TOURIST INFORMATION DELIVERED THROUGH MOBILE DEVICES: FINDINGS FROM THE IMAGE PROJECT

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This article describes a product (the “Mobility Agent”) that delivers Internet-based travel and tourism-related services through fixed and mobile devices. Intelligent agent technology was used to provide European residents and visitors with dynamic, mobile, personalized, location-based information and services, specifically related to travel and tourism in complex urban environments. The article describes the Mobility Agent and its testing and evaluation, most notably issues surrounding user acceptance, and the demand for and willingness to pay for such a product. Findings show high levels of acceptance of the Mobility Agent. Willingness to pay, especially in unfamiliar environments, is also seen to exist.

Key words: Travel and tourism information; Intelligent agents; Location-based services; User acceptance; Willingness to pay

Introduction

Fixed and mobile Internet-based technology has revolutionized the supply of up-to-date travel and tourism information and services (Department for Transport [DfT], 2002a; Staab et al., 2002). The ability to exchange large amounts of data in real time is also increasing as computer power increases and devices become cheaper. In the UK, most Internet access takes place through personal computers, although by 2002 8% of adults who had ever accessed the Internet had done so using a wireless application protocol (WAP) phone (DfT, 2002b). This figure is likely to increase as mobile phone technology improves. The UK Department for Transport (DfT) states that current 2.5G Global Packet Radio Service (GPRS) phones “allow some mobile users to access the Web . . . directly or linked to personal digital assistants (PDAs) or laptops at the relatively high speed of 32kps” (DfT, 2002b). 3G phones enable much faster, better quality mobile access to the Internet, with the likelihood that this technology will become even more desirable for accessing Internet-based information and services.

Provision of real-time travel information (RTI) in the UK tends to be mode specific. Different services are provided for road, rail, buses, and freight fleets, but there is little synchronization between these modes (DfT, 2002a). Services are provided...
by specialist software companies [e.g., Kizoom, which provides raw timetable data, real-time movement, and operator information (http://www.kizoom.com)] or information providers such as ITIS Holdings, which collects, processes, and distributes real-time data for public and private use (http://www.itisholdings.com/). Information and service providers draw together data from a variety of sources, including transport operators and local authorities, into seamless software packages. Since 2004, an Internet-based electronic travel information service has been available in the UK, called Transport Direct (http://www.transportdirect.info). Transport Direct provides information for door-to-door travel by any mode. It can be accessed via personal digital assistants (PDA), WAP phones, and e-kiosks, as well as personal computer. It obtains information and data from existing content providers for provision on one seamless, easy to use site.

In mainland Europe, provision of real-time travel information tends also to be mode specific. Systems are most advanced in the Scandinavian countries, particularly Finland, where personal navigation and location-based systems, and m-Commerce services (including m-ticketing) are available, many developed under the Navi Programme (2000–2002) (http://www.vtt.fi/tte/rd/maivisearch). Most countries have services for mobile parking payments, public transport journey planning, and mapping, though none yet have the comprehensive, integrated, nationwide service provided by Transport Direct.

The rationale behind the provision of consolidated travel information is to provide high-quality integrated public transport services. Systems are now being developed with more ambitious geographic coverage and provision of services that not only provide complete travel information, but also tourist information that can be accessed any time, any place, anywhere, by anyone. One such system, the IMAGE Mobility Agent, is described below.

The IMAGE Mobility Agent

Technical Description

The IMAGE project (Intelligent Mobility Agent for Complex Geographic Environments) was funded by the European Union under its 5th Framework Information Society Technologies (IST) Programme. IMAGE designed and developed a modular Internet-based system, using intelligent agent technology, for a Mobility Agent to supply European residents and visitors with mobile, personalized, location-based information and services, specifically related to travel and tourism. User profiling enables information and services to be customized to the particular needs of an individual.

The concept of the IMAGE Mobility Agent is very close to that of the traditional travel agent. The latter assists the user with travel decisions between two geographic points (i.e., from a departure point to an arrival point), completes the purchase of the travel and accommodation, and also provides information about possible activities during the travel process or at the destination. The IMAGE Mobility Agent does all these things, but focuses on short-distance land transport. The system collects and stores content from different source databases and processes these data according to end user requests. The services are delivered via mobile devices such as mobile phones and PDAs, or stationary devices such as personal computers or e-kiosks.

The IMAGE Mobility Agent comprises the following modules (see Fig. 1):

- Intelligent agent module: a multiagent system this is responsible for managing end user requests and dynamically building a user’s profile;
- User interface: for PCs, PDAs, and mobile phone devices;
- Geo-referenced services and GIS module: includes mapping, geo-coding, and intermodal routing;
- Data management module: this interfaces, collects, and stores content from databases, and the end user, and disseminates the information to other modules;
- Payment module: responsible for payment functions.

The services provided to end users can be summarized as follows:

- Personalized information services: based on the user’s profile, these relate to transport and tour-
ism [including positioning, routing, mapping, navigation, points of interest (POI), and tourist events];

- Nonpersonalized (“guest”) information services: these relate to transport and tourism (routing, mapping, POIs, events);
- Personalized “pushed” information services: these relate to transport and tourism (tourist events and POIs);
- Sale of e-ticketing and on-line reservation products;
- Link to external “e-shops” (e-ticketing and on-line reservation products).

Several features of the Mobility Agent system and services should be explained in more detail as these are fundamental to the efficient delivery of travel and tourist information via mobile technology:

1. The use of intelligent agent technology: Intelligent agent technology enables a user’s profile to be stored and processed. This might include, for example, mobility requirements or language preferences. Provision of services, especially for disabled people, must reflect their “multifaceted, but individual” requirements (Mentz, 2004), and this is achieved in the user profile.

The Mobility Agent user can operate in three modes: commuter, business traveler, or tourist. The user profile therefore comprises: name, age, gender, preferred language, preferred payment method, contact information (address, phone, e-mail), mode (commuter, business traveler, or tourist), disability, point of interest (home, including coordinates/other, e.g., theater), travel preferences (car, public transport, pedestrian). Furthermore, intelligent agents enable the Mobility Agent to learn from an individual’s use of the system, thus allowing service delivery to be adapted intelligently to habitual behavior, and for certain services to be pushed to the user if desired. For instance, if the user is a regular visitor to a particular restaurant, and the system knows he/she is in the vicinity of that restaurant (through the use of location-based services), it can automatically notify the user and point out information about that restaurant (such as offers, for example). In other words, the system learns from an individual’s use of the Mobility Agent.

2. Personalization of services: Intelligent agent technology enables the personalization of services. As Dia (2002) points out, the use of intelligent agents is fundamental to the provision of dynamic context-based and personalized ser-
vice provision. The personalization of service delivery is an extension of the user profiling function, mapping user profile information onto dynamic information about user mobility and the service environment within which the system is operating. The “family” of intelligent agents constantly monitors a user’s position and route and will automatically provide location-based services; for example, tourist events, which, as noted above, can be pushed if desired, based on the profile and the habitual behavior of the user.

3. The extent of mobility and coverage: The continuity of a user’s access to services is maintained regardless of location; end users will thus experience seamless service delivery.

4. The use of location-based services and dynamic geo-referenced information: All the mobile services provided are location dependent. Geographic positioning using GPS is a basic feature of the user profiling and preference management functionality. A user’s position and route can be constantly monitored, thus building intelligence into the GIS platform so that all services and points of interest (POI) can be made available to the user automatically. Data relevant to the user’s location and route are dynamically updated whenever there is a change in the service (e.g., a transport timetable alteration).

5. Integration of information services with e-commerce services: Booking, reservation, and purchase of end services (such as cinema tickets or accommodation), as well as transport tickets, is possible.

6. The use of wireless communication: Mobile communication is enabled through the GSM, GPRS, and UTMS communication standards; fast mobile Internet access is provided, accommodating data speeds of up to 2Mbps.

It is appropriate to explain about the modules of the IMAGE Mobility Agent in more detail.

Intelligent Agent Module. An intelligent agent is an autonomous software system: that is, a system that can decide for itself what it needs to do to satisfy a request. It can be thought of as a computer surrogate for a person or process that fulfills a stated need or action (Dia, 2002). Intelligent agents have numerous existing or potential applications in the transport field, but until recently these have largely focused on urban traffic control, network flow, and real-time traffic management issues (Dia, 2002; Rossetti et al., 2002).

Within the IMAGE Mobility Agent there is a family of intelligent agents that manages, processes, and monitors user requests, profiles, and preferences, and coordinates and distributes multisource services. The interrelationships between the agents are illustrated in Figure 2 and the role of each individual agent is described below:

1. Interface Agent: This is the link with the user interface. It can handle simple nonpersonalized queries, authenticate the user, decide whether the user should be served by an assistant or a personalized assistant, forward messages from the user interface to the assistants, and return messages from the assistants to the user interface.

2. Assistant Agent: This agent handles complex queries from users who do not have a registered user profile.

3. Personalized Assistant Agent: This agent handles complex queries from users who have a registered user profile. It adapts the service according to the user’s habitual behavior by keeping and processing the history of service requests and profile modes.

4. Travel Guide Agent: This agent handles queries relevant to the geo-referenced services, the GIS, and the Data Management/Interface module (see below).

5. Educator/Tourist Agent: Handles queries relevant to tourist information (e.g., information relating to museums, theaters, monuments, sports events, etc.).

6. Services Agent: Handles queries relevant to specific services (e.g., checking for availability of tickets and seats).

7. Events Handler Agent: Receives new events from the data management module and subsequently informs the personalized assistant agent.

8. Multi-Agent System Service Agent (MASS): This agent is responsible for keeping a record
of all the agents in the system and for providing them with information about agents in other systems.

User Interface Module. The user interface (UI) is the point of contact with the person using the product. It is user friendly and is designed to be consistent across various types of end device, including PCs, info-kiosks, PDAs, as well as mobile phone devices (WAP, GPRS, and UMTS), based on EU-level guidelines. Laboratory tests were carried out on the UI during the development phase to measure user interaction and finalize design aspects such as color scheme, font size, typeface, and navigational functionality. Because the interface was designed with device dependent input/output options left open, the end user and any new service provider can customize and adapt it to their needs. It is also designed in such a way to permit appropriate flexibility in the choice of media for presentation of information. It is interactive and bidirectional. Services are provided, and user requests are analyzed, in a consistent way, defining them as a set of basic services. TCP sockets interact with the intelligent agents, and the information and services are delivered to the user in HTML.

Figure 3 shows the IMAGE user interface on a PDA. Having logged in, and selected user mode from a choice (‘use last, tourist, business traveler, leisure traveler’), the user is transferred to the home page, which presents a number of options, including “guide” (which identifies a user’s location and makes available for selection a comprehensive list of points of interest), “plan a trip” (enabling a trip to be planned via any mode to a point of interest destination), “public transport timetables” (which are dynamically updated), and “buy a service.” It is simple for the user to click on the required option and navigate around the system. For instance, in Figure 3, with only one click the user sees his or her map position and nearby points of interest (POIs); with one more click he can obtain a POI’s details; and with one more he can obtain the route to the POI.

Figures 4 and 5 provide more detail of the mapping and navigation potential of IMAGE. The location-based services identify the user’s position, and by navigating around the POI database, the user can understand where she/he is in relation to selected points of interest (in this case museums).

Geo-Referenced Services Module. Location-based services aim to position and guide the end
Figure 3. IMAGE user interface on a PDA.

Figure 4. IMAGE user interface (map).
user to the required point of interest. Accurate positioning and navigation are particularly important as transport and tourism services always require geographic references. Interaction with the open GIS module plays an important role, opening up the possibility of integrating geographic data on a pan-European level.

The IMAGE geo-referencing services consist of navigation and localization, which not only “create additional value for mobile service provision” (Berger, Lehmann, & Lehner, 2003), but are in fact fundamental to providing the comprehensive geographic coverage required of such a product. Their purpose is to acquire the exact position of the end user in the geographic environment. Location-based technology requires a high level of accuracy, particularly in the field of pedestrian navigation in high-density urban areas, where the accuracy of technology such as global positioning system (GPS) may be affected by the urban structure (Spiekermann, 2004).

GIS Module. The GIS module handles diverse geographic and spatial information, most notably point of interest data such as the location of restaurants, cinemas, sports grounds, etc. GIS is mapping software that links information about where things are with information about what things are like (http://www.gis.com/whatisgis/whatisgis.html). More formally it can be described as: “organized activity by which people measure and represent geographic phenomena then transform these representations into other forms while interacting with social structures” (Chrisman, 1999). GIS ensures the satisfaction of an end user request through a set of tools for retrieval and processing of relevant data from a database, and production of the results. The GIS infrastructure can support additional information of a different nature linked to specific locations. The power of GIS over paper maps is the ability to select the information needed according to the goal to be achieved.
Data Management/Interface Module. This module interfaces with external databases in order to deliver required content. The data sources are both private and public and in many cases have been constructed on different standards. As IMAGE developed the Mobility Agent for trial in Italy (Turin) and Finland (Tampere), the data sources include:

- 5T (the transport telematics mobility management company in Turin);
- e-Tampere (for POI information and restaurants);
- Tampere City Transport (public transport and traffic information);
- City of Tampere (POI information, hotels, etc.);
- MEK (the Finish Tourist Board for tourist accommodation and activities information);
- Finland eTravel (a commercial agent for tourist accommodation and activities, online media access, and an access platform to other service providers).

IMAGE provides a standard travel and traffic data access interface allowing connection to the data in a uniform way, independent of the providers’ set-ups. An open platform has been developed that supports various formats, and data capture and management concepts. Data retrieval is also possible beyond the project lifespan.

Figure 6 shows the IMAGE system architecture. The databases are connected using TCP/IP. The received data format is in XML. The received data is converted into the appropriate format for processing using XSL or API, and then delivered to the user’ device.

E-Commerce/E-Payment Service Module. Many of the IMAGE services will require some form of financial transaction, before, during, or after the service has been provided to the user. To achieve this, an e-commerce submodule was developed. The rationale is for each service provider to take care of the payment functions related to their own services. IMAGE provides a payment procedure only for IMAGE services. It was necessary to define a common set of interfaces (new and standardized) and security solutions between the different levels of the IMAGE system. The e-commerce module depends on the payment services offered by other vendors, as well as the payment preferences of the end user. Special attention was paid to the different laws applied on money transfer across the European countries, in order to make the payment system interoperable.

Communication between IMAGE servers is established through http. A user in Turin may request information about Tampere; the server in Turin establishes a connection with the Tampere server. The user, having performed the search, can book or pay for the service instantly or book and then pay later. Once necessary payment data are received, the server initiates the clearing process.

Further details about the IMAGE technical description can be obtained from Project Deliverable 1.1 (http://www.hit.certh.gr/imageproject/image/index.html).

Evaluation of the IMAGE Mobility Agent

Evaluation of the IMAGE Mobility Agent took place in two European cities: in Tampere (Finland) and Turin (Italy). The evaluation process addressed three different aspects of the system:

Technical Performance: This determined the technical and functional performance of the IMAGE Mobility Agent during trials. Automatic log files were used to investigate the performance of all the modules (including payment).

User Acceptance: Tested and evaluated end user acceptance of the IMAGE Mobility Agent and services, and also willingness to pay for those services.

Legal Issues: Assessed the level of knowledge of legal and institutional issues in the public and private sectors across Europe, and identified possible legal and institutional barriers to the potential for expanding IMAGE, or similar products, on a Europe-wide basis.

In order to better understand the market potential for a product such as the IMAGE Mobility Agent, it is the findings of the end user acceptance work that provide the focus of the remainder of this article.

End User Acceptance of the Mobility Agent in Tampere and Turin. User acceptance was tested through trials related to “use scenarios.” A use
A scenario is defined as a sequence of different activities that the end user has to perform when he or she uses the IMAGE Mobility Agent. It is based on real-life situations. The use scenarios were designed to be similar in both test beds, and to maximize the operating potential of the IMAGE system.

Identification of different use scenarios starts with the identification of a set of real-life situations (known as use cases). Though the scenarios will be common to all users, the way they are performed generally depends on the needs and faculties of the person using the system. The people using the Mobility Agent during the trials were subdivided into four user categories: Commuters and business people; Tourists; Older and disabled people; Local people traveling for entertainment.

It was understood that the user categories are not mutually exclusive. However, disabled people participated as disabled users (whether they were locals, tourists, businessmen, etc.), people who were unfamiliar with the locations took part as tourists, and local people were divided between business travelers and leisure travelers.

The use scenarios performed were:

- “Create at least two different mode profiles” (tourist, commuter, business traveler, disabled).
- “Find the place where you are on the map and look for the nearest restaurant, plan a trip and Bookmark the map.”
- “Plan a trip by public transport, and make it.”
- “Plan a trip by car, make it, and look for road works.”
- “Plan yourself a dinner in the city centre for tomorrow. Check public transport and walking possibilities.”

Overall there were 53 trial participants in Turin and 31 in Tampere. These were subdivided between the user categories as shown in Table 1.

The participants came from public companies, private companies, and (in Turin) the local medical clinic, and (in Tampere) a disabled user group.
The tourists came from foreign companies and universities.

Most participants used the IMAGE Mobility Agent for a few hours at a time. However, 16 people in Turin and 10 in Tampere used it for a longer period (between 2 and 10 days). Only commuters and tourists used the system over a longer period. These participants had to use every service available.

Prior to individual trials commencing, a briefing was given. This included an explanation of the project, accompanied by a short demonstration. The participants were instructed to use available services across different times of day.

User acceptance was evaluated through the use of surveys, service diaries, and focus groups. All resources were translated into the appropriate language. Across the two test beds 95% owned a mobile phone and 80% in each test bed had used the Internet. The participants were therefore IT literate.

User Acceptance Findings. Several indicators were identified in order to evaluate user acceptance. These were investigated in part 3 of the user survey (“User Acceptance of the IMAGE system”). m-Payment took place in the Tampere test bed only and is not discussed here.

Most of the answers were either “yes/no,” or 4-point scales (e.g., “very easy, easy, difficult, very difficult”). The questions are listed below:

- Was the system as a whole easy to use? (“very easy” to “very difficult”)
- Was it easy to learn how to use the system? (“very easy” to “very difficult”)
- How easy to use is the interface? (“very easy” to “very difficult”)
- Is security and privacy of personal information

Table 1

<table>
<thead>
<tr>
<th>User Category</th>
<th>Turin</th>
<th>Tampere</th>
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<tbody>
<tr>
<td>Commuters and business people</td>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td>Tourists</td>
<td>16</td>
<td>12</td>
</tr>
<tr>
<td>Older and disabled people</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Local people traveling for entertainment</td>
<td>18</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>53</td>
<td>31</td>
</tr>
</tbody>
</table>

Profile of Participants. In both test beds 50% of participants were in the 30–44 year old age range. The under 18 age range was not represented in either location. With most participants of a working age, it was not surprising that 62% of the participants in Turin and 61% of the participants in Tampere worked in either the public sector or the private sector.

Gender breakdown of participants was nicely balanced in Tampere (51% male, 49% female), but weighted somewhat in favor of males in Turin (65% male, 35% female). There were six participants in the older and disabled (O&D) user category in Turin and seven in Tampere: only one of these people actually had (or revealed) a disability.

Across the two test beds 95% owned a mobile phone and 80% in each test bed had used the Internet. The participants were therefore IT literate.
something you consider important? (“very important” to “not important at all”)

- Were you satisfied with the security and privacy of the system? (“very satisfied” to “very dissatisfied”)
- Was the information provided what you had asked for? (Yes, No)
- Was the information provided understandable? (“very understandable” to “very difficult to understand”)
- Was the task/transaction described in your chosen language? (Yes, No)
- Was the information provided accurate? (“very accurate” to “very inaccurate”)

The findings relating to the indicators are presented in this section.

Ease of Use: Overall, the Mobility Agent was regarded as easy to use, with 88% of the participants agreeing on this point; 85% were of the opinion that it was easy to learn how to use the system, and 84% were of the opinion that the user interface was easy to use (Figs. 3, 4, and 5).

Security and Privacy: Security and privacy issues primarily concern the storage of user profiles and the use of the m-payment facility. Confidence in the security and privacy of the Mobility Agent was high, with 93% of the participants satisfied. This is clearly an important finding for a product that develops individual profiles and enables payment for services. However, the finding can be tempered by the fact that a full-scale trial of the m-payment facility was only carried out in one site. The findings should perhaps be interpreted as a feeling of trust in the system as a whole.

Efficiency of Information Provision: Provision of requested information also scored highly with 80% of the participants receiving what they wanted, based on their stored profiles. The main problem encountered was the occasional failure of the language selection. Receiving information in first choice language is an area that is very important to the user, in particular the tourist, and should not be underestimated. Otherwise, constructive criticism was received concerning the quantity and quality of the information. Clearly information and data enrichment—particularly for older and disabled users—should be a prime objective of any future development of the Mobility Agent, so that it is a wholly reliable and useful one stop shop environment (Gill, 2004).

Willingness to Pay Findings. A crucial further strand to this research was to understand whether people would be willing to pay for information and services, and if so, how much. These issues were investigated in part 4 of the user survey.

Three alternative methods of payment for services were suggested: Payment per enquiry; Payment by monthly subscription; Payment via a combination of subscription and enquiry.

Payment per enquiry was the most popular method of payment with 52% of respondents in Turin and 74% of respondents in Tampere making this their preference (Fig. 7).

Perhaps the key finding of this study relates to the issue of when and where people would use the Mobility Agent and their corresponding willingness to pay. The participants were asked about the likelihood of their using the Mobility Agent in a familiar location (for instance their home town) and an unfamiliar location (i.e., as a tourist or business traveler), and accordingly how much they would be willing to pay. A range of hypothetical price options was suggested, as shown in Table 2.

Sixty-two percent of respondents in Turin and 90% of respondents in Tampere would use the Mobility Agent at least sometimes in a location that is familiar to them, particularly if dynamic routing information (such as roadworks) can be provided. However, their propensity to use the Mobility Agent increases in an unfamiliar location: 87% of respondents in Turin and 100% in Tampere would be prepared to use the Mobility Agent at least sometimes if they were traveling for tourism or business in an unfamiliar location (Fig. 8). It is this increased demand for the Mobility Agent in unfamiliar locations that explains the preference to pay on an enquiry basis (i.e., when required) shown in Figure 7.

Thus, it can be stated with some certainty that willingness to pay for the Mobility Agent increases as familiarity with a location decreases. Presented with a range of hypothetical prices and method of payment (Table 2), the following trends were observed (see also Figs. 9 and 10):

- In a familiar location people are only willing to pay the minimum amount. In Turin only 13%
of people who preferred to pay per enquiry were willing to pay the top three prices of the range in a familiar location; however, this figure increased to 41% of people in an unfamiliar location.

- In Tampere 41% of people who preferred to pay per enquiry were willing to pay the top three prices in the range in a familiar location; this increased to 77% in an unfamiliar location.

Finally, the Mobility Agent is seen as useful in assisting journey planning, attending events, and booking or paying for services (Fig. 11). It is seen as a useful alternative or complement to traditional methods of obtaining service information (i.e., printed maps, guidelines and timetables, telephone enquiries and Internet searches).

Discussion

The survey results demonstrate that the IMAGE Mobility Agent is easy to use, and is reliable in terms of security and privacy. It provides good, reliable information based on the user profiles, and there are encouraging findings relating to willingness to pay. Overall, the surveys suggest that it has a viable future.

It is recognized that there are some limitations attached to the analysis. The sample size in Tampere was smaller than anticipated. The relatively small sample size makes analysis of findings between user categories less reliable. The sample of participants in both test beds shows a high degree of IT literacy. This suggests that they are likely to be more receptive to the IMAGE technology than a less IT-literate sample might be.

Focus groups were used in both test beds to augment the user surveys. The focus group findings revealed some pitfalls about the Mobility Agent’s potential that the user surveys did not pick up. Though it was regarded as an interesting idea, it was seen at this stage as too basic and too prone to technical malfunction (most importantly, the Internet connection was too slow). These issues are crucial to the overall usefulness of a product designed to be used while people are on the move or in unfamiliar locations.

Most of the improvements involve technical fine-tuning. Internet connection speeds can be addressed fairly easily. Another drawback was the need to use several pieces of hardware. However, the Mobility Agent should be well suited to new generation all-in-one hand-held devices. Such de-

Table 2  
Payment Options (Euros)

<table>
<thead>
<tr>
<th>Payment per Enquiry</th>
<th>Payment by Monthly Subscription</th>
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<tbody>
<tr>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>0.75</td>
<td>10</td>
</tr>
<tr>
<td>0.5</td>
<td>5</td>
</tr>
<tr>
<td>0.2</td>
<td>2</td>
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services will also allow multimedia presentation, such as text, graphics, keypad, voice, touch, or stylus, etc.

The user interface remains a crucial field of research as the screen size and key size of mobile devices can present a barrier to use for many people. Such issues have been discussed recently in Chae and Kim (2004), Gill (2004), and Manes (2003). As Gill (2004) notes, “a large character display is essential for many people with a visual impairment. The visual display should also be high contrast. This is particularly important now that telephones are used to access more services such as timetables.” Indeed, the continuing constraints on screen size, and the requirement for immediate retrieval and legibility of detailed information, presents barriers to usability for even the most visually adept user. Such complex tasks appear to contradict the technical capacity of small-screened mobile devices. The solution may be found in altered information retrieval techniques and menu structures for mobile users (Chae & Kim, 2004).
The findings of the IMAGE evaluation are consistent with existing research into the provision of real-time information and related services. Internet-based information provision is seen as useful for people planning their journey from home and avoiding queues at stations or other information points. In the UK at least, mobile phones, PDAs, and the receiving of SMS real-time information (something IMAGE did not test) are increasingly popular sources of on-trip information (Lyons, 2003).

The potential benefits of an IMAGE-type product to journey making, attending events, and booking and payment are, according to the survey findings, significant. However, people will, in general, only use it when a large range of services that they want to use regularly becomes available.

One further crucial issue is customer confi-
dence. If the customer lacks confidence in a product then it will fail. For the customer to have confidence the right content and services must be available, securely, and with respect for privacy of the end user and the content or service providers. This requires the right content and service providers on board, working in a trusting, harmonious way. Personalized service delivery has implications for data sharing, individual profiling, and “pushed” services, not to mention m-payment facilities, and issues of privacy and security. The IMAGE Mobility Agent demonstrated high levels of customer confidence, but it is recognized that this was achieved in a test bed environment with a relatively small number of services and providers. Though there is the technical scope for unlimited geographical and service provider expansion, any such expansion will bring with it added complexities relating to customer confidence.

Conclusion

The IMAGE Mobility Agent in its current form is at an early stage of development, and though there is generally a favorable attitude towards it, it needs further work to widen the range of services and expand its geographic coverage to make it a viable, marketable proposition.

At present the IMAGE Mobility Agent can be summed up as follows: “A product that is useful for journey planning, attending events and booking and paying for services, but only when a trip is planned to a city with which one is unfamiliar, in which case willingness to pay increases above the minimum, to be paid per enquiry.”

In terms of consumer willingness to pay, the IMAGE findings substantiate existing research (Khattak, Yim, & Prokopy, 2003; Lyons, 2003): willingness to pay increases among those who travel in unfamiliar locations and is dependent on provision of a wide range of accurate tourist content as well as travel information.

The use of focus groups was helpful in revealing the improvements that will allow the IMAGE product to be more competitive and to be transformed into a marketable product. The use of focus groups is recommended as a tool for any future research in this area. The research team also recommends the use of stated preference interviews in order to analyze individuals’ valuations of “soft” attributes such as security, convenience, and ease of use.

In the more global context, the IMAGE Mobility Agent will benefit from new technological development, such as all-in-one hardware and advances in information management and retrieval systems, including user interface and geographic coordinates. There is demand for products like the Mobility Agent, and there is willingness to pay; however, they must offer useful, reliable, useable services, and must engender user confidence and trust.

Biographical Notes

Simon Edwards is a Senior Research Associate in the Transport Operations Research Group (part of the School of Civil Engineering and Geosciences) at the University of Newcastle upon Tyne, UK. His specialist areas include mobile travel information, mobility for disabled people, including assistive technologies, use of smart cards in the transport sector, freight and logistics, and evaluation processes.

Professor Phil Blythe is Head of the Transport Operations Research Group. He has advised the EU and UK government on several areas of technology and policy-related research. Key research at present includes the delivery of services to citizens utilizing advanced fixed and mobile platforms, self-configurable systems using e-service smartcards, and the potential for pervasive computing to assist mobility in transport.

Steve Scott is a senior lecturer in the School of Civil Engineering & Geosciences at the University of Newcastle upon Tyne, UK. His interests include the use of virtual reality to model traffic flows with the aim of conducting experiments on the safety of road improvement schemes, and improving the ways that information is made available to travelers via handheld devices.

Amy Weihong Guo is a Ph.D. student of Transport Operations Research Group at University of Newcastle upon Tyne. Her research interests are in the area of Intelligent Transport Systems, especially the implementation of technologies on traveler information services. Her current Ph.D. research is entitled “Impacts of Pervasive Intelligent Traveler Information Services on Traveller Behaviour.” She has a Master of Science with distinction from the same university.
References


