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New strategies to improve governance in territorial management: evolving from "smart cities" to "smart territories"

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Abstract

The economic, urban and social development of the territory that makes up the European Mediterranean area is based on many variables of very different fields. The infrastructure policy, urban growth of cities or sustainable use of land and energy resources are decisions that need to be planned in order to establish priorities to optimize these processes. However, it is important to note that all of these fields are influenced by a multitude of interrelated economic, political or social parameters. Now that numerous protocols are appearing worldwide to develop these processes within cities (the so-called "smart cities"), the real challenge for the future is to make the leap from the urban scale to the regional scale and deploy these policies in an integrated manner, in so-called "smart territories".

This article presents a model of territorial analysis that consists of more than 50 indicators implemented in territorial information systems. The model is based on research conducted in the Otremed project, a multilateral project funded by ERDF and developed between 2009 and 2013 by various countries and institutions of the Mediterranean area. Through the results and tools developed in this project, the so-called GIS retrospective analysis is proposed. This tool, designed to help in decision-making and to advance future diagnostics in territorial management, will allow the development policies of cities to be optimized, generating synergies in transport infrastructures and planning with sustainable criteria in land and other resources use. All these processes will be integrated at regional level with an innovative methodology based on the analysis of territory evolution through referenced geographic information tools.

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1. Introduction.

The smart city concept is based on implementing sustainability and efficiency criteria in the development and planning of cities. This idea has been widely studied in different research since the late twentieth century by many authors (see for example [1], [2] or [3]). Nevertheless, this concept (of strong and innovative theoretical charge) has been materialized in practice very often through isolated actions, and sometimes even as simple political or commercial marketing products.

The concept of smart city currently transversally addresses fields as diverse as energy efficiency, information technology, transport infrastructure, resource consumption or environmental impacts, among others ([4], [5]). However, there is a common denominator on the need to establish a geographical framework to define the scope (a collection of buildings, a neighborhood, a city, etc.). In this line, many examples of the application of this philosophy can be found, both in pilot projects (more or less successful, see for example Guangzhou in Asia [6] or Lyon in Europe [7]), as well as at the level of commercial companies or research institutes (see for example Oracle [8] or the Vienna University of Technology [9]). A common deficit in many of these theoretical projects and proposals already developed is the integration of actions at different levels in order to overcome the simple proposition of singular acts, and thus obtain proposals which are able to encompass a comprehensive and coherent geographical context with the nature of objective sought. Related topics such as managing resource consumption, transport or territorial governance projects are not effective if they are limited to the surroundings of a building or a neighborhood, with the improvement achieved being a single anecdotal effect on the whole issue addressed.

Within this context, an issue that is particularly crucial for the future of cities and countries is the implementation of territorial governance mechanisms in these processes of creating smart cities [10]. Specific cases where the scope of the city is limited can easily be found in the current literature (see e.g. [11], [12], [13] and [14]). On this issue, a factor to consider is undoubtedly the adaptation to sectoral regulation and territorial legislation (see [15]), which is not usually limited to the geographical area of a neighborhood or a city.

Therefore, a barrier to overcome is to evolve the concept of smart city to a wider idea of smart territory, so to obtain that set of isolated acts transformed into a system of integrated action. In this sense the Otremed interregional research project covers this need to provide government expertise in planning with an instrument that facilitates the management and decision-making for territorial governance. The Otremed project meets three general objectives based on the principle of sustainability and efficiency in management. By implementing information technologies based on geographic information systems (GIS) it seeks to:

- Create a common and transferable methodology to provide standards for assessing the territorial management and guide decision-making, according to a joint and own territorial strategy for the European Mediterranean area (MED territory).
- Improve competitiveness of the MED space, ensuring economic growth, job creation, and social and territorial cohesion.
- Make a positive impact on public policies involved in the sustainable and balanced development.

This qualitative leap in the field of work allows us to evolve the concept of Smart City, extending it to a more comprehensive framework such as the Smart Territory. This concept of Smart Territory is more consistent with the very purpose of sustainability and efficiency.

2. Analysis of project parameters: Families of indicators.

The selection of indicators presents in the Otremed work is the result of long processes of analysis and diagnosis of the MED territory. The role of indicators is the primary key to start all the public policies that can make a good connection between technical - scientific knowledge and public decision domains in the Mediterranean area. In order to achieve that, Otremed has implemented a set of indicators of shared relevance in the Mediterranean Basin which can help to address not only the public policies of intervention for sustainable development, but also the use and development of other derived indicators in order to improve public policies. A list of 57 indicators has been proposed by the Otremed project, presented in 11 key topics / challenges.
This list of indicators constitutes a methodology for using data through an organised and selective approach, aiming at setting policies for growth and development in a wide context (economic, environmental, social and cultural); this list of indicators will make it possible to measure the territorial competitiveness.

Table 1. Indicators used by the Otremed project.

Challenge	Project code	Indicator name
1. Revitalisation of the urban system	1.1	Urban Areas: land consumption
	1.2	Index of turnover of the potentially active population
	1.3	Total number of supra-municipal plans and programs
	1.4	Number of mobility plans on a regional and / or local level
	1.5	Distance in time to basic facilities (health centres, hospitals, university, airport, etc.)
	1.6	Increase of registered population
	1.7	Procapite medium gain
2. Research and development	2.1	No. of people employed in R&D
	2.2	Changes in GDP of Public Institutions spending on Research and Development
	2.3	Changes of private/public enterprises in GDP spending on Research and Development
	2.4	Changes in number of researchers / 1000 employees
3. Crisis of rural	3.1	Employed population in Primary Sector / Region Population
	3.2	Utilised agricultural holding
	3.3	Relationship between agricultural land used for organic production and the total UAA
4. Access to transport	4.1	N.º of projects on multimodal and/or integrated platform strategies planned or realized
5. Access to information and communication technologies	5.1	Households with broadband access
	5.2	Variation Enterprises that use broadband fixed connection
6. Sustainable energy	6.1	Changes in energy intensity (TPE / € 1,000 GDP) energy intensity for the economy
	6.2	Degree of compliance with renewable energy development plan objectives or similar
	6.3	Changes in the percentage of energy produced by renewable energy sources in primary energy consumption
7. Disaster risk prevention and management of natural resources	7.1	Percentage of townships with emergency plans for prevention of natural disaster risk
	7.2	Percentage of population living in hazard prone areas
	7.3	Number of landslide events
	7.4	Number of seismic events

	7.5	Number of volcanic eruptions
	7.6	Number of alluvial events
	7.7	Urban sprawl - coastal urbanization
	7.8	Percentage of coastal areas with bathing prohibited
	7.9	Water Sustainability Index
8. Management of cultural resources	8.1	Number of museums and similar institutions
	8.2	Number of cultural professionals in workforce
9. Sustainability of regional economic resources	9.1	Industrial Production Index: percentage of investment in capital goods
	9.2	Variation in company spending on ICTs
	9.3	Changes in the percentage of companies with ISO 1400x and/or EMAS registration and/or ECOLABEL licences
	9.4	Energy planning instruments for the chief cities
	9.5	MW/year produced by renewable energy sources
	9.6	Percentage of active population with higher education qualifications (university degrees and higher level vocational training certificates)
	9.7	Variation rate of employed population
	9.8	Existence of incentives for enterprises
10. Governance	10.1	Number of partners involved in territorial networks for development projects
	10.2	Public investment/current expenditure
	10.3	% of institutions that have interactive on-line services
	10.4	Percentage of the population between 25 and 64 with higher education qualifications
	10.5	Percentage of population between 18 and 24 that has not completed secondary education
	10.6	Variation of number of interregional cooperation projects
	10.7	Number of youth associations or groups / 10,000 inhabitants
	10.8	Variation rate of annual spending on health
	10.9	No. of crimes / 10,000 inhabitants
	10.10	Gini coefficient on social polarization
11. Landscape management	11.1	Percentage of terrestrial protected areas to total of territorial areas
	11.2	Percentage of terrestrial protected areas with approved management plan over the total number of terrestrial protected areas
	11.3	Number of cultural heritage sites with a management plan or plan for their use
	11.4	Tourism & Industry impact

Each of these indicators can be decomposed into several factors according to two levels of analysis scale: NUTS (Territorial Units for Statistics) and LAUs (Local Administrative Units). These factors are implemented in a GIS system in administrative units where the competition is held in the analyzed material (either at the level of territorial legislation or sectoral regulation). If we disaggregate such factors, analysis of the first indicator "1.1 Urban areas: land consumption" we can develop the following analysis parameters:

Table 2. Parameters of land consumption indicator.

1.1 Urban Areas: land consumption	1.1-3.2/1	Land consumed	1.1 Urban Areas: land consumption	1.1-3.2/6	Land consumed per capita
	1.1-3.2/2	Land consumed intensity		1.1-3.2/7	Environmental Protection Index
	1.1-3.2/3	Annual rate of Growth land consumed		1.1-3.2/8	Urban and Residential Influence Area
	1.1-3.2/4	Fertile Soil Consumed		1.1-3.2/9	Index of Coast Occupation
	1.1-3.2/5	Fertile Soil Consumed Intensity			

These analysis parameters implemented in GIS system tools allow us to assess the current situation, make a diagnosis of existing problems and pose a future scenario toward implementing corrective measures. This qualitative leap in the governance of territory strategies enables us to evolve from simple tools based on the creation of smart cities towards systems oriented to the generation of smart territories. The hierarchization at two study levels (LAU and NUTS) allows us to hone the diagnostics performed. For example, in the Mediterranean regions of Spain (NUTS) the evolution of land consumption parameter between 2000 and 2006 would lead to different diagnoses depending on the scaling factor (Fig. 1).

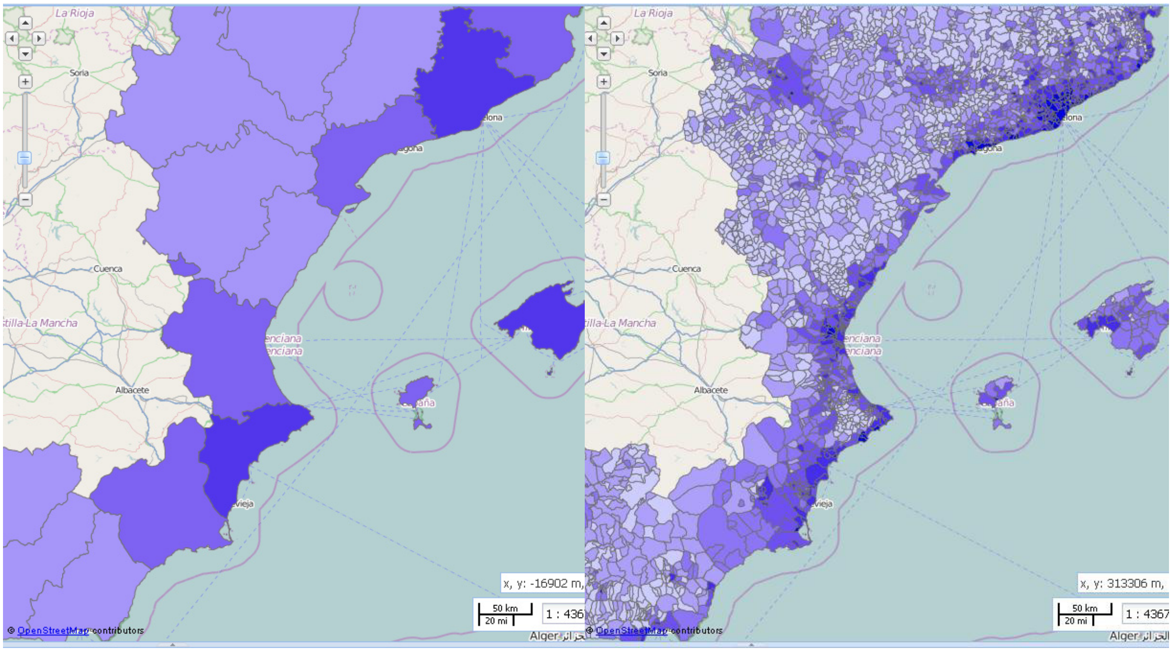

Fig. 1. Land consumption intensity between 2000 and 2006 on the Spanish Mediterranean coast (a) NUTS; (b) LAU.

Based on the data obtained with the help of various tools, a complete new methodology called "Retrospective GIS Analysis" can be performed as a decision variable in the governance and public policy of a smart territory. Thus this new methodology will be developed as a tool of choice for the first mentioned indicator of the land consumption.

3. Retrospective GIS analysis: land consumption as decision variable in territorial governance, an example of the Spanish coast.

GIS retrospective analysis of a territory is a structured methodology in four stages, based on the use of geographic information systems. To illustrate the evaluation of the mentioned land consumption indicator, the municipality of Mazarron, located on the south-eastern Spanish Mediterranean coast will be taken as an example (Fig 2). The first stage would include a macro-structural diagnosis of the study area using a georeferenced analysis tool such as SDIMED [16], as observed in Figure 1. In the studied area, developing an analysis of the territorial structure at this first stage it can be seen that in theory it is a municipality with average values of accumulated land consumption (14%), growth rates (3.4%) and annual urban intensities (4.2%) compared to the surrounding municipalities.
Diagnostic results of this first stage must be contrasted and implemented in a "retrohistoric" trend analysis (see [17]) in the second stage. This analysis must hold at least a historical perspective sufficient of the analyzed indicator (in this case 50 years) and must be developed by a GIS tool that provides a suitably precise cartographic database, such as CartoMur used herein [18] in Figure 3. Next, the existing boundary conditions of development should be established by a quantitative functional analysis of variables associated (or with some degree of regulatory

relationship) with our indicator analyzed. In this case, the GIS program Sitmurcia [19] allows us to implement in the territory the constraints related to urban planning and environmental protection of the territory (fig. 4).

Based on the boundary conditions laid down in the third stage, development parameters of trend analysis (second stage) can be corrected and future scenarios can be formulated in a fourth step of forecasting analysis. This fourth stage allows us to determine which can be problematic for the future and predict which elements are necessary to correct in order to try to avoid them. This requires using a tool that is able to implement the information from the previous three stages and translate it into qualitative variables. In this case, software for integrated land information IDERM [20] has been used (Fig. 5). In this case study, after this last stage it can be observed how implementing the historical trends in land consumption for agriculture and building construction and applying the boundary conditions imposed by urban planning for future developments, soil urban consumption and land transformation rates of 41% and 62% by 2020 can be achieved. This generates a substantial increase in resource demand, especially in water resources which would be unsustainable with the current infrastructure.

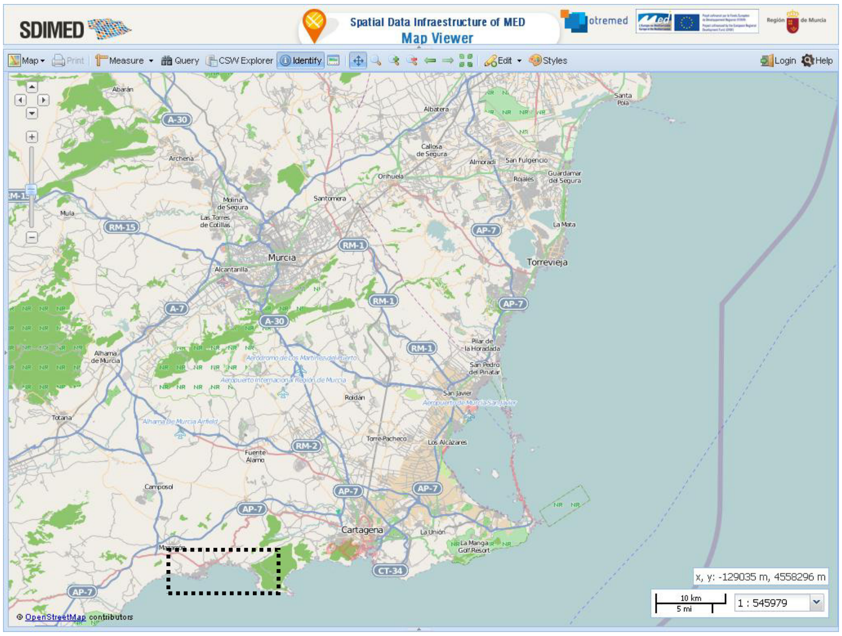

Fig. 2. Territory used as an example in GIS retrospective analysis with SDIMED.

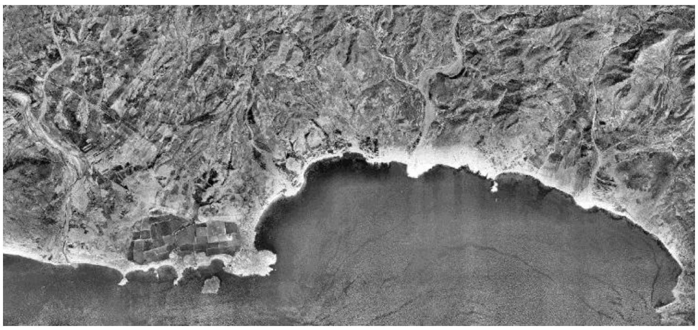

Fig. 3. “Retrohistoric” trend analysis (evolution 1956-1981-2014). Source: CartoMur.

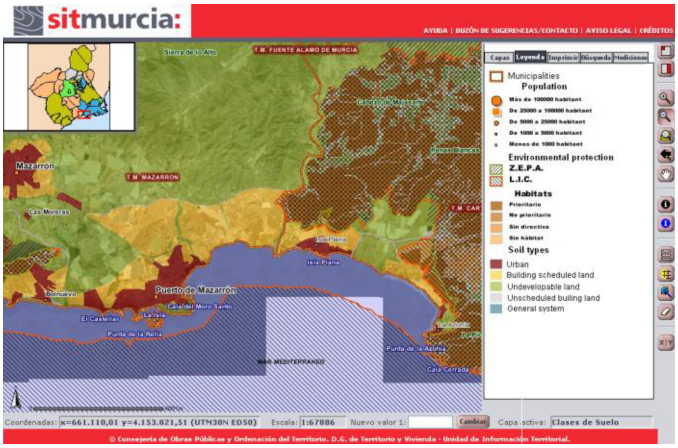

Fig. 4. Implementation of territorial and environmental boundary conditions with Sitmurcia.

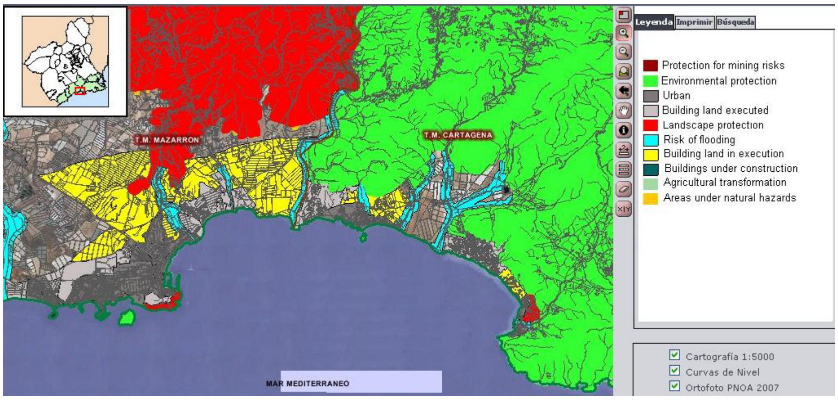

Fig. 5. Forecasting approach and future scenarios. Source: IDERM.

4. Summary and conclusions

The concept of smart city has a strong theoretical philosophy, which however, in practice tends to run as isolated and unrelated actions, thus losing much of its value. One solution for improving the application of this philosophy to govern the territory is to make the concept of smart city evolve towards a more broad and comprehensive concept of smart territory. Based on a model with 57 indicators distributed in 11 families, the Otremed project set an all comprehensive methodology of analysis, diagnosis and planning of future scenarios. This methodology has been exemplified by various GIS tools for one of the indicators of the project. Through a new methodology called GIS retrospective analysis it has been shown how to implement this philosophy of smart territory in public governance to anticipate and correct problems of the territory of the Spanish coast.

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