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Research Article

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Multicriteria Evaluation and Geographic Information Systems

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Multicriterion Gis

Setting-up of the integral center of processing residue for the metropolitan area in Rosario city.

- In chapter I, the systems of Geographical information is introduced.
- In chapter II, the development and application of two mathematical models of support for the decision based on the method ELECTRE and that of Analytical Organized into a hierarchy Processes known as method AHP is presented.
- In chapter III, a precise application to arrive at specific results is presented.

Multicriterio Evaluation

"The Multicriteria evaluation can be defined as a set of techniques pointing to help in the processes of taken decisions"

The Criteria

The criteria are one of the most important elements of the MCE, in which it correct choice will largely depends of the success or failure of the developed evaluation.

As its name indicates, Multicriteria support to the decision, consists of supporting a decision-making process, through recommendations of courses of actions, to who will make the decision.

Basic Concepts for the Application of Multicriteria Methods

The best paretiana criterion
The normalization of the criteria
The preferential deliberation of the criteria

The criterion of the best paretiana

"A collectivity is in an ideal condition if any member of this collectivity can improve their situation without worsening the situation of any another person of the same collectivity."

The normalization of the criteria

In the most of decisive problems the criteria is found in different units.

The preferential deliberation of the criteria

The relevant criteria in a decisive problem can have different degree of importance for the central decision maker.

Techniques of Evaluation Multicriterion Method Electre

It compares alternatives for pares among all the alternatives, so that it eliminates a subset of them and chooses the one that brings together the majority of the criteria.

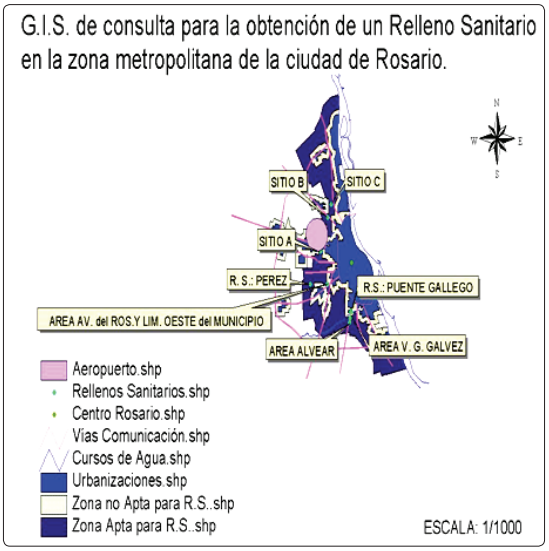
Analytical processes organized into a hierarchy

This method is stratified in three levels or hierarchies. The first one corresponds to the intention of the problem, the second one to the criteria and the third one to the alternatives or possible choices.

Application of the Technologies of Multicriterion Evaluation Setting-Up of the Integral Centre of Processing Residue for the Metropolitan Area in Rosario City

Alternatives

- Site 1: Area of Av. Rosario and its boundaries West of town
- Site 2: Villa Gobernador Gálvez
- Site 3: Alvear
- Site 4: Pérez
- Site 5: Gallego Bridge
- Site 6: Site A
- Site 7: Site B
- Site 8: Site C



Criteria of exclusion

- Minor nearness of 800 mtrs to a populated area, or future urbanizations; and industries of food products.
- Accesses to the landfilling that are less than 100 m. away from the entrance in habitated places (way is taken from the point where the traffic of the trucks alters the conditions of traffic flow).
- Protection areas of zones of important wells for the supply of drinkable water; and resources of important underground waters.
- Easily flooded areas
- Unstable reasons
- Absence of clayey soils like natural geological barrier against filtrations.
- Areas of national parks, important flora and fauna reserves, natural forests, or other national belongings.
- Minor distance of 2,5 km to Airports measured in radial way.
- We can conclude that the SIG, represent an important tool of planning for the management of spatial information. These systems do not offer adapted solutions yet for certain problems of analysis and of spatial modeling.
- In reference to our approach, the need of integration between SIG and EMC, is a fact with trend of development to solve this type of problems.

Considered criteria

- Accessibility and connectivity
- Distance to existing ways
- Topography
- Quality of the soil
- Surface

Although it is not possible to speak of the best method for estimating preferential weights, however, as long as the characteristics of the decision-making centre allow a structured interaction, AHP-type methods (hierarchical analytical processes) based on pair comparisons seem to offer a greater solidity with respect to other alternative methods.

Application of the Method Electre

Step 1: Decisional matrix

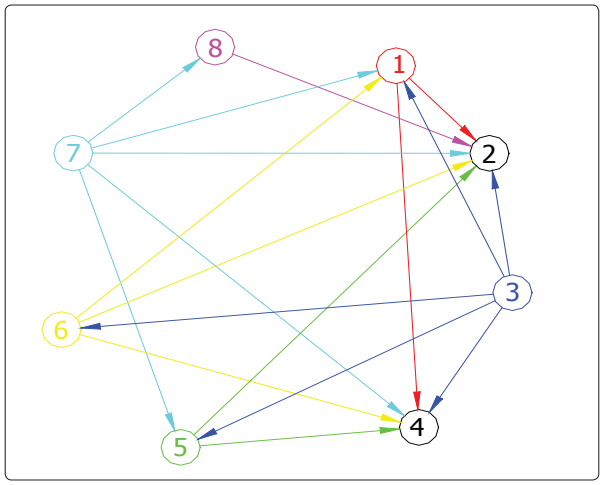
	ATRIBUTOS				
ALTERNATIVE	**ACCESSIBILITY AND CONNECTIVITY [MTRS]**	**DISTANCE TO EXISTING ROADS [MTRS]**	**TOPOGRAPHY [SCALE 1-3]**	**QUALITY [SCALE 0 o 1]**	**SURFACE [HA]**
SITE 1	10500	0	2	0	24
SITE 2	11300	0	1	0	48
SITE 3	8000	100	1	0	72
SITE 4	12500	2500	2	0	63
SITE 5	10000	0	1	1	45
SITE 6	10500	1000	2	1	65
SITE 7	9500	200	3	0	40
SITE 8	11000	300	3	0	26

Operating, of such a way we obtain the following weight

W1 (Acc. y Conect.) = 0.50
W2 (Topography) = 0.26
W3 (Surface) = 0.13
W4 (Dist. a existing ways) = 0.06
W5 (Quality) = 0.03

Step 9: Aggregate dominance matrix

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5	SITE 6	SITE 7	SITE 8
SITE 1		1	0	1	0	0	0	0
SITE 2	0		0	0	0	0	0	0
SITE 3	1	1		1	1	1	0	0
SITE 4	0	0	0		0	0	0	0
SITE 5	0	1	0	1		0	0	0
SITE 6	1	1	0	1	0		0	0
SITIO 7	1	1	0	1	1	1		1
SITE 8	0	1	0	0	0	0	0	



Below are listed the weights obtained in both hierarchical levels 2 and 3 as standard weights.

	CRITERIA					
	ACCESSIBILITY AND CONNECTIVITY [0.50]	DISTANCE TO EXISTING ROADS [0,06]	TOPOGRAPHY [0,26]	QUALITY [0,03]	SURFACE [0,13]	GLOBAL WEIGHTS
SITE 1	0,09	0,18	0,12	0,06	0,03	0,09
SITE 2	0,06	0,18	0,03	0,06	0,08	0,06
SITE 3	0,36	0,18	0,03	0,06	0,31	0,24
SITE 4	0,03	0,02	0,12	0,06	0,21	0,08
SITE 5	0,14	0,18	0,03	0,33	0,08	0,11
SITE 6	0,09	0,05	0,12	0,33	0,21	0,12
SITE 7	0,18	0,11	0,27	0,06	0,07	0,18
SITE 8	0,05	0,10	0,27	0,06	0,02	0,10

Site 1: 0,50 x 0,09 +0,06 x 0,18 + 0,26 x 0,12 + 0.03 x 0.06 + 0,13 x 0,03= 0,09.

Conclusion

- Along the present work of investigation we have demonstrated how to choose the best viable and objective decision I according to a specific territorial problem.
- To such an end the so called Geographical Information Systems (GIS) have been applied, allowing to mention zones, and of consulting graphical and thematic operations at the same time; being their fundamental incorporation in the managing of information and spatial components.
- The integration of the GIS with the technologies MCE is then an important tool in the processes of planning, forecasting and control of the uses of the soil by means of a suitable distribution of the territory activities and the study of the environment.
- It is important to emphasize that the methods of Multicriteria support to the decision do not substitute the human element when a decision has to be taken, this one continues being the fundamental element of the decision-making process since on its preferences depends the result is being looked for.
- In the application, it was allowed integrate in a coherent and practical way a very important aspect in the current planning such as the different approaches referred to the same problem based on the multidimentionalty of criteria. Therefor complex spatial problems could be analyzed spatial and they could be compared to different points of view.
- As both currents developed in Multicriteria methods (ELECTRE-AHP) we can see that the results obtained in an order of merit were of the same importance. Both methods appear then widely, intensely, neatly, and allow to reduce the size of the set of efficient solutions [1-12].

References

1. Barredo Cano J I (2005) Geographic Information Systems, and Multicriteria Evaluation in the ordering of the Territory, Madrid, Spain, Editorial Ra-Ma.
2. Romero C, Multicriteria Decision Analysis, Madrid, Spain, Editorial Isdefe.
3. Barba-Romero S, Manual for multi-criteria decision making, Santiago, Chile, Latin American and Caribbean Institute of economic and social planning.
4. Sánchez Granel A (2011) Notes on Urban Solid Waste, Buenos Aires, Argentina, Pontificia Universidad Catolica Argentina.
5. Arias Rey J L, Buitrago Rey J A (2012) Social Criteria for the selection of the location of a sanitary landfill (case Area Metropolitan of Bucaramanga). Colombia, Revista dixi At 82.
6. Jaramillo J (2002) A solution for the final disposal of waste in small town, Antioquia, Colombia.

7. Olaya V (2014) Geographic Information Systems, Girona, Spain.
8. Hurtado T, Bruno G (2005) The Hierarchical Analysis Process (AHP) as a Tool for Decision Making in the Selection of Suppliers, Lima, Peru, Universidad National Mayor de San Marcos.
9. Incociv (2016) Survey of Current Management Conditions of Waste, from each Municipality, Entre Rios, Argentina, Secretary of Environment.
10. National Law 25.916 (2004) Household waste management.
11. Provincial Law No. 10311 (2014) Integral solid waste management. urban Entre Rios, Argentina.
12. Ordinance 49/99 (1999) Household waste management. Crespo, Entre Rios.