Construction of a web-based geographical information system – the case of"Ria de Aveiro" region

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ABSTRACT

"Ria de Aveiro" is a branded tourism region site, in the Central region of Portugal, which comprises a variety of natural and cultural tourist products and resources, which needs to be integrated in a way to enhance the promotion and management of this destination. In this way, Ria de Aveiro web-based Geographical Information System (GIS) was developed, providing an integrated platform aimed to better manage the tourism activity in this region. In this paper, it is pretended to demonstrate the potential use of GISs and spatial analysis in tourism planning, and to evaluate the ability of GIS as a tool to support integrated management of tourism.

KEYWORDS

Geographical information System; sustainability; integrated management

Introduction

The tourism industry is one of the most emblematic of the global economy showing nowadays a growing tendency both in the number of arrivals and in the volume of revenue generated by the activity. In 1990, there were about 435 million arrivals worldwide, and in 2001, there were approximately 983 million, being this number progressively growing over the years, despite occasional small breaks (World Tourism Organization, 2012). Several factors have contributed to the growth of tourism in the late nineteenth and twentieth centuries, highlighting the following (Manson, 2008, p. 16)

- A rise in industrial output associated with the Industrial Revolution that in turn led to an increase in the standard of living.
- Improvements in transport technology, which led to cheaper and more accessible travel. Railways and ocean liners appeared in the nineteenth century, and cars and aircraft in the first half of the twentieth century.
- The introduction of annual holidays towards the end of the nineteenth century.
- Changing perceptions of the environment. Locations that were once viewed as hostile were now seen as attractive.
- An increased desire to travel. This was partly related to improvements in education and also to grater overseas travel, which was mainly due to the result of war. This created interest in foreign locations and also overseas business travel.

These social and economic changes enabled an increase in quality of life and greater easiness travel, allowing rapid development of the tourism industry, creating in every continent, a willingness to learn about the different customs and traditions of each place.

All this growth in touristic activities led to the growth of tourism industry that was considered as a global economic activity that involves millions of people (Manson, 2008). It is, at present time, the main industry of international trade and services and, in many countries, it has even become the main industry of economic activity generating the greatest source of economic gains and exchanges with foreign countries, and even creating an important and significant source of employment.

These factors have contributed to an intensification of new and diversified touristic interests that have led to the emergence of differentiated and redesigned destinations and of new players. This diversification of interests and tourism objectives is due to the expectations, attitudes and values of the tourists, which affect tourism supply and demand, and is based, in large part, on the environment and environmental qualities offered by various tourist destinations. Tourists nowadays have a higher interest in the possibility of discover singularities and particularities of the places that they visit and to have an integrated knowledge of the various resources in the destination. However, it must be kept in mind that destination development should be guided according to sustainability principles, which take into account both the natural and cultural resources and the well-being of local communities. Granted this balance between product/service and communities, it is important to develop tools that allow and enhance integrated destinations and tourist products management, but at the same time, allow the promotion of those same destinations and products.

Therefore, providing and promoting touristic offer through web-based Geographical Information Systems (GISs), allow the pursuit of two objectives: the provision of tools capable of aiding tourism-related activities decision-making process; and enabling potential visitors to get an overview, in geographical context, of touristic resources diversity, products and services that can be discovered when visiting each destination.

Until now, despite Internet being considered as "one of the most influential technologies that have changed traveller behaviour" (Buhalis & Law, 2008, p. 611), and tourism as one of the economic activities that mostly use Internet (Aldebert, Dang, & Longhi, 2011), literature concerning the analysis and evaluation of web-based GIS use and interest in tourism information is still scarce (Chang & Caneday, 2011). Although, it has been referred by several authors the importance of this tool for the two purposes described before. In this way, Ria de Aveiro web-based GIS, developed within the scope of PRORia (Tourism Brand Project – axis 4 of PROMAR Programme 2007 – 2013 – Fisheries Operational Programme 2007/2013), focused on the implementation and the promotion of "Ria de Aveiro" will be analysed.

Despite the importance of tourism for this region, it was verified the inexistence of an integrated database for the whole touristic resources and the lack of strategic planning for tourism activity. Defining a web-based GIS could allow a better management of tourism activity by gathering the information in one common platform that should be available for all entities responsible for tourism management, and facilitating the interaction between them and the development of common projects.

This web-based GIS aims to contribute to more sustainable and environmental friendly tourism activities in the "Ria de Aveiro" region, by disseminating, with the aid of technology, the diversity of existing resources, namely the ones linked to coastal communities (fisheries heritage, traditional salt production, among others) as complement to common practices which use paper-based communication tools.

GIS may be considered, from an e-tourism point of view, as a service based on geographic location and, in some cases, depending on the correlation that may be established between contents, user and activity, and may also be considered a context aware application. The geographical proximity between resources, and between user and resources, may enable tourists to discover and plan their trip to and around the destination before departure or during the experience.

In the case of the "Ria de Aveiro" GIS, the main objectives of its development were:

- The identification, data collection and analysis of touristic resources, products and services available in the region;
- The creation of a common and share database, which include all information collected about the tourism resources, products and services available in the region;
- The creation of a GIS, capable of aiding promotional actions and sustainable management of tourism activity in the region, and also capable of serving as a tool to support decision-making process;
- The creation of a web-based GIS, making available to tourists a suitable tool to support their trips planning.

This research goes further the literature reviewed since it is focused on the combination of the two purposes referred: the interest and importance of having a tool, accessible to the diverse stakeholders of Ria de Aveiro region, which can contribute for a more effective decision-making process and for a better management of tourism in this area; and the importance of this tool for promotion of the area and for potential visitors.

This paper is organized in five sections. First, the introduction (in this section) pretends to explain the objectives and the case study that is going to be analysed. In the second section, it is realized a literature review about GIS and its application to tourism industry, web-based GIS and the importance of these tools to the decision-making process. The third section (methodology) describes the "Ria de Aveiro" site and the implementation of the web-based GIS created for this region. The fourth section is about the results of its implementation. And finally, the last section presents some conclusions and recommendations for future researches.

Literature review

GIS are important tools since they have the ability to represent, store, manage, analyse, update and visualize spatial and non-spatial data in an integrated environment. These tools operate on two data elements (Bahaire & Elliott-White, 1999): geographical or spatial data (locational aspects), and attribute data (statistical and non-locational data associated with a spatial entity). These are powerful tools, since they can combine a geographical analysis with an attribute analysis, providing a better interpretation of the data that can be used in different research fields. Research fields such as geography, urban development and planning, environmental studies, business (Bahaire & Elliott-White, 1999; Boyd & Butler, 1996; Cuberos, Molina, Indriago, & Caldera, 2000; Dye & Shaw, 2007; Farsari & Prastacos, 2004; Mcadam, 1999; Sousa & Fernandes, 2007), among others, are benefiting from the use of GIS tools for a long time.

Literature review denotes that tourism industry is using GIS since the early 90s (Farsari & Prastacos, 2004) and that these tools are very useful for the evaluation and planning of different aspects of tourism (natural and cultural resources, facilities, activities, services, among others) (Dye & Shaw, 2007). According to this statement, Bahaire and Elliott-White (1999) have presented the functional capabilities of GIS related to tourism industry (Table 1).

As it can be seen, GIS is a tool that can be used for a multitude of functions that are of extremely importance in tourism management and planning. It is possible to make touristic resources inventories, to relate each resource with others, to identify the best places for new destinations, to evaluate tourism impacts in the environment, to manage visitors on a destination, etc; in this way, GIS tools are seen as an added value to the development of the tourism industry, both to the decision-making processes, accessing politicians and managers in tourism development, and also by giving integrated and spatial touristic information, capable of assisting tourists in planning their visits. In an *era* where sustainability is considered as one of the priorities in tourism development, GIS could work as an effective tool, helping in the determination of how, when and where tourism development should go, in such a way that natural and cultural resources are protected, and also by giving the possibility of

Table 1. Capabilities of GiS.

examples of functional capabilities of a GIS	examples of basic questions that can be investigated using a GIS		example of tourism applications
Data entry, storage and manipulation	location	What is at?	tourism resources inventories
Map production	Condition	Where is it?	identifying most suitable locations for development
Database integration and management	trend	What has changed?	Measuring tourism impacts
Data queries and searches	Routing	Which is the best route?	Visitor Management/flows
Spatial analysis	Pattern	What is the pattern	Analysing relationships associated with resources use
Spatial modelling decision support	Modelling	What if…?	Assessing potential impacts of tourism development

Source: Bahaire and Elliott-White (1999), p. 161.

an easier way of involving local communities and visitors in the tourism planning process, allowing a more effective public participation (Sousa & Fernandes, 2007).

Web-based GIS

Web-based GIS have been able to integrate current trends linked to the Web 2.0 phenomena, the use of social media as means to become prosumers rather than just consumers of information and the access to solutions with concerns with responsive interaction design. These three core concepts have driven web and mobile applications to seek for solutions that are able to convey tailored experiences in a user-friendly manner. Since the coining of the term Web 2.0 by Tim O'Reilly (2005), back in 2005, life online as we know has suffered profound changes not only in content, but also in the origin of that content and the way it is produced.

We are no longer in the age of the one-way communication web in which all of us are capable of consuming information, but only a few have the ability of creating and providing content. Through various social media services, websites and applications, we are given the chance to create user-generated content, either individually or collaboratively, and share content very easily. By embodying the role of prosumers, one who produces as well as consumes content, we are given the opportunity to contribute to a living dynamic web (Bandulet & Morasch, 2005; Zhang, Zhang, & Wu, 2008). A key enabler for the life breathed into this web is, of course, the possibility of being online in a more ubiquitous manner. Time and space are gradually becoming not an issue but a small detail. For any given activity developed online, through a laptop device, there are equivalent solutions, which enable the same activity on a tablet or a smartphone.

The challenge, in this case, resides in the capability of providing solutions with high-responsive design levels. This is something still being battle with in the GIS context of use. Within the Ria de Aveiro web-based GIS, some of these issues have been tackled and are currently being researched with the goal of providing answers rather than questions.

Web-based GIS for decision-making processes

GIS and Web-based GIS are being applied to different sectors in a way that information is shared between different stakeholders (Ramsey, 2009), allowing them "to participate in the planning process using asynchronous and distributed collaboration" (Simão, Densham, & Haklay, 2009, p. 2027). These tools are being used namely in environmental decision-making processes, facilitating the participatory processes between decision makers, experts, citizens and agents.

There are several examples of web-based GIS tools being used for collaborative and/or participatory planning, described in several research papers.

An example is the one presented by Rao et al. (2007): a web-based GIS Decision Support System to help the US Department of Agriculture in the planning and management of the Conservation Reserve Programme. These authors refer that this tool could facilitate decision makers to "manage, plan, and prioritize CRP enrolments in a distributed environment" (Rao et al., 2007, p. 1270), making possible the access to the information, in an easier way, to the different groups interested in this planning process. They also refer the importance of this tool for crossing information from various scientific areas, which could justify the "long-term benefits of the CRP to congress and legislature" (Rao et al., 2007, p. 1277). Simão et al. (2009) present also a web-based GIS for collaborative planning and public participation but in this case with the application to the strategic planning of wind farm sites in Norfolk, East Anglia. They have design a framework which "integrates three components: an information area, a Multi-Criteria Spatial Decision Support System (MC-SDSS) and an argumentation map" (Simão et al., 2009, p. 2037), with the purpose that local communities and other stakeholders can be involved in the spatial planning process in a collaborative and asynchronous way (Simão et al., 2009).

In what concerns to tourism industry, there is still scarce research about the importance of web-based GIS. Literature review points out that web-based GIS is being used for tourism informa- tion searches (Chang & Caneday, 2011), "in order to build a better user experience for the tourist" (García-Crespo et al., 2009, p. 306), but it is not explored the importance of web-based GIS to the decision-making process, namely by improving participatory approaches. Nevertheless, the SigTur/E-Destination developed in the region of Tarragona is one case study that presents a tool that allows a better decision-making process and promotes a participatory approach by helping "actors in both side of the problem to make the optimal elections, in this case, the best tourist activities" (Moreno, Valls, Isern, Marin, & Borràs, 2013, p. 633). This project seems to be similar to Ria de Aveiro web-based GIS since it provides "personalized advice to the visitors of a destination, making them aware of activities that are not the main focus of attraction and improving the chances of a better tourist flow and a more sustainable management" (Moreno et al., 2013, p. 648).

Methodology

As it was referred before, Ria de Aveiro web-based GIS was developed in order to integrate in a common and shared platform several touristic resources and information that were spread over many sources. It is believed that this integration could allow a better management of the tourism activity in this region. In the next section, it will be described the case study and the methodology used for the implementation of the web-based GIS. Due to its attributes, Ria de Aveiro web-based GIS can contribute as a case study to the enlargement of research in this field.

The "Ria de Aveiro" site (Figure 1), a well-outlined and branded tourism region site, situated in Portugal central tourism region, comprises 11 municipalities, all members of CIRA – Comunidade Intermunicipal da Região de Aveiro (Aveiro Region Inter-municipal Community). These municipalities: Águeda, Albergaria-a-Velha, Anadia, Aveiro, Estarreja, Ílhavo, Murtosa, Oliveira do Bairro, Ovar, Sever do Vouga and Vagos, cover almost 1700 km^2 and have a total population of nearly half a million people.

The region is characterized by the presence of a large wetland area that occupies almost 11,000 ha, having an approximated length of 45 km and a width of 8.5 km (Fidélis, 2001). This is one of the biggest, most expressive and biologically more important littoral wetland in Portugal (D' Abreu, Correia, & Oliveira, 2004), representing a unique landscape and a resource that has numerous potentialities: port platform, fisheries, saltpans, aquaculture and agriculture, sports, tourism or nature conservation.

This is a region that presents several natural and sociocultural resources, such as sea and river beaches, riverfronts, saltpans, forests, nature reserve, interesting conservation areas, mountain villages, built heritage, namely religious patrimony, "art nouvelle" houses, traditional wooden houses, museums, archaeological sites, among others.

The proximity between sea and mountains functions as a modeller of the area, being possible to observe diverse landscapes, from valleys to mountains, contrasting with the coastal plain with sandy beaches and the Ria de Aveiro lagoon, referred before. Consequently, this is an area characterized by an environmental

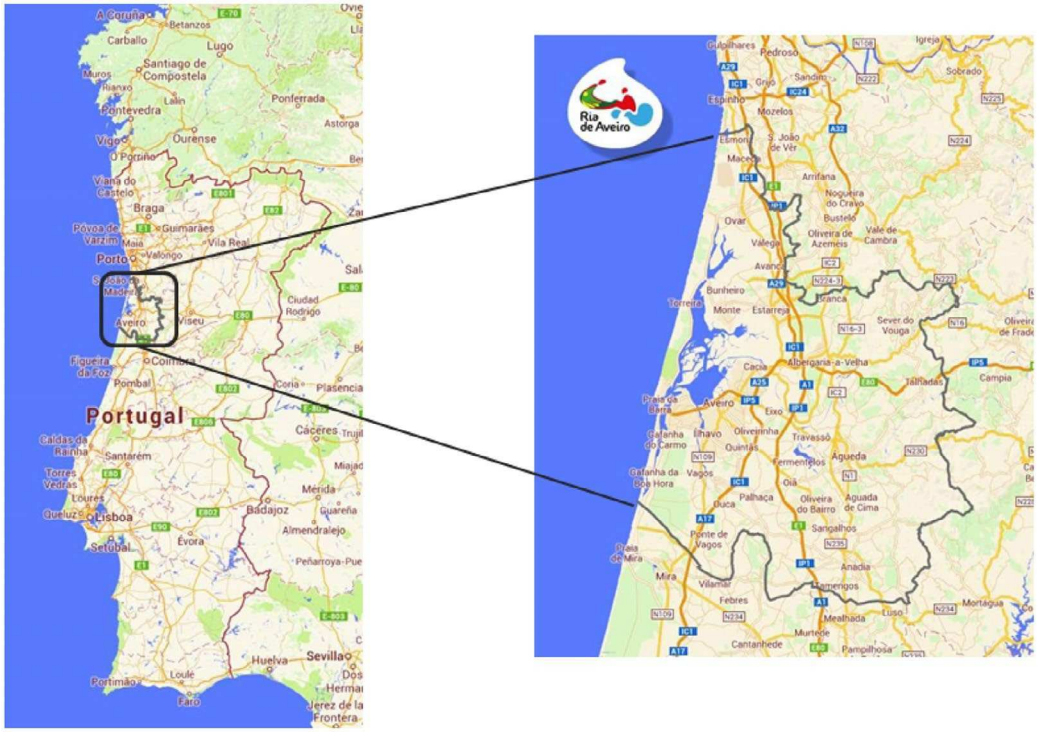

Figure 1. Ria de Aveiro region (source: http://sig.riadeaveiro.pt/web/).

and cultural richness, characteristics that could be used to boost tourism industry in the region, focusing on the integrated management of this industry, making it competitive with other regions of Portugal. It is pretended that visitors have a memorable trip when spending their leisure time in Ria de Aveiro.

There were two main reasons that led to the necessity of developing a web-based GIS in Ria de Aveiro region: the inexistence of a common tourist resource inventory and a common platform of those resources, that could be used by the different tourist stakeholders and managers; and also the necessity to improve the promotion of Ria de Aveiro region as an important tourist destination in Central region of Portugal. In addition, developing new resources for tourist promotion could strengthen sustainability of the region, without forgetting the priority that should be given to the conservation and protection of natural and cultural resources.

Implementation of Ria de Aveiro web-based GIS

The design and implementation of the "Ria de Aveiro" GIS was developed according to a set of objectives established by Turismo Centro Portugal (TCP), a public Portuguese destination management organization, based on the promotion of the region and its resources. Turismo Centro de Portugal (2010) also defined the categories, which resources, products and services would be associated with. The categories defined were: Cultural and Landscape Touring; Nature; Nautical; Gastronomy & Wine, Sun & Sea, Business and Golf. This information was then discussed within the transdisciplinary project team and, through a participative design process, it was fine-tuned at an initial stage of the project and then reviewed in and iterative manner throughout the remain of the project's life cycle. Reviews done during the design and implementation phases of the project were due to the fact that transdisciplinary collaboration was constantly feeding what was underdeveloped with new ideas derived from current trends in e-tourism and the strive to improve the resulting GIS. GIS development work was done in four different steps, as described in Figure 2.

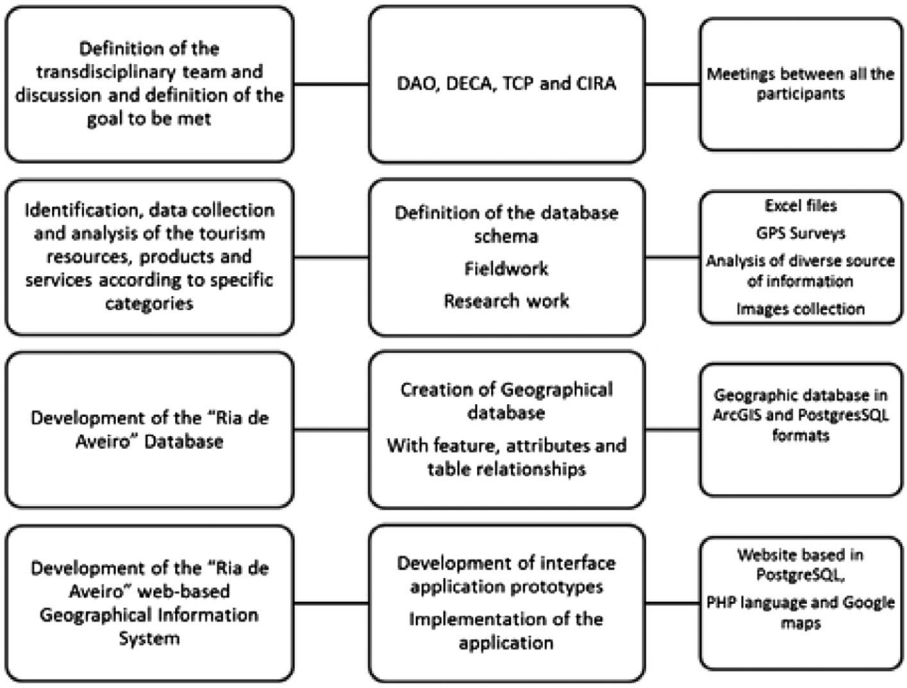

Figure 2. Ria de Aveiro web-based GiS development work.

In the first step, meetings between all the participants (Aveiro University, namely GIS developers and web developers, TCP and CIRA) took place to define the transdisciplinary team, and to discuss and to define the goal to be met with the development of the project.

The second step corresponded to the identification, data collection and analysis of tourism resources, products and services. This data collection was done according to the specific touristic categories, defined by TCP, the principal responsible entity of tourism in this region. According to these categories, it was designed, primarily, a database schema, which was discussed and validated by TCP.

Afterwards, research and field works were developed to collect all the information, in a first phase, to datasheets. It was also necessary to collect GPS surveys and field work for missing resources, and to validate the existent information and to do image collection.

The Ria de Aveiro database was developed in the third step of the project. In this step, the geographical database was created and populated, with features, attributes and table relationships according to the schema defined in the previous phases. This database was created using ArcGIS and converted to PostgreSQL format.

The last step corresponded to the development of the Ria de Aveiro web-based GIS. Its implementation involved several stages, namely:

- Functional design;
- Technical design;
- Interaction and interface design;
- Prototyping;
- Iterative evaluation and debugging;
- Deployment.

During the functional design stage, the transdisciplinary team was asked to share any ideas they might have about what they thought the GIS should be able to do. This, of course, led to a long list of functions that were then filtered according to criteria such as time left for development, the overall

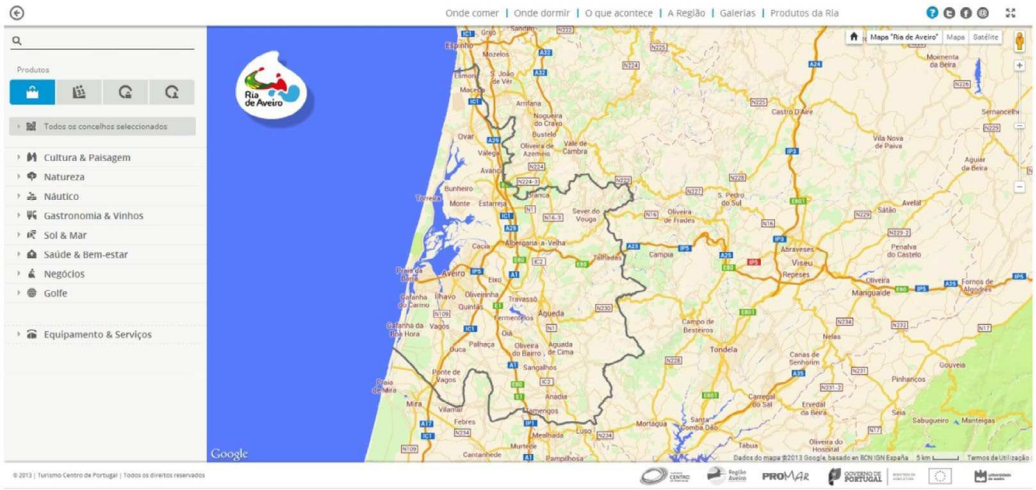

Figure 3. Ria de Aveiro GiS interface (source: http://sig.riadeaveiro.pt/web/).

project budget, the size of the team and, most important of all, the goal and vision for the project. This led to a shorter list that was thoroughly dissected in the next stage, the technical design of the web-based GIS. Due to the fact that part of the technical development, related with the database used to feed the web front-end, had already been developed attention was directed to the evaluation of viable solutions capable of providing a fully functional front-end solution for the GIS capable of providing a reliable interface with the database and, at the same time, enabling the development of a user-friendly experience. By adopting a solution based on PostgreSQL, php language and some Google maps API, we were able to satisfy all parts and meet some predefined requisites related with the server-side technology used by two of the project partners (CIRA and TCP).

The following stage, that one may call the make-up and make-use-of phase, included the drafting, discussion and fine-tuning of the GIS application interface and interaction design. By now the team knew what the GIS should be able to do, what users should be able to do with it and how it would be implemented as a whole. Work developed in this phase included giving the project a visible and usable form. The final interface is illustrated in Figure 3.

The prototyping phase of the project was done in accordance with the guidelines and results of the three previous phases and, to some extent, may be merged with the iteractive evaluation and debugging phase. In reality, while prototyping, work done was tested and bugs were corrected will implementation work was in progress. This enabled us to avoid major setbacks further on along the line.

Results

"Ria de Aveiro" web-based GIS, has completed an initial stage of its life cycle with the launching at 2013 Lisbon Tourism Fair. The goals established for this project were achieved. Firstly, it was compiled by the tourism resources in "Ria de Aveiro" region in a common shared database and it was designed the web-based GIS. Secondly, the web-based GIS for Ria de Aveiro was created and it was placed online, being accessible any interested person that wants to have information about tourism resources, products and services, for the purpose of visitation, or for the purpose of analysing the area in terms of tourism offer. And finally, it was developed as a tool ready to assist local and regional destination management organizations, entities and authorities (i.e.: TCP, CIRA and the 11 municipalities included in the region). That can be considered as a first step for the creation of dynamic networks among managers and entrepreneurs (Denicolai, Cioccarelli, & Zucchella, 2010).

It is possible to identify a set of main contributions of this project, for instance the possibility of an extent analysis of existing resources, products and services in an integrated manner, by consulting the GIS and the database developed. This analysis may also take in to account the spatial distribution of these resources, products and services with a set of descriptive characteristics of each one. Instead of developing autonomous work, the web-based GIS serves as an aggregating tool capable of compiling and correlating information about resources scattered throughout the 11 municipalities, namely by giving the possibility of understand the interconnectivity between them. The fact that the technological component of the GIS was designed with a clear concern of interoperability issues is also worth pointing out. The municipalities were not asked to re-do their current practices in relation to GIS software use or even update the software version they are currently using for their own municipal GIS.

It is considered that "Ria de Aveiro" web-based GIS may also serve as a facilitating tool for a more active public participation in the tourism activity decision-making process and planning. The possibility of building personal touristic routes in the region, may work as an indirect public participation component, by providing information for local and regional entities and authorities about preferred touristic resources, services and products. This can feed future decision-making by the evaluation of consumers preferences, consumers' quality perception of touristic resources, services and equipment, creation of new tourist routes based on the consumers preferences, etc.

It is also believed that this GIS, because of its freely used web-based nature, will also assist potential tourists planning to visit or already in "Ria de Aveiro" region, by giving them spatial information about the diversity of existent cultural and natural resources, such as their characteristics, exact location and the means for contacting some of them (i.e.: museums, restaurants, etc.). By taking in the variety and amount of resources available in "Ria de Aveiro" region, tourist may also be impelled to plan future visits to the region. The fact that the GIS allows tourists to plan their visit, by selecting resources and places that they intend to visit, and to organize it taking into account the geographical distribution of each point of interest, may spark the interest to return and discover other aspects of the region. For instance, tourist can plan to explore specific resources, products and services in each visit to "Ria de Aveiro" region.

Conclusion and implications

Biophysical characteristics and natural endogenous potential of "Ria de Aveiro" region provide competitive and differentiating advantages that may allow sustainable tourism development in there. Furthermore, it is intended that tourism industry should work as a spur for economic and social dynamism in this region, particularly through social strengthening of local communities, especially in cases where these communities are experiencing a reduction in their income.

Tourism industry has been considered, by responsible entities and authorities, the principal economic activity in "Ria de Aveiro" region, existing already a strong commitment to fostering and promoting tourism industry. This can only be achieved by collaboration efforts capable of providing a region wide strategy supported by tools shared among all local and regional authorities, destination management organizations, stakeholders and even minor-sized entrepreneurs. Compiling all the tourism resources in a common shared database, built in a participative manner, is just one of the steps being taken in the right direction. Using web-based GIS tool will hopefully improve conditions for a better integration of environmental concerns related with the design of tourism strategies at a macro- and micro-level. Furthermore, the information available on the web-based GIS, accessible to the diverse stakeholders of this area (entities, authorities, economic stakeholders and communities), is expected to strengthen the development of integrated sustainable tourism strategies and also promote public participation in territory and resource conservation planning and management decision-making processes.

Despite the work already done on the GIS, it is believed there is still room for additional research and development in areas linked to its use on mobile devices and further developments related with the adoption of participative activities through social media.

Disclosure statement

No potential conflict of interest was reported by the authors.

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References

Aldebert, B., Dang, R. J., & Longhi, C. (2011). Innovation in the tourism industry: The case of Tourism@. *Tourism Management, 32*, 1204 – 1213. doi:10.1016/j.tourman.2010.08.010

Bahaire, T., & Elliott-White, M. (1999). The application of geographical information systems (GIS) in sustainable tourism planning: A review. *Journal of Sustainable Tourism, 7*, 159 – 174. doi:10.1080/09669589908667333

Bandulet, M., & Morasch, K. (2005). Would you like to be a prosumer? Information revelation, personalization and price discrimination in electronic markets. *International Journal of the Economics of Business, 12*, 251 – 271. doi:10.1080/13571510500128038

Boyd, S., & Butler, R. (1996). Seeing the forest through the trees: Using GIS to identify potential ecotourism sites in Northern Ontario. In L. C. Harrisson & W. Husbands (Eds.), *Practicing responsible tourism: International case studies in tourism planning, policy and development* (pp. 380 – 403). New York, NY: Wiley.

Buhalis, D., & Law, R. (2008). Progress in information technology and tourism management: 20 years on and 10 years after the Internet-The state of eTourism research. *Tourism Management, 29*, 609 – 623. doi:10.1016/j.tourman.2008.01.005

Chang, G., & Caneday, L. (2011). Web-based GIS in tourism information search: Perceptions, tasks, and trip attributes. *Tourism Management, 32*, 1435 – 1437. doi:10.1016/j.tourman.2011.01.006

Cuberos, P., Molina, N., Indriago, J. A., & Caldera, N. (2000). Sigtur-Zulia: An application of GIS technologies for tourism planning. In *Twentieth Annual ESRI User Conference – ESRI*. San Diego. Retrieved from http://proceedings.esri.com/library/userconf/proc00/professional/papers/PAP709/p709.htm

D´Abreu, A. C., Correia, T. P., & Oliveira, R. (2004). *Ria de Aveiro e Baixo Vouga* [Ria de Aveiro and Baixo Vouga]. In A. C. D´Abreu, T. P. Correia, & R. Oliveira (Eds.), *Contributos para a Identificação e Caracterização da Paisagem em Portugal Continental* [Contribution to the landscape identification and characterization in Portugal] (Vol. 3, pp. 139 – 146). Lisboa: Direcção Geral do Ordenamento do Território e Desenvolvimento Urbano.

Denicolai, S., Cioccarelli, G., & Zucchella, A. (2010). Resource-based local development and networked core-competencies for tourism excellence. *Tourism Management, 31*, 260 – 266. doi:10.1016/j.tourman.2009.03.002

Dye, A. S., & Shaw, S.-L. (2007). A GIS-based spatial decision support system for tourists of Great Smoky Mountains National Park. *Journal of Retailing and Consumer Services, 14*, 269 – 278. doi:10.1016/j.jretconser.2006.07.005

Farsari, Y., & Prastacos, P. (2004). GIS applicatios in the planning and management of tourism. In Alan A. Lew, C. Michael Hall, & Allan M. Williams (Eds.), *A companion to tourism* (1st ed., pp. 596 – 1107). United Kingdom: Blackwell Publishing.

Fidélis, T. (2001). *Planeamento territorial e ambiente: o caso da envolvente à Ria de Aveiro* [Territorial and environmental planning: The case of Ria de Aveiro surrounding] (p. 320). Cascais: Principia.

García-Crespo, A., Chamizo, J., Rivera, I., Mencke, M., Colomo-Palacios, R., & Gómez-Berbís, J. M. (2009). SPETA: Social pervasive e-tourism advisor. *Telematics and Informatics, 26*, 306 – 315. doi:10.1016/j.tele.2008.11.008

Manson, P. (2008). *Tourism impacts, planning and management* (2nd ed.). New York, NY: Routledge.

Mcadam, D. (1999). The value and scope of geographical information systems in tourism management. *Journal of Sustainable Tourism, 7*, 77 – 92. doi:10.1080/09669589908667327

Moreno, A., Valls, A., Isern, D., Marin, L., & Borràs, J. (2013). SigTur/e-destination: Ontology-based personalized recommendation of tourism and leisure activities. *Engineering Applications of Artificial Intelligence, 26*, 633 – 651. doi:10.1016/j.engappai.2012.02.014

O´Reilly, T. (2005). *What is web 2.0 design: Patterns and business models for the next generation of software*. Retrieved November 11, 2013, from http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html

Ramsey, K. (2009). GIS, modeling, and politics: On the tensions of collaborative decision support. *Journal of Environmental Management, 90*, 1972 – 1980. doi:10.1016/j.jenvman.2007.08.029

Rao, M., Fan, G., Thomas, J., Cherian, G., Chudiwale, V., & Awawdeh, M. (2007). A web-based GIS decision support system for managing and planning USDA's Conservation Reserve Program (CRP). *Environmental Modelling and Software, 22*, 1270 – 1280. doi:10.1016/j.envsoft.2006.08.003

Simão, A., Densham, P. J., & Haklay, M. (2009). Web-based GIS for collaborative planning and public participation: An application to the strategic planning of wind farm sites. *Journal of Environmental Management, 90*, 2027 – 2040. doi:10.1016/j.jenvman.2007.08.032

Sousa, P. R., & Fernandes, S. B. (2007). Aplicação Dos Sistemas De Informação Geográfica No Turismo [Application of geographical information system in tourism]. *Finisterra, XLII*, 105 – 117. Retrieved from http://www.ceg.ul.pt/finisterra/numeros/2007-84/84_06.pdf

Turismo Centro de Portugal [Central Portugal Regional Entity of Tourism]. (2010). *PRORIA – Implementação e Promoção do Pólo de Marca Turística Ria de Aveiro. Memória Descritiva da candidatura ao eixo 4 do Programa Operacional de Pesca – PROMAR* [Implementation and promotion of the tourism brand of Ria de Aveiro. Descriptive document of the application to the axis 4 of PROMAR Programme 2007 – 2013 – Fisheries Operational Programme 2007/2013] (p. 53). Portugal: Aveiro.

World Tourism Organization. (2012). *UNWTO Tourism Highlights 2012 Edtion. UNWTO Tourism Highlights* (pp. 1 – 16). Retrieved from http://mkt.unwto.org/en/publication/unwto-tourism-highlights-2012-edition

Zhang, H., Zhang, W., & Wu, W. (2008). The mass customization of tourism products based. In *4th International Conference on Wireless Communications, Networking and Mobile Computing. WiCOM '08* (pp. 1 – 5). Dalian: IEEE. doi:10.1109/WiCom.2008.2115