FOSS4G in education: a multi-disciplinary case study for the promotion of slow tourism

Michela Arnaboldi
Politecnico di Milano, Dipartimento di Ingegneria Gestionale, Piazza Leonardo da Vinci 32, 20133 Milano (Italy)
0039 02 23994069
michela.arnaboldi@polimi.it

Maria Antonia Brovelli
Politecnico di Milano, DICA, Laboratorio di Geomatica, Como Campus, Via Valleggio 11, 22100 Como (Italy)
0039 031 3327517
maria.brovelli@polimi.it

Marco Minghini
Politecnico di Milano, DICA, Laboratorio di Geomatica, Como Campus, Via Valleggio 11, 22100 Como (Italy)
0039 031 3327540
marco.minghini@polimi.it

ABSTRACT
Centred on the values of environmental friendliness and rediscovery of cultural knowledge, slow tourism has recently emerged as a new model for sustainability which cannot be achieved without a proper balance between GIS-based technological innovation and a managerial infrastructure to operate it. This study investigated the promotion of slow tourism in the charming naturalistic area located on Lake Como (Northern Italy) around Cernobbio. The work was carried out within a multi-disciplinary MSc course given at Politecnico di Milano (Como Campus) in which students from Environmental, Management and Science Computing Engineering work in groups to develop real projects proposed by companies with the support of junior and senior academics. After an analysis of the problem from the managerial point of view, and taking into account the needs of the stakeholders involved, FOSS4G (Free and Open Source Software for Geospatial) was used to develop concrete products which could fulfill the project goals. Two Web viewers were built which display a number of suggested paths for hiking, trekking, and mountain biking, showing also the cultural points of interest available along them together with several contextual information. While GeoServer was used to serve data as WMS/WFS layers, the viewers were developed with OpenLayers, GeoExt and Ext JS for traditional computers; and OpenLayers and jQuery mobile for touch-screen enabled mobile devices. Finally a promotion plan for presenting and advertising these products was developed. Besides providing innovative tools for the promotion of slow tourism, the study represented an interesting and easily replicable example of using FOSS4G in education as a means to foster multi-disciplinary cross-collaboration.

Keywords
Education, FOSS4G, Multi-disciplinary, Slow tourism, Web.

1. INTRODUCTION
Nowadays used within almost any human activity, the concept of sustainability was first coined in the 1987 Brutland Report, which defined sustainable development as a "development that meets the needs of the present, without compromising the ability of future generations to meet their own needs" [1]. Current literature identifies three main dimensions of sustainability: environmental, social and economic, sometimes adding a fourth one, i.e. technology [2].

The idea of sustainable tourism has recently emerged as a reactive response to the negative impacts caused by the tourism industry to society. The impressive contribution of this industry to the world economy, which has constantly grown since the second half of the past century [3], began in some cases to generate negative effects in the host communities as it was based on a mass-process model. Thus, sustainable tourism emerged as the set of both conventional and alternative forms of tourism that are compatible with and can contribute to sustainable development [4], or a tourism addressing the needs of the visitors, the industry, the environment and the host communities, by taking into account its current and future economic, social, and environmental impacts [5].

A specific type of sustainable tourism is given by slow tourism, a concept derived from the slow food movement which opposed to the standardization of taste and culture as well as the unregulated corporate power in the food and agricultural industry [6]. In the same way slow food promotes a return to cooking by using local ingredients and providing information about the eaten food, slow tourism promotes environmentally-friendly forms of transport that involve shorter trips and longer stays [7]. In turn this makes the experience a relaxing time instead of a stressful interlude between home and destination [8].

GIS-based technology represents a crucial element to successfully promote tourism (and specially slow tourism) as it can provide a means to access multi-source geospatial information (e.g. cultural, historical, administrative, and gastronomic) from both traditional computers and even mobile devices, whose geolocation sensors (e.g. the GPS) can orientate the tourists during the journey. However, tourism-related projects show that not only this technology is often disregarded, but it is usually not coupled with the design and implementation of a proper managerial infrastructure needed to operate and maintain it.

1.1 Case study
Against this background, a multi-disciplinary case study is shown which relates to the promotion of slow tourism in the well-known region around Cernobbio, located on Lake Como (Northern Italy) in a charming area from the naturalistic perspective. The work is carried out in the frame of an Interreg project between Italy and

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Switzerland, named "The Paths of Via Regina – Cross-border paths linked to Via Regina" (http://www.viaregina.eu) and focused on the valorisation of the territorial and cultural heritage represented by Via Regina [9]. Overlooking the West coast of Lake Como, this road highlights a net of soft mobility links across a mountainous region at the border between Italy and Switzerland (see Figure 1). Via Regina has been a fundamental trade route since the old Roman times, fostering communication, commercial and cultural exchanges not only between Italy and Switzerland but also throughout Europe. Despite being a system of beautiful paths surrounded by an astonishing natural landscape, this transalpine system has never been properly grasped from the tourism point of view. Initiated for this reason, the project gathers experts from a number of disciplines (cultural heritage, landscape planning and design, and geomatics engineering) with the overall purpose of valorising the targeted area through a rediscovery of the common European cultural identity into the artistic and cultural heritage. Main beneficiaries of the project are the local communities, which can enhance and exploit the tourism potential of their territories, and the travelers and tourists themselves who can safely undertake a trip to appreciate the nature and together exploit the services available along the paths.

Figure 1. Area covered by the Interreg project "The Paths of Via Regina".

Despite being carried out in the frame of the Interreg project, the described work was proposed as a project for an interdisciplinary educational initiative named Lake Poli School (LaPS) of the MSc in Management Engineering at the Como Campus of Politecnico di Milano. Officially entitled "Cross Boundary Processes", this course (5 ECTS) is attended by students from Science Computing, Environmental and Management Engineering who work in groups to develop real projects proposed by real organizations with the support of junior and senior academics. The idea at the origin of LaPS was linked to the visible difficulty of both practitioners and academics in overpassing the boundaries of their disciplines and languages. This difficulty limits the potential to innovate, creates tensions when cooperation is required among diverse groups, and can undermine long-term results. Very common examples occur exactly in the field of cultural heritage, and more generally in the public sector, when "perfect" software applications are developed without the implementation of the tools required to successfully manage them. The "Cross Boundary Processes" course develops during a semester through weekly meetings with three teachers (senior researchers) from the three disciplines involved as well as biweekly meetings with the external organizations. A key role is played by junior researchers, who are assigned to each group with the goal of coordinating the work and being the reference for both the students and the companies. Traditional lessons are substituted by seminars or lessons "on demand" when gaps in knowledge are highlighted during project development. The main role of senior researchers is to provide more experience advice to the junior researchers and the students, and to solve problems that can rise. To further stimulate students in doing well with their projects, a final workshop is organized where the best works, on a judgment of a qualified committee, receive a money award.

2. METHODOLOGY

Following the discussion of Section 1, the group of LaPS students involved in the work (which was carried out from September 2013 to February 2014) was composed of three MSc students from Management Engineering, one from Environmental Engineering, and one from Science Computing Engineering. Their complementary knowledge and skills allowed to globally address the problem and develop the most useful tools to achieve the project mission, i.e. the promotion of a slow tourism model for the integration and valorisation of cultural paths in Cernobbio municipality. The main steps of the work are described in the following Subsections 2.1, 2.2, and 2.3. Special attention is placed on the GIS development using FOSS4G (see Subsection 2.3).

2.1 Managerial analysis

The problem was first tackled from the managerial point of view. Macro and micro demand analysis were carried out to identify the tourist profiles visiting Cernobbio municipality. The main sources of secondary information were administrations (Cernobbio, Como and Milan) and Iubilantes, i.e. a cultural not-for-profit association focused on the preservation and valorization of historical routes of soft mobility. Primary data was instead gathered through surveys and interviews. The most significant results revealed that a high percentage of people would like to perform slow tourism activities involving trekking and discovery of Italian traditions, but most of them were not aware of any mountain and cultural paths around Cernobbio. Most of the respondents were also not aware about the concept of slow tourism, but they were interested in knowing it.

A strategic segmentation based on the gathered information was then performed to select homogeneous groups of potential customers according to their nationalities and other elements which characterize them towards slow tourism (e.g. cultural experience and length of stay). The targeting step was carried out afterwards to select the most relevant customer groups for the project. Each of the previously identified groups was analyzed following four different aspects, i.e. technology orientation, attraction to discover traditions and culture, attraction to slow tourism, and group size. The most relevant groups according to the project objective were found to be Italian and European tourists.

A competitive analysis was then performed to reveal the strategic advantages and disadvantages of similar projects according to four domains: information access and quality, tourist facilities, use of GIS Web technology, and use of local traditions as a marketing lever. Four cases were considered: an Italy-Slovenia slow tourism project (http://www.slow-tourism.net); the Alpine Pearls offer (www.alpine-pearls.com) focused on soft mobility in the Alpine region; the French hiking offer (https://www.france-randonnee.fr); and the Swiss offer (http://www.wanderland.ch). A positioning was thus developed focusing on the two main domains that could represent a strategic advantage for the project: local tradition (i.e. contents about cultural heritage and traditional habits) and use of Web technology to support and enhance tourism experience (i.e. a website and a GIS viewer). The result (see Figure 2) shows that, in order to be perceived by the market as a high-performance offer both in tradition and technology, the project should couple the best characteristics of the French option (providing a high level of

tradition but lacking a GIS Web application) and the Swiss option (which is a strong competitor from a technological point of view).

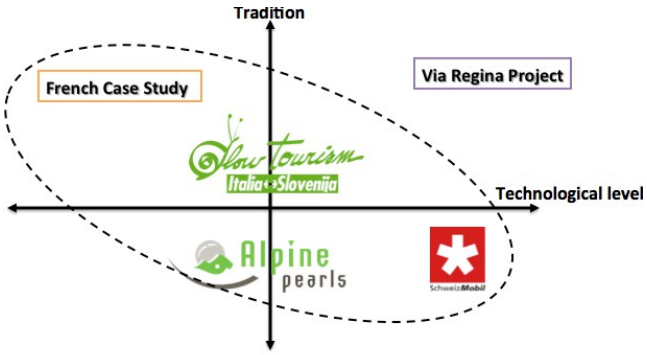

Figure 2. Positioning result based on tradition and technology.

2.2 GIS Web technology

An integral part of the LaPS project consisted in the development of FOSS4G Web platforms to concretely support and promote the slow tourism model. As inferred from the managerial analysis performed (see Subsection 2.1), technological innovation plays a key role to make potential users knowledgeable about the contents of the project as well as to interact with them.

A proper collection and pre-processing of the needed geospatial data represented the initial phase of the work. The official vector cartography of Cernobbio municipality, available within the main Interreg project, was mainly exploited to derive layers belonging to: a) anthropic elements (e.g. administrative boundaries, vehicle and pedestrian areas, buildings, and the hydrologic network); and b) green areas (e.g. woods, areas without vegetation, pasture areas and agricultural crops). Besides this basic information, the really essential geospatial data to be used for the project were obtained from Iubilantes association, Cernobbio municipality, and even ad hoc field surveys. The corresponding layers can be grouped into: a) pedestrian and cycling path networks; b) lodging and eating services (e.g. hotels, hostels, restaurants and bars); c) folkloristic and historical events; d) public services (e.g. public transportation and tourist offices); e) cultural heritage (mainly architectural); and f) mountain bike and hiking paths with relevant points of interest along the way, which represented the most important contents of the work. All the point-feature layers were supplied with specific information and pictures to be provided to users interacting with the Web viewers (see below). Additionally many of the geospatial data mentioned above required pre-processing operations on both their attributes and geometry (e.g. a cutout around the boundaries of Cernobbio municipality).

The following step was to make these contents accessible through standard Web geoservices. To this purpose two viewers were developed with FOSS4G according to the architecture depicted in Figure 3, which shows both the server-side and client-side of the system. All the pre-processed data were published as WMS/WFS layers using GeoServer (http://geoserver.org), running under the Tomcat servlet container (http://tomcat.apache.org) and chosen because of its ease of use as well as its certified performance [10]. On the client-side the first viewer was built for desktop computers using the JavaScript libraries OpenLayers (http://openlayers.org), Ext JS (http://www.sencha.com/products/extjs) and GeoExt (http://geoext.org). The second viewer was instead developed with OpenLayers and jQuery mobile (http://jquerymobile.com) to offer an optimized interaction from mobile devices (e.g. tablets and smart phones). The viewers can also access some base layers (e.g. road and satellite maps) provided by external servers such as Google Maps, Bing Maps, and OpenStreetMap.

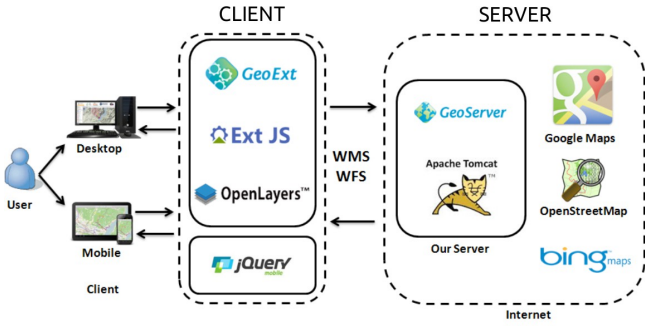

Figure 3. Architecture of the system.

The Web viewer for desktop computers (see Figure 4) exploits the potential of OpenLayers in managing geospatial data and the one of GeoExt and Ext JS in customizing the related user interface. On the main map panel the WMS/WFS data published by GeoServer are displayed on top of one among several base maps served by Google and OpenStreetMap. The traditional navigation buttons are available as well as the scalebar, the indication of the current map scale and the cursor position. The layer panel allows users to manage the visibility of layers, which are grouped into the same categories mentioned above. Finally all the suggested paths, the points of interest along them and all the other point-feature layers can be queried in order to access their picture and description into a customized popup (see Figure 4).

While the first viewer was conceived for simply consulting data as well as for arranging the trip/journey, the second viewer was specifically developed for being used on the field during the slow tourism experience. OpenLayers was again used for the mapping part thanks to its navigation controls handling map browsing with touch events (i.e. dragging, double-tapping, tap with two fingers, and pinch zoom). The jQuery mobile Web framework was instead exploited for the creation of the page graphics. Being designed for small-size screens, the viewer consists of a full-screen map panel and a top menu (see Figure 5). An OpenStreetMap base map with the sole layers of suggested paths and points of interest are shown, while all the other contents can be accessed from the *Select Layer* button. Using one of the mobile device geolocation services (e.g. the GPS), the *Your Position* button allows instead to display the device position as a new layer on the map. This option can be usefully exploited for orientation purposes during the trip. When a layer feature is clicked, the corresponding results are shown this time into a separate page (see Figure 5), which is more suitable than a popup for the typically small screen of mobile devices. The viewer was successfully tested on both Android and iOS devices.

2.3 Promotion and performance evaluation

The impact of the implemented technological solutions could be quite scarce without a proper promotion strategy, which can raise awareness and in turn increase the number of tourists in the area. Two promotional channels were identified. Physical channels aim at targeting the tourists already present in the area and make them discover the suggested paths. Brochures and posters about slow tourism and Via Regina's paths as well as a QR code to connect to the website (see below) are meaningful examples of this strategy. The campaign must be focused on local tourist offices, restaurants and hotels, travel agencies, and specialized shops (e.g. sport bike rental, hiking and sport material). On the contrary online channels

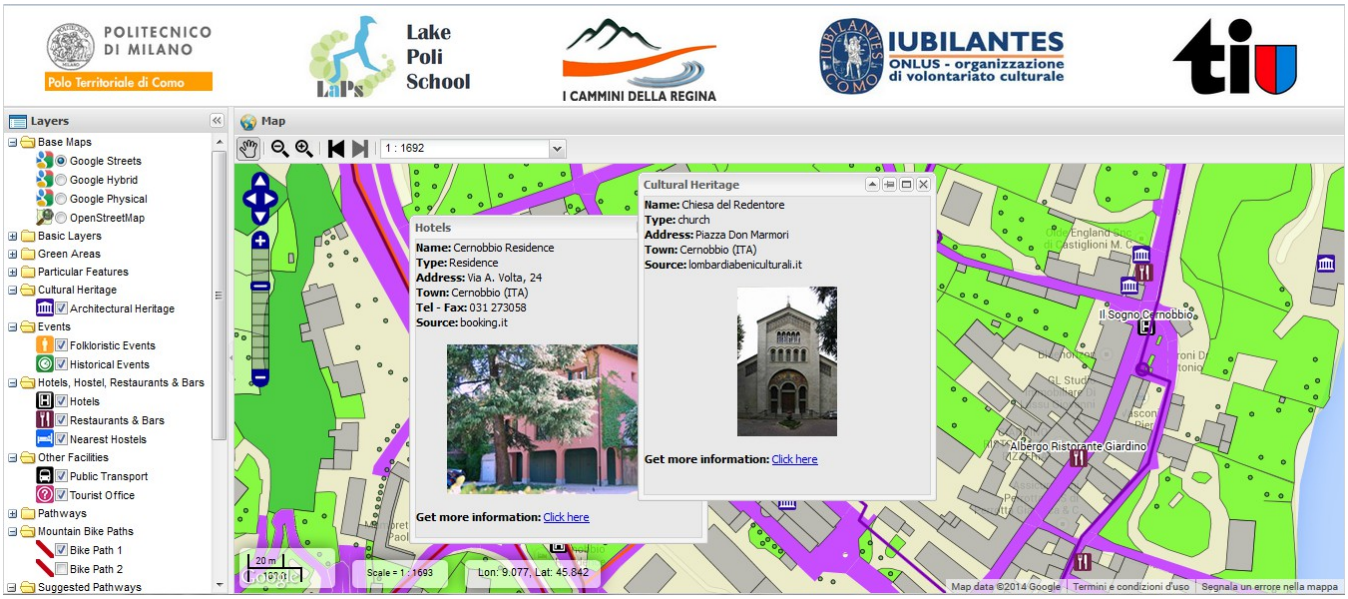

Figure 4. Web viewer for desktop computers.

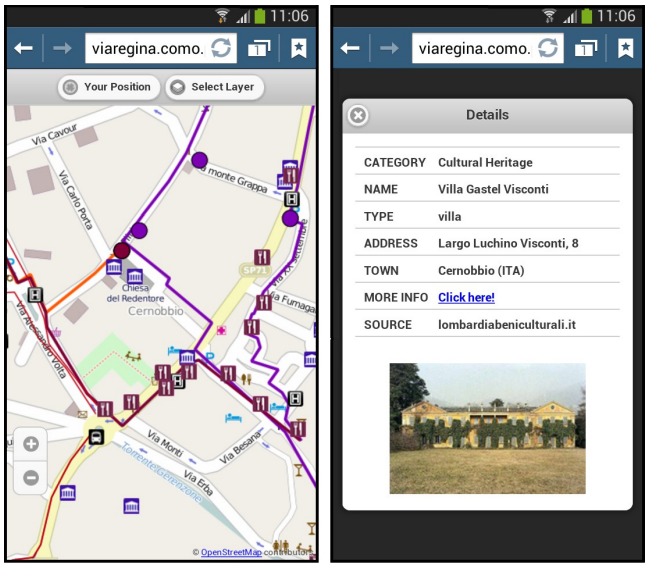

Figure 5. Screenshots of the Web viewer for mobile devices showing data display (left) and query results (right).

represent the best way to attract new tourists and they consist of a dedicated website and the interaction with social networking sites. The website (temporarily http://viaregina.co.nr), available in both Italian and English, provides general information about slow tourism, the suggested paths (including their detailed descriptions and pictures) and the Web viewers (including instructions on their use). In addition, accounts were created on the most popular social networking sites to start a viral spreading on the Internet and favor the connection to the website and the Web viewers.

Performance evaluation is another key step to measure the overall impact of the project and manage its long-time operation. A set of KPIs (Key Performance Indicators) was defined to measure the project achievement of the different strategic objectives. Examples of KPIs are the number of reported errors on the attributes or position of the published geospatial data, the number of articles in newspapers/blogs, the monthly visits to the website and followers on the social networking sites, and the number of places with the designed brochures/posters.

3. DISCUSSION AND CONCLUSIONS

Tourism-related projects represent a fertile ground for GIS Web applications, but they are often conceived from the pure technical perspective without planning a global managerial infrastructure to operate and maintain them. This study demonstrated the potential of exploiting FOSS4G in a multi-disciplinary educational project coping with a real problem and therefore requiring multiple (and complementary) competencies. Performed within a MSc course titled “Cross Boundary Processes”, the work has precisely shown how the university and business worlds must be intersected to find integrated solutions which overcome the usual barriers of thinking in “working packages”. Management engineers had a relevant role in building a business model to pursue a self-financing cultural network. On the other side GIS experts understood the importance of considering these elements to develop products answering to the identified needs. Carried out in the frame of a real, larger-scale Interreg project, the work was all developed in cooperation with the researchers and the stakeholders involved (e.g. administrations and cultural associations), which have been the first beneficiaries as they were able to better identify problems and their solutions.

Constituting the main output of the project, the Web viewers were all developed using FOSS4G. After the conclusion of the project, a fundamental step has been thus to interview the five students in order to understand their perception about this kind of technology. The survey showed a very positive opinion of FOSS4G, regarded as powerful tools suitable for any project and application. Despite the developing team's expectations of dealing with not stable and not documented software, almost no bugs were found and a lot of community resources (e.g. tutorials and discussions) were helpful in solving the encountered problems. The most effective feature of FOSS4G proved to be their high flexibility, that allowed to build customized products according to the needs (e.g. some small edits were made to the OpenLayers library). This brought simplicity and effectiveness to the whole project, allowing students to focus their effort more on the output than on the means needed to reach the output. On the contrary, the main FOSS4G limitation outlined

was the need of an adequate programming background which was specially crucial for developing the Web viewers. Finally, the key role of FOSS4G in educational projects was recognized not only because they are simple to access and learn, but also because their results can be easily shared, reused and enjoyed in an almost unlimited range of disciplines.

Carried out during the first semester of A.Y. 2013/2014, the study represented the initial step for shaping the conceptual framework of the overall Interreg project, in which the slow tourism model created for Cernobbio municipality will be extended to the whole areas linked to Via Regina. Regarding FOSS4G development, the presented Web viewers are currently under further enrichment to implement new functionality: examples are the inclusion of user crowdsourced data, and a WPS computation of the terrain profile of the paths as well as the shortest path between selected network nodes.

4. ACKNOWLEDGMENTS

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