ETOURISM SERVICES AND TECHNOLOGIES: CURRENT ISSUES AND TRENDS

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ABSTRACT

eTourism services are increasingly changing the nature of and processes in the tourism industry. The aim of this paper is to address the implications of e-tourism services in the tourism industry. The main areas of concern are a combination of technical and social issues, which need to be addressed in order the tourism industry to adopt eTourism services. We present the current trends of eTourism technologies in the structure, organization and functionality of tourism. In particular, we discuss core technologies such as *intelligent agents, dynamic packaging, recommender systems, ambient intelligence, context awareness technologies,* and *mobile tourism guides.*

Key words: eTourism, intelligent tourism information systems, intelligent wireless web services, mobile tourism guides

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1 INTRODUCTION

eTourism is defined as the use of information and communication technologies (ICTs) in the tourism industry. It involves the buying and selling of tourism products and services via electronic channels, such as the Internet, cable TV, etc. eTourism includes all intranet, extranet and internet applications as well as all the strategic management and marketing issues related to the use of technology. ICTs include the entire range of electronic tools, which facilitate the operational and strategic management of organisations by enabling them to manage their information, functions and processes, as well as to communicate interactively with their stakeholders for achieving their mission and objectives (Buhalis, 2003).

Most tourism products (e.g., hotel rooms or flight tickets) are time-constrained and non-stockable. Generally, the tourism product is both *perishable* and *complex* (Cooper *et al.*, 1997). For example, a hotel bed not sold for one night represents a lost income; suppliers are in a risky situation, which can be reduced if access to information about 'stocks' is available. In addition, the tourism product itself is a bundle of basic products aggregated by intermediaries. To support this, basic products must have well-defined interfaces with respect to consumer needs, prices or distribution channels. Additionally, a tourism product is a 'confidence good'. As a result, the product itself cannot be tested and controlled in advance. At the moment of decision-making, only an abstract model of the product (e.g., its description) is available. Therefore, decision-making and consumption are separated in time and space. This characteristic of tourism products requires information on the consumers' and suppliers' sides, entailing high information search costs and causing informational market imperfections. These, in turn, lead to the establishment of specific product distribution and – comparably long – information and value-adding chains. Certainly, the tourism industry is a consumer of a diverse range of information (Chon, 1998) and lends itself well to the support offered by eTourism services.

The aim of this paper is to address the implications of eTourism services in the tourism industry. The rest of this paper is organized as follows: Section 2 focuses on the tourism technology and eTourism services. Section 3 describes state of the art technologies, in which eTourism services are based. These technologies are: Web services, semantic Web, intelligent agents, dynamic packaging, recommender systems, ambient intelligence, context awareness technologies, and mobile tourism guides. Finally, Section 4 concludes and presents future research directions.

2 TOURISM TECHNOLOGY AND ETOURISM SERVICES

Tourism technology is referred to as travel technology or even hospitality automation. It includes many processes (e.g., dynamic packaging) which provide useful new options for consumers. It is remarkable that immigration technology, known as *tecurity*, such as the 'biometric passport' may also be included as tourism technology in the broad sense. Actually, ICTs emerge as an integrated system of networked equipment and software, which enables effective data processing and communication for organisational benefit towards transforming organisations to eBusinesses. In particular, ICTs are having the effect of changing mainly:

(1) The ways in which tourism companies contact their business – reservations and information management systems, such as computer reservation systems (CRS) and electronic point of sales (EPOS). CRS are computerized systems used to store and retrieve information and conduct transactions related to travel. Originally CRS were designed and operated by airlines. Later they were extended to travel agents as a sales channel; major CRS operations are also known as Global Distribution Systems (GDS). Airlines have divested most of their direct holdings to dedicated GDS companies, and many systems are now accessible to consumers through Internet gateways for hotel, rental cars, and other services as well as airline tickets.

(2) The ways companies communicate; how customers look for information on and purchase travel goods and services (Smith and Jenner, 1998, p.77).

Internet enabled tourism organisations develop their processes and adapt their management via the use of emerging digital tools and mechanisms. In particular:

- They increase their internal efficiency and manage their capacity and yields better. For example, an airline's reservations system allows the company to manage their inventory more efficiently and the managers to increase occupancy levels. They also incorporate sophisticated yield management systems that support organisations to adjust their pricing to demand fluctuations in order to maximise their profitability.

- They interact effectively with consumers and personalise the tourism product. For example, the British Airways has launched a strategy to enable passengers to undertake a number of processes, including booking, ticketing, check-in and seat and meal selection, from the convenience of their computer.

- They revolutionise tourism intermediation and increase the points of sale (EPOS). For example, Expedia, Lastminute.com, Orbitz and Opodo have emerged as the most dominant electronic travel agencies, offering an one-stop-shop for consumers.

- They empower consumers to communicate with other consumers. For example www.virtualtourists.com or www.igoyougo.com supports the exchange of destination information and tips, whilst www.untied.com or www.alitaliasacks.com enable dissatisfied customers to make their views available.

- They support efficient cooperation between partners in the value system. For example, Pegasus enables independent hotels to distribute their availability through their web sites and other partners online. Rayman-Bacchus and Molina (2001) shed light on the ways that pioneering and novel forms of Internet-based tourist organisations are contributing to the evolution of the hospitality sector.

- They enhance the operational and geographic scope by offering strategic tools for global expansion.

In terms of consumer access to technologies, the use of the World Wide Web (abr. Web) is the dominant force. A large number of web sites on travel information exist and the number is increasing. It is estimated that there are 90 million Internet users globally (Smith and Jenner, 1998, p. 62). However, despite the increasing amount of information available to potential tourism consumers, several problems exist in generating a satisfactory level of service from the Internet. One of the main problems is that users cannot always find the information they are seeking. Moreover, those users wishing to make purchases with credit cards via the Internet are concerned about security. A new type of user is emerging who doesn't just try one or two services but all kinds of travel and leisure services. Such users don't mind becoming their own travel agents, but given the extensive use of distributed systems on the Internet, there comes the urgent need to find, combine, and sift through the right pieces of information *intelligently*.

3 STATE OF THE ART ICTS MEET THE TOURISM INDUSTRY

eTourism services are provided by tourism information systems, which are based on various ICTs. Hereafter, we present some of these major technologies. The presentation of all technologies involved in eTourism is out the scope of this paper.

3.1 The Web services technology

The World Wide Web Consortium (W3C) defines a Web service as a software system designed to support interoperable machine to machine interaction over a network. Web services are frequently just application programming interfaces (API) that can be accessed over a network, such as the Internet, and executed on a remote system hosting the requested services (Ouzzani & Bouguettaya, 2004). The W3C Web service definition (http://www.w3.org/2002/ws/) encompasses many different systems, but in common usage the term refers to those services that use SOAP-formatted XML envelopes and have their interfaces described by WSDL. The specifications that define *Web services* are intentionally modular, and as a result there is no one document that defines it. Instead, there are a few "core" specifications that are supplemented by others as the circumstances and choice of technology dictate. The most common are the following ones (Fig.1):

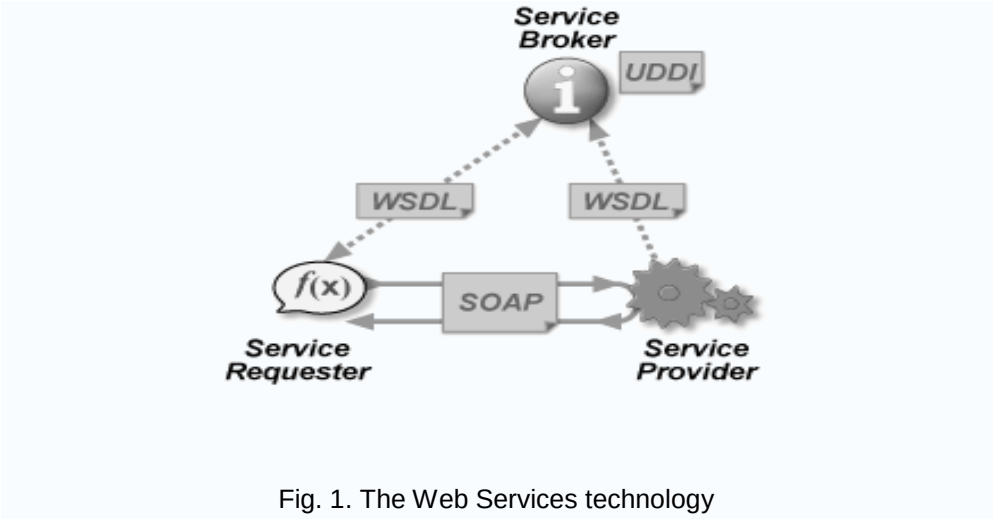

Fig. 1. The Web Services technology

- *SOAP* (Simple Object Access Protocol) is a protocol for exchanging XML-based messages over computer network, normally using HTTP. In particualr it is an XML-based, extensible message envelope format, with "bindings" to underlying protocols (e.g., HTTP, SMTP and XMPP).

- *WSDL* (Web Services Description Language): It is an XML format that allows service interfaces to be described, along with the details of their bindings to

specific protocols. Typically it is used to generate server and client code, and for configuration.

- *UDDI* (Universal Description, Discovery, and Integration). It is a protocol for publishing and discovering metadata about Web services, to enable applications to find Web services, either at design time or runtime.

3.2 The semantic Web

The *semantic Web* technology is an extension of the current Web where, in addition to being human-readable (using Web browsers), documents are annotated with meta-information (Berners-Lee *et al*., 2001). This meta-information defines what the information (document) is about in a way, which is machine processable. The semantic Web allows tourism-related content to become aware of it. This awareness allows users and software agents (viz. Internet-based programs that are created to act autonomously) to query and infer knowledge from web tourism information quickly and automatically. The semantic Web vision includes intelligent software agents, which 'understand' semantic relationships between Web resources and seek relevant information as well as perform transactions for humans (Hendler, 2001). It provides an open infrastructure, which is based on formal domain models (ontologies) that are linked to each other on the Web. *Ontologies* offer a promising infrastructure to cope with heterogeneous representations of tourism web resources. The domain model of an ontology (e.g., an ontology representing tourism destinations) can be taken as a unifying structure for giving information in a common representation and semantics. Recently, the travel industry has developed open specifications messages, based on *eXtensible Markup Language* (XML), to ensure that messages can flow between industry segments as easily as within (Dell' Erba *et al.*, 2002). For example, the *Open Travel Alliance* (OTA, 2004) is an organization pioneering the development and use of specifications that support e-business among all segments of the travel industry.

The intelligent tourism information systems require a lot of flexibility of underlying infrastructures. Moreover, they comprise accurate access to any tourism service that provide, and they are usable by corporate and private customers alike. The management and interoperation of semantically diverse tourism information systems are facilitated by semantic Web technology that provides methods and standards, which allow accurate access to information as well as flexibility to comply with needs of tourism information

system users and administrators. Kanellopoulos (2006) considers ontologies, semantic modelling and querying, semantic portals and semantic-based e-markets, concerning the exploitation of the semantic web technologies and applications in tourism information systems. Furthermore, Kanellopoulos *et al.* (2006) focuse on the new possibilities afforded by the semantic Web in the area of knowledge management (KM) applied to the travel industry.

3.3 Ontologies for Tourism

In the OnTour project, a working group deployed the *e-Tourism* ontology (Prantner, 2004) using OWL. The e-Tourism ontology (http://e-tourism.deri.at/ont/) was based on an international standard: the "*Thesaurus on Tourism & Leisure Activities*" of the World Tourism Organization (WTO, 2002). This thesaurus is a very extensive collection of terms related to the area of tourism. The *e-Tourism* ontology describes the domain of tourism and it focuses on accommodation and activities.

The *ISO 18513* standard (ISO, 2001) defines terms used in tourism in relation to the various types of tourism accommodation and other related services. This standard defines a common vocabulary for a better understanding between the users and providers of tourism services.

Mondeca's tourism ontology (http://www.mondeca.com) defines tourism concepts based on the WTO thesaurus. These concepts include terms for tourism object profiling, tourism and cultural objects, tourism packages and tourism multimedia content.

Another research group developed a comprehensive and precise reference ontology named *COTRIN* (Comprehensive Ontology for the Travel Industry) (Cardoso, 2004). The objective of the COTRIN ontology is the implementation of the semantic XML-based OTA specifications. Major airlines, hoteliers, car rental companies, leisure suppliers, travel agencies and others will use COTRIN to bring together autonomous and heterogeneous tourism web services, web processes, applications, data, and components residing in distributed environments.

Destination management systems is a perfect application area for semantic Web and P2P (Peer-to-Peer) technologies as tourism information dissemination and exchange are the key-backbones of tourism destination management. Kanellopoulos and Panagopoulos (2007) developed a novel ontology for tourism destinations in the LA_DMS project

(layered adaptive semantic-based DMS based on P2P technologies). The aim of this project was to enable DMS adaptive to tourists' needs concerning tourism destination information. They proposed a metadata model to encode semantic tourism destination information in an RDF-based P2P network architecture. Their model combines ontological structures with information for tourism destinations and peers.

The *Harmonise* (http://www.harmonise.org) is a EU Tourism Harmonisation Network (THN) established by eCTRL (ECommerce and Tourism Research Laboratory: http://ertrl.itc.it:8080/home/index.jsp), IFITT (International Federation for IT and Travel & Tourism: http://www.ifitt.org) and others. It is an ontology-based mediation and harmonization tool that establishes the bridges between existing and emerging online marketplaces. The Harmonise project allows participating tourism organizations to keep their proprietary data format and use ontology mediation while exchanging information (Missikoff *et al*., 2003).

In the *Satine project,* a secure semantic-based interoperability framework was developed for exploiting web service platforms in conjunction with P2P networks in the tourist industry (Dogac *et al.,* 2004). Semantic Web methodologies and tools for the intra-European sustainable tourism were developed in the Hi-Touch project (Hi-Touch Working Group, 2003). These tools are used to store and structure knowledge on customers' expectations and tourism products.

Finally, Hyvonen *et al.* (2005) proposed a semantic portal called *MuseumFinland* for publishing heterogeneous museum collections on the semantic Web. In their work it is shown how museums with their semantically rich and interrelated collection content can create a large, consolidated semantic collection portal together on the Web. By sharing a set of ontologies, it is possible to make collections semantically interoperable, and provide the museum visitors with intelligent content-based search and browsing services to the global collection base. The architecture underlying *MuseumFinland* separates generic search and browsing services from the underlying application dependent schemas and metadata by a layer of logical rules.

3.4 Intelligent software agents

There are research prototypes of intelligent travel support systems based on software agent technology (Ndumu *et al*., 1998; Camacho *et al.*, 2001). Traveller software agents can assist travellers in finding sources of tourism products and services and in

documenting and archiving them. A set of software agents can be deployed for various tasks including tracking visitor schedules, monitoring meeting schedules, and monitoring user's travel plans. Monitoring travel plans is a well-suited task for applying agent technology for several reasons:

- This is a fairly complicated task with many possible forms of failure ranging from flight cancellations and schedule changes to hotel rooms being given away when a traveller arrives late at night.

- There are a large number of online resources that can be exploited to anticipate problems and keep a traveller informed, and

- These tasks would be tedious and impractical for a human to perform with the same level of attention that could be provided by a set of software agents. For example, to deploy a set of agents for monitoring a planned trip, the user first enters the travel itinerary. Then the user specifies which aspects of the trip he/she would like to have the software agents to monitor. A set of information agents is then spawned to perform the requested monitoring activities (Camacho *et al*., 2001). Kanellopoulos *et al.* (2004) designed a novel management system of semantically enriched web travel plans in order these to become manageable, effective and adaptive to the users' needs. The new system is based on a P2P network architecture. Furthermore, their system includes a web log analysis module to evaluate how online travel plans are being consumed and to identify the individual differences among the users in terms of content usage.

3.5 Dynamic packaging systems

Dynamic packaging is a method that is becoming increasingly used in package holiday bookings that enables consumers to build their own package of flights, accommodation, and a hire car instead of a pre-defined package. Dynamic packages differ from traditional package tours in that the pricing is always based on current availability, escorted group tours are rarely included, and trip-specific add-ons such as airport parking and show tickets are often available. Dynamic packages are similar in that often the air, hotel, and car rates are available only as part of a package or only from a specific seller. Dynamic packages are primarily sold online, but online travel agencies will also sell by phone owing to the strong margins and high sale price of the product. The CSI Media company are amongst the leading providers of dynamic packaging technology for the travel industry via

their Travelberry software. Dynamic packaging systems create customized tourism packages for the consumers. The objective of dynamic packaging is to pack all the components chosen by a traveller to create one reservation. Regardless of where the inventory originates, the package that is created is handled seamlessly as one transaction, and requires *only one* payment from the consumer. Cardoso (2005) propose a platform to enable dynamic packaging using the semantic Web technologies. A dynamic packaging application allows consumers or travel agents to bundle trip components. The range of products and services to be bundled is too large: Guider Tour, Entertainment, Event/Festival, Shopping, Activity, Accommodation, Transportation, Food and Beverage etc. Dynamic packages can be created and booked effortlessly with private and published air, car hire, hotels, attractions and insurance rates.

3.6 Recommender systems

In the *intelligent Recommendation for Tourist Destination Decision Making project* (DieToRecs) (http://etd.ec3.at) a web-based recommendation system was developed that aids the tourist destination selection process and accommodates individual traveller's preferences. Based on the user profiles, personalised recommendations are created to support potential tourists to choose their ideal tourism destination. The *Travel Recommender System* (Trip@dvice) (http://tripadvise.itc.it) assists e-travellers in their search for tourism products and services. A prototype called *NutKing* (http://itr.itc.it) is available. Using the WAP (Wireless Application Protocol), the *Mobile Tourism Recommender System* (mITR) (http://mobile.itc.it) implements mobile tourism services such as airlines (reservations, check-in, flight status, etc.), hotels and restaurants (reservations), maps, transportation (schedules, connections etc.), traffic and weather conditions.

From another perspective, context-aware applications such as *mobile tourism guides* utilise contextual information, such as location, display medium and user profile, in order to provide tailored functionality to the end-user.

3.7 Tour guides and mobile tourism guides

At present the tour guide can be a soundseeing tour, and the guidebook could be an audioguide, podguide or I-Tours. An *audioguide* is a audio recording prepared to "guide" viewers through a museum exhibition by providing background, context, and information on the works included. Recently, city audioguides describing the attraction of cities or recommended walking tours are becoming more popular. An audioguide can be rented on the spot, often in multilingual versions, but also downloaded from the Internet, often in mp3 format. Some audioguides are free or included in the entrance fee, others have to be paid for.

There are numerous web-based mobile tourism guides proposed and evaluated (Schwinger *et al.*, 2002). The most of them offer to the user a map-oriented interaction paradigm. The *COMPASS* system (Context-aware Mobile Personal Assistant) provides tourists with context-aware recommendations and services (Van Setten *et al.*, 2004). Context characteristics are usually categorized into *scope* of context, its *representation* and *acquisition*, as well as the *access mechanism* used. *CRUMPET* is an European Union project aiming at the “CReation of User-friendly Mobile Services Personalized for Tourism” relying particularly on agent technology (Schmidt-Belz *et al.*, 2002). The *GUIDE* system provides tourists with up-to-date and context-aware information about a city via a PDA (Personal Digital Assistant). The GUIDE system is based on a client/server architecture, with a *Fujitsu TeamPad 7600* used as terminal. Based on the closest access point, the client determines the approximate location of the tourist and provides him/her with information about sights, a map, and the possibility of creating a tour. The access points broadcast information pages in the geographical area of the cell (Cheverst *et al*., 2002). Tourists on the move frequently access these information pages.

3.8 Location based services for Tourism

As we said before CRUMPET is a mobile application that uses multi-agents to construct a context-aware system. Its use is mainly limited to providing query and recommendation services. Schmidt-Belz *et al.* (2003) analysed CRUMPET implementing tourism-related value-added services for nomadic users across mobile and fixed networks and evaluating agent technology in terms of user-acceptability, performance and best-practice as a suitable approach for fast creation of robust, scalable, seamlessly accessible nomadic

services. To evaluate the usefulness of CRUMPET, they conducted a research about what kind of information the tourists need during their visit in a tourism destination. Regarding the information that a mobile tourism service should supply, transportation, maps, tour information, and sites of interest are the kind of information that tourists consider as the most useful. Ghandour and Buhalis (2003) based their research on secondary data and primary data collected through qualitative and quantitative methods. They analysed the market for location-based tourism services (e.g., what LBS the mobile travelers need, when and in what form they would like to receive it, and how much are they willing to pay for it). Moreover, they analysed the impact of the new mobile services on destination information providers and destination management systems. The major initiative that has been developed within a European IST project is the *Mobile Tourist Guide* prototype (Kamar, 2003), which promotes the use of 2.5/3G cellular networks with LBS.

3.9 Web intelligence and Intelligent Wireless Web (IWW)

Web Intelligence explores the practical impacts of Artificial Intelligence (AI) and advanced information technology on the next generation of Web-empowered products, systems, services, and activities (Zhong, 2003). The developments of AI in tourism are at the forefront. For example, individualized pricing (http://www.priceline.com), reversed multi-attribute auctioning http://www.mytraveldream.com), recommendations in bundling products, semantic Web and mobile applications (Kanellopoulos & Kotsiantis, 2007) are provided to the end-users. Using the Web, travelers can get information on timetables, routes, seat availabilities, accommodations, rental cars, and restaurants to help them plan their travels (Ndumu *et al.*, 1998). Remarkable progress has been made in the automation of travel planning with the help of the easily accessible information. There are also semi-automated commercial service web sites like travelocity.com, expedia.com and orbitz.com (Paprzychi *et al.*, 2002).

Alesso and Smith (2001) define Intelligent Wireless Web as a “network that provides anytime, anywhere access to information resources with efficient user interfaces and applications that learn and thereby provide increasingly useful services whenever and wherever needed”. The vision of Intelligent Wireless Web (IWW) goes beyond just connecting mobile devices to the Internet. It includes the creation of a pervasive, user centred mobile environment, which has the ability to provide highly specific data and services to users on as needed basis, by intelligent interpretation of the user context. IWW

services could provide mobile tourists highly precise data and services on an as-needed basis, with flexibility of use for the user. With the emergence of high-speed wireless networks, such as Wi-Fi, Bluetooth and 3G, and analogous developments in Internet technologies such as the Semantic Web, Web Services, Agent based technologies and Context Awareness, the realisation of the vision of the IWW has become a possibility. The realisation of the IWW will enhance the value proposition of mobile communications in tourism. Delivering context-relevant and personalised information to mobile tourists will save valuable time and will improve efficiency and productivity. Moreover, there is a need to integrate technology innovations in other areas, such as multimodal interfaces and speech technologies, to enhance the usability of the mobile devices. However, a key challenge is to link various technological enabling elements with methodological, cultural, social and organisational aspects specific to the tourism industry. Kanellopoulos and Kotsiantis (2006) present a state-of-the-art review of the enabling technologies and discusses how, by exploiting the convergence and synergy between different technologies, it has become possible to deliver IWW support to mobile tourists.

3.10 Ambient intelligence

Ambient intelligence is the convergence of ubiquitous computing and communication, and intelligent user-friendly interfaces. Such systems should be embedded, personalized, adaptive, and anticipatory, and they should provide access for everybody, anywhere, at any time. Whereas today the dominant mode of interaction is lean-forward, it will become laid-back (relaxed and enjoyable). People should enjoy computer interaction for travel planning, and technology should move to the background.

3.11 Context aware computing

Context-aware computing is the use of environmental characteristics such as the user's location, time, profile, identity and activity to inform the computing device so that it may provide information to the user that is relevant to the current context. The application of context awareness has been demonstrated in many tourism applications (Abowd *et al*., 1997; Laukkanen *et al.*, 2002), museums (Fleck *et al.*, 2000) and route planning (Marmasse & Schmandt, 2002). Basic projects that have specifically focused on location-based data delivery are the Mobile Shadow Project (MSP) (Fischmeister *et al.*, 2002) and the GUIDE

project (Cheverst *et al.*, 2000). The MSP approach is based on the use of software agents, to map the physical context to the virtual context. The Ambience Project (http://www.extra.research.philips.com/euprojects/ambience/) has adopted a different approach by focusing on creating a digital environment that is aware of a persons' presence, context, and sensitivity and responds accordingly.

Context-aware computing plays an instrumental role in realisation of the vision of the IWW by allowing tourism applications to better understand user context and adapt services to the interpreted context, thereby ensuring that the busy tourist gets highly specific data and services. Using context aware services delivery, it is possible to eliminate distractions for mobile tourists, related with the volume and level of information. Also, user interaction with the system can be reduced by using context as a filtering mechanism to put context relevant information to the users. This has the potential to increase the usability, by decreasing the level of interaction required between the mobile devices and the end users. The emergence of complementary technologies such as *ubiquitous computing, user profiling,* and *sensor networking* enables the capture of many other context parameters.

3.12 Ubiquitous computing technologies

The vision of IWW is to integrate ever-increasing intelligence in the mobile tourists' environment. *Ubiquitous computing* is an emerging paradigm of personal computing, characterized by the shift from the dedicated computing machinery (requiring user's attention e.g., PCs) to pervasive computing capabilities embedded in our everyday environments (Weiser, 2003). Realisation of the vision of the ubiquitous computing has become possible because of advances in different technologies including sensors, wireless and wired communications, memory, processor architectures, software technologies and communication systems such as mobile phones, Internet and WWW (Ailisto *et al*., 2003). Over the past decade, several projects have focused on ubiquitous computing. These projects include IBM's pervasive computing (http://www.research.ibm.com/thinkresearch/pervasive.shtml), Xerox PARC's ubiquitous computing (http://www.parc.com/about/default.html) and MIT's Oxygen initiative (http://oxygen.lcs.mit.edu/Overview.html).

Ubiquitous computing technologies can play a key role by bridging the gap between the physical world of travel operations and the virtual world enabled by the ICT infrastructure.

Although many tourism collaboration applications make extensive use of virtual project environments, in reality, a significant working time of the mobile tourist is spent on activities in the physical environment. Ubiquitous computing technologies have the potential to make collaborative processes and services sensitive to the data available in the physical world.

3.13 Profiling technologies

A key feature of context awareness is to adapt various data and services to the needs of the users. Also the data need to be transformed as per the device capabilities. Profiling technologies allow delivery of personalised information to users, based on their profile and device capabilities. Initiatives for the description of personalised information such as preferences have already been studied by a W3C working group and propositions such as CC/PP (Composite Capability/ Preference Profiles) (http://www.w3.org/2001/di/Activity) have been made. The goal of the CC/PP framework is to specify how client devices express their capabilities and preferences to the server that originates content. The information that the terminal provides, using CC/PP, can be used not only to tag information that is being collected but also to enable selection and content generation responses, such as triggering alarms or retrieving information relevant to the task at hand.

3.14 Wireless sensor networks

Recent advances in wireless sensor networking technology have enabled the development of low cost, low power, multifunctional sensor nodes, capable of sensing, data processing, networking with other sensors and data communication to external users (Akyildiz *et al.*, 2002). These advances promise a much wider range of applications for tourism processes. Sensor networks can be used to monitor a wide range of environments and in a variety of applications, including wireless data acquisition, tourists monitoring, smart highways, environment monitoring, site security, automated tracking of expensive products on a tourism destination, safety management and many others.

3.15 Web usage mining

Web usage mining can employ data mining techniques to analyze search logs or other activity logs to find interesting tourist patterns. Web usage mining can answer to research questions concerning the tourists' interest in tourism destinations or specific eTourism services. These answers could be related with the tourists' age, ethnicity, educational attainment, annual income, and country of origin. Web usage mining can be achieved if users register on the Web tourism applications demographics such as their age, ethnicity, educational attainment, annual income, and country of origin. Kanellopoulos (2007) argues that the Web usage mining technology can reveal female tourists' interest for eTourism services, which are related with romance or sex tourism.

3.16 Virtual tour and virtual reality

Virtual tourism refers to pre-planning alternative tourist activity before your departure, by integrating multiple digital resources to explore regions of the world without having to physically travel. It helps focus attention onto people, places and exploring changes over time! Virtual reality (VR) offers numerous distinct advantages over the actual visitation of a tourist site: 1) it affords access into a controlled environment, as all variables in the VR can be modified to create the perfect virtual experience, and 2) a virtual vacation dispenses many of the hassles that accompany an actual vacation. However, VR can never become a complete substitute for tourist experience, because it is unable to replace the feeling of being in nature and seeing, hearing, feeling, and breathing an environment that is real (Williams & Hobson, 1995).

At this point, we note that there additional ICTs which can be used as a basis to provide many additional complex eTourism services. However, their presentation is out the scope of this paper.

4 SUMMARY

The tourism domain is a decent area for new information and communication technologies by assisting users and agencies with quick information searching, integrating, recommending and various intelligent eTourism services. The eTourism market's dynamics

and the requirements of future tourism information systems emphasize eTourism's importance and raise several technical research issues:

- (Semantic) interoperability and mediated architectures.
- E-business frameworks supporting processes across organizations.
- Mobility and embedded intelligence.
- Natural multilingual interfaces and novel interface technologies.
- Personalization and context-based tourism services.
- Information-to-knowledge transformations— data mining and knowledge management (KM).

Tourism is also an excellent example of the trend toward personalized services and a complex market mechanism. It reflects users becoming a part of product creation. Consequently, researchers must also consider non-technical issues related to markets and users, such as: 1) dynamic market and network structures, 2) pricing and market design, 3) design and experimenting business models, 4) user decision modelling and usage analysis. These research issues underline the importance of an interdisciplinary approach. Many different disciplines should contribute, including computer science, management science, economics, law, statistics, sociology, and psychology. The information and communication technologies applied to the tourism domain represent the nucleus of the eTourism industry that will produce new tourism products, skills, and jobs.

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