

<p>Measuring the Digital Integration of EU Coastal and Marine Policies Using an MCDA Method <i>(Christiana Koliouka, Zacharoula Andreopoulou)</i></p>	<p>“Cercetări Marine” Issue no. 50 Pages 47 - 53</p>	<p>2020</p>
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MEASURING THE DIGITAL INTEGRATION OF EU COASTAL AND MARINE POLICIES USING AN MCDA METHOD

Christiana Koliouka, Zacharoula Andreopoulou

*Laboratory of Forest Informatics
Faculty of Forestry and Natural Environment, Aristotle University of Thessaloniki
P.O. Box 247, 54124 Thessaloniki, Greece,
E - Mail address: ckoliou@for.auth.gr*

ABSTRACT

This paper aims to measure the digital integration of coastal and marine policies in the Member – States of European Union (EU), using a Multiple Criteria Decision Analysis (MCDA). Multiple Criteria Decision Analysis methods are strongly associated with EU environmental policies and their decision-making process, and it can reduce the uncertainty in planning by producing highly efficient solutions. The Preference Ranking Organization METHod for Enrichment Evaluations (PROMETHEE) along with Geometrical Analysis for Interactive Decision Aid (GAIA) analysis, through Visual PROMETHEE software, were used to provide a ranking of the EU policies about coastal and marine environment in their digital performance drawing on their ICT implications. Findings confirm that the impact of ICT on EU coastal and marine policies is getting stronger since 2010, but it is still in initial level. Digital integration constitutes an efficient tool to promote the progress towards the Sustainable Development Goals (SDGs) and at the same time, contributes to better quality of life. The introduction of innovative ICT solutions, including network connection and services is an essential factor to achieve synergy in terms of an e-innovation society.

Key-Words: EU policies, coastal and marine policies, digital integration, MCDA method, PROMETHEE, GAIA, Visual PROMETHEE

AIMS AND BACKGROUND

The term Information Communication Technology (ICT) is widely considered as a type of technology used for displaying, creating, manipulating, storing and exchanging information (Liburd and Christensen, 2013; Chen et al., 2019). Undoubtedly, ICT characteristics can make a significant contribution to the processes of all sectors, providing innovative tools, media and friendly environments for being creative and sustainable (Loveless, 2007; Zhou and Purushothaman, 2019). ICT have created an important impact on all aspects of human life from basic survival needs to transformation of an “Industrial” to “Global Connected” world (Solanki and

Nayyar, 2019). ICT constitutes a vital catalyst for driving economy forward in developed countries and strengthens economic development entrepreneurship through innovation, productive capacity and development of trade (Morrar et al., 2019). However, innovation in environment-friendly technologies, the so called green technologies, is crucial to achieve sustainability (Cesere et al., 2019). In particular, green Information Technology (IT) is primarily focused on efficient energy utilization and equipment usage, while green Information Systems (IS) deals with the design and implementation of IS for the sustainable process management and the creation of opportunities regarding productivity enhancement, profitability enhancement and cost reduction (Boudreau et al., 2008; Ziemba, 2019). The European Commission (EC) has already addressed issues linked with energy efficiency through ICT and establishes three conditions required for encouraging sustainable behaviour: supporting management processes, the provision of economic development incentives, a high level of information and communication (Bastida et al., 2019). As for the European Union (EU) maritime policy, EU can achieve higher returns from seas and oceans in a sustainable way through the coordination of its actions and its policies by incorporating individual fields such as aquaculture and fisheries, seaports and shipping, offshore energy, marine environmental research, shipbuilding and peripheral activities, coastal and maritime tourism, maritime surveillance, coastal area development, employment and external relations in maritime affairs (EU, 2018).

This paper aims to evaluate the EU policies on maritime affairs and fisheries according to their ICT implications and present the current status. It is applied the Preference Ranking Organization METHod for Enrichment Evaluations (PROMETHEE) and Geometrical Analysis for Interactive Decision Aid (GAIA), through Visual PROMETHEE software, to rank the EU policies while this total ranking is validated and sensitivity analysis is conducted.

EXPERIMENTAL

EU coastal and marine policies were retrieved by the official website of European Union (www.europa.eu). In the beginning, all the coastal and marine policies (the directives, the regulations, the communications the decisions, etc.) were recorded. The next step was to develop a 2-dimensional table aiming to find out the fulfillment or not of the criteria that EC adopts to evaluate the ICT adoption on EU policies since 2010 (EC, 2010). These criteria form the variables X1, X2, ..., X12 (Table 1).

Furthermore, the digital integration was measured and the EU coastal and marine policies were ranked with the application of the multicriteria analysis PROMETHEE II. PROMETHEE is a prescriptive method that

allows to rank the actions/cases according to the preferences of the decision-maker (Mareschal and De Smet, 2009).

Table 1. Criteria (Koliouka and Andreopoulou, 2020)

Category	Variable	Criteria
Dependence on the ICT solutions	X₁	Does the legislation require the design of information rich processes?
	X₂	Does the legislation require the design of new business processes?
	X₃	Are large amounts of data gathering required in these processes?
	X₄	Is collaboration between ICT systems of multiple DG's or institutions/ organizations required?
	X₅	Is the legislation concerning ICT systems or is ICT a supporting function of the legislation?
Complexity of the ICT solutions	X₆	Does the legislation require new ICT solutions or can existing applications fulfill the requirements?
	X₇	Are there any legacy systems which might hamper the implementation?
	X₈	Does the legislation impose authentication requirements?
	X₉	Is a large amount of data exchange between Member States and/or the Commission required?
	X₁₀	What is the required lead -time of the implementation (urgency)?
	X₁₁	Are new interoperability specifications required?
	X₁₂	Does the initiative impose high security requirements on the ICT solution?

The PROMETHEE is implemented in four steps (Yu et al., 2013): a) define preference function; b) calculate preference index; c) construct valued outranking graph; d) rank alternatives / cases according to the valued outranking graph.

One of the most important steps in MCDA methods is the determination of the weights of the criteria (Tsolaki-Fiaka et al., 2018). Brans and Mareschal (2005) and Andreopoulou et al. (2017) provide a more detailed description of the PROMETHEE II method.

Finally, the application of PROMETHEE method results in partial rankings or total ranking of the alternatives, while the application of GAIA method results in a graphical representation of the decision problem (Macharis et al., 1998). GAIA analysis uses the unicriterion net flows (Mareschal and De Smet, 2009) and the principal components analysis (PCA), a widely used dimension-reduction technique (Mareschal, 2013).

RESULTS AND DISCUSSION

The research through the official website of (EU) (www.europa.eu) resulted in the collection of 60 coastal and marine policies. The partial rankings of the 60 EU coastal and marine policies based on the calculation of the two preference flows (Phi+ and Phi-) are presented in Figure 1.

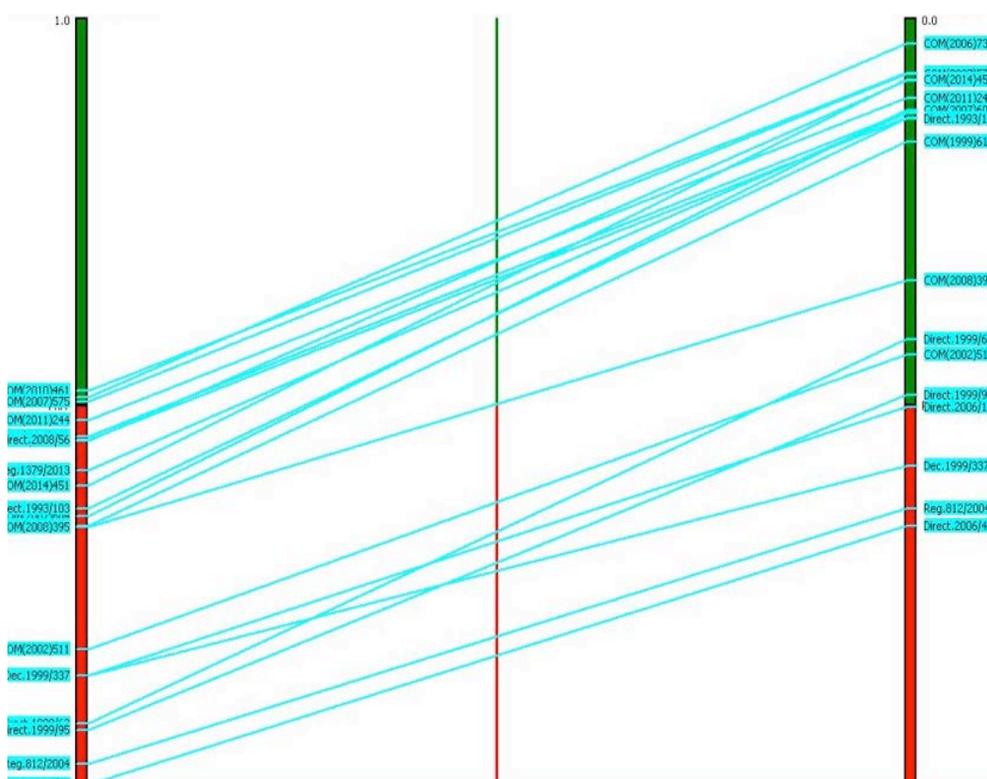


Fig. 1. Partial ranking of EU coastal and marine policies

The GAIA plane is presented in Figure 2. The red line represents the decision axis, i.e. the direction of the optimal solution based on the already defined weight vectors.

- MCDA and GAIA methods produce similar results concerning the scenario ranking

Findings confirm that the digital integration of EU coastal and marine policy is strengthening since 2010, but it is still in initial level. The methodology used in this research forms an effective planning tool for EU policy makers regarding the assessment of ICT integration on coastal and marine policies. Furthermore, these findings can constitute a helpful tool for the decision makers because they can use as benchmarks the superior EU coastal and marine policies in planning future policies with reference to sustainable development. Digital integration constitutes an efficient tool to promote the progress towards the Sustainable Development Goals (SDGs) and at the same time, contributes to better quality of life (ITU, 2018). The introduction of innovative ICT solutions, including network connection and services is an essential factor to achieve synergy in terms of an e-innovation society (Koliouka and Andreopoulou, 2016).

REFERENCES

- Andreopoulou Z, Koliouka C, Zopounidis C (2017), *Multicriteria and Clustering: Classification Techniques in Agrifood and Environment*. Springer, Switzerland
- Bastida, L., Cohen, J. J., Kollmann, A., Moya, A., and Reichl, J. (2019), Exploring the role of ICT on household behavioural energy efficiency to mitigate global warming. *Renewable and Sustainable Energy Reviews*, **103**: 455-462.
- Boudreau, M. C., Chen, A., and Huber, M. (2008), *Green IS: Building sustainable business practices*. Information systems: A global text, 1-17.
- Brans, J. P., and Mareschal, B. (2005), PROMETHEE methods. In *Multiple criteria decision analysis: state of the art surveys* (pp. 163-186). Springer, New York, NY.
- Cecere, G., Rexhäuser, S., and Schulte, P. (2019), From less promising to green? Technological opportunities and their role in (green) ICT innovation. *Economics of Innovation and New Technology*, **28** (1): 45-63.
- Chen, L., Chen, T. L., Lin, C. J., and Liu, H. K. (2019), Preschool Teachers' Perception of the Application of Information Communication Technology (ICT) in Taiwan. *Sustainability*, **11** (1): 114.
- EC (2010), *Method for Assessing ICT Implications of EU legislation*. Available on <http://ec.europa.eu> (14/6/2020)
- EU (2018), *The Integrated Maritime Policy*. Available on: <http://www.europarl.europa.eu> (14/6/2020)

- ITU (2018), ICTs for a Sustainable World. Available on: <https://www.itu.int> (14/6/2020)
- Koliouka, C. and Andreopoulou, Z. (2016), Classification of ICT in EU Environmental Strategies. *J Environ Prot Ecol*, **17** (4): 1385-1392.
- Koliouka, C. and Andreopoulou, Z. (2020), A Multicriteria Approach for Assessing the Impact of ICT on EU Sustainable Regional Policy. *Sustainability* 2020, **12**: 4869.
- Liburd, J. J., and Christensen, I. M. F. (2013), Using web 2.0 in higher tourism education. *Journal of Hospitality, Leisure, Sport and Tourism Education*, **12** (1): 99-108.
- Loveless, A. (2007), Preparing to teach with ICT: subject knowledge, Didaktik and improvisation. *The Curriculum Journal*, **18** (4): 509-522.
- Macharis, C., Brans, J. P., and Mareschal, B. (1998). The GDSS promethee procedure. *Journal of decision systems*, **7** (4): 283-307.
- Mareschal, B. (2013), Visual PROMETHEE 1.4 Manual. Visual PROMETHEE, 1.
- Mareschal, B., and De Smet, Y. (2009), Visual PROMETHEE: Developments of the PROMETHEE and GAIA multicriteria decision aid methods. In *Industrial Engineering and Engineering Management, 2009. IEEM 2009. IEEE International Conference on* (pp. 1646-1649). IEEE.
- Morrar, R., Abdeljawad, I., Jabr, S., Kisa, A., and Younis, M. Z. (2019), The Role of Information and Communications Technology (ICT) in Enhancing Service Sector Productivity in Palestine: An International Perspective. *Journal of Global Information Management (JGIM)*, **27** (1): 47-65.
- Tsolaki-Fiaka, S., Bathrellos, G. D., and Skilodimou, H. D. (2018), Multi-Criteria Decision Analysis for an Abandoned Quarry in the Evros Region (NE Greece). *Land*, **7** (2): 43.
- Yu, X., Xu, Z., and Ma, Y. (2013), Prioritized multi-criteria decision making based on the idea of PROMETHEE. *Procedia Computer Science*, **17**: 449-456.
- Zhou, C., and Purushothaman, A. (2019), Developing creativity and learning design by Information and Communication Technology (ICT) in developing contexts. In *Advanced Methodologies and Technologies in Artificial Intelligence, Computer Simulation, and Human-Computer Interaction* (pp. 499-511). IGI global.
- Ziemba, E. (2019), The contribution of ICT adoption to the sustainable information society. *Journal of Computer Information Systems*, **59** (2): 116-126.