sustainability indicators. This is because the score attributed immediately gives a reference value and relevance instead of just a snap-shot single figure which stands for nothing but itself.

The ranges of values are mainly defined, based on European Union Directives and when these do not cover the specific parameters, limits provided by International Bodies are used. Local/ National regulations are also considered. The approach to score through ranges instead of using precise values, provides the method with flexibility: even data which could not be specifically identified and have a level of being imprecise or give an approximation, can be used if identified within a range, and thus they are descriptive for the method and can be taken into consideration and contribute with a certain score. It is usual to skip parameters/criteria when their precise value cannot be reached. With this approach of scoring through ranges, all key parameters/criteria are incorporated in the decision process.

1.3 Step 3: weighting

This is the final step of DeCyDe. The criteria are organized in matrices, based on Saaty's concept of comparing couples[3]. The number of matrices, i.e. the number of levels that will be incorporated in the decision support method is defined in step 2, when the key parameters/ criteria are decided. Well structured

workshops are organized, with the participation of the decision makers and the stakeholders that have already participated in step 2. The facilitator explains the process on how to compare the importance level between couples of parameters/criteria. The matrices are presented in a spreadsheet form and they need to be ready and programmed in order to have direct results the moment the weight/ importance between a couple of parameters/criteria is agreed among the participants. Through this step a high level of participation is achieved. By increasing the level of actual participation, and by enhancing conversation among conflicting interests, DeCyDe achieves consensus building among the group of decision actors (decision makers and stakeholders) that are involved in the process. They get into a discussion that eventually leads them to a common perception or at least common understanding.

1.4 Final stage:

When all three steps are completed, then the spreadsheet tool is ready to "play" with: the decision makers can check how the existing situation can be change if, for example, they change the score of one or more parameters/criteria. That means that they can easily check what will happen to the entire set of criteria/ parameters, if they invest to support the change of score and thus the range, of that certain parameter. Or they can check what will happen if they change the importance among the different parameters/criteria, i.e. change their policy. Through this exercise, the decision makers can check and assess a large range of concepts, of actions, of policies. They have a "number" that gives them their "score" each time they take a decision, based on real data of the existing situation. They have the chance to pre-see the impacts of their decisions, identify the pros and cons of different options and discuss them among the entire group of decision actors. And eventually, they conclude to the decision. As mentioned before, since the decision is taken through a participatory process, with the consensus of the decision actors, they are all committed to support the implementation of their decision. This is one important issue: promote the implementation of decisions through the consensus of decision actors.

2. Case study: implementation of DeCyDe in waste management decision making process

DeCyDe was transformed to accommodate the challenges of supporting decision makers in waste management improvement. Local Authorities are usually responsible for waste management, so DeCyDe-for-waste was tailored to address the needs of Local Authorities and took into consideration their competences[4].

The DeCyDe-for-waste approach to waste management is based on the concept of integrated approach: waste management is an important action per se, however, if it is not regarded within an integrated frame, it has a "sectoral" character, which is not in line with the aim of sustainable development. Thus:

1. The first step of DeCyDe-for-waste was to formulate a synoptic set of dedicated indicators, that could give a picture of the impacts that any decision on waste management has in other sectors of development, always addressing the needs and competence of Local Authorities. The four "classic" pillars of sustainability have been used, i.e.

- Economics

- Environment
- Social
- Governance

For each of the four pillars, a set of representative indicators was selected. Tables 1 to 4 show the indicators that have been selected for each pillar. The effort was to have a small set of indicators, not difficult to find local data and important for the sustainable development.

2. The second step involved the scoring for each indicator, implementing the DeCyDe "scoring through ranges" approach. The range of "scores" for each indicator was defined mainly based on European Directives, regulations and codes of practice. The ranges can be seen in the same Tables 1 to 4.

3. The third step was, based on the previous two steps, to form a list of data that a Local Authority would need in order to have the Data base needed to run DeCyDe (this is the first of DeCyDe as described in the first part of this paper, i.e. in the description of the method. However, this first step always comes third during the implementation, since it is important to define the set of indicators in order to draft the list of data that would be needed).

4. The fourth step and final step in the transformation work, was to complete the spreadsheet tool as it is described before, i.e. program the matrices for the weighting process (tables 5 and 6) and the summary with the final score (table 7).

3. "Running" DeCyDe-for-waste:

Local Authorities and local stakeholders are invited to "run" the tool. The groups should be small, no more than five people and should be diversified, i.e. groups composed of people of different position in Local structure (i.e. from Local Authority, from NGOs, business people dealing with waste management etc.

The role of the facilitator, i.e. the person that will "guide", facilitate the participants throughout the implementation of the DeCyDe –for-waste, is important. The facilitator has to be aware of local conditions, of the technical part on waste management and has to realize the role of "facilitator", i.e. not impose decisions, but just enable the participants to reach a decision.

The DeCyDe-for-waste incorporates four principles:

- **Clear** with no questions possible about the meaning of any procedure described or indicator or range presented;
- **Complete** and detailed enough to support itself, by providing results, i.e. the different scores for different decisions
- **Correct** since nothing is more important than accuracy in technical studies

- **Concise**, kept short, since decision makers, especially in Local Level, will not spend hours and hours trying on a decision support tool
- **Compelling,** as much as possible. The concept and the operation of the tool compels the users: it is easy to comprehend, avoids complex indicators and difficult technical vocabulary.

4. DeCyDe-for-waste innovations

The implementation of DeCyDe in waste management incorporates certain innovations:

1. Waste Management is not accepted as a sectoral, purely technical issue, but it is considered as part of a wider frame, the frame of sustainable development.
2. This is succeeded through a synoptic and concise approach: the effort is not to have a "complete but complex" tool, but an "effective and friendly" tool that is going to be used by decision makers so they will have a scientific background/ support when taking decisions and don't rely on their intuition and judgment and even interests
3. The decision makers who are going to use the DeCyDe-for-waste, will go through the entire list of indicators and will become conscious of the interrelation among all these different aspects, that have a role in development.
4. DeCyDe-for-waste is flexible and adaptive. It can be modified in order to serve in the optimum way local needs and local particularities.

5. Concluding remark

More than 10 years of implementing and improving simple decision support methods in real cases, led to the development of DeCyDe, a clear method and a friendly decision support tool, flexible to accommodate different kind of decision problems when multiple decision alternatives exist. It offers a framework that supports the decision makers and the stakeholders to understand and justify the main issues that are involved in the process of decision and the trade-offs between different decision alternatives. At the same time it gives them the chance to a real participation, i.e. to incorporate their views, evaluations and perspectives in the process through the weighting part.

DeCyDe is a multi – task/ multi-purpose/ multi-use decision support method.

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Tables

	ECONOMICS												
		Issue: Economic Opportunity											
1		Core indicators	Units	Scoring Ranges									
	6.5	1. Employment by sector	% Primary sector	>10%	11-20%	21-40%	41-60%	61-80%	<81%	No Data (N/D)			
				2	4	10	6	4	2		SCORE		
				2							2		
			%Secondary sector	>10%	11-20%	21-40%	41-60%	61-80%	<81%	No Data (N/D)			
				2	4	10	6	4	2		SCORE		
							6				6		
			%Tertiary sector	<10%	11-20%	21-40%	41-60%	61-80%	>80%	No Data (N/D)			
				2	4	10	6	4	2		SCORE	Ind. TOTAL SUM	
						10					10	18	
		2. Unemployment rate	%	>20%	15-19%	10-14%	5-9%	3-4%	<2%	No Data (N/D)			
				1	2	4	6	8	10		SCORE		
								8			8		
											Cat. TOTAL SUM	Cat. TOTAL SCORE	
			SUM	2	0	10	6	8	0		26	6.5	
2	Tourism		Units	Scoring Ranges									
	7.33	7. Tourism intensity	% of bed occupancy (annual)	0%	1-20%	21-40%	41-60%	61-80%	81-100%	No Data (N/D)			
				1	2	4	6	8	10		SCORE		
					2						2		
		8. Seasonality: Bed occupancy/ season	%(annual) from May to October	0 - 10%	10-20%	21-40%	41-60%	61-80%	81-100%	No Data (N/D)			
				1	4	6	10	6	1		SCORE		
							10				10		
			% (annual) from November to April	0 - 10%	10-20%	21-40%	41-60%	61-80%	81-100%	No Data (N/D)			
				1	4	6	10	6	1		SCORE	Ind. TOTAL SUM	
							10				10	20	
											Cat. TOTAL SUM	Cat. TOTAL SCORE	
			SUM	0	2	0	20	0	0		22	7.33	

Table 1: Economics: indicators and ranges for scoring

1	Air Pollution		Units	Scoring Ranges								
			No. of times limits are exceeded for PM10 (times/year, limit: 70%, 35 μg/m3))	>35 times	27-35 times	19-26 times	11-18	4-10 times	<4 times	No Data (N/D)		
				1	2	4	6	8	10		SCORE	
									10		10	
	9.5	1. Air Quality (according to 2008/50/EC, annex 2)	No. of times limits are exceeded for Nitrogen Dioxide (NO2), 70%, 140 μg/m3)	>18 times	17-12 times	11-6 times	5-3 times	2-1 times	0	No Data (N/D)		
				1	2	4	6	8	10		SCORE	
				0					10		10	
			No. of times limits are exceeded for Ozone (O3), 120 μg/m3, 8 hours per day, 25	>25 days	18-24 days	11-17 days	5-14 days	4-1 days	0 days	No Data (N/D)		
				1	2	4	6	8	10		SCORE	
								8			8	
			No. of times limits are exceeded for Sulphur Dioxide (SO2), 60%, 75 μg/m3	>3 times	2 times	1 time	0			No Data (N/D)		
				1	2	4	10				SCORE	
							10				10	
											Cat. TOTAL SUM	Cat. TOTAL
			SUM	0	0	0	10	8	20		38	9.5

2	Energy & Climate Change		Units	Scoring Ranges								
		6. Energy consumption	Tonnes of oil equivalent (TOE)/ capita	>5 TOE	4,1 to 5,0	3,1 to 4	2,1 to 3	1,1 to 2	1 TOE>	No Data (N/D)		
				1	2	4	6	8	10		SCORE	
											0	
	2.00	7. Greenhouse gas emissions	tonnes CO2 equivalent /capital	>12 t	10,1-12 t	10,1 - 8 t	8,1 - 10 t	6,1 to 8 t	6 t>	No Data (N/D)		
				1	2	4	6	8	10		SCORE	
							6				6	
		8. Share of renewable energy	% of renewable to total energy consumption	<5%	5,1-9%	9,1-13%	13,1-17%	17,1-20%	20,1%<	No Data (N/D)		
				1	2	4	6	8	10		SCORE	
											0	
											Cat. TOTAL SUM	Cat. TOTAL
			SUM	0	0	0	6	0	0		6	2.00

3	Land use		Units	Scoring Ranges								
			Urban areas: % of green areas/ parks	<=10	10,1-15%	15,1-20%	20,1-25%	25,1 - 30%	30,1%=<	No Data (N/D)		
				1	2	4	6	8	10			
					4				10			
	7	10. Area of built - up land	Rural areas: % of "artificialised areas (acc Corine Land Cover)	>=60%	60,1-45%	45,1-30%	30,1-19%	19-5%	5%<	No Data (N/D)		
				1	2	6	8	10	10		SCORE	
											0	
											Cat. TOTAL SUM	Cat. TOTAL
			SUM	0	4	0	0	0	10		14	7

4	Waste Management		Units	Scoring Ranges								
		12a. Waste production	kg / capita/ year	>600 kg	600 - 700 Kg	500-600 kg	400-500 kg	300-400 kg	300 kg=<	No Data (N/D)		
				1	2	4	6	8	10		SCORE	
					2						2	
		12b. Disposal method	% to landfills	>80%	79-60%	59-40%	39-20%	19-5%	5%<	No Data (N/D)		
				1	2	4	6	8	10		SCORE	
							6				6	
	4.80		% recycling	<4%	5-9%	10-19%	20-29%	30-39%	40%<	No Data (N/D)		
				1	2	4	6	8	10		SCORE	
						4					4	
			% incineration	<4%	5-9%	10-19%	20-29%	30-39%	40%<	No Data (N/D)		
				1	2	4	6	8	10		SCORE	
									10		10	
			% compost	<4%	5-9%	10-19%	20-29%	30-39%	40%<	No Data (N/D)		
				1	2	4	6	8	10		SCORE	Ind. TOTAL SUM
					2						2	22
											Cat. TOTAL SUM	Cat. TOTAL
			SUM	0	4	4	6	0	10		24	4.8

5	Water resources and Pollution		Units	Scoring Ranges								
		15. Wastewater threatment	% of waste water treated (tertiary treatment)	<30%	30,1 - 45%	45,1-60%	60,1 - 75%	75,1-90%	90%<	No Data (N/D)		
				1	2	4	6	8	10		SCORE	
									10		10	
	5.00	16. Quality of sediments and/or biota	% of monitoring points which DON'T comply with Environmental Quality Standards	>8%	7-8%	5-6%	3-4%	1-2%	0%	No Data (N/D)		
				1	2	4	6	8	10		SCORE	
											0	
											Cat. TOTAL SUM	Cat. TOTAL
			SUM	0	0	0	0	0	10		10	5

Table 2: Environment: indicators and ranges for scoring

SOCIAL														
1	Demography		Units	Scoring Ranges										
				>41%	36-40%	30-35%	26-30%	21-25%	20%<	No Data				
	4	1. Demographic dependency		1	2	4	6	8	10	(N/D)	SCORE			
						4					4			
											Cat. TOTAL SUM	Cat. TOTAL SCORE		
			SUM	0	0	4	0	0	0		4	4		
2	Equity		Units	Scoring Ranges										
		2. Actions for the promotion of equal opportunities and social inclusion	% of people covered by actions	<5%	1-20%	21-40%	41-60%	61-80%	81-100%	No Data				
	3.5			1	2	4	6	8	10	(N/D)	SCORE			
				1							1			
		3. Poverty	% under poverty limit	<30%	20-29%	10-19%	5-9%	3-4%	2%<	No Data				
				1	2	4	6	8	10	(N/D)	SCORE			
							6				6			
											Cat. TOTAL SUM	Cat. TOTAL SCORE		
			SUM	1	0	0	6	0	0		7	3.5		
3	Public Health and Safety		Units	Scoring Ranges										
				<10%	11-20%	21-40%	41-60%	61-80%	80%<	No Data				
	1	9. Provision of health care services	No. of doctors / 1000 inhabitans	1	2	4	6	8	10	(N/D)	SCORE			
				1							1			
											Cat. TOTAL SUM	Cat. TOTAL SCORE		
			SUM	1	0	0	0	0	0		1	1		

Table 3: Social: indicators and ranges for scoring

GOVERNANCE														
1	Policies/ strategies for sustainability		Units	Scoring Ranges										
		A sustainable development strategy which includes specific references to waste management, is in place		Yes	No	No Data (N/D)								
				10	1		SCORE							
							0							
		There is effective political support for the sustainability process.		Yes	No	No Data (N/D)								
	7.50			10	1		SCORE							
				10			10							
		There are integrated, sustainability development plans.		Yes	No	No Data (N/D)								
				10	1		SCORE							
				10			10							
		Guidelines have been produced by national, regional or local governments which advise planning authorities on appropriate waste management schemes		Yes	No	No Data (N/D)								
				10	1		SCORE							
				10			10							
							Cat. TOTAL SUM	Cat. TOTAL SCORE						
			SUM	30	0		30	7.50						
2	Monitoring tools for sustainability		Units	Scoring Ranges										
		There is regular monitoring of the waste management policies and practices		Yes	No	No Data (N/D)								
	10.00			10	1		SCORE							
				10			10							
		Reviewing and evaluating progress in implementing sustainability criteria in waste management exists		Yes	No	No Data (N/D)								
				10	1		SCORE							
				10			10							
							Cat. TOTAL SUM	Cat. TOTAL SCORE						
			SUM	20	0		20	10.00						
3	Human resources capacity building		Units	Scoring Ranges										
		Local/regional administrations have adequate capacity of staff to deal with sustainable waste management		Yes	No	No Data (N/D)								
				10	1		SCORE							
					1		1							
	0.67	Local/regional administrations have adequate expertise available to deal with waste management matters		Yes	No	No Data (N/D)								
				10	1		SCORE							
					1		1							
		Staff are trained on sustainable waste management matters.		Yes	No	No Data (N/D)								
				10	1		SCORE							
							0							
							Cat. TOTAL SUM	Cat. TOTAL SCORE						
			SUM	0	2		2	0.67						
4	Stakeholder involvement/ public participation		Units	Scoring Ranges										
		There is a public participation process involving all necessary stakeholders, including business.		Yes	No	No Data (N/D)								
	10.00			10	1		SCORE							
				10			10							
							Cat. TOTAL SUM	Cat. TOTAL SCORE						
			SUM	10	0		10	10.00						

Table 4: Governance: indicators and Yes/No/Don't know "scoring"

ECONOMICS

	Economic Opportunity		Tourism		Weight Coef
	score		score		
Economic Opportunity	1	0.9	9	0.9	0.90
Tourism	1/9	0.1	1	0.1	0.10
Total	1.11		10.00		1.00
Total check	1.00		1.00		

ENVIRONMENT

	Air Pollution		Energy & Climate Change		Land use		Waste Management		Water resources and Pollution		Weight Coef
	score		score		score		score		score		
Air Pollution	1	0.7	9	4/5	9	0.7	9	0.5	9	0.4	0.63
Energy & Climate Change	1/9	0.1	1	0.1	3	0.2	3	0.2	3	0.1	0.14
Land use	1/9	0.1	1/3	0.0	1	0.1	3	0.2	7	0.3	0.14
Waste Management	1/9	0.1	1/3	0	1/3	0.0	1	0.1	1	0.0	0.05
Water resources and Pollution	1/9	0.1	1/3	0	1/7	0.0	1	0.1	1	0.0	0.04
Total	1.44		11.00		13.48		17.00		21.00		1.00
Total check	1.00		1.00		1.00		1.00		1.00		

SOCIAL

	Demography		Equity		Public Health and Safety		Weight Coef
	score		score		score		
Demography	1	0.8	7	0.9	9	0.5	0.73
Equity	1/7	0.1	1	0.1	7	0.4	0.22
Public Health and Safety	1/9	0.1	1/7	0.0	1	0.1	0.05
Total	1.25		8.14		17.00		1.00
Total check	1.00		1.00		1.00		

GOVERNANCE

	Policies/ strategies for sustainability		Monitoring tools for sustainability		Human resources capacity building		Stakeholder involvement/ public participation		Weight Coef
	score		score		score		score		
Policies/ strategies for sustainability	1	0.1	3	0.2	7	0.9	1/9	0.0	0.30
Monitoring tools for sustainability	1/3	0.0	1	0.1	1/9	0.0	7	0.4	0.13
Human resources capacity building	1/7	0.0	9	0.7	1	0.1	9	0.5	0.34
Stakeholder involvement/ public participation	9	0.9	1/7	0.0	1/9	0.0	1	0.1	0.24
Total	10.48		13.14		8.22		17.11		1.00
Total check	1.00		1.00		1.00		1.00		

Table 5: Weighting of indicators per sustainability pillar

General Table

	Economics		Environment		Social		Governance		w eight coef
	score		score		score		score		
Economics	1.00	0.07	7	0.49	1/7	0.03	1/7	0.02	0.15
Environment	1/7	0.01	1.00	0.07	3	0.70	1/6	0.02	0.20
Social	7	0.46	1/3	0.02	1.00	0.23	7	0.84	0.39
Governance	7	0.46	6	0.42	1/7	0.03	1.00	0.12	0.26
Total	15.14		14.33		4.29		8.31		1.00
Total check	1.00		1.00		1.00		1.00		

Table 5: Weighting among sustainability pillars

Pillars	Weight Coef. Pillar	Criteria/ Issues	W. Coef. Issues	Final Weight Coef.	Criteria / issues Score	Final Issue Score
Economics	0.15	Economic Opportunity	0.90	0.14	6.5	**0.88**
		Tourism	0.10	0.02	7.3	**0.11**
						1.00
Environment	0.20	Air Pollution	0.63	0.13	9.50	**1.19**
		Energy & Climate Change	0.14	0.03	2.00	**0.06**
		Land use	0.14	0.03	7.00	**0.19**
		Waste Management	0.05	0.01	4.80	**0.05**
		Water resources and Pollution	0.04	0.01	5.00	**0.04**
						1.53
Social	0.39	Demography	0.73	0.28	4.00	**1.14**
		Equity	0.22	0.08	3.50	**0.30**
		Public Health and Safety	0.05	0.02	1.00	**0.02**
						1.45
Governance	0.26	Policies/ strategies for sustainability	0.30	0.08	7.50	**0.57**
		Monitoring tools for sustainability	0.13	0.03	10.00	**0.34**
		Human resources capacity building	0.34	0.09	0.67	**0.06**
		Stakeholder involvement/ public participation	0.24	0.06	10.00	**0.61**
						1.58
TOTAL	**1.00**		**FINAL SCORE**			**5.56**

Table 6: Final table: summary of weightings and final score