Adding Value and Improving Processes Using Location-Based Services in Protected Areas: The WebPark Experience

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Abstract. This article reports the WebPark implementation experience. WebPark is a location-based system used by visitors and administrators of protected areas. The system allows for visitors to get information and answer their questions in the field, using handheld computers. The system was developed in the framework of a R&D project funded by the EC (IST programme), nevertheless, following the successful prototype and trials, a real implementation in the Swiss National Park took place. This paper starts by summarizing the education and conservation policies that contextualize such a service. Then the potentialities and technological setup of the system are described. The paper then elaborates on the lessons learned in implementing an advanced technological tool in the mismatching environment of nature protection: 1) overcome the conservative views of park administrators with tangible benefits; 2) demonstrate economical self-sustainability via tourism rental models; 3) involve and valorise local communities (local knowledge has a crucial role in developing and maintaining up-to-date content); 4) create innovative economic flows (and the creation of jobs) within underprivileged rural areas by enabling the urban visitors to pay for the local knowledge.

1. Introduction

Recent years have witnessed a change from the passive, low key use of rural areas for recreation to the explosion of tourism as a highly active and dominant agent of change and control in the countryside and associated rural communities (Butler et all, 1998). At a time when protected and recreation areas are under extreme pressures from the sheer weight of visitor numbers, mobile information services are looked as a possible "instrument" to encourage that the visitors and tourists make eco-friendly and safe use of the environment. Mobile information Services can make it possible for more people to achieve full awareness of the richness of natural and cultural resources,

since their mobile device will be capable of offering information about the places they visit.

Fig. 1. Tourists assessing a conventional analogue information delivery mean: an information board. Although boards are a form of location-based information it is not environmentally viable to spread such a solution around the all park. Consequently they are not ubiquitous.

Fig. 2. Example of an ubiquitous Mobile Information Service in Natural Areas.
(source: WebPark)

Alongside the "Protection of Nature" and "Research", national parks play an increasingly important role in the passing on of knowledge. The National Parks provide a wide range of information, thereby helping visitors to have a wider understanding of our environment (SNP 2003). Previous tourism research in protected areas has showed that current Park visitors have information needs/questions during their visit (Abderhalden et al 2002). The questions can be related to environmental information, like the name of a plant or the behaviour of an animal, or practical information, like can I make a picnic here or, how many hours left to walk to the peak. The majority of these information requests are dependent on where the visitors are (Abderhalden et al 2002). Managers of natural areas are looking into new digital means of Information provision, searching for a way to improve the overall tourist experience. Examples of adoptions of such digital means are the recent publications of CD-ROMs and increasing availability of official Natural Areas websites. However, these new ways of providing dynamic and updated information to the visitors fall short in satisfying the visitor's questions when it's most important: out on the field during the visit.

Developments in recent years have showed that mobile technology is becoming increasingly available and it's usage is nowadays widespread (Barnes 2002). Therefore, mobile Internet devices with geo-location capabilities (see example on Fig. 2) may create the opportunity of meeting the present information needs of visitors to natural areas. Technology can enable the concept of overlaying the real world with the digital world of information and create mutual added value, both for the Individual visitor and for the Natural Park Area managers.

2. Conservation Policies for Education and Communication

This chapter illustrates some of the existing education and conservation policies and priorities from international institutions as the World Conservation Union (IUCN) , the Alps Network for Protected Areas (NAZ), the United Nations Environment Programme (UNEP), and the EuroParc Federation that contextualize and support the implementation of services in protected areas that promote the access to information, increase environmental awareness of visitors and involve the local communities.

It must be underlined that protected areas are created above all with the aim to conserve the natural heritage and secondly for supporting the leisure or tourism industry. Nevertheless, environmental education is, for a majority of the protected areas, a main mandate (Dias et al 2004). As an illustration, ***educational aims*** can be found listed in the management categories defined by the IUCN (1994), see Box 1.

Moreover, according to the Alps Network for Protected Areas, a number of protected areas have **leisure as a goal**, not the main goal (which is usually natural assets protection) but as a secondary goal. But, it should be emphasized, it is never intended to develop physical infrastructure (e.g. roads, hotels) to support the leisure goal (NAZ 2002). Looking into the world oldest National park example, the Yellowstone National Park, its act of dedication declares that the area "is reserved and withdrawn from settlement, occupancy, or sale under the laws of the United States, and dedicated and set apart as a public park or pleasuring ground for the benefit and **enjoyment of the people**..." (Congressional Act, 1872). The Swiss National Park – the oldest National Park in Central Europe – has also restricted human activities inside the area, but visitors are tolerated, as long as they do not disturb the natural processes (Act of the Swiss National Park, 1914, renewed 1980).

The last decade was distinguished by rising of a different view on the protected areas goals. The initial point was the Convention on Biological Diversity (CBD) that was negotiated under the auspices of the UNEP. It was open for signatures at the "June 1992 UN Conference on Environment and Development" and put into action on 29 December 1993. In October 1998, more than 170 countries had adhered. Article 13 of the CBD declares that the parties that sign the convention should *"*(a) Promote and encourage understanding of the importance of, and the measures required for, the conservation of biological diversity, as well as its propagation through media, and the inclusion of these topics in **educational programmes**; and (b) Cooperate, as appropriate, with other States and international organizations in developing **educational and public awareness programmes**, with respect to conservation and sustainable use of biological diversity".

Additionally, IUCN has established a Commission for Communication (CEC) "to foster leadership in conservation and sustainable development by innovating, guiding and assisting in the strategic use of knowledge, capacity development, **learning**, **education** and **communication** (…)". CEC proposes a tool for changes in protected areas. The tool is called CEPA (**Communication, Education and Public Awareness**) and provides the link from science and ecology to people's social and economic reality.

The World Summit on Sustainable Development 2002 recommended to the United Nations General Assembly "adopting a **Decade of Education for Sustainable**

Development starting in 2005", which was adopted by consensus in December 2002, resolution 57/254 on the United Nations Decade of Education for Sustainable Development, beginning 1 January 2005.

Box 1 - Protected Area Management Categories (IUCN 1994)

Category Ia

Strict Nature Reserve: Protected Area managed mainly for science.

Area of land and/or sea possessing some outstanding or representative ecosystems, geological or physiological features and/or species, available primarily for scientific research and/or environmental monitoring.

Category Ib

Wilderness Area: Protected Area managed mainly for wilderness protection.

Large area of unmodified or slightly modified land and/or sea, retaining its natural character and influence, without permanent or significant habitation, which is protected and managed so as to preserve its natural condition.

Category II

National Park: Protected Area managed mainly for ecosystem conservation and recreation.

Natural area of land and/or sea, designated to

1. protect the ecological integrity of one or more ecosystems for this and future generations:
2. exclude exploitation or occupation inimical to the purposes of designation of the area: and
3. provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible.

Category III

Natural Monument: Protected Area managed for conservation of specific natural features.

Area containing one or more specific natural or natural/cultural feature which is of outstanding value because of its inherent rarity, representative or aesthetic qualities or cultural significance.

Category IV

Habitat/Species Management Area: Protected Area managed mainly for conservation through management intervention.

Area of land and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species.

Category V

Protected Landscape/Seascape: Protected Areas managed mainly for landscape/seascape conservation and recreation.

Area of land, with coast and seas as appropriate, where the interaction of people and nature over time has produced an area of distinct character with significant aesthetic, cultural and/or ecological value, and often with high biological diversity. Safeguarding the integrity of this traditional interaction is vital to the protection, maintenance and evolution of such an area.

Category VI

Managed Resource Protected Areas: Protected Area managed mainly for the sustainable use of natural ecosystems.

Area containing predominantly unmodified natural systems, managed to ensure long term protection and maintenance of biological diversity, while providing at the same time a sustainable flow of natural products and services to meet community needs.

In addition to the role of education and awareness, a especial support is being given to the involvement of local people in Protected Areas activities. The CEC, the World Commission on Protected Areas and the EuroParc federation supported a workshop and a publication entitled "Challenge for Visitor Centres - Linking Local People, Visitors and Protected Area" that focuses on the role visitor centres play in environmental education and in the relationship of the protected areas to the surrounding society (Kyostila et al 2001).
All these examples are illustrative of the international political importance of education and environmental awareness within protected areas framework and are an evident support of these international organizations in developing tools and processes that enable the access to information, increase environmental awareness and involve the local communities in the protected areas activities.

3. WebPark – Mobile Environmental Information System

WebPark is a research and development project funded by the European Commission that developed a series of services for users of protected areas. The service is based on wireless technology and is available for mobile phones and PDA's. Several personalized Location Based Services were developed within the WebPark framework. The services can be built upon:
1. existing information;
2. environmental sciences research data; and/or
3. tailored collected data.

Existing information involves the adapting of currently delivered info to tourists of recreation and protected areas (via CD, kiosk and web) to the new delivery mechanism (PDA); Environmental research data (like animal counts and vegetation maps) can be used after a conversion process that can produce high value tourist information, like animal location probability maps or plants species density maps. With or without existing data, local communities play a crucial role in collecting and managing content through a defined process (for example, tour guides can register the location of interesting places and present facts and multimedia to describe them) and local communities can manage logistics databases (as restaurants and hotel details).
WebPark enables users to request information from several databases from their PDA and filtering the information based on location, time and user profile relevance. The kind of online information users could expect are: flora and fauna description linked to the habitat the tourist is visiting, routes and tracks, hotels and restaurants close to the visitor, positioning of oneself, and more.

Fig. 3. Testers on the rain during a technical and functional test of the system performed at the Wadden Sea, Netherlands in October 2003.

Fig. 4. Detail of the Mobile Information System. Topographic Map with user location (via GPS signal) for navigation purposes.

The project development cycles were finalized in October 2004 and the main result was the delivery of a platform that allows the deployment of location-based services for protected/Natural areas that requires just some source content adaptation. To the present date, the platform has been implemented in two partner sites: The Wadden Sea Islands, the Netherlands and the Swiss National Park, Switzerland. For these two areas, a specific prototype has been developed and tested with real visitors (See fig. 3 and fig. 4).

Some technical specifications of the system are (Rhin 2004):

- Runs on any PDA with PocketPC2003[1] operating system (or higher);
- Web based via wireless internet (GPRS[2] or UMTS[3]);
- Operates also locally with stored data when not connect to the Internet;
- Position obtained from GPS[4], via Bluetooth[5] wireless connection to the PDA.

The architecture of the system is graphically represented Fig. 5.

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[1] PocketPC is a trademark of Microsoft Corporation (http://www.microsoft.com/windowsmobile/products/pocketpc/default.mspx)

[2] GPRS: General Packet Radio Service

[3] UMTS: Universal Mobile Telecommunications System

[4] GPS: Global Positioning System is a worldwide radio-navigation system formed from a constellation of 24 satellites and their ground stations (source: http://www.trimble.com/gps/what.html)

[5] Bluetooth® wireless technology enables connections between devices through specific radio frequencies (official website: http://www.bluetooth.com/)

It is important to refer three issues/constrains that the service architecture allows to cope with:

1. Since the user is mobile, the communication with the services is wireless (has been tested with GPRS);
2. Since the user is mobile and pedestrian, the devices used are palm-sized, the services can rely only on limited resources and computing power from the user terminal;
3. the type of areas targeted by WebPark services are Natural Areas, which means partial coverage for wireless communication. To cope with this partial coverage condition, the WebPark services do not rely on fulltime permanent connection, not even on constant bandwidth.

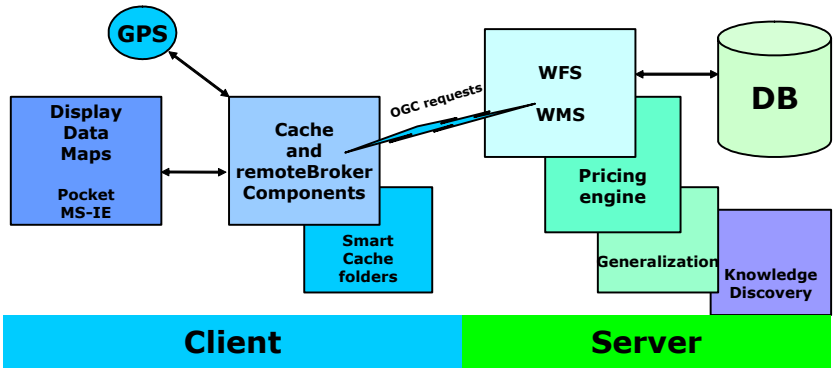

Fig. 5. Architecture of the Mobile Information System

This technical set-up allows the deployment wireless services in Natural areas. A prototype was developed under the framework of the project that includes the following features:

- Visitor self locating on a digital topographic map (through GPS positioning);
- Search for points of interest (POI) as hotels, restaurants, bike rentals, etc (around the position, ahead of, or in all the park);
- Access species information (fauna and flora): description and multimedia data;
- Species can be sorted by habitat closeness to the visitor (location filter for easier identification);
- Visualize accessed information on a map (information like the location of a POI or the location of the habitat of an animal);
- Insert location based comments (e.g. animal spotting, parking place). These comments can be public (shared on-line with other visitors).
- receive location-based warnings with the proximity to interesting landscape features with facts and multimedia about these features.

The system has been extensively tested in the two partner sites: the Wadden Sea, Netherlands, and the Swiss National Park, both in terms of functionality and reliability. The technical test results demonstrated that the system is very reliable, system failures were a very rare occurrence with no statistic significance. The functional tests were performed with real tourists and aimed at collecting the visitors' reaction to the functionality and performance of the system. The feed-back was very positive, both in terms of functionality and performance and the technology acceptance tests predicted very positive adoption (Dias 2004).

4. WebPark Implementation: The Swiss National Park (SNP) case study

Despite the international support for tools like WebPark (see chapter 2) and the successful delivery of a stable system that was enthusiastically received by the visitors (see chapter 3), an unproblematic adoption by the Park managers was expected. But the conservative environment of nature protection (most likely also allied with the late involvement of the park administration) caused some unexpected delays.

This chapter illustrates the emotional environment that involved the project adoption by the SNP administration. It is characterized by the personal experiences of the SNP responsible people, the persons which are part of the park administration. The project, initiated as a R&D project, included an influential partner: the SNP, a protected area. The presence of SNP, not just to guarantee the user view within the project, was revealing the awareness of the complexity to build bridges between natural environment and IT tools (not only for technical reasons but also for social reasons). The GIS-Department of the SNP was officially responsible for the project within the SNP. Therefore the project was perceived inside the SNP organization as a technical project. But the project had a secondary aim: to measure and adapt visitors and park managers reactions to the introduction of a IT tool in the natural environment exploration and protection activities. Moreover, the communication department of the SNP was allowed to express their point of view without influencing the project flow itself.

Concerning the emotional evolution, the project implementation can be divided in three parts:

Phase 1 revealed sceptical (or denying) attitude from the persons in charge. Two staff members of the information department wrote letters that called the whole concept into question. The main critics were related with:

- the technological approach, using PDA/ mobile phones out in the nature;
- the personal contact with visitors was missed.
- the missing of a mental approach.
- the carrying capacity of the area: WebPark would push the number of visitors above the carrying capacity.

Today, the WebPark tool is accepted as a way to influence the distribution of visitors by drawing attention on specific trails in detriment of others depending of the area vulnerability and occupancy. The influence is enabled by making available interesting

information on trails where the feature of interest are not obvious. Last but not least, there was an concern about the introduction of safety mechanisms to the tool: National park authority would not have the knowledge and resources to take over the responsibility providing people with safety information. In case of accidents this could be a problem for the SNP. This concern was respected by the WebPark consortium: Today, the only direct safety information tool is the "Where am I" which writes the current position on the device that can be used to give to the rescue authorities when calling for help.

Phase 2 was determined by a careful observation strategy by the SNP staff, if and how technical problems of WebPark would be solved. The strict abidance of the law to not introduce new infrastructure (e.g. Wireless-LAN) brought some confidence toward the National Park authorities.

Phase 3 began when WebPark reached an acceptable functionality. Functionalities and benefits of the system could be demonstrated to park managers, rather then just concepts and technical limitations. One of the functionalities that helped to the acceptance of WebPark (because it had a very tangible benefit) was the introduction of a digital reporting system for the park rangers. The rangers have to digitally file their observations at the end of each day and store them in the server. WebPark could provide the framework to enable such work to be done in the field and in a semi-automated way (automatically storing the GPS location and time). This functionality was developed with the key involvement of the rangers (in the user needs process) and was therefore immediately accepted. The main idea was to reduce the operating expenses by eliminating the process of digitizing in the office the observations performed in the field. It was time consuming and vulnerable to mistakes the digitalization of the paper field notes. With this tool, the ranger would not store the observations directly in digital format via the use of forms. In light of the Ranger's acceptance of this new tools, so did the institutional acceptance grew.

In the information department, a short message service was introduced to provide SNP visitors with the latest up-to-date information. The lack of current information from rangers in the field for supporting this service and time consuming work to write the information were two reasons to accept an application like WebPark, which could transfer information directly from a ranger in the field to a visitor in the field.

A major argument to accept the tool was: The possibility to replace notice boards in the area to keep the wilderness impression. This was the most convincing advantage. The information presently at the boards could be delivered via a digital mean and avoid changes in the landscape (the intrusive information boards).

In summary, a growing acceptance of the idea to bring location based services to visitors in the field accompanied the technical and functional developments of the WebPark tool.

5. Data Needs, Local Community involvement and economical development

The WebPark system and related processes can be simplistically viewed as a publishing tool that enables the benefits of:

- Allowing an intense information sharing from the local knowledge to the visitors; and
- financially self-sustainable system (it's economically maintained via the tourism industry i.e. rental model).

Mobile and ubiquitous LBS require the development of distributed geolibrary storage, data integration solutions and e-commerce business processes to define and satisfy new markets for Geographic Information (GI) and multimedia content relating to professional, leisure and tourist use of protected and recreational areas. Integrating these processes into new value chains will offer new services to users and create new markets for Europe's GI industry (WebPark 2001).
The GI content needed for the WebPark service can be divided into the 'background' and 'foreground' types. Typical background GI consists of a map base with roads, paths, coastlines, water features and boundaries; false colour imagery classified by land cover; terrain information and public service and safety information.
By contrast, foreground GI contains processed and interpreted GI and multimedia such as weather information, trail conditions, flowers in blossom, snow and tidal information and up-to-date photographs and other multimedia information. This kind of GI will be acquired from distributed data sources.
For the background information, the adaptation process is straight forward and requires simple reformatting of existing data into standard formats, acceptable by the system. For the foreground data there is a spectrum of possibilities, ranging from the scenario of a park that holds a vast amount of GI data and skills (common in large park organizations) and is willing to adapt its existing tourism and research data for display through WebPark (simple GIS skills are needed); to the scenario where no data is available (more common in smaller parks) for which WebPark can provide basic mapping capabilities and tools to collect locations, description and multimedia of features of interest inside the park. This locations are then available through the system and the visitors can be warned of the proximity of these particular features of interest.
For producing and maintaining the foreground information, involvement of the local population is of crucial importance. The local people have an in-depth knowledge of the area, processes and logistics that is valuable for the visitors. It is meant that the (typically urban) visitors can pay for that knowledge of the locals via the system rental. Therefore, innovative work positions can be created providing useful training skills for capturing and managing content inside and around Protected Areas.

The WebPark system enables a valorisation of the local knowledge and the creation of an economic flow from the visitors to the local communities.
The local park is the ultimate responsible for the data to be available in the system. The WebPark technology can be compared to a mobile website which contents are

dependent on the location of the user. Being a digital medium, it is expected by the users high spatial, temporal and semantic accuracies. A visitor can forgive a book that still indicates a restaurant that has been closed, but the digital medium can and should overcome the up-to-date limitations of the paper mediums. To guarantee that the most current information is available in the system, it is important that the local population is involved and rewarded for its maintenance. Examples include the hotel owner that keeps the room rates up-to-date, or the mountain guide that keeps dynamic information about nature features (e.g. flowers in blossom or open vs. closed trails).
When possible, these new specifically collected information should be complemented with currently existing information (e.g. available through the website, leaflets, research projects). Nevertheless, the already existing info needs to be adapted to the new delivery mechanism, a palm-sized device with geo-location capabilities. The adaptation could involve rewriting it into short texts and adding a spatial relevance (x,y coordinates), when applicable.

6. Conclusion

From the original working description, the WebPark system proposes to "*ensure that administrations and workers in these areas will be able to influence the attitudes and preferences of the urban visitors through the flow of information to their phones/PDA's while also deriving some economic benefit from their visit*" (WebPark 2001).
The idea is impressive: To support the park administrators with a tool to reach their goals of information, education and communication. Nevertheless, the enthusiasm of the consortium for this tool was not always followed by the park managers. The Park Managers believe there is a mismatching in the goal of a protect area and the introduction of mobile devices. Further, they argue the policies concerning information, communication and geographically based education could be achieved with other solutions. So the acceptance of the tool depends on other arguments. Arguments that show tangible benefits as the improvement of management processes (ranger reporting) or the elimination of landscape destructive boards.
The possible negatives impacts of the new system must be accompanied and out weighted by the demonstration of beneficial impacts. This argument is the strongest regarding the conservation strategies.
More and more, the visitors satisfaction is an important value of the existence of a protected area. Parks increasingly rely on market funding with a shift from government grants to visitor fees and service charges (Eagles 2003). This results in higher levels of visitor focus and in attempts to improve the visitor experience. But the investment in improving the visitor experience should be economically self-sustainable and should allow for the creation of new revenue sources for the Parks.

Further work

Due to the enthusiastic and positive feedback the WebPark system is experiencing. The R&D consortium team is still together (even after the project officially terminated) and is actively setting up a spin-off institution to allow the extension of this research. It is intended to take the WebPark experience to more partner sites all over the world in order to gather conclusive evidences that technology can play influential role in Nature protection by bridging gaps between people and their environment. The WebPark consortium welcomes other protected areas that would like to become partner in this research and develop pilot testing in their sites.

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