

74th MEETING OF THE EUROPEAN WORKING GROUP “MULTIPLE CRITERIA DECISION AIDING”



**Applying PROMETHEE and ELECTRE methods in selection of storage sites
of soil/rock excavation: case study of the Messina Strait Bridge project**

MCDA74 - 6-8 October 2011

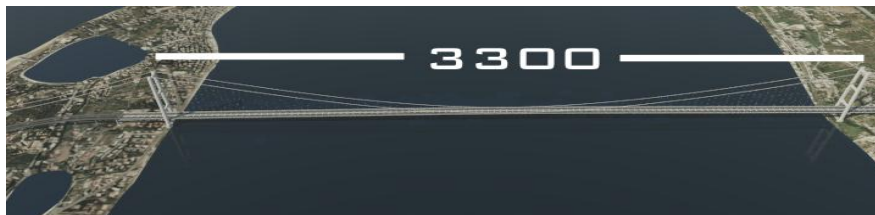
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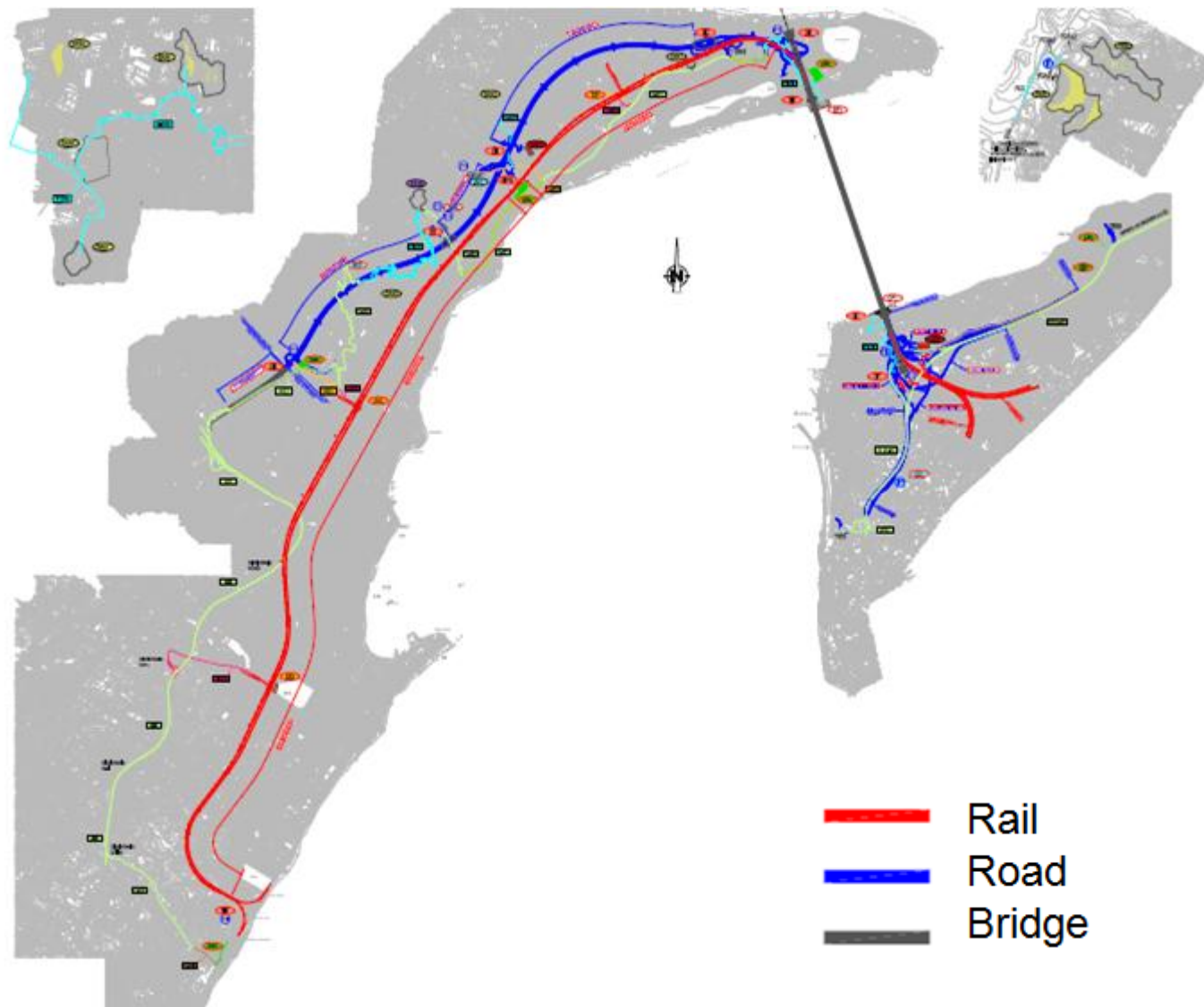
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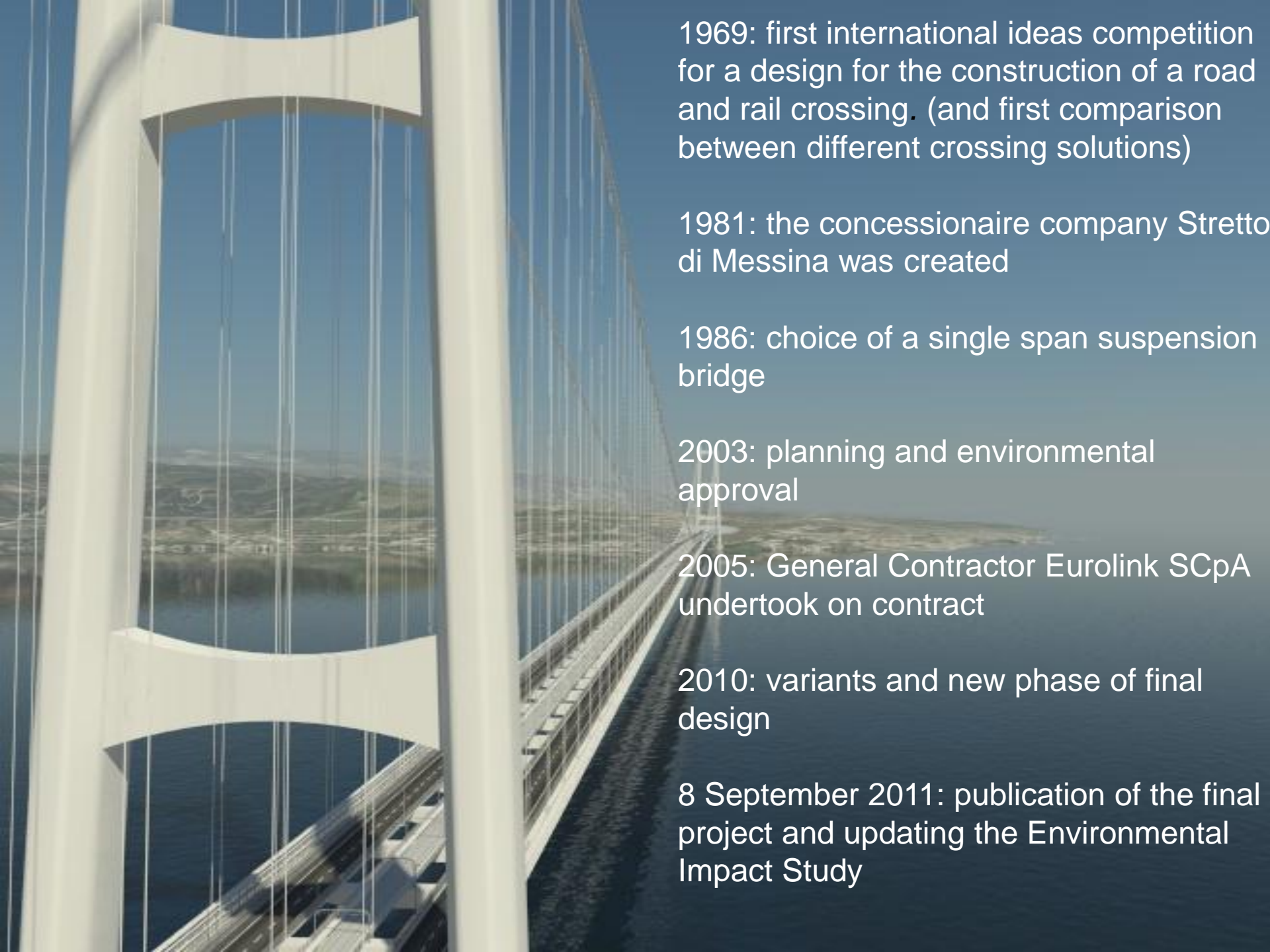


Geographical context



The project





1969: first international ideas competition for a design for the construction of a road and rail crossing. (and first comparison between different crossing solutions)

1981: the concessionaire company Stretto di Messina was created

1986: choice of a single span suspension bridge

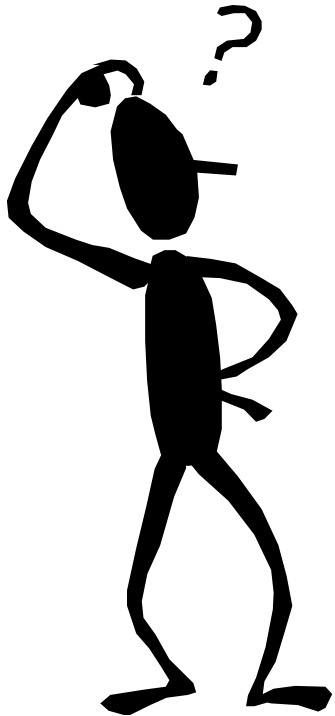
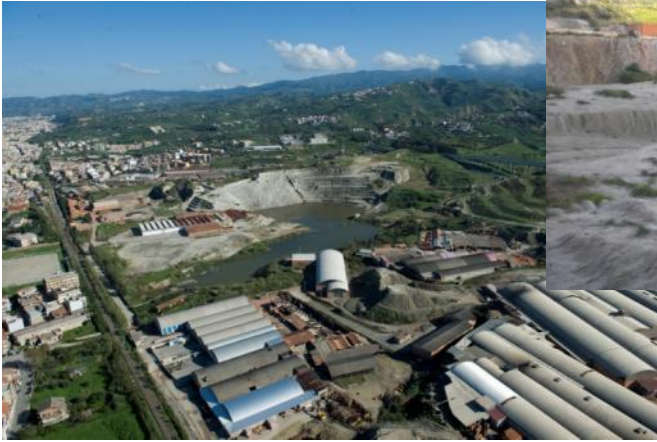
2003: planning and environmental approval

2005: General Contractor Eurolink SCpA undertook on contract

2010: variants and new phase of final design

8 September 2011: publication of the final project and updating the Environmental Impact Study

Selection and choice of sites



Input: technical specifications provided for the comparison

Performance

- morphology;
- capacity;
- soil capability for agricultural use;
- possible effects on road system to prevent the transit of heavy lorries on improper roads or in excessive amounts;
- interference that heavy lorries may have with towns and selection of those who have lower impacts;
- territorial distribution of the areas, in order to prefer those closest to production sites.

Normative

- Areas under national/regional parks jurisdiction ;
- Local parks approved by regional municipality; nature reserves and their buffer zones; wetlands;
- protection institutions provided by the Wildlife Management Plan;
- Cultural and Environmental Heritage, under D.Lgs. 42/2004;
- SCI under the Habitats Directive;
- networks and technological systems preservation;
- services preservation (cemeteries or military servitude);
- preservation of infrastructure networks and road corridors according to sector plans.

Environmental

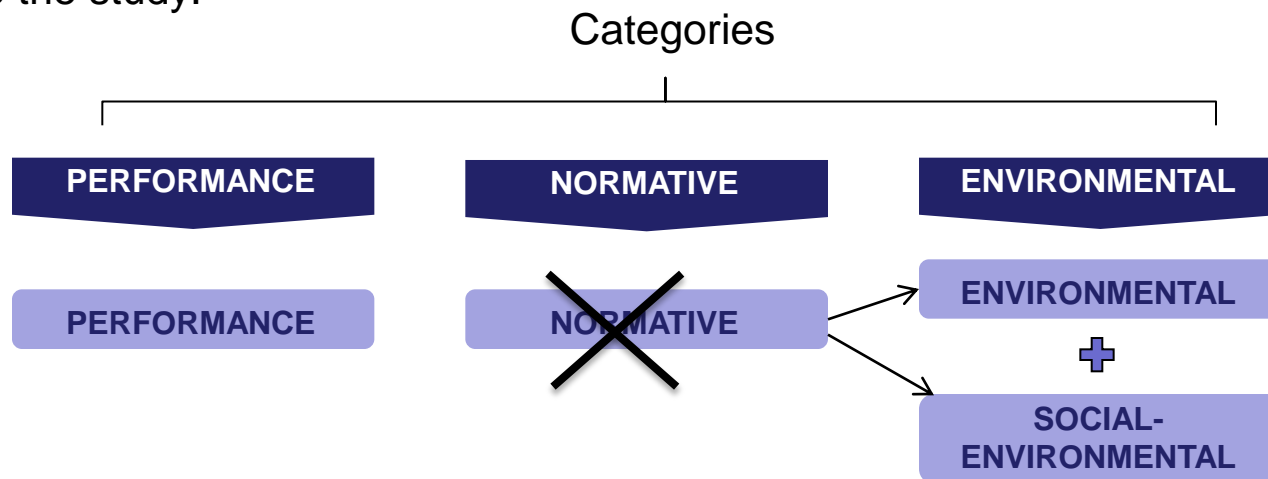
- The selection will prefer environmentally degraded or already compromised (quarries) areas and the location shall not include:
 - interference with used or potentially usable sources;
 - changes to the catchment area, natural or artificial;
 - damage to valuable sites from the standpoint of environment, landscape;
 - damage to valuable sites from the standpoint of ecosystem/territorial function ;
 - too close to residential areas that may suffer interferences due to the production of noise, dust, the passage of heavy lorries.

Some legal and environmental factors were not interpreted as elements of comparison, but rather of exclusion:

- networks and technological systems preservation;
- services preservation (cemeteries or military servitude);
- protection institutions provided by the Wildlife Management Plan;
- SCI under the Habitats Directive;
- interference with used or potentially usable sources;
- changes to the catchment area, natural or artificial;
- damage to valuable sites from the standpoint of environment, landscape or ecosystem/territorial function

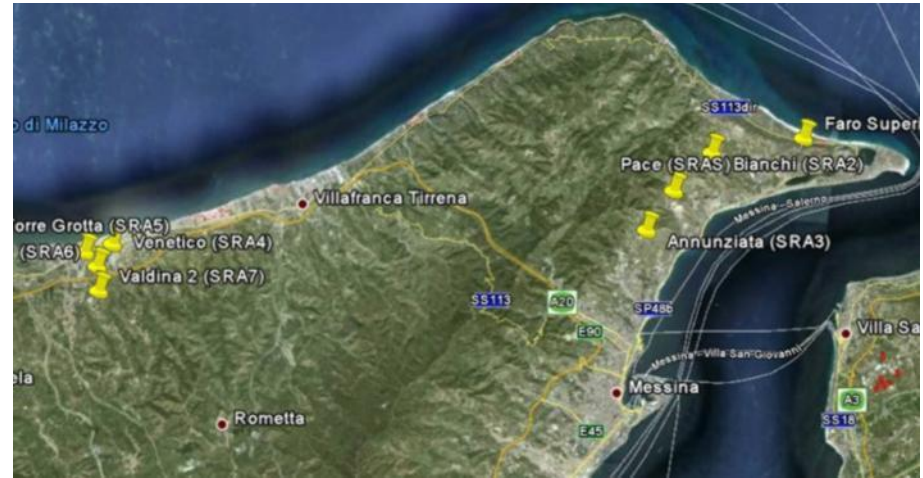


In addition, the categories and criteria defined by the technical specifications have been adapted to the study:



Sicily

N°	ACRONYM	NAME	LOCATION
1	SRA1	"Faro Superiore Nord"	Messina
2	SRA2	"Bianchi"	Messina
3	SRA3	"Annunziata"	Messina
4	SRA4	"Venetico"	Venetico
5	SRA5	"Torre Grotta"	Torregrotta
6	SRA6	"Valdina 1"	Valdina
7	SRA7	"Valdina 2"	Valdina



Calabria

N°	NAME	LOCATION
1	"Acqua Murata"	Fiumara
2	"Arghillà"	Reggio Calabria
3	"Campo Calabro"	Campo Calabro
4	"Covala 2 bis"	Bagnara Calabra
5	"Melicuccà 1" (CRA1)	Melicuccà
6	"Melicuccà 2" (CRA2)	Melicuccà
7	"Melicuccà 3"	Melicuccà
8	"Milanesi"	Calanna
9	"Rosali"	Reggio Calabria



Categories, criteria and indicators used

CATEGORIES	n°	ACRONYM	CRITERIA	Type	Measure	Aim
Performance	1	MOR	Morfology	QUAL	1-3	Max
	2	VOL	Capacity	QUANT	m ³	Max
	3	DIS	Distance	QUANT	km	min
	4	TEM	Travelling time	QUANT	minuti	Min
Environmental	5	ORR	Opportunities for recovery and remediation	QUAL	1-3	Max
	6	PAI	Environmental pressure on catchment area	QUAL	1-5	Min
	7	PVF	Environmental pressure on vegetation and flora	QUAL	1-5	Min
	8	PAE	Pressure on landscape	QUAL	1-5	Min
Social-environmental	9	RUM	Storage site pressure con residential areas due to noise and dust production	QUAL	1-5	Min
	10	LCC	Interference with soil capability for agricultural use	QUAL	1-5	Min
	11	TRF	Pressure on road system	QUANT	km	Min
	12	IMC	Interference between heavt lorries and residential areas	QUANT	n° buldings in 250 m	Min
	13	IAP	Occupancy of commercial, industrial areas	QUANT	ettari	Max
	14	RET	Preservation of infrastructure networks and road corridors according to sector plans.	QUAL	1-5	Max

Model and Result Analysis using two MC Methods (PROMETHEE and ELECTRE III)

**In order to improve our
knowledge about Model
Structuring and
Preference System elicitation**

**...and to propose simple
guidelines to the Italian
analysts and decision makers
who are interested in MCDA**

Model analysis

g_1 and g_{14} present the same evaluation for each action
and g_3 is strictly correlated to g_4
 q and p can be improved and veto threshold introduced

CATEGORIA	n°	SIGLA	CRITERI	Tipo	Unità di misura	Obiettivo	Funzione di preferenza	Peso	Peso criterio	peso elettro	q	p	veto	SRA1	SRA2	SRA3	SRA4	SRA5	SRA6	SRA7
Prestazionale	1	MOR	Morfologia dell'area	QUAL	1-3	Max	Usual	33	8,25	0,083	bet			3	3	3	3	3	3	3
	2	VOL	Volume abbancabile in modo stabile	QUANT	m³	Max	Linear		8,25	0,083				144.000	2.363.000	939.000	1.154.000	1.333.000	344.000	319.000
	3	DIS	Distanza dai siti di produzione	QUANT	km	min	Linear		8,25	0,083				0,30	7,00	4,00	35,45	35,45	35,45	35,45
	4	TEM	Tempi di percorrenza	QUANT	minuti	Min	Linear		8,25	0,083				1	9	5	32	32	32	32
Ambientale (ambiente naturale)	5	ORR	Opportunità recupero e riqualificazione	QUAL	1-3	Max	Usual	33	8,25	0,083				2	1	2	3	3	3	3
	6	PAI	Pressione su ambiente idrico	QUAL	1-5	Min	Level		8,25	0,083				1,0	1,5	1,5	1,0	1,0	1,0	1,0
	7	PVF	Pressione su vegetazione e fauna	QUAL	1-5	Min	Level		8,25	0,083				4	4	4	1	1	1	1
	8	PAE	Pressione sul paesaggio	QUAL	1-5	Min	Level		8,25	0,083				4	4	3	1	1	1	1
Socio-ambientale (ambiente antropico)	9	RUM	Pressione dell'area di deposito su centri abitati che possono subire disturbi dovuti alla produzione di rumori e polveri	QUAL	1-5	Min	Level	34	5,66667	0,057				5	4	2	2	3	1	1
	10	LCC	Interferenza con capacità d'uso del suolo ai fini agricoli	QUAL	1-5	Min	Level		5,66667	0,057				3	3	5	2	2	2	1
	11	TRF	Pressione sulla viabilità pubblica	QUANT	km	Min	Linear		5,66667	0,057				0	4,75	4	2,2	2,2	2,2	2,2
	12	IMC	Interferenza dei mezzi di trasporto del marino e centri abitati attraversati	QUANT	n° edifici in fascia 250 m	Min	Linear		5,66667	0,057				113	1.579	822	3.135	3.401	3.141	3.171
	13	IAP	Interessamento di attività produttive (commerciale, artigianato, industriale)	QUANT	ettari	Max	Linear		5,66667	0,057				0	0	0	7,2	6,4	6,2	2,7
	14	RET	Silvoparchia di reti infrastrutturali, infrastrutture esistenti della mobilità, tracciati e corridoi stradali previsti dai piani di settore	QUAL	1-5	Max	Level		5,66667	0,057				5	5	5	5	5	5	5

Sicily model and its results



Graphe final

sra4

sra5
sra7

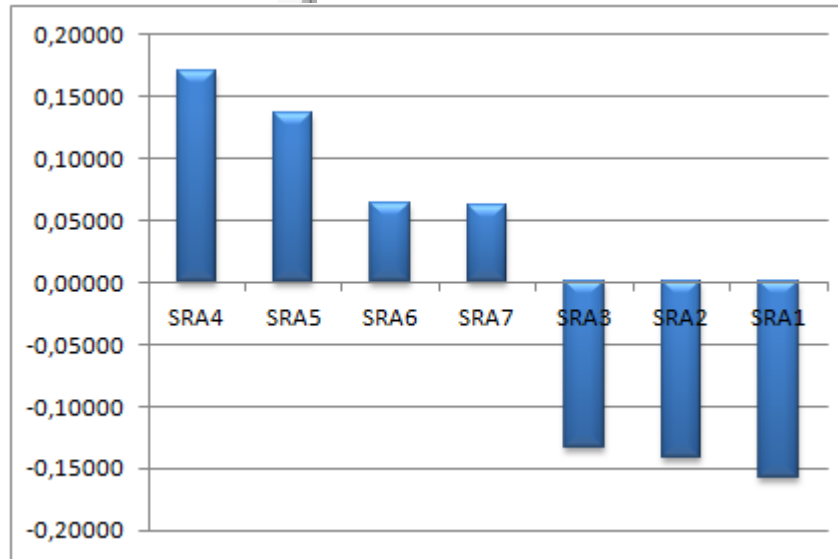
sra6

sra2

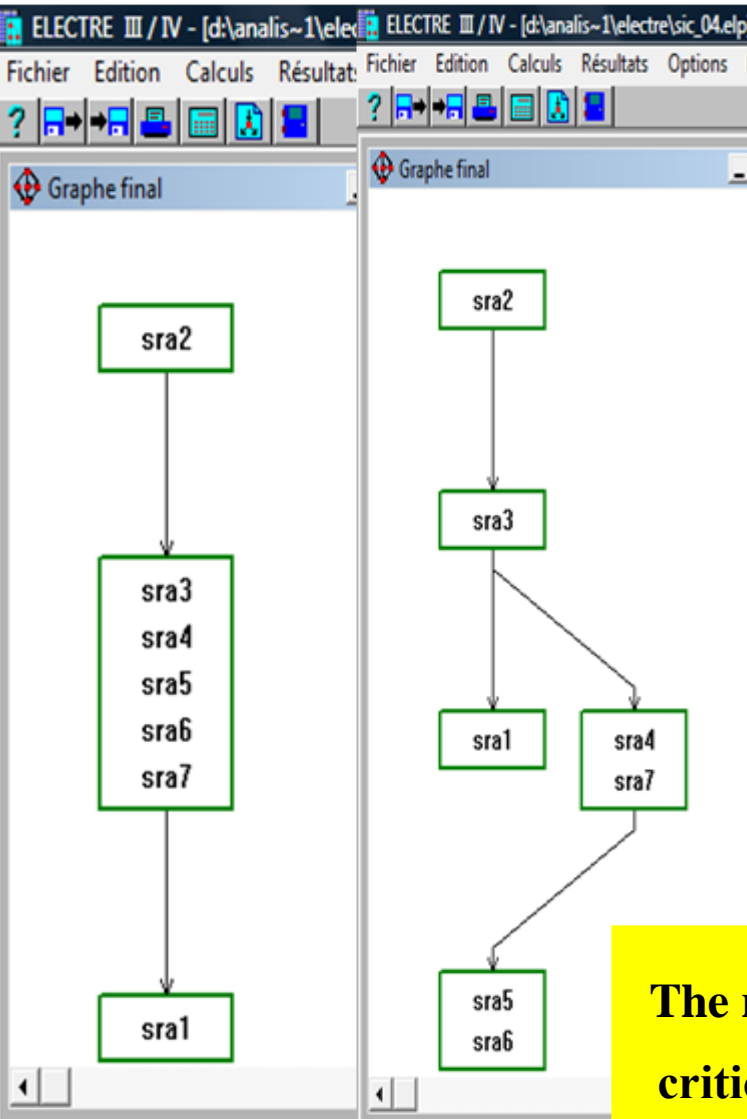
sra1

sra3

ELECTRE III and Promethee II (13 criteria, original importance coefficients, indifference and preference thresholds)

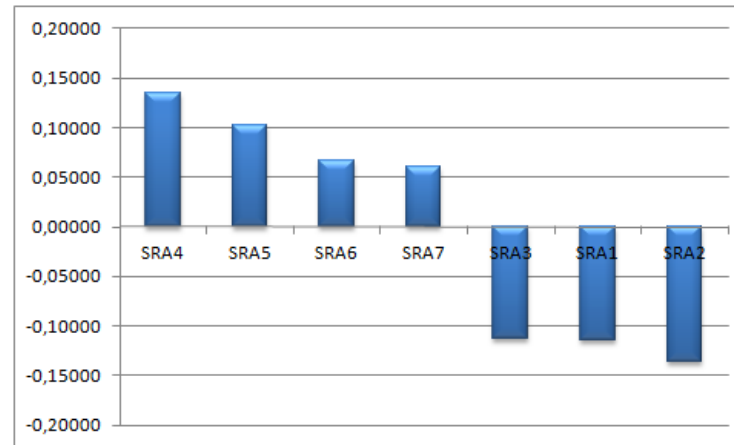


Ranking	Alternative	ϕ	ϕ^+	ϕ^-
1	SRA4	0,17000	0,30053	0,13053
2	SRA5	0,13607	0,28774	0,15168
3	SRA6	0,06363	0,24390	0,18028
4	SRA7	0,06225	0,25670	0,19444
5	SRA3	-0,13267	0,22852	0,36119
6	SRA2	-0,14145	0,23528	0,37673
7	SRA1	-0,15782	0,21193	0,36975



ELECTRE III and Promethee II

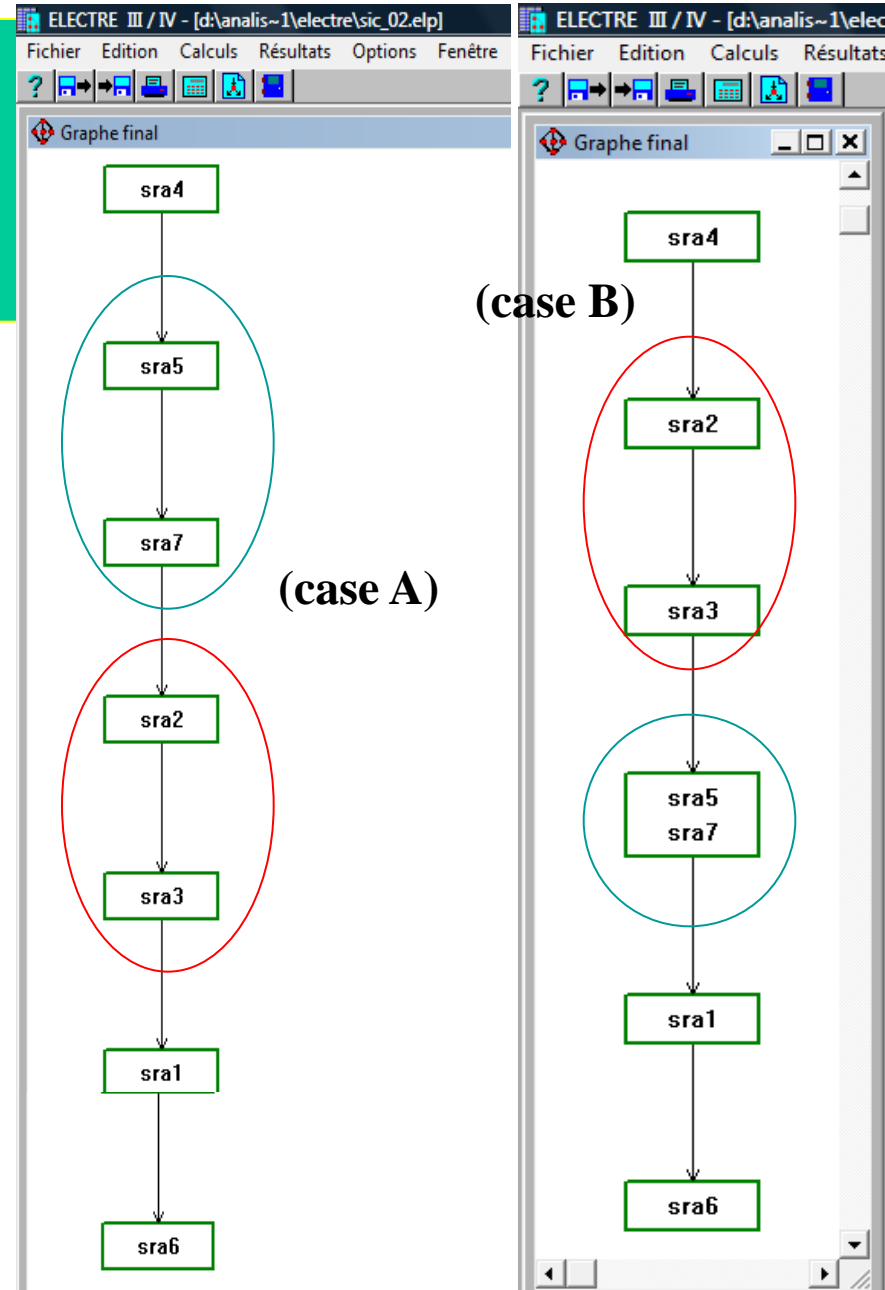
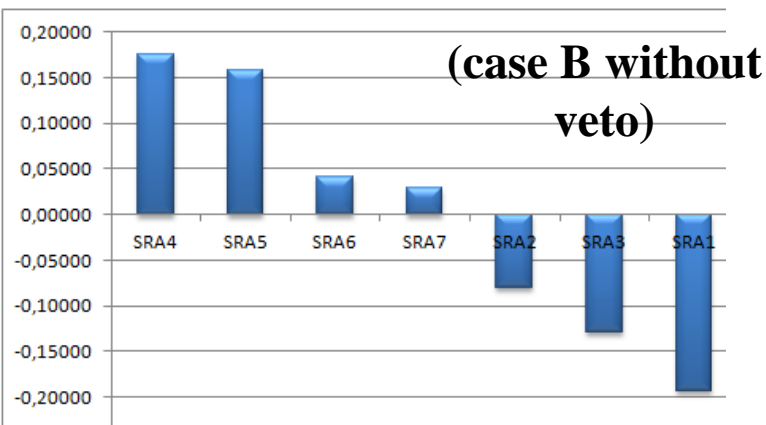
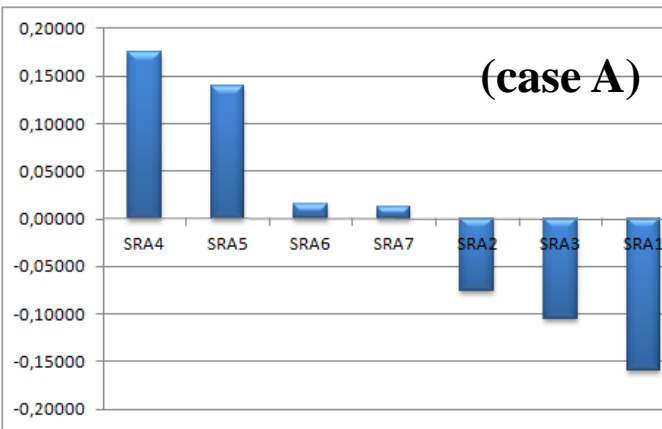
14 criteria and their importance coefficients,
new indifference and preference thresholds and
two variants of veto thresholds (three criteria)



The results of the ELECTRE III applications present some critical elements, they are not “clear“, are hardly sensitive to the veto variants and the position of an action (sra2) is strange in both the results

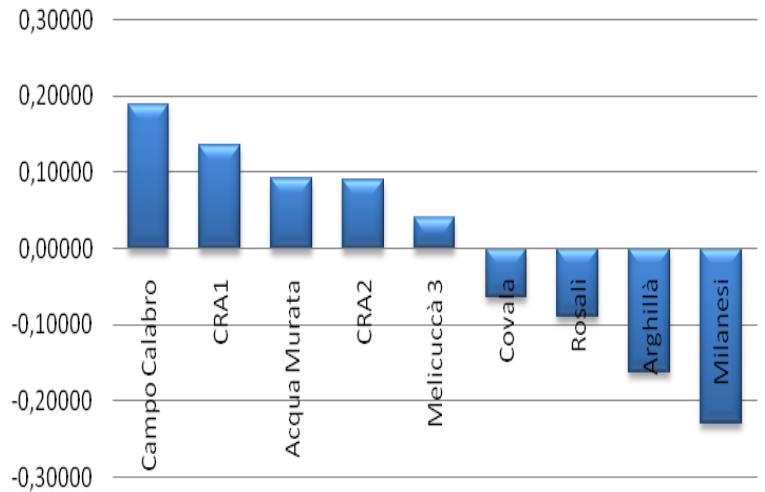
New model and new thresholds

A new model with 11 criteria, original q and p thresholds (case A) or new q and p and veto thresholds (case B)

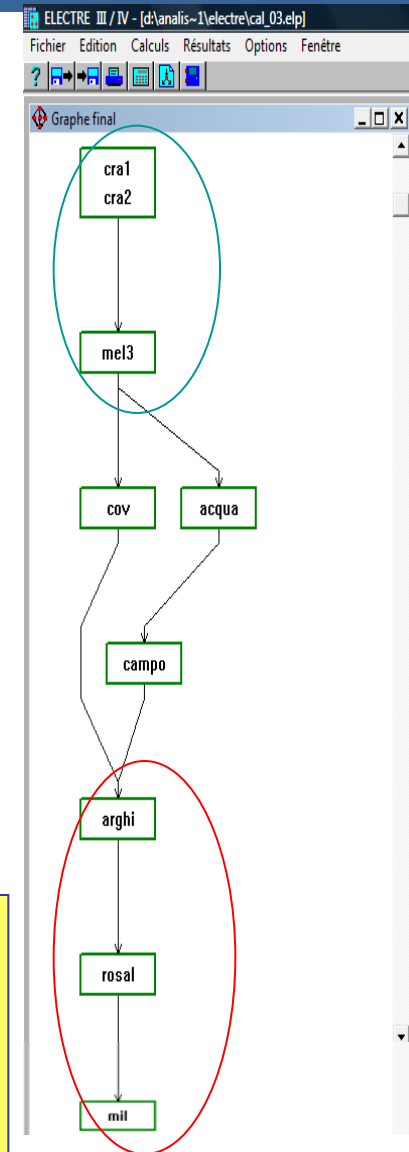


Alternative actions (9) in Calabria

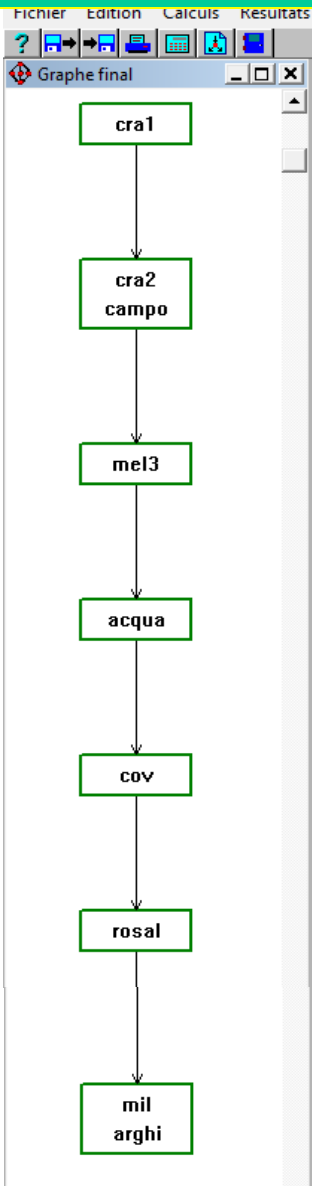
- Promethee II



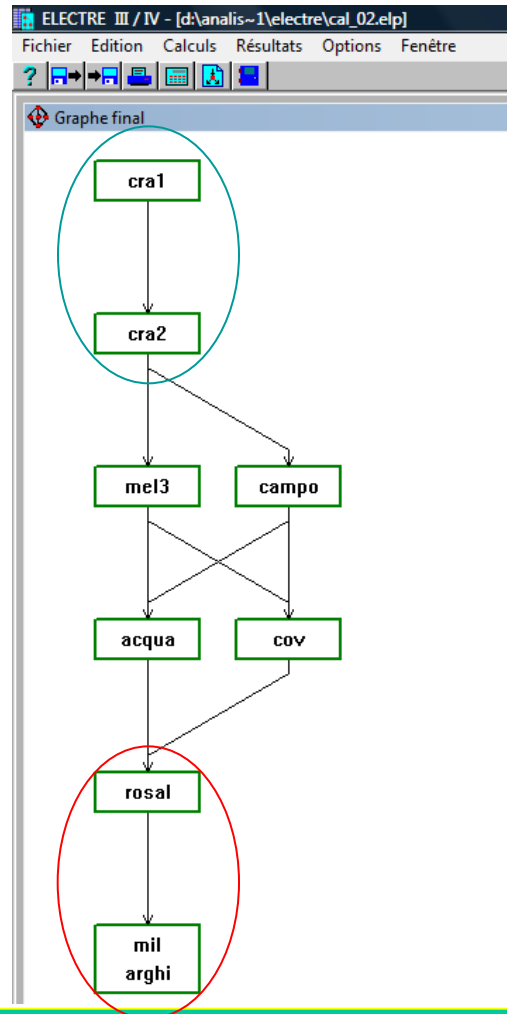
Only one result from two ELECTRE III applications to the original model of Promethee (14 criteria and their importance coefficients) with new indifference and preference thresholds and two variants of veto thresholds on three criteria



13 criteria, only q and p thresholds



11 criteria, q p and veto thresholds



11 criteria, only q and p thresholds

