Information Technology in the Tourism Industry
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Presentation

Information Technology, a Powerful Tool for Tourism

Antonio Guevara-Plaza, Andrés Aguayo-Maldonado, and Roman Egger

Introduction
Tourism is one of the largest sectors of the economy in the whole world, is responsible for a large number of jobs and represents a major contribution to the economy of many countries. In such a huge industry, Information and Communication Technologies, ICTs, play a fundamental role in boosting organizational efficiency and improving services.

Some of the key factors that have driven technological innovation in the industry have been its very size, the volume of business involved and the enormous challenge posed by its highly competitive nature. Yet above all, the fact that intensive processing of information is required means that ICTs must be used properly to ensure that the processes involved in generating, processing, applying and communicating information become more efficient.

Even though these technologies have been steadily and successfully applied since the middle of the 20th century, bringing down costs and enhancing the quality of service, the advent of the Internet has been what has triggered a radical change in the management, marketing and promotion of the services offered by tourism companies and institutions. Tourism-related products rank at the top of the list of Internet’s best-selling products: transport tickets, leisure, accommodation bookings, etc.

Background and Trends
There are countless players in the tourist industry, some concerned with passenger transport, others with accommodation, or brokering, promoting or managing tourist destinations. Each player has different information needs, which

The Guest Editors

Antonio Guevara-Plaza is a lecturer in the Department of Computer Languages and Sciences at the Universidad de Málaga, Spain, having obtained his PhD in 1991. He is Assistant Director of the School of Tourism at the same university, where he lectures on several information technology- and tourism-related subjects. He is Director of the Master and Doctoral Courses in Tourism management and planning. He currently heads the Cooperative Information Systems research group, from which he has conducted different projects on Information and communications technologies applied to tourism. He is Chairman of the Scientific Committee of the Tourism and Information and Communications Technologies conference, TURITEC, and member of the International Federation of Information Technology for Travel and Tourism (IFITT). He has coordinated and co-authored four books, three of them on Information Technology and Tourism and has had articles published in a large number of national and international journals and congresses. He is a senior member of ATI (Asociación de Técnicos de Informática, Spain) and co-editor of the "ICT and Tourism" section of its journal Novática. <guevara@lcc.uma.es>

Andrés Aguayo-Maldonado has a Degree in Physical Sciences from the Universidad de Granada, Spain, and a Diploma in Computer Science from Malaga University. He is currently lecturer in tourism at Malaga University. He lectures on several informatics-related subjects at the Malaga School of Tourism, and in the Master’s Degree in Tourism Management and Planning. He has taken part in different tourism-related projects and forms part of the scientific and organizing committees of the TURITEC conference on Tourism and Technology. He has co-authored four books, three of them on Information Technology and Tourism. And he has had more than twenty articles published in journals and at congresses, the majority of them regarding the application of ICTs to tourism. He is a senior member of ATI (Asociación de Técnicos de Informática, Spain) and co-editor of the "ICT and Tourism" section of its journal Novatica. <aguayo@lcc.uma.es>

Roman Egger attended the Tourism and Hospitality Management School in Klessheim, Austria, from 1989 to 1994. He graduated in Communications Sciences and gained his Doctorate from the University of Salzburg, Austria, where he specialised in the fields of Information and Communication Technologies in Tourism. Then he worked at the Tourism Board of Salzburg. At present he is Professor at the Salzburg University of Applied Sciences and head of tourism research department. Roman advises a number of national and international projects in the fields of Information Technologies in Tourism and counsels a number of international eTourism-development activities. He has written and co-edited four books and published a good number of articles in books and journals. He is co-editor of the scientific journal Zeitschrift für Tourismuswissenschaft and member of the International Federation of Information Technology for Travel and Tourism (IFITT), DGOF, ÖGAF and DGT, and also a member of the Executive Committee of the eTourism Foundation. <roman.egger@fh-salzburg.ac.at>
is why the extent to which ICTs have penetrated their operations differs from one to another.

In the passenger transport industry, it is the air transport companies that stand out most, having pioneered the implementation of information technologies and computer networks since the last century. They were the first to bring in Computerized Reservation Systems, CRS, to handle their flight ticket sales and later to coordinate with one another to be able to integrate their systems with other companies’ systems, integrating additional services, such as accommodation and car rentals, giving rise to what are known as Global Distribution Systems, GDS. That is when major, global booking systems such as Amadeus, Sabre, Galileo, Worldspan, etc., began to form, and later became large technological companies that today control the market.

And as the numbers of flights and passengers grow larger and larger, airport management systems now rank among the most sophisticated, cutting-edge computerized systems: the air traffic applications used in traffic control towers, or the automated luggage check-in and distribution systems in place in some major airports, are just a few examples of such systems.

Other transport-related companies, such as maritime, railway or car rental companies have also steadily computerized their in-house management processes and brought in reservation centres.

Technology has not made the same inroads throughout the hotel industry. Major hotel chains realized right away that they had to computerize all their hotel management and sales processes, while technology was far slower in penetrating smaller establishments and, even though nowadays almost all hotels have technology in place, one can still find hotels that have yet to fully integrate their back-office applications with the front-office applications they use to handle reservations and room availability. Another problem that arises has to do with the capacity to adapt to users’ new behaviour patterns, as more and more book their trips and holidays themselves via the Internet. Yet more and more companies are introducing sophisticated hotel management systems such as PMS, Property Management System, and CRM, Customer Relationship Management systems, etc. As technological changes occur, they are also mirrored in the hotel, both customerwise (Wifi connectivity, interactive TV, etc.) and in terms of efficient control of the hotel (building automation), computerized energy and security management, etc. This issue of UPGRADE includes an article that describes the current reach of technology in the hotel industry.

There are all kinds of players and middlemen in the tourist industry, ranging from major tour operators to retail travel agencies that specialize in different market niches like incentive tourism, active tourism or meetings. Prior to the Internet explosion, retail agencies relied on network technology to log into the databases of the GDS with which they were commercially associated, to check availability and rates and to make reservations. When the Internet burst onto the scene, it brought radical changes to the industry, and several consequences for travel agencies, which were forced to tailor their business models to the new circumstances. It also brought new players and middlemen, such as virtual travel agencies and IDS, Internet Distribution Systems, some of them linked to GDS, airline companies or hotel chains. Expedia.com, Travelocity.com, Booking.com and Lastminute.com are just a few of the famous names among the thousands of new distributors.

Today, so many homes have Internet that more and more users now book services themselves online. This trend has, to a certain extent, triggered a disintermediation of the system, yet new intermediation roles have also arisen. Traditional agencies have had to adapt their business model to the new scenario, but new models, like the virtual travel agencies that perform all their transactions over Internet, have arisen too. There has been an upsurge in Internet distribution systems, IDS, online booking systems or travel portals, specialised in marketing trips and related services. These new distributors represent an excellent platform from which service providers can market their products, exponentially boosting their Internet presence.

However, this proliferation of distribution channels has posed another kind of problem for providers, especially hoteliers, who are having to spend more time and dedicate more human resources to managing, updating, supervising and optimising bookings and pricing policies in these channels. To respond to these kinds of needs and to handle the fragmented intermediation, new technology meta-intermediaries have emerged, and offer services for facilitating interconnection and integrating online tourist service providers’ bookings in the different distribution channels (including the web site per se) and managing the Internet marketing strategy on a combined basis.

These technology intermediaries are increasing their market share and are becoming the true controllers of the market in which reservation centres and tourist service providers are being integrated. Booking Booster and Travel Click are just two examples of this new kind of intermediation.

The integration technology is based on XML, Extensible Markup Language, and on different standards, the most widely-known being the one proposed by the Open Travel Alliance, OTA. The OTA is a not-for-profit trade association, founded in 1999, with the mission of solving the problems inherent with connecting multiple systems within the complex travel distribution arena. It is comprised of companies representing airlines, car rental firms, hotels, cruise lines, railways, leisure suppliers, service providers, tour operators, travel agencies, solutions providers and technology companies.

Destination marketing organizations, DMOs, are generally public institutions or companies that are set up to attract tourists and generate business in a specific place, be it a country, region or city. Even though the volume of information that has to be gathered, processed and maintained is in direct proportion to the size of the destination, evidently the right technology has to be used to manage it. DMOs started off with a limited Internet presence, offering
content and links to the area’s websites, but that trend is changing and now they are steadily generating business directly through their own reservations centres or through deals with third-party reservation centres.

Tourism 2.0
The term Web 2.0 refers to a change in how the Web is used, which is now user-centred. Tourism 2.0 or Travel 2.0 is the use of Web 2.0 applications in the tourist industry. The key features are the user-generated content, the fact that users can express opinions about their preferences and social networking.

More and more travellers are putting together their own personalized package on Internet, buying each product or service separately, and it is here where the Web 2.0 plays a prominent role. In planning their trip, tourists not only consult the destination’s websites, but visit social webs and check travel blogs looking for other user’s recommendations and opinions, look at other people’s photos and videos, use geolocalization systems, etc. Once they reach their destination, they take photos and videos, and then share their own experiences on the Internet and so let others see it. For instance, they remark on and rate the hotels where they have stayed in Tripadvisor (www.tripadvisor.com) or in Booking.com, <http://www.booking.com>, publish their photos in Flickr, <http://www.flickr.com>, or Panoramio, <http://www.panoramio.com>, create a map with their trip’s highlights in Google Maps™, <http://maps.google.com>, upload their videos to YouTube, <http://www.YouTube.com>, and share their experience in Wikitravel, <http://wikitravel.org>. They also share their experiences with their contacts in Twitter, <http://twitter.com>, or Facebook, <http://www.facebook.com>.

Web 2.0 is also revolutionizing the industry’s marketing strategies. It is essentially a question of being wherever users are, and users are spending more and more of their time social networking. That’s why it is more usual for companies and organizations to set up their own channels in YouTube or their own pages in Facebook or Twitter. Hotel chains were the first to adapt their websites, but the websites of destination marketing organizations are also steadily reflecting this new philosophy.

Innovation and Research
Due to its very structure, tourism offers an excellent field in which to apply the latest research being conducted with the different information technologies. All over the world, research establishments and universities are studying how to apply the latest trends in the semantic web, destination recommendation systems, person-computer interaction, ubiquitous computing, augmented reality, mobile technologies, E-learning, search systems and meta search engines, e-payment systems, price management, branding and brand reputation, reputation localization-based services promotion in social media, connectivity and systems integration, etc.

The most significant results are presented in different international conferences, including ENTER, organized by the IFITT (International Federation for IT and Travel & Tourism). Also linked to the IFITT is the leading scientific journal in this field, the Journal of Information and Technologies (ITIT), whose chief editor has contributed to this monographic issue.

If, for example, we focus on Spain, one of the tourism world powers, important thematic events are held throughout the country, most notably the TURITEC (Tourism and Information and Communications Technologies) congress, organized by the Universidad de Málaga. Several national and regional authorities have set up bodies and establishments to foster research and facilitate the transfer of technology to the companies within their territorial scope, in order to enhance their capacity to compete. For instance, at a nationwide level, the State-owned company for the Management of Innovation and Tourist Technologies, SEGITTUR, created to support tourist promotion and the marketing of products and services through the use of new technologies and to contribute, through research, development and innovation, to raise levels of professionalism in the industry.

The regional initiatives include the IBIT Foundation and the Tourist Technologies Innovation ParkBIT, in partnership with Microsoft, in the Balearic Islands, as well as CICtourGUNE in the Basque Country, the Andalusian Research Centre for Tourism Innovation, CINTTA, while in the private sector, one could mention the Hotel Technology Institute (ITH),

The Monograph
This monographic issue presents different kinds of articles that will provide an overall perspective of the current and future applications of information and communications technologies in the industry, looking at different spheres of action, ranging from public to private enterprise, and including research and development establishments.

The first article, ”Specific Inter-Cultural Features in Online Distribution”, written by the Guest Editor Roman Egger, from the University of Applied Sciences of Salzburg, Austria, together with Mario Jooss and Sabine Schmeisser, analyses users’ behaviour in searching for leisure information when planning a trip and how important it is to take account of the specific cultural characteristics of the target groups, if one wants to get a competitive edge in view of the wealth of information on the Internet. Carlos Lamsfus, Aurkene Alzuza-Sorzabal, from CICtourGUNE, together with Christoph Grün, and Hannes Werther, from Vienna Technological University, Austria, present a decision-making system that helps tourists when they are planning to visit a destination. In their article “Context-based Matchmaking to enhance Tourists’ Experiences”, they present a context-based semantic matching structure, designed to make personalized proposals to tourists during their trip, thereby improving their experiences while they are at a given destination.

Next, Cathy Guthrie, from the London Tourism Management Institute, UK, and Lluis Prats-Planagumà, from
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the Universitat de Girona, Catalonia, Spain, in their article "Testing Delivery Systems in Transnational Virtual Learning: The Vocational Management Training for the European Tourism Industry (VocMat) Case Study", put forward some thoughts about the VocMat project (Vocational Management Training for the European Tourism Industry) which aims to provide a flexible online training method for the European tourism industry.

In the next article, "Technological Tools to support Online Marketing: SEGITTUR’s Role", Carlos Romero-Dexeus, Head of R&D&I at SEGITTUR, Spain’s State-owned company for the Management of Innovation and Tourist Technologies, outlines the latest technology tools that SEGITTUR has developed in recent years to support online marketing of the tourist services that Spanish companies offer over the Internet.

The article "Technological Innovation, a Challenge for the Hotel Sector", signed by Patricia Miralles, project coordinator of the Hotel Technology Institute, describes the current state of technological innovation in the hotel industry and the future challenges that it faces.

Last of all, Mateo Amengual-Rigo, Director of the Centre for Tourist Innovation and Development (CIDTUR), Jaime Bagur-Mora and Sandor Van der Meer, both from the Department of Research, Technological Development and Innovation of the Regional Government of the Balearic Islands, and Anne-Laure Debric, of the IBIT Foundation, have written the article "Technology Map: Bringing R&D+I Benefits to SMEs in the Tourism Sector. The Case of TOUREG Project", in which they present the approach and methodology followed in the TOUREG project, included in the 7th European Framework Programme, which aims to draw the technology map of the different regions and countries participating in the project. This technology map includes both supply and demand, that is to say, which technological solutions are provided by technology suppliers and what solutions the potential end users need and demand.

As usual we have included at the end of this presentation a limited number of useful references (books, websites, articles, reports, etc.) for those UPGRADE readers wishing to know more about the subject matter covered in this monograph.

To wrap up the presentation, let us express our gratitude to the authors for their valuable papers and to editorial teams of UPGRADE and Novática for having offered us the opportunity of editing this monograph, that we hope will be of interest for non-specialized readers too.
Useful References on "Information Technology in the Tourism Industry"

These links and references, together with the ones available in each of the papers of this issue, may help the reader to go further into the knowledge of the matter covered by this monograph.

Organizations

Journals and Congresses
- Journal of Information Technology & Tourism, ITT. ISSN 1098-3058. Published by Cognizant, USA.
- International Journal of Digital Culture and Electronic Tourism, IJDCET. ISSN (Online): 1753-5220. ISSN (Print): 1753-5212.
- Journal of Hospitality and Tourism Research. ISSN: 1096-3010.
- Tourism Management. ISSN: 0261-5177. Published by Elsevier.

Centres for Research on Tourism and Tourism Technology Innovation
- Université de Québec à Montréal, UQAM, Chaire de Tourisme Transat, <http://www.chairedetourisme.uqam.ca>.

Books

Research

Other Sources
Specific Inter-Cultural Features in On-Line Distribution

Roman Egger, Mario Jooss, and Sabine Schmeisser

Poon’s statement (1993) that "information is the lifeblood of tourism" is certainly one of the most quoted sources in the relevant scientific literature. And not without reason, as tourism proves to be an extremely information-intensive, complex and dynamic industry. At the same time, the Internet has become established as the most important medium of information that users turn to when preparing a journey. If a hotel aims to remain competitive, a resort to the web – and especially direct marketing via the Internet – is inevitable. It is imperative that the right information is communicated to the pre-defined target group at the right time via the right channel. In this paper, the information search behaviour of leisure travellers is analysed against this background. In addition, the focus is on cultural particularities guests display in preparing their journeys on the web. Hence, taking account of distinctive cultural features to achieve optimum communication with the defined target group is a decisive competitive edge within the hotel trade and has become indispensable given the increasing competitive pressure and the information overload on the Internet.

Keywords: Culture Tourism, eTourism, Hotel Trade, Hotel Rating Portals, Information and Communication Technologies, Information Search Behaviour.

1 Introduction

Information search behaviour plays a central role in the process of purchasing a tourism product. Because of the intangible character of tourism services, consumers depend to a high degree on high-quality, reliable and trustworthy information [1, p. 21]. This applies to both primary decisions about the travel destination and secondary decisions, such as the choice of accommodation [2, pp. 13-16].

In tourism-relevant marketing literature, information behaviour is one of the most thoroughly researched fields. The majority of studies, however, deal solely with the information search behaviour guests display when deciding on their travel destinations and do not address the choice of hotels. The need to investigate the information search behaviour of guests with special focus on the hotel trade is consequently high [3, pp. 165-176]. What is lacking in particular are findings on the information search and use behaviour at national level, even though these aspects would be especially relevant for tourism and the hotel trade. The use of information and communication technologies provides SMEs with the great opportunity of optimising their business transactions and operational processes, of using new distribution channels, improving their quality management and, in general, of achieving cost savings which in turn can improve their competitiveness.

2 General Information Search Behaviour

To elucidate the influence of travel motivation on tourists’ information search behaviour when it comes to deciding on a vacation it can be said that a general distinction needs to be made between pull factors and push factors. [4, p. 186]. Only detailed knowledge about the push and pull factors of leisure travellers make it possible for suppliers in the tourism trade to address their target groups appropriately. The intensity of information sourcing must be seen as a function of some determinants. First, it is influenced...
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by the product-related knowledge the consumer possesses. If the consumer can fall back on previous experience of purchasing and/or using tourism products/services, the intensity of information sourcing declines as the consumer will need only limited or no additional information.

Secondly, the intensity of information sourcing increases the higher the relevance (high involvement) of a purchasing decision and the higher the purchasing risk as perceived by the customer [5, p. 128 et seq.].

Thirdly, by deciding on purchasing a specific product or service, other products are rejected, which often triggers a feeling of uncertainty or cognitive dissonance as it is called [6, p. 185]. In order to minimise this feeling of uncertainty, consumers thoroughly search for information with the aim of finding the optimum alternative among all the offers [5, p. 129].

The fourth determinant in the context of information sourcing intensity is the degree of complexity of the decision. It increases if the choice of alternatives is wide, the number of relevant product features high and/or differences between the individual products great [5, p. 130]. A closer look at these determinants reveals a high degree of intensity of information sourcing in the tourism context.

The times when the Internet simply served as a mere source of information for vacation planning have long been over. In the year 2008, for example, 80 percent of the 30 million Germans experienced in planning and booking travel, prepared, planned or booked their holidays online. [7].

The sub-category of booking portals, such as Expedia or Travelocity, websites of service providers in the tourism trade (airlines, hotels) and destination websites make up some 70% and thus the most important on-line information sources for travel decisions. [8].

The development of ICTs (Information and Communication Technologies) and the tremendous increase in the amount of information on the web, attach a whole new importance to recommender systems (on-line recommendation systems). Consumers use on-line rating platforms, such as Tripadvisor or Holidaycheck, to look for general information, with the perceived quality of the product and/or service as seen by the peer group being particularly important in addition to corporate information. In summary, destination websites, booking and rating portals and the websites of service providers in tourism play the most important role in information provision of tourism contents.

3 Central Approach to explaining Information Search Behaviour of Tourists

From a marketing perspective, it is of enormous importance to understand the customer with respect to those information processes that can be seen as preceding the actual decision, as a precursor stage from which optimised communication structures can be derived and established [9]. Scientific literature provides a wealth of explanations for the information, reception and decision behaviour in tourism from various disciplines. Table 1 shows a selection of models.

Albeit a large amount of research has been carried out on the topic of information search and decision-making behaviour of tourists, studies on the use of the Internet for holiday planning are scarce. The models can be broken down to three general approaches that are also used in the context of tourism. These are the psychological-motivational, the economic-functional and the process-oriented approach, with the latter also being covered in the framework of the psychologically-motivational approach so that it can be neglected in the treatise below.

The psychological-motivational approach focuses mainly on socio-demographic features in explaining the information sourcing behaviour. Age, education, income, gender and culture1 are the decisive parameters of influence here. The importance of recommendations of friends and acquaintances and the tourist’s own experience becomes higher the older the person is. Studies have shown that the determinant factors of education and income are closely

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<td>Pan &amp; Fesenmaier 2006 [10]</td>
<td>Semantic Mental Model</td>
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Table 1: Models of Information Search and Decision-making.

1 Culture is here seen as "mental programming" in the definition of Geert Hofstede [17], but where not only geographic, but also gender or class-specific cultural areas are to be subsumed.
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linked to the intensity of the information search. The cultural aspect in particular, when seen from a geographic point, opens up an interesting view angle for tourism-specific issues. Numerous studies have proven the significant difference in the use of sources of information in different cultures and show that navigation, search and interaction patterns as well as the perceived user-friendliness are strongly influenced by culture.

The psychologically-motivational approach is oriented along the sources of information used, the number of sources included in the information process, as well as the search complexity, always in dependence on the respective travel. In this context, in [14] the importance of a trip’s features is underlined. Length of trip, travelling experience, form of travelling, travelling party as well as distance have a major impact on the information process. The intensity of information sourcing is higher the longer the trip, the farther away the destination and the bigger the party.

The economically-functional approach, also referred to as the cost-benefit approach, is often used in literature when the information phase is to support the purchasing decision. The expenses incurred during the search – in the form of time, money and energy – are measured as to their perceived informative value. The number of information sources used and the intensity of the information search are oriented along the success that can be expected and that can be seen as the basis of an optimum purchasing decision. Tourism provisions are highly complex and cannot be tested beforehand and therefore involve a high risk. The cost-benefit approach not only takes success (benefit) but also possible failure into account. The risk reduction achieved – which is consequently inherent to the economic-functional approach – displays distinct cross-references to the psychologically-motivational approach. The costs accepted in the search of information about unknown destinations and long-haul journeys are, for example, disproportionately high.

4 Findings of Relevance for Practice

Based on the theory elucidated above and the illustrated relevance of this topic for practical applications, some central statements of a study carried out by the authors are presented below. These statements could be used as possible solutions and for practical implementation. The authors looked into the question of what information from what sources needs to be available for German, Italian and British leisure travellers and at what time in order to have a positive effect on the booking of a hotel. The survey was conducted in the autumn/winter of 2008. During the period under review, 238 guests were interviewed with the help of highly structured written questionnaires. The questionnaires were distributed upon the defined leisure travellers’ arrival, i.e. after the hotel had been selected and booked. The results of the empiric investigation are based on a number of 151 valid questionnaires.

As already explained, the information sourcing behaviour is a decisive process in the purchasing decision of a tourist. Leisure travellers make their decisions on booking a hotel on the basis of a very limited number of criteria and limited information. To ensure a purchasing decision, the relevant information content for leisure travellers are the criteria of ‘central location’, ‘price-performance ratio’, ‘hotel category’, ‘reputation and/or rating’, ‘photos’ and ‘hotel furnishing and equipment’. These criteria need to be captured as well as possible by hotels in the main information sources of their target group. The importance of these criteria for the purchasing decision in percent is as shown in Figure 1.

Figure 1: Top Criteria for Choice of Hotel.
Broken down by nations there are, however, very distinct differences between the relevant selection criteria. The criteria of ‘central location’ and ‘price-performance ratio’ are the most decisive ones for all three nations in terms of purchasing decision. It was shown, however, that ‘ratings and/or the hotel’s reputation’ is of a distinctly higher relevance for the purchasing decisions of British travellers than for German and Italian ones. In contrast, German leisure travellers more often use hotel photos to select a hotel.

To ensure optimum target group communication, it is essential that information about the travelling motivation is included in the communication policy. Crucial driving forces for the motivation of city travellers and for German leisure travellers are ‘leaving everyday life behind’, ‘entertainment’ and ‘gift’. It must be noted here that the ‘gift’ motivation has so far been mostly neglected by general motivation research. This motivation shows that city trips are seen as perfect gifts, which leads to the recommendation to proactively promote gift vouchers in hotels’ marketing measures, especially in their communication with German guests. The predominant motives for Italian leisure travellers on the other hand are ‘trips with the family’ and ‘recovery’. Consequently, the focus of marketing activities should be on the ‘family’ aspect and family-friendly services should be underlined to ensure a competitive edge in the customer’s decision. The development of information and communication technology has brought about major changes in the information sourcing behaviour of tourists and the influence of the Internet on tourists’ information search is undisputed. There is, however, disagreement as to whether offline sources could be fully replaced by on-line sources of information or if these are to be used also in future as supplemental information. 78 percent of leisure travellers use up to three sources of information – on-line and off-line sources together – in their search for information about hotel accommodation; 19 percent use four sources of information, and only 1 percent each use five and six sources of information.

The most important on-line sources of information are hotel websites, booking portals and hotel rating portals (see Figure 2). What is especially noteworthy is the considerably smaller relevance that destination websites have for the sourcing of information about hotels. In the search for hotels, off-line sources of information are nearly entirely replaced by on-line sources. However, the stress here is on “nearly”. The importance of the most relevant off-line sources, i.e. travel agency, travel guide and recommendation, especially for the first step of the information search process, must by no means be disregarded. This holds true, in particular, for target group communication with British and Italian guests. British guests in particular tend to shift between media, which means that a well-balanced combination of on- and off-line marketing is of high relevance for these travellers. Even though off-line sources now play a

Figure 2: Sources of Information used by All Leisure Travellers.
relatively subordinate role for the communication with target groups of leisure travellers from nearby source markets, the information provided in selected off-line sources should not be neglected in future.

The use of sources of information is subject to distinct cultural difference, just like the other two aspects presented above. Table 2 illustrates these differences. At first glance, there seem to be no cultural differences, as hotel websites are the most important sources of information for all three source markets. A closer look at the top 5 information sources of the three nations reveals clear differences as from the second source. German leisure travellers resort considerably more often to search engines than British and Italian tourists. In contrast, booking portals are of higher relevance for these two nations than for German travellers. The national differences are particularly striking in the use of hotel rating portals, recommendations and other off-line sources. While 57.1 percent of British holiday makers used hotel rating portals for their search for hotels, this tool was used by only 35.3 percent of the Italian and 29.4 of the German guests surveyed. Italians, on the other hand, have recommendations as a top 5 source of information, while this source is only ranked eighth among German and British travellers. In order to translate the importance of recommendations to marketing activities, bonus systems are recommended to enforce recommendations of Italian guests. German guests quote off-line sources (categorised) far more often. These sources include tourist associations – a source only contacted by German guests, contacting the hotel by telephone, travel magazines, hotel brochures and hotel guides. Since German guests contact tourist associations also for direct hotel inquiries, it is recommended that hotels establish good links to such associations.

The evaluation of the most important information sources for purchasing decisions provides comparable results, as shown in Figure 3.

Hotel rating portals are the most important sources of information for leisure travellers when it comes to taking a purchasing decision. This is especially true for British and Italian travellers. It must be noted that hotel rating portals are of considerably higher relevance for British travellers along their entire information process. An optimum presentation in on-line recommendation systems is therefore an absolute must for hotels in their communication with

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<th>Nation</th>
<th>Germany</th>
<th>Great Britain</th>
<th>Italy</th>
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<tr>
<td>Top 1</td>
<td>Hotel website</td>
<td>74.5%</td>
<td>Hotel website</td>
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<tr>
<td>Top 2</td>
<td>Search engine</td>
<td>45.1%</td>
<td>Booking site</td>
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<td>Top 3</td>
<td>Booking site</td>
<td>43.1%</td>
<td>Hotel rating sites</td>
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<td>Top 4</td>
<td>Hotel rating sites</td>
<td>29.4%</td>
<td>Search engine</td>
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<td>Top 5</td>
<td>Offline sources</td>
<td>25.5%</td>
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Table 2: Top 5 Sources of Information Broken Down to Nations.
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British guests. Hotels are called upon to promote positive inputs of satisfied British guests. Given the higher relevance of on-line hotel ratings, the focus in communication with British and Italian guests should also be on the great importance of customer satisfaction and ideal complaint policies of a company. Behind rating sites, hotel websites are the decisive source of information for the selection of the hotel, before booking portals. The survey clearly showed that it is above all German travellers who refer to a hotel’s website to take their final purchasing decision.

To address travellers at the right time during their information sourcing process, the search process needs to be examined as to the order in which the respective information sources are used. The information sources ‘booking portals’ and ‘search engines’ are the two starting points. All in all, four predominating search processes of leisure travellers were determined, as shown in Figure 4.

27.8% of leisure travellers use booking portals to start their information search. Hotel websites and/or hotel ratings follow in relevance.

23.8% of leisure travellers prefer search engines as their primary source of information. As far as the search process according to nations is concerned, German leisure travellers start their information search mostly in search engines (search processes 3+4, seen in Figure 5), while the first steps of searching of British and Italian guests are mainly done on booking portals (search processes 1+2); these two nations also resort more often to travel agencies than German holiday makers. Italians use search engines often only as a second step of their search for information to search for additional information about the hotel selected. According to these findings, targeted search engine management is therefore recommended to address German guests; i.e. it is important to be displayed above the fold in the organic listing of search engines. As far as keyword optimisation of the hotel website is concerned, reference is made to the relevant information for hotel selection and travel motives as described above. To address British and Italian travellers, hotels must ensure the best possible ranking on booking portals in order to be found right at the beginning, when the tourist starts his/her search for information. Since travels with the family are of high relevance for Italians, it is also recommended to offer rooms labelled "family rooms" in booking portals and list in detail all the family-friendly services in the description of the hotel’s offers.

In terms of the timing of information searches it can generally be said that leisure travellers from closer source markets start looking for travel destination and hotel information at the same time and that they search for information at relatively short notice, i.e. up to three months before setting out to their journey.

5 Discussion

Scientific literature lists points of critique for the applied research method of the quantitative survey. These were taken into account by the authors when selecting the method. The most important point of critique in terms of recording information behaviour of leisure travellers by means of surveys is that the survey is only conducted after the information search has been completed so that only the consciously controlled and remembered part of information absorption is queried [6]. The authors were aware of this limitation when they selected the empiric method. Due to lacking scientific investigations of the field of research for the hotel trade, this paper aimed at analysing the basic sources and steps of information behaviour. The problem was also by-
passed by means of the list of categories of the most relevant sources of information in tourism that were developed based on literature and helped the respondents. And it should also be said that nearly 80 percent of the respondents were polled within three months after their search for information.

References


Context-based Matchmaking to enhance Tourists’ Experiences

Carlos Lamsfus, Christoph Grün, Aurkene Alzua-Sorzabal, and Hannes Werthner

Tourists preparing for a journey suffer from information overload when they use the Internet to look for information about their next potential destination. Although approaches exist to support tourists in decision making (e.g., in form of recommendation systems), providing the right information for each type of tourist is still a challenging task. This is a major issue, especially when tourists are already at a particular destination and desire to use their mobile devices to consume up-to-date travel-related information tailored to their current situation i.e. context. This paper presents a context-based matchmaking approach that addresses the needs of tourists during their trip and aims to provide a more satisfying visit experience. In order to identify a set of tourism objects (e.g., attractions) that are most attractive for tourists, the CONCERT framework is presented that exploits contextual information, such as location and time, as a filter to select relevant tourism objects. Within a second step, the matchmaking framework VMTO is introduced that acts on top of CONCERT and ranks the selected tourism objects according to personal tourist preferences.

Keywords: Context, Matchmaking, Ontologies, Semantic Web, Tourism, Tourist Classification.

1 Motivation

One of the industries that has benefited enormously from the use of the Internet is the tourism sector. Internet technology has created an online travel market where travel organizations are able to sell their products and communicate with their customers through electronic media. On the other hand, the richness of information that is available online has empowered tourists to exploit the Internet for researching travel-related information and even partially book objects for their trip online. This way, stakeholders (suppliers and consumers) benefit from the use of the Internet for information research and as additional selling channel. The provision and consumption of online travel services have become for both nearly a "daily" business.

The penetration of high-end mobile devices equipped with GPS together with decreasing mobile data prices have resulted in an increased usage of mobile services. Therefore, tourists like to access travel-related services not only in the pre-trip phase, but especially in the on-trip phase of the tourist life cycle (cf. Figure 1).

In the on-trip phase, tourists are mobile and act in unknown environments where they especially need personalized, up-to-date on-trip assistance in the form of information about tourism objects (e.g., attractions, museums, restaurants). Mobile tourism services, accessible through mobile applications, context-aware systems and the Semantic Web, have become for both nearly a "daily" business.

The Authors

Carlos Lamsfus has a degree in Mechanical Engineering and another degree in Industrial Management Engineering. He is in the final phase of his PhD dissertation about contextual computing services in tourism at the University of Deusto. His research interests include context, context-awareness, semantics and interoperability. He has been a member of various international research groups, such as CEN/ISSS and CIDOC/CRM. He has taken part in several regional, national and international projects and has several publications in the areas of semantic technologies, context-awareness and tourism. <carloslamsfus@tourgune.org>

Christoph Grün studied business informatics at the University of Linz in Austria. After finishing his study he continued research and started his PhD within the E-Commerce group at the Vienna University of Technology. His work is related to the E-Tourism domain, as he focuses on customizing travel-related information through a sophisticated matchmaking process that relates tourist profiles against tourism objects. His research interests include mobile applications, context-aware systems and the Semantic Web. <gruen@ec.tuwien.ac.at>

Aurkene Alzua-Sorzabal received her PhD in Outdoor Recreation and International Tourism from Purdue University, U.S.A (1999). She is the director of the Basque Competence Research Centre in Tourism, CICTourgUNE, and a faculty at the University of Deusto. She has lead significant research programs at national and European level in the field of Tourism and Technologies: measurement and modelling of ICT in tourism and the adoption and integration of ICT in tourism. She has several publications and is Board Member of relevant organisations. <aurkenealzua@tourgune.org>

Hannes Werthner is Director of the Vienna PhD School of Informatics and Professor for E-Commerce at the Vienna University of Technology, where he directs the E-Commerce group. Previously, he was Professor for Computer Science and E-Commerce at the Vienna University of Economics, the University of Innsbruck and the University of Trento, Italy. He acts as the Editor-in-Chief of the journal Information Technology and Tourism, and is the founding president of IFITT (International Federation for Information Technology and Travel/Tourism). He also established the international conference on IT and Tourism (ENTER), which is the leading academic conference in this domain. <werthner@ec.tuwien.ac.at>
bile handsets, provide the opportunity to cope with the temporal and special constraints. However, using mobile devices to obtain the right piece of information at a given moment of time presents a real challenge. One reason is the limited interaction possibilities due to the small mobile phone screen size and lack of a keyboard, which demand more cognitive work from the tourist.

In order to prevent information overload of the tourist and provide only relevant information, these services should sense and react to the current situation of the tourist. This in turn might lead to an increase in the tourist’s satisfaction of experiencing a relaxed sightseeing trip. Thus, given that human mobility is the essence of tourism and that tourists intensively use mobile devices, how can the right piece of information be sent to tourists on the move? This goal can be achieved by using customization, i.e. adapting an application towards the current context of the tourist.

The main objective of the context-based matchmaking framework presented in this paper is to support tourists’ mobility at a particular destination by helping them to identify relevant tourism objects matching their personal interests. This objective will be accomplished in a two-step process: firstly, contextual information is exploited to eliminate those tourism objects that do not fit the current situation of the tourist [1]. For example, it might be the case that they are too far away and not reachable from the current position of the tourist or that they are temporarily closed. Secondly, a matchmaking process is presented that ranks the selected tourism objects by matching the tourist preferences against tourism objects on the basis of tourist types that are found in scientific tourism literature [2]. The more similarities they have in common, the more the tourism object contributes to the tourist’s satisfaction and therefore should be ranked higher.

The structure of the paper is as follows. Section 2 outlines relevant related work. Then section 3 presents the CONCERT framework that exploits context information to select relevant tourism objects. Section 4 introduces the VMTO framework that ranks the selected set of tourism objects based on tourist preferences. Finally, Section 5 concludes this paper.

2 Related Work

In the following, we report on state of the art in the area of context-awareness, tourism ontologies as well as user profiling.

2.1 Context-awareness

Context-aware mobile systems have a long tradition in tourism, which is a very well suited application domain for these kinds of systems [3][4]. In fact, some studies show that tourists will soon require mobile context-based services [3][6][7]. However, most of the existing mobile tourism guides and research prototypes do not fully exploit context information in order to adapt the information to the individual situation and requirements of tourists [8]. Only few examples exist that provide more personalized information by taking into account together various context information [9][4][7]. Even though the CAIPS system [4] provides rule-based push information, it does not present a general framework to support mobility. It is rather focussed on the modelling and definition of rules that can be used by destination management organisations in order to push personalized content to visitors.

The study of context in tourism plays a crucial role, since it is an information facilitator in the negotiation process between all available tourism information (offered by travel organizations) and the information that visitors require at a given moment of time based on their situation. Context is the link between the need for information and the information itself.

Since research in context-awareness began almost 20 years ago, two phases can be clearly distinguished. The first one covered the 1990s and was primarily focused on studying the notion of context under different disciplines. The main objective of these applications was to enhance human computer interaction by providing the application with context information. Although context was studied as a secondary variable in these applications, intensive work was conducted in setting its theoretical foundations and thus the most important definitions of context originated in that decade [10][11][12].

During the 1990s ontologies were still not very well
known in the computer science community. Some ontology-based applications appeared during these years in different domain areas, such as knowledge management, information integration etc., but still the benefits of ontologies had not been fully discovered and their applicability in context-aware systems had not been yet experienced.

However, as of the year 2000, the second phase in context-aware research began, aiming at establishing a standard context management model that leverages semantic technologies. In fact, one of the greatest differences between the two phases is the use of semantic technologies to model context and to manage context information. However, in the second phase researchers have been more concerned in developing an ontology-based standard context management framework [13][14][15][16] rather than working on its theoretical foundations.

Existing approaches with respect to context-awareness in the field of human mobility have more or less re-used the concept of context and ignored the requirements for context modelling within this specific field. Not surprisingly, the subsequent models do not completely suit its requirements.

In most recent years ontologies have been widely used in pervasive computing and have been pointed out as adequate tools for context modelling and management [17][18]. They can be used to integrate, share and re-use context knowledge stemming from distributed and heterogeneous sources of information and in addition, facilitate the usage of logical reasoning capabilities that can be used both to check the context model’s consistency and to make implicit information explicit.

2.2 Tourism Ontologies

Recently, there has been a proliferation of ontologies that have been developed in the area of e-tourism. QALLME [19] is an EU-funded project that aims at establishing a shared infrastructure for multilingual and multimodal question answering in the tourism domain. Thereby, it allows users to pose natural questions and returns a list of answers in the most appropriate modality.

The HARMONISE [20] ontology is now the central element within the HarmoNET (Harmonisation Network for the Exchange of Travel and Tourism Information) that aims to create an International network for harmonization and data exchange in the tourism industry. The ontology focuses on two sub-domains of the tourism domain, namely events and accommodation.

CRUZAR’s ontology [21] is based on the upper-ontology DOLCE in order to model visitor’s profiles, travel routes and POIs. To describe POIs, it further reuses properties from the Dublin Core, FOAF and SKOS-Core. SPETA exploits concepts from the e-tourism ontology [22] in order to describe tourist services. In addition, it links to concepts from DBPEDIA and YAGO to describe social links of tourists. DTG’s ontology [23] is built leveraging some existing taxonomies from DAML and GETTY.

2.3 User Profiling

As tourists have individual preferences, tourist profiling plays an essential role in the provision of personalized travel information. With this purpose in mind, the classical user model employed for personalization [24] needs to be adapted to model the needs and interests of tourists.

Based on Maslow’s hierarchy of individual need [25] a huge number of studies of tourist motivation have been conducted that investigate different factors as to why certain tourists undertake specific types of travel [26]. Related to...
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this field is the work described in [27] that proposes a model of information needs of tourists forming a categorization of different types of needs, including functional, recreational, as well as aesthetic needs. Such needs, wants, behaviour and expectations of tourists can be further classified into tourist types. In [28] four different tourist types are distinguished, comprising the organized mass tourist, the individual mass tourist, the explorer and the drifter. A set of 15 different tourist types such as the action seeker, active sport tourist or thrill seeker is proposed in [2]. For example, the thrill seeker is described as type of person “interested in risky, exhilarating activities which provide emotional highs for the participant”. As pointed out in [26], such an absolute classification to classify tourists may not take into account the diversity of holidays tourists undertake and the inconsistencies in tourist behaviour. Over time, tourists might change their behaviour or have a mixed profile. The work in [29] examined whether such predefined travel types can be used as shortcuts to deliver personalized recommendations instead of forcing the user to fill out lengthy forms. Thereby, each of the predefined travel types is linked to certain activities. The study shows that travel types are indeed a useful means to capture the interests of tourists with respect to certain activities.

### 3 CONCERT: Contextual Computing in Tourism

CONCERT’s objective is to study the context of visitors of a particular destination with respect to the field of human mobility. The goal is to determine in a more precise way the information that formally describes the mobile visitor context and to define requirements of such applications. In this sense, context is regarded as the main entity, not an auxiliary variable for studying something else as in earlier approaches (cf. Section 2). Hence, it is of high importance to study the factors that define the context of people on the move and to find out which kind of information is at least needed to describe a mobile visitor’s context [1].

On a practical level, CONCERT proposes not to use sensor infrastructure to gather contextual information. Populating cities, regions and/or open areas with networks of sensors is not affordable.

In order to tackle this issue, the CONCERT framework gathers both contextual and tourism data from the Internet as well as from mobile embedded sensors (e.g. GPS), and

<table>
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<tr>
<th>Ontology</th>
<th>Definition</th>
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<tr>
<td>Visitor [33]</td>
<td>Characteristics of the human being in mobility.</td>
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<td>Preferences [33]</td>
<td>Information that describes the visitor’s personal characteristics, demographics, etc.</td>
</tr>
<tr>
<td>Role [33]</td>
<td>The role a visitor plays at a given moment.</td>
</tr>
<tr>
<td>Activity [15]</td>
<td>Represents what the visitor is doing at a given moment. This information can be taken from the mobile device’s agenda. (COMANTO).</td>
</tr>
<tr>
<td>Environment [16]</td>
<td>Represents the surroundings of the visitor (CoDaMoS) as well as the weather conditions at the location of the visitor.</td>
</tr>
<tr>
<td>Device [35]</td>
<td>Physical object the visitor carries with him/her.</td>
</tr>
<tr>
<td>Network [36]</td>
<td>Infrastructure to connect devices and convey information.</td>
</tr>
<tr>
<td>Motivation [33]</td>
<td>Represents the reason why the visitor is travelling.</td>
</tr>
<tr>
<td>Location [16]</td>
<td>Coordinates that define where a visitor is at a given moment of time.</td>
</tr>
<tr>
<td>Time [37]</td>
<td>Physical dimension that measures span between facts.</td>
</tr>
<tr>
<td>Tourism Objects</td>
<td>Represents the services provided in a certain environment.</td>
</tr>
</tbody>
</table>

Table 1: The ContOlogy Network of Ontologies.
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...does not require further complex infrastructural deployments (cf. Figure 2b). In this way, the need to populate a particular area of interest with sensors is avoided, and in addition, the usage of an application based on the CONCERT framework is not limited to those areas (cf. Figure 2a). The idea behind this approach is to increase the level of abstraction of context (thus, increasing the level of portability - interoperability - of the model), by providing the model with the means to access context information in an anywhere-anytime manner.

Finally, context information has to be translated into a consistent computing model so that it can effectively assist tourists in their mobility, in addition to enhancing and improving their visiting experience. Various context models have been identified and analyzed according to ubiquitous computing environments requirements [17] and context-aware applications [30][18]. Both studies indicate that ontologies clearly address all context modelling requirements and are an adequate tool for that purpose. Besides, ontologies have proven to be useful in information integration, reuse as well as sharing, which are essential to provide interoperability at the model level.

In an attempt to increase the level of scalability, modularity and interoperability at the model level, context is modelled in CONCERT by means of a network of ontologies [31][32]. This network of ontologies, called ContOlogy, incorporates the requirements identified in the field of human mobility and implements them in terms of motivation, preferences-demographics and role, according to standard parameters established by the tourism scientific community [33][34]. At the moment ContOlogy integrates 11 ontologies. Altogether there are 86 classes, 41 object properties, 22 datatype properties and 43 restrictions. The language used to specify each of the ontologies has been OWL [35] in its DL sublanguage. The level of expressivity shown by the network of ontology is SHOIN(D). The following table depicts ContOlogy’s main components.

A rule-based information engine, built on top of the ContOlogy network, filters the incoming tourism objects with respect to certain context factors at a given moment. These factors represent the situation of a visitor, i.e. his/her preferences, current weather condition and location, etc. and are used to filter personalized information as depicted in the examples in Figure 3.

For instance, the second rule depicted in Figure 3 takes into consideration the food preferences of a particular visitor. Given the visitor’s location, environment, preferences, time of the day, etc., a number of restaurants are offered to the user, that are in his/her surroundings and match his/her context.

4 VMTO: Vector-based Matching of Tourists and Tourism Objects

The task of the VMTO framework is to define a function that matches tourist profiles against the filtered set of tourism objects obtained from CONCERT, in order to produce a ranked list of objects for each given tourist. If a tourist profile matches the characteristics of an object, this object should be recommended to the respective tourist. Therefore, the matchmaking algorithm has to examine whether they share similar structures.

To estimate the similarity degree between tourist profiles and tourism objects, VMTO follows a vector-based matchmaking approach, whereby a given profile and each tourism object constitute vectors and are compared in a vector space model. The dimensions of the vector space model correspond to a restricted set of tourists types found in scientific tourism literature [2], such that each distinct tourist type (e.g. adventure or cultural type) represents one dimension in that space. The selected tourist types have to conform to the characteristics of the respective destination (e.g. a sun lover type may not be well suited for a city destination).

Thereby, a tourist profile vector indicates the degree to which tourists identify themselves with the given types. Typically, individual tourists cannot be characterised by only one of these archetypes but have mixed profiles as they show attributes of several types, although to varying degrees. Thus, tourist types model the tourists’ generic interests in an abstract form. Vectors are suited to model such tourist...
types, whereby each dimension corresponds to a certain tourist type while the value indicates how much the tourist identifies himself or herself with the corresponding type.

Figure 4 depicts an exemplary tourist, who likes to enact the role of an adventurer, followed by sport and sightseeing, and rather dislikes cultural activities.

In the same way as the tourist profile is represented in form of a vector, every tourism object is modeled through a vector as well. Thereby, this vector describes in a quantitative way how much the object is related to the given types. For example, the famous cathedral "Stephansdom" (St. Stephen's cathedral) in Vienna might be highly relevant for sightseeing tourists but not for such kind of tourists that would like to do some risky activities.

As destinations usually offer a large number of tourism objects to visitors, we propose a semi-automatic process to link the given tourist types to appropriate tourism objects. Therefore in a first step, domain experts mark, for each of the prototypical tourist types (e.g. adventure or cultural types), a small sample of typical tourism objects that are closely related to these types (cf. Figure 5). The degree of relationship is specified with different weightings. That is done individually for each tourist type.

After this step, certain tourism objects (e.g. the Spanish Riding School) are linked to their best corresponding tourist type (e.g. the cultural type). Some tourism objects (e.g. the clock museum) might not have been linked to any of the tourist types by the domain expert. In addition, some
weighting information might be missing. For example, we do not know whether the "Spanish Riding School" is also relevant for other tourist types such as the explorer.

To tackle these issues, ontological knowledge is exploited to define a similarity metric between the different tourism objects. For establishing a similarity metric, all tourism objects have to be semantically annotated according to a tourism ontology. This similarity metric can then be used to propagate the weightings throughout the semantic network (of tourism objects). For example, based on the fact that the Albertina Museum is highly relevant for cultural tourists and the given statements #Albertina_Museum rdf:type Museum, #Museum_Modern_Art rdf:type Museum, it can be derived that the "Museum of Modern Art" might be relevant for cultural tourists as well as it belongs to the same class. Not only rdf:type and rdfs:subClassOf relations can be exploited to derive the similarity between objects, but also user-defined properties. If two objects have the same architectural style or are linked to the same ruling house (e.g. house of Habsburg) they also should have a higher similarity degree. The weightings are thus dependent on the relationships within the semantic network.

For defining a similarity metric, ontology-based similarity approaches can be used, including taxonomy-based and feature-based similarity measures [38][39]. After this step, every tourism object has now a vector that expresses the correlation to each of the given tourist type in a quantitative way. A common method to obtain the similarity between the tourist profile vector and the set of tourism object vectors is to measure the cosine angle between two vectors. If the vector space is non-orthogonal, kernel based algorithms can be applied to measure the similarity in such a space. At the end of this matchmaking process, a numerical score can be assigned to each tourism object to indicate its attractiveness for a given tourist.

5 Conclusion
eTourism represents an active field of research in several disciplines, comprising computer science, human-computer interactions, recommendation systems, as well as mobile pervasive computing. This paper presents a context-based semantic matchmaking framework in order to propose personalized tourism objects to tourists on their trip, thus enhancing their experiences while they are at a particular destination. The framework combines two existing approaches, i.e. the contextual computing framework in tourism, CONCERT and the VTMO ranking framework. Although the emphasis of this paper is on promoting context-based services in the realm of tourism, it also aims to provide new aspects in the realm of ubiquitous computing, semantic technologies and recommendation systems.

The CONCERT framework is based upon a thorough review of relevant literature and its main contributions can be summarized as follows. First, it provides a new theoretic approach to study the notion of context, which is framed within the field of human mobility. In addition, CONCERT provides a double interoperability level: at the infrastructural level by not using sensors to gather contextual information and at a model level by using networks of ontologies in order to be able to share, re-use and integrate contextual knowledge.

However, tourists have individual preferences, which CONCERT does not address in a holistic way, since its profiling approach is based on the concept of roles, which are defined by the UNWTO and describe various purposes of trips. User profiling and classification are an important research issue in tourism and especially tackled by recommender systems. Understanding users’ interests is an important prerequisite for delivering personalized information. Thus, the VMTO framework defines a function that matches tourists’ profiles against a filtered set of tourism objects in order to produce a ranked list of objects for each given tourist. This way, the ranking produced by the VTMO enhances the context-based functionality provided by the CONCERT framework.

References


Testing Delivery Systems in Transnational Virtual Learning: The Vocational Management Training for the European Tourism Industry (VocMat) Case Study

Cathy Guthrie and Lluis Prats-Planagumà

This article discusses the lessons learned from developing and delivering the Vocational Management Training for the European Tourism Industry (VocMat) online training programme, which was aimed at providing flexible, online distance learning for the European tourism industry. The programme was designed to address managers’ need for flexible, senior management level training which they could access at a time and place which fitted in with their working and non work commitments. The authors present the two main approaches to using the Virtual Learning Environment, the feedback from the participants, and the implications for this application of online technology in extending tourism training opportunities.

Keywords: Delivery System, Management, Tourism, Virtual Learning, VocMat.

1 Introduction

Tourism jobs are considered in many forums as low skilled and open to anyone, requiring little in situ training particularly for the lowest level positions. Traditionally, management or decision maker positions have been occupied by tourism outsiders, often business economists or historians, among others. Fortunately in recent years this perception has begun to change, partly as a result of two factors:

1. Tourism forecasters are taking the lead in tourism organizations as the latter realize the need to be aware of latest trends in order to evolve their business in line with tourist demands; and

2. Managers entering tourism from other disciplines recognise that they need specialized tourism training to manage those aspects of their business which are specific to tourism.

This evolution, creating the need for training specifically developed for tourism managers, has been a primary driver in the growth of tourism based masters level courses seen since the latter years of the 20th century. However, the University of Girona has found that even where managers expressed interest in the training programme, in fact only 5% of students enrolling were tourism managers.

There are several reasons why it is difficult for tourism managers to participate in the normal academic timetable:

1. Working hours are extremely variable during the year, especially in peak seasons. The obvious example is summer time in a beach hotel, but consider also a city hotel, which is busy during the week and much less so at week-ends.

2. The physical distance between universities offering tourism studies and the main tourism resorts can very often mean that travel time is required in addition to actual training time.

3. There is a high level of job turnover in this sector due to low salaries and poor working conditions, including the lack of flexibility and the lack of economic support for training provided by companies to their employees.

4. In Catalonia, the majority of undergraduate tourism students (67%) work at the same time as pursuing their studies and the rate of graduate employment is one of the highest. A research project undertaken by the University of Girona shows that 88% of students have a job within 4 weeks of finishing their degree course.

So every single one of these elements suggested the relevance and potential utility of virtual distance learning as a means of delivering vocational training for tourism managers, which in turn became the starting point for the VocMat projects on which this article is based. Moreover, [1] defined self-regulated learning as a proactive process that stu-
...dents use to acquire academic skills, such as setting goals, selecting and deploying strategies and self-monitoring ones effectiveness. This idea helps to match management courses and virtual learning.

The two VocMat projects were supported by European Union funding, the VocMat pilot project (2005-2007) by the Leonardo da Vinci programme and VocMat 2 as a transfer of innovation project under the Lifelong Learning Programme. Both projects involved higher education institutions and tourism trade organisations in the partner countries (Table 1). The aim of each project was to develop, test and deliver postgraduate level modules to middle and senior level tourism managers in the public and private sectors via online distance learning. This was done in such a way as to allow the participants to benefit not only from the module materials but also from interaction with the other tourism managers taking part in the different partner countries.

Training needs analyses were carried out using focus groups and questionnaire surveys among tourism managers and representatives of tourism organisations in each partner country. As reported elsewhere [2][3] the four subjects identified as priorities for the VocMat pilot project were: Strategic Management, Tourism Marketing, Human Resource Management for Tourism and Operations Management for Tourism. When the survey exercise was repeated at the start of the VocMat 2 transfer of innovation project, the existing Strategic Management (StratMan) module was prioritised for further testing with new pilot group participants and with Entrepreneurship and Innovation for Tourism (E&I) as the new subject for development and delivery. This article is based on the experience of developing and delivering these two modules in the VocMat 2 transfer of innovation project.

Each module was validated, by the lead university which developed it, as a standalone CPD module attracting 7.5 European Credit Transfer System credits. Therefore, pend-

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<th>VocMat 1 (V1) Pilot Project</th>
<th>VocMat 2 (V2) Transfer of Innovation Project</th>
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<td>• Universitat de Girona</td>
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<tr>
<td>• Tourism Management Institute</td>
<td>• Tourism Management Institute</td>
</tr>
<tr>
<td>• Tourist Board Training Ltd</td>
<td>• Tourist Board Training Ltd</td>
</tr>
</tbody>
</table>

Table 1: Partner Countries V1 and V2.
Information Technology in the Tourism Industry

In these terms, a VLE falls into category 1 when it is a space in which to place and check various items of information, whereas it falls into category 2 when it is a place in which to communicate and to create and share knowledge.

With this in mind, one objective of the VocMat projects was to assess different styles of online delivery. Therefore the two modules were developed and delivered in quite different ways. Strategic Management (StratMan) was a traditional text based module more in line with category 1: topic content was uploaded as text and diagrams to the VocMat Virtual Learning Environment (VLE) and assessment was via a single piece of written work submitted through the VLE at the end of the module. Nonetheless, international online chat sessions were planned at regular intervals throughout the module and the subject tutor would post discussion questions in advance of each chat session to stimulate discussion.

By contrast, the E&I module was specifically designed to encourage online interaction. Each of the four sections contained an assessment, which was in part a short written submission and in part interactive, in which participants had to upload a blog post on the topic and post comments on at least two other blogs. Again, international online chat sessions were planned at regular intervals throughout the module and the subject tutor would post discussion questions in advance of each chat session to stimulate discussion.

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2 Testing the Delivery Systems

The use of technology is not in itself a guarantee of success. It must be borne in mind that inappropriate use of these technologies can generate the opposite effect to that originally intended [4]. Particularly where learners are first time users of e-learning, dropout rates can be high [5]. Furthermore, education is undergoing something of a major change at present, moving from the Transmission-Reception paradigm to an Interaction paradigm [6]. Interaction has become an essential element of any educational environment and is particularly relevant when students are developing learning in a virtual community where the educational interactions, whether student/professor or student/student, lead them into active knowledge sharing and creation [7].

VocMat developed a Virtual Learning Environment (VLE) using the Moodle platform to achieve this virtual interaction. Hamuy & Galaz [8] defined two broad categories of interaction in virtual environments such as the one used in the VocMat project:

1. Informational level, encompassing: Meaning Information Presence; Informative Interaction; Consultative Interaction
2. Communication level, encompassing: Communication interactivity; Transactional interaction through the VLE.

Table 2: Composition of V2 Pilot Groups across the two Modules.

<table>
<thead>
<tr>
<th>Partner Country</th>
<th>Type of organisation</th>
<th>Organisation location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Public sector</td>
<td>Private/SME</td>
</tr>
<tr>
<td>Catalonia (Spain) *</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>Estonia</td>
<td>7</td>
<td>18</td>
</tr>
<tr>
<td>Italy</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Malta</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Turkey</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Totals</td>
<td>32</td>
<td>55</td>
</tr>
</tbody>
</table>

* 3 participants declined to indicate location and withdrew very early on in module 1

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ject tutor dealt with module content related questions and moderated the online chat sessions and discussion boards. English was used as the common language in the international discussion boards and online chat sessions; however, recognising that not all participants would be comfortable expressing themselves in English, local tutors were given a pivotal role in passing comments and enquiries in their native language upwards to the subject tutor and then disseminating the response back down through their local group. This worked particularly well with the Catalan group, although it was a challenge for the local tutor to be in two chat rooms simultaneously.

Despite the adoption of strategies that generate interaction and communication between participants, such as the chat sessions, Table 3 shows that many students did not take part. This may be due to the students being ineffective in regulating their own study time [9]. There was also an external element which affected the online chats: the European students were distributed across three different time zones and their daily schedules varied from country to country, making it difficult to arrange a chat session at a time which suited every participant. It should also be borne in mind that VLEs allow students to construct their own knowledge by selecting representations and elements they find helpful, thus giving them more control [10]. However, this control can also be a risk in view of the issues of self-regulation of study time mentioned above.

Despite these factors, nonetheless better participation in the E&I module was achieved by asking for four partial assignments instead of one; this encouraged the students to work steadily throughout the module, rather than focusing on one burst of activity for a final assignment as well as requiring a higher level of interaction.

### 3 Results

After each module, pilot group participants were asked for feedback on their experience of using the Virtual Learning Environment (VLE). The survey was posted online using SurveyMonkey or participants could complete and return a Word version of the questionnaire. After StratMan, 17 responses were received out of a potential total of 58; the survey following E&I was sent to the total pilot group.

<table>
<thead>
<tr>
<th>How often?</th>
<th>A %</th>
<th>B %</th>
<th>Hours per week</th>
<th>A %</th>
<th>B %</th>
<th>Was this?</th>
<th>A %</th>
<th>B %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Twice a week</td>
<td>23.5</td>
<td>36.4</td>
<td>2-3</td>
<td>5.9</td>
<td>31.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once a week</td>
<td>29.4</td>
<td>27.3</td>
<td>1-2</td>
<td>58.1</td>
<td>27.3</td>
<td>About right</td>
<td>52.9</td>
<td>59.1</td>
</tr>
<tr>
<td>Every other day</td>
<td>22.7</td>
<td></td>
<td>3-4</td>
<td>5.9</td>
<td>13.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once every two weeks</td>
<td>23.5</td>
<td>9.1</td>
<td>Less than 1</td>
<td>23.0</td>
<td>13.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once a day</td>
<td>4.5</td>
<td></td>
<td>4-5</td>
<td>4.5</td>
<td></td>
<td>Too little</td>
<td>41.2</td>
<td>36.4</td>
</tr>
<tr>
<td>Once a month</td>
<td>23.5</td>
<td></td>
<td>5-6</td>
<td>5.9</td>
<td>4.5</td>
<td>Too much</td>
<td>4.5</td>
<td></td>
</tr>
</tbody>
</table>

A= Post StratMan survey; B=Post E&I survey

Table 4: Use of the VLE.
generating 27 responses from a potential total of 78 (the total number registered across both modules minus those known to have withdrawn and who had already completed feedback requests). In this second survey, 7 respondents had completed both modules. In each case, e-mail addresses for several participants generated undeliverable return messages or automatic replies indicating the individual had moved on but giving no forwarding contact details. Those who responded, therefore, could well constitute a greater proportion of the active participants than at first appears. Moreover, in a project of this nature, the responses to qualitative open questions were of equal if not greater value in determining changes required and the reality of participants’ experience of the online delivery.

### 3.1. Use of the VLE

Participants were asked how often they used the VLE, for how many hours per week and whether they felt this was too often, not often enough or about the right amount of time. Table 4 presents the results. Reasons given for not accessing the VLE were lack of time, preference for using the hard copy provided as back up and, in one case only, insufficient incentive or encouragement. Asked what would encourage greater use of the VLE, whilst 20% of respondents replied "Nothing", others suggested having more time, use of weekly exercises to encourage using it, having more recommended texts online and improving speed of access.

Although Moodle provides statistical data, this has not been used because some students registered their log-in details in such a way as to open the VLE automatically, which made it impossible to monitor access time in any meaningful way.

Participants were asked to rate and comment on various aspects of the VLE. Table 5 gives the results, and the following section highlights the main comments received.

**Online Chat**

Respondents across both modules considered the online chat good for exchanging ideas and experiences and for real time contact with other students and the tutors. Suggestions for enhancement included improving the ease and speed of connection into the chat, more direction on the topics for discussion and providing a way to see questions and answers previous to the point at which participant joined the chat. StratMan respondents regretted the low numbers of participants, whereas comments from the second survey included appreciation of the larger numbers of people taking part, a suggestion that global and in-country chats should be scheduled at different times as well as using Skype or MSN groups instead of the VLE chat room as a way of overcoming the technical difficulties experienced.

**Who’s Online**

This feature allowed participants to see who else was logged into the VLE. All respondents referred to the benefits of being able to interact with other learners and not feeling isolated.

**E-mail Digests**

Participants could choose to receive e-mail updates of activity on the discussion boards. These could be daily, weekly or monthly and were triggered only when new posts were made. Those who used this feature considered it a useful tool for keeping in touch with activity on the VLE, despite initial problems, and some lack of clarity as to where a new posting had been made.

**Discussion Boards**

These were considered to be useful for sharing information and opinions across the pilot groups. Suggested improvements included formalising use of the discussion boards with a topic every week and creating a summary of the ideas expressed.

**Submitting an Assignment**

Participants found it easy, fast and convenient to be able to submit their assignments via the VLE, although some would like to see better confirmation of safe receipt by the tutor and one StratMan respondent would have preferred

---

<table>
<thead>
<tr>
<th>Excellent</th>
<th>Good</th>
<th>Average</th>
<th>Fair</th>
<th>Poor</th>
<th>Did not Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Online chat</td>
<td>4</td>
<td>1</td>
<td>7</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Who’s online</td>
<td>3</td>
<td>1</td>
<td>7</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Email digests</td>
<td>3</td>
<td>2</td>
<td>7</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Discussion boards</td>
<td>4</td>
<td>2</td>
<td>9</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Submitting assignment</td>
<td>5</td>
<td>10</td>
<td>9</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Ease of getting around site</td>
<td>6</td>
<td>5</td>
<td>7</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>Appearance</td>
<td>6</td>
<td>4</td>
<td>5</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>Site layout</td>
<td>7</td>
<td>4</td>
<td>5</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Ease of finding materials</td>
<td>8</td>
<td>5</td>
<td>4</td>
<td>7</td>
<td>2</td>
</tr>
</tbody>
</table>

A = Post StratMan survey; B = Post E&I survey

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Table 5: Assessment of Various Aspects of the VLE.
Information Technology in the Tourism Industry

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th></th>
<th>B</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>Count</td>
<td>%</td>
<td>Count</td>
</tr>
<tr>
<td>Excellent</td>
<td>47.1</td>
<td>8</td>
<td>14.3</td>
<td>3</td>
</tr>
<tr>
<td>Good</td>
<td>35.3</td>
<td>6</td>
<td>66.7</td>
<td>14</td>
</tr>
<tr>
<td>Average</td>
<td>11.8</td>
<td>2</td>
<td>9.5</td>
<td>2</td>
</tr>
<tr>
<td>Fair</td>
<td>5.9</td>
<td>1</td>
<td>4.8</td>
<td>1</td>
</tr>
<tr>
<td>Poor</td>
<td>0</td>
<td>0</td>
<td>4.8</td>
<td>1</td>
</tr>
</tbody>
</table>

A= Post StratMan survey; B=Post E&I survey

Table 6: Overall Module Delivery.

<table>
<thead>
<tr>
<th></th>
<th>Too much</th>
<th>About right</th>
<th>Too little</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>With local tutor</td>
<td>2</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>With subject leader</td>
<td>1</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>With project team</td>
<td>1</td>
<td>0</td>
<td>10</td>
</tr>
</tbody>
</table>

A= Post StratMan survey; B=Post E&I survey

Table 7: Level of Interaction.

<table>
<thead>
<tr>
<th></th>
<th>Via VLE</th>
<th>E-mail</th>
<th>Phone</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Local tutor</td>
<td>9</td>
<td>9</td>
<td>14</td>
<td>21</td>
</tr>
<tr>
<td>Subject leader</td>
<td>10</td>
<td>6</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>Project team</td>
<td>8</td>
<td>7</td>
<td>12</td>
<td>13</td>
</tr>
</tbody>
</table>

A= Post StratMan survey; B=Post E&I survey

Table 8: Means used to contact Project Personnel.

to see a reduction in the number of click-through steps required.

**Navigation, Appearance and Layout of the VLE**

The majority of those who commented on these aspects found it informative, simple, clear and easy to navigate. They also found it easy to locate module materials. Two individuals had experienced difficulties in downloading Directed Reading articles. It was not clear whether this was a technical problem with their computer or a temporary problem on the VLE. Suggested improvements included increased use of hyperlinks to avoid excessive scrolling on any one page, better use of colour and images and the option to print blog posts.

**General Technical Issues**

A common thread across the feedback, but particularly in relation to online chat, was that participants experienced issues with logging in and staying logged in, or with the elements of the site taking time to load. Some of these were due to conflicts with the participant’s computer system or work network, where firewalls or company security policy did not permit participation in synchronous interaction. Changes were also made to the hosting server to try to improve speeds; it was found, however, that the Moodle platform is known for its inability to handle more than ten individuals online in any one chat room simultaneously.

**3.2 Module Delivery Mode**

Participants were asked to give their views of the delivery model using the VLE with support from the subject tutor, local tutors and technical support. Table 6 summarises the overall opinion of the delivery model, whilst Tables 7 & 8 show participants’ views on the support received in terms of the amount of contact and the means participants used to contact used to contact local and subject tutors and the project team.

Overall, participants viewed the delivery model as good to excellent. Additional comments fell into five main areas which will be discussed further below. Most respondents considered the level of interaction with local and subject tutors and project team to be about right. By far the most common method of contact was by e-mail, followed by con-
Information Technology in the Tourism Industry

“...I live in a small town where it is very difficult to access to some specialized education/training, so for me the online support it is always highly valued. The CD we were sent it is also great.”

“I liked the modules. They were in a logical order. I am still little against the term intuitive innovation and how much attention it got. In general, however, I think it was great that the tasks really made one think and think. It was great that we had to come up with so many ideas for each assignment.”

“What’s next?”

“It was interesting way (e-learning) and useful topic. Very good chance to get known what others do in different countries, their positive and negative aspects in tourism.”

“Enjoying this experience from October to March would be easier for my agenda!”

“Thanks for providing me this nice opportunity to study on-line, now I would dare to undertake any other on-line training; congratulations!”

“It’s been a great experience, thanks. Count on me for the next one.”

“I am happy to have had this experience. This taught me a lot, made me think a lot and motivated to move forward. With improving the web you will have a great tool which encourages people to act through their assignments.”

Table 9: Participants’ Comments.

Table 10: VocMat Completion Rates.

<table>
<thead>
<tr>
<th>Module</th>
<th>Registered</th>
<th>Withdrawn</th>
<th>Remaining</th>
<th>Completed</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1:1</td>
<td>43</td>
<td>12</td>
<td>31</td>
<td>12</td>
<td>39</td>
</tr>
<tr>
<td>V1:2</td>
<td>43</td>
<td>12</td>
<td>31</td>
<td>10</td>
<td>32</td>
</tr>
<tr>
<td>V1:3</td>
<td>38</td>
<td>3</td>
<td>35</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>V1:4</td>
<td>25</td>
<td>2</td>
<td>23</td>
<td>15</td>
<td>65</td>
</tr>
<tr>
<td>V2:1</td>
<td>59</td>
<td>18</td>
<td>35 (41-6 from V1)</td>
<td>22</td>
<td>63</td>
</tr>
<tr>
<td>V2:2</td>
<td>58</td>
<td>6</td>
<td>52</td>
<td>46</td>
<td>88</td>
</tr>
</tbody>
</table>

Comments on the delivery and support received fell into the following main areas: technical issues; timetabling and tutor support; overall experience; constructive suggestions for future development.

Comments on technical issues reiterated concerns raised elsewhere in the survey relating to difficulties with the online chat sessions: "Idea excellent but in reality I failed to successfully participate and this was frustrating as I was online at the time".

In general, participants were pleased with the support received from the tutor. One participant noted that they personally had not needed additional help, but was confident that support would have been forthcoming if required. Problems with lack of support from one of the local tutors were resolved by changing tutor along with the change of subject and for another when additional resources were obtained by their university. There were several comments about submission deadlines being very challenging, particularly at busy operating times. This was in part due to the timelines imposed by the project’s funding, and more flexibility might be possible if freed of the constraints of delivering to a tight project timetable. However, some participants felt that deadlines appeared to be one-sided, with a long gap between submission and feedback. This indicates the need for tutors as well as students to participate actively in order to ensure that a VLE falls into the second of Hamuy & Galaz’ categories referred to earlier [8].

In terms of the overall experience, participants were generally enthusiastic. They liked the contact with other participants both within their own and across the partner countries. For the most part they appreciated that this was a pilot project and so were understanding of the technical problems which arose and indeed made constructive suggestions for future developments, such as more opportunities for online interaction between students. The comments following the E&I module were particularly appreciative of the interactivity built into the module.
3.3 Completion Rates

Table 10 sets out the completion rates for each of the VocMat modules, including the four developed and delivered in the VocMat pilot project 2005-2007. The general trend is for increasing completion rates, culminating with an 88% completion rate for the E&I module. Whilst it might be expected that rates should improve across the original pilot project, the authors contend that the very great increase from StratMan to E&I in the second project reflects the increased engagement with participants as a result of embedding interactivity within the module rather than uploading a traditional text based module.

4 Conclusions

The programme was designed to address tourism managers’ need for flexible, senior management level training which they could access at a time and place which fitted in with their working and non work commitments. We suggest that this experience demonstrates that these two modules, developed within the overall VocMat framework, allowed the development of flexible, specifically targeted training and contact with other international students and practitioners.

After testing the two main approaches to using the VLE we suggest that the feedback of the participants and tutors indicates that the approach used in the second module (E&I) module delivered a better learning experience than the previous module (StratMan) in terms of interaction, communication and knowledge sharing and creation, the main criteria for judging any virtual course. In addition to this we argue that the significantly increased completion rate for the second module confirms the utility of the second category of VLE described by Hamuy & Galaz [8] in increasing engagement and commitment from learners and counteracting the factors identified by Tyler-Smith (2006) which contribute to distance learners withdrawing from this type of course.

In conclusion, therefore, we suggest that the VocMat projects show that embedding interactivity within the Virtual Learning Environment, combined with both on and offline support from tutors and technical staff, will both enhance the learner experience and reduce withdrawals, leading to improved completion rates. Feedback from project participants shows that this type of e-learning has already achieved positive results; the VocMat model delivers senior level tourism management education in a flexible manner which overcomes traditional barriers to learning, and has the potential to improve access to this type of education for a wide variety of tourism managers whether in the public or private sector, urban or rural location.

References

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Technological Tools to support Online Marketing: SEGITTUR’s Role

Carlos Romero-Dexeus

The purpose of this article is to present the latest technological tools which SEGITTUR, Spain’s State Company for the Management of Tourism Innovation and Technology, has developed in recent years to support the online marketing of tourist services offered by Spanish firms over the Internet. Some of these tools are included on Spain’s official tourism promotion portal, Spain.info, such as the Booking Centre Directory (Segitturhotels) and the Travel and Offers Search Engine (Segitturdiscover). Other tools were developed independently, such as the Marketing Platform or www.unsitioideal.com. All of them aim to provide the sector with access to a promotion and marketing channel with tremendous potential and to significantly reduce the intermediation and positioning costs which would be incurred if these tools did not exist.

Keywords: 2.0 Communities, Internet, New Technologies, Offers, Online Marketing, Search Engine, Tourism, Tourist, Tourist Promotion, Trips.

1 Introduction

The Spanish Sociedad Estatal para la Gestión de la Innovación y las Tecnologías Turísticas, State Company for the Management of Tourism Innovation and Technology (SEGITTUR), was created at the end of 2002 as a way of using new technologies in the promotion of tourism. SEGITTUR’s mission is to develop new technologies related to tourism, and to promote their use among the sector’s stakeholders in order to place Spain in a leading position worldwide as a tourist destination, while helping improve the competitiveness of Spanish companies and resorts.

To this end, SEGITTUR uses new technologies to complement TurEspaña’s work in promoting and marketing Spanish tourism abroad, as is the case of the management of Spain’s tourism portal, Spain.info. Based on this platform, SEGITTUR has developed a whole range of initiatives and technological tools to help enhance the visibility of the Spanish brand, ensure that the image tourists perceive online is one of reliability and quality, and enable tourists to access the entire spectrum of existing tourist services.

Specifically, the targets SEGITTUR pursues through its projects are:

- To foment the use of new technologies in the tourism sector, especially in the field of the Internet
- To enhance the efficiency of the tourism sector by generalizing access to the new technologies
- To support online marketing of Spanish tourist services and products
- To contribute to the online promotion of Spain as a first rate tourist destination

With these objectives in mind, SEGITTUR believes that, in the specific case of online marketing, the Internet offers the sector an unparalleled channel for any tourist service provider, regardless of its size and geographical location, to reach tourists directly wherever they may be, in equality of conditions, and with lower intermediation costs.

The main advantages which this marketing channel brings companies and destinations which provide tourism services can be summarized as follows:

- Rapid adjustment to market needs; companies can add products to their catalogues or remove them online, or change prices and descriptions according to demand.
- A reduction in costs; companies save on the distribution cost.
- Size of the target public; online sales through a website can be made anywhere in the world. This means that the potential public is the same size as the number of Internet users: over 1,400 million worldwide, making the Internet is the best and largest showcase in the world – a global supermarket.
- Creating relationships; through existing applications (e-mails, forums, 2.0 communities, etc.), companies can create and maintain relationships with their customers rapidly and instantaneously, which is an extremely valuable source of information for the sector.
- Coexistence in time and space; with online sales, the business can be open 24/7 anywhere in the world.

Author

Carlos Romero-Dexeus is an economist and currently holds the post of Director of Research, Development and Tourist Innovation at SEGITTUR (Sociedad Estatal para la Gestión de la Innovación y las Tecnologías Turísticas - State Company for the Management of Tourism Innovation and Technology). He previously worked for the United Nations World Tourism Organization, where he held various managerial posts, among them Executive Director of Affiliate Members of the World Tourism Organization, WTO, based in Madrid. Prior to that, he was General Manager of the OMT-Themis Foundation in the Principality of Andorra. <carlos.romero@segittur.es>
The main online marketing tools on which SEGITTUR has worked and is working on now are set out below.

2 Spain.info, Spain’s Official Tourism Portal
SEGITTUR manages Spain.info, Spain’s tourism portal <http://www.spain.info/> (see Figure 1), which leverages the new technologies for publicizing, promoting and marketing the country’s tourism. One of the most remarkable features of the portal is the large number of visits it receives: over 30 million a year.

At Spain.info, tourists can find travel ideas that are aligned with their own particular interests (if they are travelling with children, if they want to learn the language, if they want to do sport, etc.), together with the latest novelties in various areas, such as new health and beauty techniques or adventure tourism activities. They will also find information on interesting events which they can attend during their stay and suggestions which vary according to the time of year. The portal includes a multimedia section, with images, videos, recordings, virtual visits, guided tours, 3D panoramic views and other interactive tools.

Tourists can plan every aspect of their trip on the web, since they have access to detailed updated information about accommodation (hotels, apartments, camp sites, country hotels, whether they allow pets, etc.); places of interest (museums, monuments, spas, golf courses, ski resorts...), and services (transport, street maps, tourist offices, embassies...). Spain.info also provides flight information and the possibility of booking hotels online (over 2,000 hotels), hiring a car, or contracting a wide range of activities and tourist products through its offers search engine.

The portal also contains a wealth of practical information about what you need to know when you travel to Spain, such as entry requirements, timetables, approximate prices, the documents required for driving, sailing, etc. Tourists can also choose to receive regular e-mail messages with the news and reports published on Spain.info. Today, over 100,000 users worldwide subscribe to the portal’s newsletter.

All the Spain.info content is translated into several languages, and the information is adapted to the various international markets, with specific versions of the portal for each country. There are currently 17 portals in different languages which address the specific markets of Germany, Austria, United Kingdom, United States, France, Switzerland, Norway, Denmark, Sweden, Belgium, Italy, Holland, Japan, China, Canada, Portugal and Brazil.

3 Segitturhoteles: Booking Centre Directory
SEGITTUR developed and manages this tool which integrates booking centres for accommodation and hotel...
chains on Spain’s official tourism portal, Spain.info. The directory currently lists more than 2,000 establishments and provides tourists with the possibility of booking their accommodation in Spain online. Transactions are not conducted through Spain.info, but directly on the booking systems of the companies, associations or institutions which subscribe to the project.

One of the main advantages of this initiative for tourists is that the booking is made from a single point, while they are also offered different booking centre options for the same accommodation. When users have chosen the establishment on Spain.info, they make the reservation on the booking centre web page and then, once they have completed the transaction, they return to Spain’s tourism portal.

In order to ensure correct customer service with guarantees of reliability and quality, the booking centres in this directory have to meet a set of requirements in terms of the product offered, the booking terms, and the way the booking is made.

These requirements can be summarized as follows: given Spain.info’s international approach, the portal of a member booking centre must be in at least one foreign language; it must comply with current legislation; it must be able to confirm bookings in real time; it must inform users of the terms under which bookings, changes and cancellations are made; and it must guarantee payment security and provide a customer care service, among other things.

The main advantage which this booking tool provides for the sector in comparison with other distribution channels on the Internet is the support which the Spain.info tourism portal provides, with a large number of visits, lower distribution costs, and control over the marketed product and the price shown. All of this is underpinned by an international promotion campaign, which has been run in over 13 languages in more than 20 countries, with a minimum offer of 16 different products through over 53 different channels.

4 SegitturDiscover: Travel and Offers Search Engine

This is a space in Spain.info for publishing individual tourist programmes, by which is meant a set of activities and services in the same package, organized by a travel agency or by the service provider included in the programme. Its interest lies in the possibilities it offers for both the travel agency sector and the end customer, since it opens up a world of possibilities for organizing a trip to Spain.

The service provider chooses the sections of the portal where they wish to publish their offer (art and culture, resorts, gastronomy, nature, sport, fiestas, etc.) and has an exclusive search engine for complementary tourist activities.

Tourists can look for information through the exclusive offers search engine, where the search can be narrowed down by the type of activity desired, geographical location, or date. Booking requests are sent from Spain.info directly to the supplier, who is responsible for completing the sales process with the tourist.

The main advantage this tool has for the sector is the guarantee that publishing these offers on Spain’s official tourist portal implies, a portal which receives nearly thirty million visits a year, along with the possibility suppliers have of choosing the sections in which they wish to publish their programmes. All of this is underpinned by an international promotion campaign which reinforces all the communication work.

The service also allows users to maintain control over the product marketed and the price shown.

5 UnsitioIdeal.com

The project UnsitioIdeal.com (<http://www.unsitioideal.com/>) ("un sitio ideal” is Spanish for "an ideal place") was conceived to promote the use of new technologies in the accommodation tourism sector. To this end, various tools and services were developed to enhance companies’ competitiveness.

Among other options, UnsitioIdeal.com offers Web page creation, domain maintenance, user support services and self-management of the website. This provides establishments with a comprehensive tool which enables them to promote and manage their business. In addition, they have the added value of the brand created and the advantage of forming part of a specialized portal, which increases their visibility and their access to potential demand. Thanks to the page’s advanced search engine, tourists have ready access to all available accommodation.

With this project SEGITTUR also supports the marketing of accommodation, with advice on communication with customers and joint promotion and marketing projects, loyalty-building campaigns, and programmes for positioning in search engines.

6 Segittreserve: Marketing Platform

This is based on the development of a technological platform for the integrated management of tourist bookings from which the stakeholders of the tourism sector within the system can manage the whole of their inventory on the Internet and, under SEGITTUR’s guidance, control and monitoring, offer it to all the tour operators and Internet users.

The system promotes the creation of various booking centres which may be associations of suppliers, town and city councils, private entities… Each booking centre can connect consumers directly with suppliers without the need for intermediation. In addition, there is also a professional version which facilitates dealings between suppliers and intermediaries with a differentiated treatment in terms of rates and functionalities.

In conclusion, we would highlight the fact that all of these initiatives arose from the need for Spain’s national tourism authority, through SEGITTUR, to respond to the technological revolution sparked by the Internet in recent years, which has transformed the way the stakeholders of the sector relate to one another, their services and their end customers, rewriting the rules of the game and expanding the playing field in which we had been used to competing up until now.
Technological Innovation, a Challenge for the Hotel Sector

Patricia Miralles

Since the 60s tourism has been an undeniable driver of economic and social development for Spain, accounting for 10% of the GDP and 12% of all jobs in 2009. The hotel sector, with approximately 14,000 establishments and 198,000 professionals, is one of its cornerstones. However, the tourist industry is facing a number of challenges (new competing destinations, changes in the business model, new habits and practices of tourists, etc.) which require all the players in the value chain to embrace innovation and technology in their businesses in order to boost competitiveness and productivity. Since 2004 the Spanish ITH (Instituto Tecnológico Hotelero, Technology Institute for Hotels), has led the hotel sector initiative in this field, and has proposed new solutions to the changing needs of Spanish tourism.

Keywords: Enhanced Reality, Hotels, ICT Tools, Innovation, Internet, Mobile Internet, Social Networks, Spain, Technology, Tourism.

1 Introduction

The hotel sector is in the midst of a transformation process in which its capacity to innovate and adjust to the new conditions and demands of the market has become one of the underlying values and goals of the hotel sector. This is due to the combination of a number of structural and strategic changes in the market affecting the hotel business, and the reactions to those changes.

More specifically, the structural and strategic changes which are most altering the way we understand tourism in recent years are the following:

- The introduction of new technologies
- The impact of the Internet
- The change in demand
- The emergence of new players
- Emerging competitor destinations
- Excessive supply
- Concern for the environment and sustainability-related issues.
- Etc.

Meanwhile, the reactions to these structural and strategic changes, and the various measures taken to address the non-structural changes affecting the sector, may be grouped under three different headings:

1. Differentiation
2. Outsourcing of services
3. Market segmentation

2 Current Situation

One of the change drivers that may help the hotel sector in its process of adaptation or change to this new scenario is the introduction of the new information and communication technologies (ICTs). However, the level of development and implementation of the new technologies in the hotel sector is as varied as the sector as a whole is segmented.

On the one hand in Spain we have the major hotel chains, such as Sol Meliá and NH Hotels, worldwide pioneers in the design and implementation of the most competitive and innovative solutions of the sector at a global level. But these chains account for a very small and unrepresentative part of the hotel business as a whole. Most of the sector is made up of SMEs and small chains that are slow to respond to the need to introduce the new technologies, due, in many cases, to the conservatism and inertia that still persist in the organizational culture of small companies and their staff’s resistance to change. They also come up against factors external to the company which slow down the introduction of technology in hotel management (although it is not too late to remedy that) such as the unsuitability of available technological tools for the needs of SMEs, or their high price.

However, we are starting to see signs of improvement in this respect, as second and third generation family members begin to enter the management of these smaller companies. These new professionals are more familiar with the integration of technology in the world of tourism. The increasing number of training programmes in new technologies set up by the various public authorities is also helping. These include the Plan Avanza de Turismo training programme or the opening of public financing facilities for the acquisition of software, hardware or online marketing tools (such as the NEW- No Company without Web - programme).

What would appear to be unquestionable is that progress in the introduction of these new technologies in all companies, both the very innovative ones and small SMES, is vital if the tourism sector is to:
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- Improve competitiveness
- Differentiate the product

We are therefore facing a scenario in which hotel managers need to consider the importance of embracing innovation and technology as key success factors for their companies and for the growth of the sector as a whole, and thus meet the demands of consumers, the market, and global competition. To achieve this it is necessary to make a serious commitment to innovation, by introducing the new technologies into the hotel business.

3 Internet as a Marketing Tool

The arrival of the Internet has revolutionized the hotel sector in recent years. If we look at some relevant statistics [1] [2], we can see that 67% of all trips made by foreign tourists are self-planned and made to measure, leaving the demand for package holidays at a mere 32%.

It can also be seen that consumers not only consult the Web to obtain information (50%), but 42.2% book their holidays online and 39% pay for their trips online too. This is due to a greater confidence in online transactions, a positive trend which is sustained over time for all activities (consultation, bookings and online payments).

The behaviour of Spanish tourists is similar, since in 2007 nearly 64% of all Internet users looked for tourism and travel related information. A similar percentage of users bought tourism products online in 2007. On the whole, statistics on tourism-related Internet use show that the Spanish are above the European average, which stands at 40% [3].

But this situation changes if we look at the way people plan their holidays in Spain compared with trips abroad. Only 11% used the Internet for holidays inside Spain while 34% used it for trips abroad. Also, in the case of domestic trips, the Spanish use the Internet mainly to look for and book accommodation.

In the case of trips abroad, the search to booking ratio is much higher than for domestic trips, as is the booking to payment ratio. Also transport plays a much more important role than accommodation in terms of both bookings and online payment.

Thus the Internet opens up a new business opportunity for the hotel sector as it provides access to an unlimited number of potential customers, either directly through its own web or through channels other than the tour operator, such as the online travel agencies (Travelocity, Expedia, Rumbo) and offer aggregators (SideStep, Kayak, Atrapalo). As a result, the online market is now a reality full of future possibilities which the hotel sector cannot afford to miss out on.

When asking hotel entrepreneurs [4] directly about their opinion of the Internet as a marketing channel, we see that there is a high level of use (over 70%), their main reasons being to reach new customers (36% of respondents), improve management quality and speed (31%), reduce business costs (27%) and enhance the company’s image (21%).

Nevertheless, according to research conducted by Turitec (Conference on Tourism and ICT [5], there is still room for improvement in aspects such as the incorporation of specific and detailed information regarding the hotel product when booking online. This would include information regarding the type of room (smoking / non-smoking), access for the handicapped, the possibility of changing or cancelling online, the lack of options in the search section (city and region, activity, setting out a route and offering the nearest hotels, places of interest, price, airport, etc) plus the lack of any differentiation in terms of profile (loyalty club members, business tourism, etc.) To a great extent this limits the possibility of segmented offers or getting information online.

At this point, we would highlight the case of NH Hoteles, whose webpage shows a clear, effective and innovative marketing and sales strategy which the hotel chain developed after asking itself the following questions:

- How can we capture the traffic there is today on the Internet? Where do we look for our customers?
- How do we make our own webpage attractive?
- Are we prepared for bookings and e-commerce? We have to work on information and content.
- How do we interact with our customers’ data?

As a result, they decided to try out different web and marketing formulas to find the most suitable and profitable one.

4 The Impact of Social Networks

Given all the above, we come to the conclusion that a business model which fails to consider the Internet as another natural channel for the distribution of its products will soon be unsustainable. Furthermore, the Internet’s development towards social networks, what has become known as the Web 2.0 and, when applied to the world of tourism, Travel 2.0, will play an increasingly important role in the promotion and marketing of tourism as a whole.

When looking at the statistics drawn from several studies and surveys[6] [7], we can confirm that Spanish Internet users are increasingly more active in social networks and communities. The following data endorses this: 30% of Internet users have an active account in forums, 14% have their own blog or participate actively in others, 17% offer their opinions in product assessment sites, 19% use the Myspace social network, 15% use Facebook and 12% use Tuenti. Furthermore, 2.0 users are active members with 84% of them accessing more than once a week while 61% are daily users. 76% of these 2.0 users buy online, and as many as 54% buy tourist products (transport, accommodation, etc). What is surprising here is that they do not use any other type of communication such as television or radio

With regard to content applications [8], we see that 40% of Spanish Internet users watch videos on YouTube or NSN Videos. 34% offer comments or opinions on news, videos and other contents and there is an exponential growth in the use of Twitter in Spain, which is now ranked ninth in the world in terms of number of users, according to the Twitter itself.

However, when looking into the use of social networks
and communities by hotel sector [9], we reach the conclusion that 75% of hotel chains have a page on Facebook and a little over half (55%) use Twitter. However, although the figures are promising, the problem is that, in most cases, there is no clear identification of the corporate brand (no name of the chain/hotel, no logo) and in many cases the content is generated by users and not by the entrepreneur. In some cases, it has been the employees themselves who have created it, outside the company, making it difficult to coordinate or control the message. More importantly, however, with regard to social networks we see that normally this is an infrequent, isolated and repetitive activity, and on the whole one which is somewhat unsuccessful from a communication point of view. Generally speaking, there are very few hotels which are able to engage in a real dialogue with their customers. In fact, communication is limited as the messages are generated automatically from contents replicated in other media. Therefore, more often than not the content is sales-oriented as it gives information about special offers but with a very low level of interactive communication. There is very little information about the environment or sustainability, or the organizations’ human resources, or innovation and quality.

Clearly the hotel sector should make use of social networks and communities as a new way of channelling communication with their customers, since one of its greatest advantages is that it is a cheaper and faster way of transmitting information, enabling the development of innovative strategies:

- Marketing and loyalty campaigns, enabling the sector to reach a highly segmented target public among travellers sharing the same interests.
- Downloadable podcasts on tourist information of interest (e.g. the Gremi de Hotels de Barcelona).
- Specialized blogs on specific subjects (wine tourism, nautical tourism, castle routes, etc.).
- Participation in websites showing tourists’ comments and opinions (e.g. Tripadvisor) or letting users participate in the hotel’s own website.
- Including georeferencing as a visual element on the Web.
- Managing the brand’s reputation on the Web.

But this is only possible if you have people with a proactive and enthusiastic attitude and the heart of a 2.0 user, whether they are the owners, managers or staff.

An example of this phenomenon is the Artiem chain which uses the Internet as a tool for advertising its new business vision (“to provide its guests with a feeling of well-being, tending not only the body but also the mind”) and not just as a sales channel. It also uses social networks to interact with its customers, creating its own community comprising both customers and staff. People use this social network to give their opinions, upload their photos and videos, relate their experiences, and interact with the users by exchanging recipes, for example. (See Figure 1.)

Palladium, the brand belonging to Fiesta Hoteles, is another example of good use of social networks. It was the customers themselves who created the specialized blog for
this brand, as a space where they could relate their experiences. The chain has used this new channel to ask customers for their opinion about the new services or decor they want to bring in.

Last but not least is the group created by staff in BestHotels in Facebook. Set up by the IT department, this group is the only page in Facebook created by this organization. Although the content is in no way negative and there are no direct references to the hotel group’s services, products, offers, etc., its reputation and image could be damaged.

By way of conclusion we might say that the strategy employed with regard to social networks must take into account the following points for it to be really efficient and valid:

- The brand must converse.
- The user must be identified, segmented and personalized.
- There must be a constant, orderly flow of "live" information.
- There should be technical integration between the official web and social channels.
- The internal organization should be 2.0-oriented.
- Staff should be encouraged to provide their own approach.
- Finally, results should be measured and managed within a general communication strategy which leverages the Web 2.0.

5 The Introduction of New Technology

In addition to the Internet, new technologies can help improve the profitability of a hotel business through hardware, software and services tools. These tools can facilitate management and work, and reduce production costs, thereby increasing the operating margin as well improving efficiency and productivity.

Today, there are many types of ICT technology which are already present in the hotel sector [11]:

- Software: the professionalization of hotel managers, e-distribution, the new services complementary to accommodation, the increase in direct bookings, higher customer expectations and demands, and growing competition are forcing hotel managers to press for new applications and management systems, such as PMS (Property Management System) for the hotel business; CRM (Customer Relationship Management) for the management and segmentation of customers and loyalty programmes; CRS (Central Reservation System) for the management of direct and indirect bookings; ERP (Enterprise Resource Planning) for billing, procurement, faults, business management, etc.; revenue and yield management tools for the management of channels and prices; the software for managing the maintenance of hotel infrastructures (preventive and corrective maintenance, job applications, asset management and storage or management of spare parts); online payment gateways for marketing systems; electronic billing systems; business intelligence for the agile management of to facilitate decision-making; and integration with service and product providers through purchasing centres to facilitate purchasing processes.

- Hardware: customers, accustomed to the introduction of new technologies in their daily lives, are demanding more hardware in their rooms. The most common are WiFi, digital television, connection with mp3 and mp4, etc. More advanced technology has also been introduced in the hotels themselves, such as computers, cash registers, POS (point of sale) terminals, which are not always prepared for the extreme conditions suffered by hotels (areas of high humidity, high salinity, extreme temperatures, grease splashes, etc.) which may cause serious management problems.

- Networks and connections: having an optimum network and connection infrastructure has become essential for providing customers with security, availability and quality of service or for in-house hotel management processes.

- Mobility solutions: the introduction of mobile applications offers the hotel sector a tangible competitive advantage. These solutions increase productivity and improve business management (support for sales-people, geolocation, access to business management, mobile e-mail, etc.) or help provide a better service for customers (information search, bookings, use of the services provided by the hotel, automatic check-out, special offers or services for the customer, etc.), through various devices (mobiles, PDA, interactive kiosks or interactive television).

- Intelligent services: these systems (domotics, access control, illumination, air-conditioning, swimming pool, water system, alarm systems alerting against flooding, fire or gas, surveillance cameras, etc) serve to improve hotel facility management and maintenance systems. Together they can significantly reduce costs and enable work to be done faster and more efficiently.

When looking at the actual use of these technologies in hotel management today [10], we see that a large percentage of companies have a computer and Internet access (63%). Conversely, very few use intranets or extranets (25% and 14%, respectively); only 55% use electronic signature and 30% use electronic billing; 28% use ERP management tools and 30% use CRM loyalty systems. As for sales systems, we see that 28% have an online sales system but only 29% offer payment online.

Regarding the impact of these new technologies on hotel business procedures [4], those with the highest impact are sales systems (booking and quota management) and reception systems (check-in/check-out), followed by administration systems (billing and accounting). However human resources tools provide no added value.

An important point, and one that the hotel sector highlights, is the need to adapt ICT tools to the hotel sector’s own particular needs as it is not always possible to copy those used in other sectors. For example, as the criteria applied are different (for instance, loyalty programmes, which are not only based on quantitative issues), so the relevant business indicators are also different, among other things. Another urgent need is the integration of the different tech-
nological tools (management systems with booking or loyalty systems) so that they are able to share information and become easier to use.

To illustrate the growing use of ICTs in the hotel business, we can cite a number of good examples: Sol Melia’s Sirius system (which includes bookings, inventory, CRM, the hiring of tour operators, etc); the AC Hoteles’ booking and information centre with its own distribution system: Mardavall Hoteles’ Star Guest solution for customer care with centralized services and a single-point customer complaints service with the possibility of knowing the state and progress of the incident in real time; the intranet developed by Relais Termal as a knowledge management vehicle: in Derby Hotels, they have a Revenue Management tool which manages prices and room allocation; in H10 Hotels, they have a tool which studies the staff’s behaviour and profiles.

6 Future Trends

Looking at the future, perhaps the most significant trend is the growing use of the mobile Internet in the wake of the mass, almost universal, implementation of mobile telephony in the western world. Consequently, the Internet is going to become increasingly more mobile, either through broadband phones or mini-laptops, mainly due to the possibility of connecting to the Internet from anywhere. Proof of this is that there are now over 1,000 million users worldwide, and the 3G penetration rate stands at 21% [12]. In Spain, 23.8% of users access the Internet from these devices, and the 38% 3G penetration rate places the country in 7th place worldwide [10]. By 2014 the number of users worldwide is expected to top 2,750 million with a 43% penetration rate [12].

This will lead to the incorporation of new applications such as QR codes which are already very common in countries like Japan or South Korea. A QR code consists of a bi-dimensional barcode system which includes a content which is read by mobile devices. These codes could be included in the establishment’s advertising material or photographs, as is already being done in other sectors. This will enable customers to access a corporate or promotional website without writing in the address or knowing the promotional message contained within. You can create these codes free of charge at this address: <http://qrcode.kaywa.com/>. If you want, you can discover the hidden message in the code in Figure 2.

Finally, a promotion tool which is becoming increasingly popular is augmented reality which consists of inserting a digital layer on top of what is seen through a mobile phone camera, giving us information about what is around us, such as nearby hotels, places of interest to tourists, the hotel’s offers and promotions, etc. Users can activate the layers whenever they want, according to what they need to find. All you need is an application like Layar, which works like a search engine, allowing you to visualize all the information about a hotel on the screen of your phone.

Research and work is also being done on new tools and technologies such as:

- A virtual personal assistant which offers customers the information they require according to their preferences. This can be used to show restaurants close to a meeting, share prices, flight information, etc.
- New material such as nanofibers which help prevent noise, dirt and bacteria or which adapt to the needs of the customer by changing colour, consistency or temperature.
- A bath mat which is able to detect our vital signs and determine which nutrients we need to make us a customized shower gel.

But these are gadgets of the future which will not be with us for some time. Perhaps they will not meet the needs of the market, so we need to go forward, slowly but surely, generating new ideas based on product differentiation and attraction of demand.

7 ITH: Leading the Necessary Change or Transformation

Our main conclusion is that there is strong but insufficient trend towards the introduction of ICTs in the hotel sector. The sector is a mere buyer of external technology and is not playing an active role in its development. To help the hotel sector along this path, the Spanish ITH (Instituto Tecnológico Hotelero - Technology Institute for Hotels), has become a reference point for the promotion and diffusion of innovation and technology in the sector and a facilitator of the integration of innovative technological solutions.

To this end we organize conferences on awareness-raising and the diffusion of innovation and technology (Fiturtech, National Workshop on Technology applied to Tourism, an awareness-raising programme on tourist innovation) and we coordinate Thinktur (Plataforma Tecnológica del Turismo, Plataforma Tecnológica del Turismo - Technology Platform for Tourism), formerly the RedHotec Platform, which identifies the needs of hotel companies and promotes R&D+I projects of interest to the tourism sector.

References

[1] Instituto de Estudios Turísticos (Institute for Studies on Tourism). Encuesta de Movimientos Turísticos en Fronteras, Frontur (Survey on tourism movility in borders, Frontui), 2009

[2] Instituto de Estudios Turísticos (Institute for Studies on Tourism). Informe sobre el Turismo español, año
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Keywords: FP7, ICT, SME, Technology Transfer, Technology Map, Tourism R&D, Virtual Marketplace.

1 Introduction

The purpose of this paper is to present the approach and methodology followed in the TOUREG Project, a 7th Framework Programme Project, promoted by the European Union, that is being led by the General Directorate for R&D+I of the Regional Government of the Balearic Islands, Spain. The project is aimed at the construction of a Technology Map, from the supply and demand perspectives (i.e. what technological solutions are provided by technology suppliers and what are the needs demanded by potential end users). Apart from the methodology, the initial results that are described here include a web-based tool (available on the Internet) that will help to the final construction of the Technology Map as long as it is used by suppliers and end users to introduce their information. Final results are expected to be available at the end of the project however some preliminary ones will be also shown.

1.1 Who is behind this Project? Profile of the Participating Regions

Balearic Islands, Spain: The Balearics is a group of islands in the Mediterranean: Majorca, Minorca, Ibiza and Formentera. Its population of over 1,000,000 people, triples in the summer. The services sector is the main employer in the region: more than 50% of the region’s businesses work in this sector. In fact more than 80% of the regional GDP is generated by the services sector, most of it coming from the tourism industry.

Authors

Mateo Amengual-Rigo holds a PhD degree in Telecommunications Engineering from Universitat Politècnica de Catalunya, Spain, and a Master in Business Administration from IESE – Universidad de Navarra, Spain. Currently he is the Director of CIDTUR (Centro de Investigación y Desarrollo para el Turismo), a Tourism R&D+I Institute at ParcBIT in Palma de Mallorca, Balearic Islands, Spain. <mamengual@cidtur.org>.

Jaime Bagur-Mora holds a Bachelor of Business Administration and Management from the Universitat de les Illes Balears, UIB, Spain. He is currently a PhD student in Tourism and Environmental Economics from the UIB. He began his career in the private sector in the hotel industry. Since 2005, he is managing tourism R&D+I projects at Regional and European level for the Directorate General for Research, Technological Development and Innovation of the Balearic Islands Regional Government. <bagur@dgrdi.caib.es>.

Sandor Van der Meer graduated in business studies at the University of Deventer, The Netherlands. He has worked in the private sector in the hotel and tour-operator industry. Since March 2006, he is working in the public sector as a technician at the Directorate General for Research, Technological Development and Innovation of the Balearic Islands Regional Government, where he has participated in several R&D+I projects at the Regional and European level. <svandermeer@dgrdi.caib.es>.

Anne-Laure Debrix holds a Bachelor in Tourism Business Management from the Université d’Angers, France, as well as a Master in Marketing for Hospitality from the Universidad de Puerto Rico and a Master in International R&D Project Management from the Universidad Politécnica de Madrid, Spain. Her professional background has always been directly linked to the tourism industry, in the public as well as the private sector. She is project manager and programme’s coordinator at the IBIT Foundation (Balearic Islands, Spain) since January 2008. <adebrix@ibit.org>.
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Madeira, Portugal: Madeira accounts for 2.81% of the country’s GDP at market prices, and services is the major economic sector in the region, with 81.85% of the regional GDP. Specifically, the tourist industry subsector contributes roughly 37.12% of the sector GDP. With some 115,200 employees, Madeira accounts for 2.25% of the total number of Portuguese workers. 74,700 people work exclusively in the services subsector.

Crete, Greece: Crete accounts for 5.49% of the National GDP at current prices. In the regional economy, in 2000 the services activities accounted roughly for 75% of the regional GDP. In 2004 the region of Crete had roughly 250,300 employees, accounting for 5.49% of all national employees. The regional services sector employed 157,900, i.e. a good 63% of the regional total.

Mehedinti, Romania: The region of Mehedinti in Romania accounts for 9.04% of the national GDP at basic prices, the services sector being the main economic sector in the region, as it accounts for 42.96% of the regional GDP.

South West, Bulgaria: The South West region of Bulgaria accounts for 55.78% of the national GDP at basic prices. The services sector has the biggest influence in the regional economy with 64.82% of the regional GDP. With roughly 1,603,000 employees, the South West region of Bulgaria accounts for 44.53% of the national employee total. 713,900 of them (work exclusively in the subservices sector.

Norbottens Iän, Sweden: The Norbottens Iän region accounted for 5.2% of the national GDP at basic prices in 2004. The services sector is the most influential in the regional economy with 62.24% of the regional GDP. With some 231,200 employees, the region of Norbottens Iän accounts for 5.35% of the national employee total. The services sector employs around 173,400 people, i.e.75% of the regional employment total.

The different partners in the project are coming from these regions and may be grouped into three major classes, each one bringing priorities, and specific interests rewarding the outputs:

- As regions composed by Mediterranean islands with over 20 years of experience as leisure tourism destinations:
  1. Regional Government of the Balearic Islands, Spain
  2. IBIT Foundation, Balearic Islands, Spain
  3. AREAM, Madeira, Portugal
  4. Expedita, Madeira, Portugal
  5. Technical University of Crete – TUC, Greece
  6. Science and Technology Park of Crete- FORTH, Greece
- As an area with major technological development in knowledge-intensive areas such as IT:
  7. Project Management Consulting - PEMENCO, Norbotten, Sweden
  8. CDT- Lulea University, Norbotten, Sweden
- As new EU member states that are proving to be major tourist destinations thanks to their heritage and history:
  9. CG&GC. Mehedinti, Rumania
  10. ARC Fund, Sofia, Bulgaria
  11. Madeira Tecnopolis, Portugal

1.2 What are the Specific Objectives of the Project and its Timeframe?

The project started in January 2008 and initially is expected to last 30 months.

The main objectives of the project are:

- Promote, diversify and specialize in R&D+I activity in the tourist sector.
- Facilitate the establishment of a platform for the generation of knowledge in the tourist sector.
- Help suit the research to the real business requirements concerning new technologies, equipment, etc.
- Establish mechanisms giving Small and Medium Enterprises, SMEs, bigger access to knowledge about tourism-related R&D+I.
- Diffusion of best practices and knowledge about R&D+I, and about the strategic importance and the mechanisms for promoting such activity as a basis for regional development.
- Creation of regional working networks to improve competitiveness in the tourist-oriented services sector, with the idea of transferring knowledge, technology and experiences to the other regions involved.

The best way to accomplish these objectives is to inform and involve the largest possible number of businesses interested in the definition of needs, and the instrumentation of recommendations and action proposals.

Therefore businesses in the sector have been taking part in the project since the beginning. This is enabling them to express their needs and let us know what are, in their opinion, suitable measures which satisfy them.

1.3 What are the Expected Results for the Project?

The following tangible and intangible results are expected for the project:

- Structuring of research driven cluster at international and regional level.
- Strengthening of the R&D+I public policies linked to the tourist sector.
- The definition of an itinerary for the generation and transfer of knowledge in tourist-related R&D+I.
- The construction of a Technology Map for the generation of knowledge in the tourist sector.
- Battery of conclusions and recommendations to improve and adapt public R&D+I policies.
- Joint action plan for the members of the research-driven international cluster.
- Study the feasibility of creating an international research-driven cluster in the tourist-oriented services sector, in the participating regions, lasting beyond the end of the project.
- Definition of a joint action project that can be financed in future Frame Programme calls.

1.4 What is the Relevance of the Technology Map
Within the TOUREG Project?

After realizing a complete analysis of the R&D in the Tourism sector of each region, reinforced by SWOT analysis in depth, we entered the second phase of the project based on field work.

The idea is to ensure the active participation of SME and trying to seek the maximum impact on SME and in particular on their implemented R&D+I activities.

One of the main results of TOUREG is the production of a Technology Map. The Technology Map collects the field work carried out by all partners in their respective regions. The field work consisted of the identification of the main technologies presented in all the regions taking part in the project and also the needs of the SMEs related to the technology areas considered in TOUREG, over 200 interviews in all participating regions have been carried out.

The fieldwork in each region, including the realization of interviews with 25 companies and 10 important players. It is a good starting point for the future and provides a sustainable point of reference in order to build a tool that allows for the incorporation of new requirements and technology solutions.

The development of the mapping technology has meant a considerable effort on the part of the partners. The Technology Map alone would have been a project in itself. It is perhaps one of the most ambitious elements of the project TOUREG.

This Technology Map will be a privileged source of information for the next steps in the project which are the creation of a Handbook on how to apply efficiently the IT to tourist sector and works on technology transfer itinerary.

1.5. How are the Technologies Classified?

There are three important areas within the tourism sector technologies which are the focus of the TOUREG project: Information and Communication Technology - ICT, Energy and Environmental Technologies.

These areas are considered strategic in the competitiveness of the tourism sector. Their impact is critical for promoting and achieving sustainable tourism and a sector based on knowledge and technology.

While tourism is an important sector for some regions taking part in TOUREG, in the generation of employment and wealth, it also provides an option for others to diversify their economies. Tourism is a services sector where innovation has been difficult to measure. However, innovation and technology implementation in other sectors has had an important impact on tourism competitiveness, for example in: transport, building, energy, ICT, environmental technologies, audiovisual, etc.

The Technology Map aims to bring the benefits of R&D+I to SMEs through highlighting the practical use (application) of the benefits of the technologies. Furthermore, this tool will become a useful reference in other initiatives, particularly in the technological development of the tourism sector in European regions.

From now on the Technology Map will be focused on the identification of potentially transferable ICT technologies to other European regions and their possible effects on the tourism industry.

2 Concept and Purpose of the Technology Map

The main objective of the Technology Map is to identify the supply and demand of the ICT technologies. The map sets out to define these key technologies and look at their current status within each region, examining the influence of each sector and their potential to provide more competitive tourism through their extended use.

The concept of Technology Map is to have a picture that includes available technologies in the ICT arena of the Tourism Sector as well as end user ICT needs in that sector. As the picture is moving the Technology Map will include a web based tool that will permit updating of the picture with information of new products or regarding new demands.

The purpose of this Technology Map is to build interrelationships between businesses and other entities involved in the tourism sector; in supply and demand not just in their respective home markets, but also between participating regions in the TOUREG project. The starting point of the Technology Map has been the identification of existing technologies in all the regions involved and the definition of those that might potentially be transferred. This identification of technologies has been carried out through the comprehensive analysis of the tourism sector in the participating regions, as well as through direct contact with the tourism industry and technology providers. So far the Technology Map includes over 80 SME’s offering over 200 technological products but the on-line tool remains open and will be sustained after the end of the contract with the EC and other regions. Non members of the consortium are also free to register their SMEs on our Technology Map.

The map uses an interactive tool for matching and offering all available technologies provided by companies located in each region while showing what is used and needed by the demander (hotels, destination management organization, etc...). This tool has been initiated and will be maintained in the long term, acting as a virtual market place of technologies for tourism.

The design of the Technology Map is a starting point for analyzing existing technologies in the tourism sector, which involves the study of emerging research lines in the industry, the technological applications that are far reaching in the market as well as those companies and entities that are developing emerging technologies.

In addition, the methodology of the Technology Map includes a comprehensive analysis of the needs of the institutions established in the regions involved in the project. This will serve as an indicator of future technologies associated with the tourism sector. As a result, the Technology Map will enable the classification of solutions for technology areas and the degree of future development.

The Technology Map is designed to produce a global
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analysis with local results. With regard to the global analysis, the conclusions drawn from the activities implemented by the research-driven cluster will lay the foundations for a guide on how to apply IT efficiently in the tourist industry. This guide will include elements applicable in different European regions.

From a local perspective, the on-line tool is free of charge and will offer all registered companies an interactive catalog of solutions. This means that, on filling out an online questionnaire, the user will have the possibility of finding a specific technological solution to meet their needs. The solution could be offered by another company from anyone of the region partners. The tool will present the possibility of a clear description of the technologies on offer along with full contact details.

To develop this tool three dimensions have been considered:

- **Supply**: Identify all available ICT technologies in participating regions affecting the tourism sector. Analysis includes technology companies and research centers with transfer potential to other European regions.
- **Demand**: The demand analysis obtained from the Technology Map will focus on the needs of SMEs involved in the field of ICT. The Technology Map will collect the needs of specific technological applications of SMEs that have a relationship with the tourism sector.
- **Technology Transfer**: Through the online tool, tourism enterprises seeking technological solutions will have access to information on existing applications on the market, which are offered by other firms in the territory of the regions associated with the TOUREG Project. It is a pairing or matching tool that links the demand and supply of technologies associated with the tourism sector. The tool will facilitate contacts between companies interested in selling and acquiring applications.

### 3 Methodology

The methodology has been detailed as presented and its scheme is shown in Figure 1.

#### 3.1 Classification of Technologies into Subcategories

As a starting point, ICT has been divided into subcategories (these different categories are shown in the on line application <http://www.tourisminnovation.eu>). These categories may be common to all regions or specific to some. This subdivision is very important in facilitating the further development of the project. Thanks to this ground-work only a simple cross check point was used during the interviews.

#### 3.2 Interviews & Surveys

The field work to collect all the data for the Technology Map was realized by each partner for its region. Table 1 below shows the number of interviews done by each region.

#### 3.2.1 Supply

During the interviews, the work focused on the collection of information based on the already available technologies. The information obtained will be useful to understand what specific technological applications are available in the tourism sector in the participating regions.

The information obtained will be used to classify the identified technologies and determine the future potential for tourism as well as their degree of transferability to other regions.

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**Figure 1**: Scheme of the Methodology used in the TOUREG Project.
Furthermore, the interviews have served to establish direct contact between businesses and will encourage them to take part as experts in the next steps to be taken in the project. One of these stages takes the form of regional round tables where technological transfer will be discussed and agreed.

3.2.2 Demand
A similar series of interview were carried out for the collection of information regarding technological needs or requirements (regional analysis survey results). In this case the objective was to analyze by means of the interviews what the technological gaps of companies working in the tourism sector in each region were.

3.2.3 Policy Markers
To complete this study, we all agreed the importance of the views of policy makers like tourism board who are giving support to the tourism technologies. This way, a similar series of interview were carried out for the collection of information regarding technological needs or requirements (regional analysis survey results).

3.3 Results Analysis
In the same spirit, the Technology Map is made up of regional reports prepared by each region describing their particular technology supply offer and demand needs.

With regard to supply, the analysis of the interview results defined the basic characteristics of each technology and its developers, while also evaluating the real or potential impact on tourism sectors and subsectors.

In addition, the interview results have helped to identify synergies with others technologies or characteristic elements of the tourism sector, as well as:

- Detection of areas for improvement or R&D lines to be covered.
- Technology situation and ways to transfer it.

With regard to a demand analysis based on the technology needs of businesses, it has to be remarked that it has offered qualitative and quantitative information analysis obtained from questionnaires-interviews and needs description per area.

3.4 Validation
PEMENCO & CDT Lulea are in charge of validating the Technology Map, based on their experience and specialization. Their work will include the reviewing of all relevant documents to ensure quality and functionality of the online tool.

3.4.1 Technology Map Validation Process
The task of Validating the Technology Map in the Toureg project was based on the following steps:

1. A preliminary evaluation of the Technology Map is done by CDT/Pemenco. The report is sent to the project members for consideration. The comments indicated an overall positive impression of the Technology Map, while identifying areas to improve which would increase the usability of and the ease of understanding the Technology Map, especially with regard to new users outside the Toureg Project.

2. A short questionnaire is put together with questions regarding the usability of the Technology Map. The questionnaire is sent to the project members, to be returned to CDT/Pemenco.

3.4.2 Preliminary Evaluation
The questionnaire included three tasks to be performed by the person filling out the questionnaire. The intention was to ensure that participants have had a hands-on experience of the Technology Map.

The responses have generally been positive, with suggestions to improve usability and consistent use of terminology. An important comment is the need to align the tools for the supply and the demand side (the version of the Technology Map at the time consisted mainly of the demand side).

Following the evaluation a series of teleconference were
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3.5 Technology Map

The Technology Map in the shape of the online tool is the most visible outcome of the tasks carried out so far. The Technology Map is accessible for anyone via internet through the site <http://www.tourisminnovation.eu>. The following pages describe the configuration of the online application of the Technology Map. This should make it easier to upload data into the online application in terms of demands and technology offerings.

The structure of the Technology Map is divided into two main areas:
- Solutions/Technologies
- Needs

4 Development and Operation of the Technology Map

As already mentioned, the Technology Map has been uploaded to the TOUREG project website <http://www.tourisminnovation.eu>. It is necessary for companies to register in advance to get access to the database. Once registered, companies obtain a password and are assigned a username which allows them to complete the questionnaire for suppliers or technology applicants. They will be able to use the tool to see the available technology applications and the demands arising in the participating regions.

The logic behind the generation of the map is based on:
- A simple and intuitive interface to input all the information and contents about the technological applications and demands identified in the participating regions.
- A regular update of information contained in the Technology Map.
- The information is processed and transformed into a structured knowledge base available for the firms established in the partner regions of the TOUREG Project.
- The knowledge base automatically loads the information to a query interface;
  - The interface is dynamic.
  - The interface is designed to connect the suppliers with the technological demands of the participating regions (matching process) and vice versa.

To obtain homogeneous information in all project participating regions, the following methodological tools were defined by the coordinator of this work package:
- General schema of contents for the regional reports including the information on the current situation in the tourist-oriented services sector.
- Questionnaire for in-depth interviews of the major

Figure 2: Home Page of <http://www.tourisminnovation.eu>.
5 Input Requirements

Upon entering the private area of the website, each company can access the SMEs area and fill in the questionnaire (either demander SMEs or suppliers). To allow this, the main input requirements are:

- To obtain a password for access to the private area;
- Each partner or SME interested must be registered in the SMEs area, so they can insert the answers to be collected;
- All the questionnaires must be filled in using the online forms.

The questionnaires will be saved in a specific structure, in order to build the Technology Map, based on the responses received.

In a first step, each region, having carried out an average of 30 questionnaires is responsible for the uploading of the questionnaire responses to the online tool in order to create a primary database and generate interest in this tool. However, it has been decided that after this initial impulse to the tool, all companies will register directly.

5.1 How to fill in the on-line Questionnaires?

Each company will access the private area by entering their respective username and password in the homepage in the TOUREG website, <http://www.tourisminnovation.eu>.

In the private area there is a link to each of the questionnaires. This way, both suppliers and consumers can submit their answers.

After choosing the questionnaire, the questions will be presented with the format of a word documents as defined earlier. To complete the questionnaire, the answers just need to be submitted. The responses will all be saved in a database.

Figure 2 shows the home page of the website.
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made by companies working in the tourism sector.

5.2 Consumers Map

Consumers are always looking for the right solution for their problems, so the following levels have been defined:

- **1st level:** The most common problems in each sector are listed in relation to energy, water, waste, land transport, ICT and management, and those with greater potential for optimisation, of which the user selects one.

- **2nd level:** The map details some available solutions and technologies for the resolution of the problem selected. This step can be considered as a catalogue of solutions. To further detail the map the following two levels have been introduced.

- **3rd level:** Once the solution/technology is chosen, the map gives feedback in the form of a Results Sheet containing technical and financial information, and a suppliers list organized according to region.

- **4th level:** Once the supplier is chosen, the map presents the available contact information of the supplier and a link to their website.

5.3 Suppliers Map

Suppliers are providing a series of technologies responding to the market demand. With this in mind, the levels are structured as follows:

- **1st level:** The supply map includes the following list of technologies by sector:
  - Communication and hardware.
  - Environmental solutions.
  - ICT Solutions.
  - Renewable energy use and energy saving solutions.

- **2nd level:** The map presents all the solutions that were mentioned as needed by the demand companies through the questionnaires.

- **3rd level:** Once the solution is chosen, the map responds with the description of the specific solutions, the complexity of its implementation, benefits, return of investment and a cost indicator as well as the list of companies that supply that kind of solution ordered by country.

- **4th level:** after choosing the company, the map responds with the contact of the supplier, including address, phone, fax, e-mail and description.

The next page contains two specific examples. On one hand there is a map of technology demands and on the other there is another including technology provider as shown in the online tool.

5.4 The Technology Map in Figures

From the interviews conducted by the different partners, the initial results of the global picture by regions related to the Technology Map are presented below in Tables 2 and 3.
These tables show that the ICT group is the one that is representing the biggest amount of technological solutions as well as demand so we can see that is this sector the market is well adapted to the needs of the tourism companies, and there are more possibility to create a market transfer in this area.

Secondly we can see a gap: The Energy solution demand is higher than the amount of technologies available. As far as the Environment sector is concerned, the tables show a lack of technological demand which is a surprising data. Nowadays, we cannot ignore the global climate change situation, what should lead to adopt environmental technologies in the tourism companies.

Figures 3 and 4 show examples of consumers map and suppliers Map.

6 Point of Situation and Next Steps

This paper is a description of the work realized to elaborate the Technology Map of the TOUEG Project.

It includes different aspects like:

The methodological process, as well as the vision of the partners on how it has to reflect the technological situation of the SME in each region.

An on-line web based tool is part of the project backbone and has been presented to the SME during the regional meeting with a lot of interest demonstrated by the participant. This format is very well adapted to our project as it is in continuous evolution, in the way that a new SME can register any time and update the information to the market reality.

Taking into account that the final objective of the project is the technological transfer the on-line Technology Map is aimed to be a "virtual market place", a place to facilitate a meeting point between the technological industry and the consumers.

Final results of the Technology Map will depend on data introduced by end users from both perspectives (supply and demand) into the on-line tool. It is important to have both quality and quantity. To achieve this some Marketing and Communication activities will be carried out next at the short term.

Additionally, next steps will include the definition of the itinerary of the transfer and give practical recommendations and best practices in a practical handbook to the SME in the Tourism Sector.
Health Informatics

Large-Scale Antibody Profiling of Human Blood Sera: The Future of Molecular Diagnosis

Andreas Keller, Nicole Ludwig, Sabrina Heisel, Petra Leidinger, Claudia Andres, Wolf-Ingo Steudel, Hanno Huwer, Bernhard Burgeth, Matthias Hein, Joachim Weickert, Eckart Meese, and Hans-Peter Lenhof

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Despite the progress in cancer diagnosis the timely detection of many cancer types is still a grand challenge. For various human cancer types including lung cancer, prostate cancer, and breast cancer, several groups recently demonstrated that autoantibody profiling might be a promising approach towards earlier and more accurate cancer diagnosis. In this paper, we confirm the ability of autoantibody profiling as a diagnostic test by providing evidence that not only cancer sera can be distinguished well from normal controls, but also from sera of patients with noncancerous diseases. Altogether, we screened blood sera of 191 cancer patients, 60 physiologically unaffected controls, and 177 sera of patients with noncancerous diseases for more than 1800 immunogenic clones. The measured autoantibody fingerprints were evaluated using a novel image analysis pipeline. For 13 antigens, statistically significant ($p < 0.05$) and at least two-fold elevated immuno-reactivity in cancer sera compared to normal sera could be observed. Nine of these antigens also showed increased reactivity compared to sera of patients with other diseases, including the tumor marker vimentin. Supervised discrimination between cancer and normal sera by using linear Support Vector Machines was possible with an accuracy of 94.04%, a specificity of 83.38%, and a sensitivity of 97.44%. Here, our so-called MIMM (minimally invasive multiple marker) approach showed no significant difference in the classification accuracy between low and higher tumor grades. The classification in healthy and diseased sera showed an even higher accuracy of 96.12% while the discrimination in cancer sera and diseased controls revealed an accuracy of 69.58%. These results demonstrate that autoantibody profiling offers the possibility of cancer screening for a variety of different cancer types as well as inflammatory diseases at an early disease stage.

Keywords: Antibody Profiling, Antigen Marker, Human Blood Sera, MIMM, Molecular Diagnosis.

1 Introduction
Tumor markers have been successfully applied to detect various cancer types. Popular examples are the Prostate Specific Antigen PSA for prostate cancer, CA-15.3 for breast cancer, and CA-19.9 for pancreatic cancer. In the recent past a trend towards small antigen marker sets instead of single markers has emerged, since single markers...
results. In detail, we carried out three pair-wise classifications using our MIMM approach: normal control sera vs. cancer sera, normal control sera vs. sera of all patients, and sera of patients with noncancer diseases vs. sera of patients with cancer diseases.

The results presented indicate an overall increased humoral immune response in cancer patients and patients with inflammatory diseases. In addition, the study demonstrates that autoantibody profiles offer themselves as a promising approach for noninvasive cancer detection at early stages.

2 Materials and methods

Patients’ sera: Blood samples of patients and normal controls were obtained with patients’ informed consent. Serum was isolated and subsequently stored at –70°C. The local medical ethics committee approved the study.

Screening procedure: The applied screening procedure consisted of two steps. (1) A prescreening to select the clones that show reactivity with pools of patients’ sera and (2) a screening of many diseased and control sera using the immunogenic clones defined in the first step.

1. We screened a total of 38,016 recombinant *Escherichia coli* clones using a human fetal brain library. Thereby, we analyzed a total of 30 serum pools of patients with different cancers (among others meningioma and glioma), neurodegenerative diseases, and inflammatory diseases. Autoantibodies bound to clones on the protein array were detected using a secondary antibody (anti-human IgG/IgM/IgA-conjugated with HRP, Dianova). The scanned protein arrays were manually evaluated. Our analysis showed 1827 clones showing reactivity in at least one serum pool. These 1827 disease-related immunogenic clones were assembled in duplicates on a customized protein array.

2. The resulting protein arrays were screened with patients and control sera. Here, bound autoantibodies were detected using a fluorescence-conjugated secondary antibody (anti-human IgG/IgM/IgA-Cy5, Dianova). After screening, the protein arrays were scanned using a Typhoon 9410 scanner and reacting spots were picked out by a newly developed image analysis procedure. Consequently, we investigated a total of 428 blood sera including 191 blood sera of malignant and benign cancer entities of different organs, 60 sera of physiologically unaffected individuals, and 177 sera of patients with various other diseases. The resultant 428 protein arrays were processed using a newly developed image analysis pipeline as described below.

**Image analysis:** In order to compute intensity values for each immunogenic clone on each protein array we developed an image analysis pipeline. In a preprocessing step, the scanned images were standardized, i.e., slight rotations of the scanned images were corrected and the edges of the image were cut accurately. Thereafter, the array was segmented into regular sub-grids and each immunogenic clone was assigned a spot target area. By 3-means clustering, each target area was divided into foreground and background pixels. The three clusters corresponded to background pixels, pale foreground pixels, and dark foreground pixels. After clustering, if foreground pixels exceeded the originally calculated target area, the previously computed spot areas were enlarged. To this end, we carried out a local search for each target area border separately. In detail, we shifted the border in each direction by up to five pixels. For each position, we calculated the number of foreground pixels that lay on the border and selected the horizontal and vertical border hitting the minimal number of foreground pixels.

To extract the dark foreground spots from the pale background, we applied the so-called black top hat, well known from the field of image analysis [18]. Here, morphological closing is applied, consisting of a dilation step followed by an erosion step. For erosion and dilation, we applied a squared structuring element of size approximately 40 pixels. Finally, the intensity of each spot was computed as the mean value of all pixels comprising the spot after application of the black top hat operator, i.e., the difference between each of the pixels and the correspond-
ing closed pixel. The completely automatically computed analysis constructed for each protein array an autoantibody reactivity pattern consisting of about 1827 intensity values with a range of between 0 and 255.

**Merging replicates:** For each immunogenic clone, two replicates were spotted on the protein arrays. The respective two values were combined by computing their mean intensity.

**Data normalization:** To make the protein arrays directly comparable to each other, a quantile normalization [14] was carried out. Here, it is assumed that most clones are not changed in their reactivity across the arrays. Thus, this normalization may decrease the difference between normal and disease sera.

**Ranking of antigens:** To rank immunogenic clones, we applied several standard methods:

1. **AUC:** The receiver operator characteristic curve (ROC) shows sensitivity as a function of 1-specificity. If two distributions can be separated completely from each other, the area under the ROC curve (AUC value) computes as 1, if two distributions overlap completely it computes as 0.5. AUC values for each of the immunogenic clones were computed to get an idea as to how well this clone separates serum groups.

2. **Wilcoxon–Mann–Whitney testing:** We computed for each immunogenic clone whether the distribution in normal and cancer sera differs significantly by carrying out unpaired two-tailed Wilcoxon–Mann–Whitney testing [15, 16]. The significance values of this nonparametric test were adjusted for multiple testing using the Benjamini–Hochberg adjustment [19].

3. **Reactivity frequencies:** Besides the AUC values and t-test significance values, the percentage of reactivity in

<table>
<thead>
<tr>
<th>Ensemble</th>
<th>Gene</th>
<th>Area under curve</th>
<th>p-value</th>
<th>Normal (%)</th>
<th>Cancer (%)</th>
<th>Other (%)</th>
<th>Cancer/normal</th>
<th>Other/normal</th>
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<td>ENSG00000074600</td>
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<td>0.0051</td>
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<td>0.54</td>
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<td>0.0754</td>
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<td>0.33</td>
<td>0.32</td>
<td>2.05</td>
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<td>ENSG00000125817</td>
<td>Centromere protein B, 80kDa</td>
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<td>0.0177</td>
<td>0.25</td>
<td>0.50</td>
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<td>2.01</td>
<td>1.51</td>
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Table 1: Antigens occurring with at least two-fold increased frequency in cancer sera compared to normal sera. Italic genes are statistically significant (adjusted p-value < 0.05).
normal and cancer sera of each immunogenic clone is highly important. Thus, the computed intensity values have to be discretized in two bins: reacting and not-reacting. To this end, an empirically determined intensity value threshold of 50 was applied to the data. Clones with higher intensities were defined as positive, all other clones as negative. For each clone the percentages of cancer and normal sera with intensity values larger than or equal to 50 were computed.

Separation of cancer and normal sera: Separation of cancer and control sera was performed using Support Vector Machines [17] with a linear kernel. Reported accuracy, specificity, sensitivity, and AUC values are averaged values from 100 repetitions of a standard 10-fold cross validation.

The large number of features always suggests the possibility that the applied machine learning technique (in our case the Support Vector Machine) is adapted too much to the data set. To test for this so-called over-training, we carried out stratified permutation tests. Here, we randomly sampled the class labels of the considered classification task by ensuring that the class probability matches the original class distribution. Again, we repeated 100 runs of the 10-fold cross validation to compute averaged accuracy, specificity, and sensitivity.

Altogether, we carried out three comparisons, including cancer versus normal sera, diseases (cancer sera and sera of patients with other diseases) versus normal sera, and cancer versus noncancer diseases.

3 Results

We carried out a large-scale autoantibody profiling of 428 blood sera including 191 blood sera of malignant and benign cancer entities of different organs, 60 sera of physiologically unaffected individuals, and 177 sera of patients with various other diseases as described in the Materials and Methods section. For each serum, we computed reactivity values for 1827 immunogenic clones using our newly developed image analysis pipeline. Please note that the clones have been spotted in duplicates onto the protein array and we computed the mean value of these replicates. Before analyzing the data, we carried out a standard quantile normalization, to account for differences between the 428 protein arrays.

3.1 Increased immunoreactivity in cancer sera

For each of the 1827 immunogenic clones, we computed the area under the receiver operator characteristic curve, the percentage of cancer, normal, and other control sera showing reactivity with the clone. Additionally, we calculated p-values using two-tailed Wilcoxon-Mann-Whitney tests and adjusted the p-values for multiple testing by controlling the false discovery rate. To compute reactivity frequencies, we binarized the data: each reactivity value higher than 50 was considered as a positive response; all other values as negative.

For 25 clones, we detected an at least two-fold increased reactivity in cancer sera compared to normal controls and an adjusted p-value of less than 0.05. Of these clones, 13 could be mapped on to human proteins that were transcribed in the correct reading frame (inframe clones, in the following referred to as antigens). It was notable that four of these 13 antigens reacted more frequently with sera of patients with other diseases compared to cancer sera. The remaining, out of frame clones, represent so-called mimotopes. Details of the antigens are provided in Table 1 – this contains all antigens with an at least two-fold increased reactivity in cancer sera compared to normal sera.

The highest quotient of reactivity in cancer sera divided by reactivity in normal sera was obtained by enolase 1, showing a 7-fold enrichment of reactivity in cancer sera (p-value of 0.0261). Remarkably, this antigen showed an even higher reactivity in sera of patients with noncancerous diseases. The best AUC was reached by vimentin 1 that shows a 4-fold enrichment of reactivity (p-value of 0.0001) (see Figure 1 for intensity values of vimentin).

Moreover, the DEAD box polypeptide 54 reacted in 40% of cancer sera, 15% of normal sera, and 21% of other control sera. Likewise, the DEAD box polypeptide 24 reacted in 20% of cancer sera, 8% of normal sera, and 8% of other control sera. The general transcription factor IIB showed reactivity in 29% of cancer sera, 13% of normal sera, and 12% of other sera.

Specifically, we found no antigens that showed an at least 2-fold enrich-
Remarkably, no small-cell lung carcinoma sera were predicted as being normal. The classification in sera of diseased patients and physiologically normal controls reached an even higher accuracy of 96.12%, with a specificity and sensitivity of 77.48% and 99.16%, respectively. Permutation tests reached an accuracy of 78.44%, specificity of 10.5% and sensitivity of 89.52%.

The classification of cancer and noncancer disease sera showed an accuracy, specificity, and sensitivity of 69.58, 67.73, and 71.29%, while the respective values for the permutation tests were 49.92, 51.44, and 48.27%. This comparison demonstrates that the results are better than random, but do not reach the exceptionally high accuracy rates as found in the other two scenarios considered.

### 4 Discussion and Conclusion

The analysis of the reactivity in cancer, noncancer, and normal sera detected several antigens that are already known to be tumor markers. The most prominent example was vimentin. However, vimentin also showed reactivity in many sera of patients that are diseased but have no cancer. Thus, this protein belongs to the category of disease markers rather than to the category of cancer markers. Moreover, we detected several proteins that have so far not been related to cancer diagnosis. These proteins partially showed decreased reactivity in noncancer sera compared to cancer sera.

The classification into cancer sera and normal sera as well as the classification into diseased sera and normal sera both showed very high accuracy rates of about 95%. The classification in cancer sera and sera of noncancer diseases was possible at an accuracy of about 70%, specifying the current frontiers of our molecular disease diagnosis methods.

The accuracy of some of the permutation tests is by far higher than the rate of 50% that one might expect for a two-class scenario. As mentioned in the Materials and Methods section, we carried out stratified permutation tests, with respect to the class distributions. In the case of the comparison of normal sera versus diseased sera, we compared 60 to 368 samples. Thus, the permutation tests show a high sensitivity (89.52%) at very low specificity (10.5%). Here, the mean value of specificity and sensitivity (50.01%) represents a more sensible measure for the actual performance of the permutation tests. The respective mean value for the original class labels computes as 88.32%.

In summary, autoantibody profiling represents an approach that is well-suited for the detection of various diseases, including cancer. Since our classification results showed no decreased performance for low-grade tumors, the approach as presented might also be suited to the detection of tumors in their early stages, which would, in turn, lead to improved cure rates of the respective tumors.

### Bibliography


### Table 2: Classification outcome for the three classification scenarios. The numbers in squared brackets denote the 95% confidence intervals.

<table>
<thead>
<tr>
<th>Classification</th>
<th>Accuracy (%)</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
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<td>Cancer vs. normal</td>
<td>94.08</td>
<td>97.44</td>
<td>83.38</td>
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<td>(93.93–94.22)</td>
<td>(97.32–97.55)</td>
<td>(82.96–83.8)</td>
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<td>Diseases vs. normal</td>
<td>96.12</td>
<td>99.16</td>
<td>77.48</td>
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<td>(96.03–96.21)</td>
<td>(99.09–99.22)</td>
<td>(76.99–77.97)</td>
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<tr>
<td>Cancer vs. noncancer diseases</td>
<td>69.58</td>
<td>71.29</td>
<td>67.73</td>
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<tr>
<td></td>
<td>(69.3–69.85)</td>
<td>(70.93–71.66)</td>
<td>(67.33–68.13)</td>
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</tbody>
</table>


[14] Bolstad BM, Irizarry RA, Astrand


CEPIS Chairs CEN ICT Skills Workshop

It is with great pleasure that we announce the election of former CEPIS Honorary Secretary, Dudley Dolan, as Chair of the European Committee for Standardisation (CEN) Workshop on ICT Skills. Mr. Dolan has extensive experience in this field and we are confident that he will provide strong leadership in forging new agreements to support the long-term European e-skills agenda and will strengthen the workshop by building on the work already achieved.

Mr. Dolan has been member of the CEN/ISSS workshop since the beginning, and prior to this new position had been successful as Assistant Project Leader of the End-User ICT Skills Framework Project. CEPIS offers congratulations to Mr. Dolan on this new appointment.

CEPIS welcomes new Member society from Montenegro!

The Montenegrin society, Drustvo Informaticara Crne Gore (DICG) was unanimously approved to become a full CEPIS Member society during the recent 44th CEPIS Council meeting in Bucharest. The total number of Member societies in CEPIS is now 36.

We extend a warm welcome to DICG and are confident in their abilities to promote and preserve CEPIS’ strategies in Montenegro and beyond.

Call for Participation: CEPIS Green ICT Task Force

CEPIS Members are invited to participate in the important work of the Green ICT Task Force. The topic of Green ICT is essential for Europe and its environmental sustainability in the future by lowering greenhouse gas emissions, and improving energy efficiency. CEPIS Honorary Secretary, Byron Nicolaides, presented a paper on Green ICT during the 44th Council meeting <http://www.ecdl.org/files/cepis/20100414102948_Green%20ICT%20-%20CEPIS%20proposal.pdf>.

The proposed aims of the Task Force include:

- To raise Green ICT issues to both the European Commission and European Institutions and to participate in all relevant initiatives and events;
- To ensure that ICT professionals have the required knowledge to handle Green ICT issues and are capable to design solutions and operate systems in accordance with Green ICT rules;
- To mobilize the ICT product end-users to change their habits and to ensure that they purchase and use more environmentally friendly ICT devices that are compatible with Green criteria;
- Award enterprises or organisations that adopt and apply Green ICT measures;
- Promote the good practice of Green ICT by adopting a Green ICT certification or a Green ICT mark/sign.

If you are interested in becoming a representative on this new Green ICT Task Force, please contact Fiona Fanning <fanning@cepis.org>.

Call for Participation: CEPIS Research Task Force

The CEPIS Research Task Force is in the process of formation and members are invited to express an interest in joining. As presented by Vice President Malgorzata Kalinowska-Izskowska at the 44th CEPIS Council the suggested work programme for the Research Task Force may include:

- A review of common research issues across Europe;
- Creating a list of issues and concerns affecting the area of Research to focus action on;
- Preparing reports expressing CEPIS’ views on Research;
- Investigating how legal regulations may impact on ICT Research e.g. patent law, copyright levies, and intellectual property rights.

In order to achieve the above objectives along with other topics relevant to Member societies, CEPIS would like to call upon the vast wealth of knowledge and experience that all CEPIS members possess, to create a strong and committed task force.

Expressions of interest to become a representative on this new Research Task Force should be submitted by emailing Carol-Ann Kogelman <kogelman@cepis.org>.