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OVERCOMING ONLINE BOOKING BARRIERS WITH A SOFTWARE AGENT APPROACH

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ABSTRACT

Through online self-booking travel sites on the Web, consumers are offered great opportunities for convenient and inexpensive travel bookings. Nevertheless, they face certain problems and limitations in this respect: The booking process tends to be time-consuming and complicated, and the retrieved fares are often expensive. This research suggests that the most significant barriers to online bookings can be eliminated or reduced with a software agent approach. The paper presents the structure, behavior and the operating environment of a multi-channel software agent application, FareTracer, which has been designed to assist consumers in making their own travel reservations on the Web. Based on a dynamic modular design, the FareTracer can scan any number of pre-defined and ill-structured data sources on the Web to pick out and retrieve only the essential information in a matter of seconds/minutes.

1. INTRODUCTION

The slow growth of business-to-consumer e-commerce has surprised many analysts whose growth predictions have been proven false, and many companies whose heavy investments in ec-applications have been hasty and unprofitable. A great exception in this regard is the travel industry, to date the largest Internet commerce category (McCartney, 2000). The fact that tourism-related services have emerged as a leading product category to be promoted and distributed to consumer markets through the Internet (Palmer and

McCole, 2000) is hardly surprising considering the high suitability of the tourist product for e-commerce (Byerley and Ewers, 1996; Sheldon, 1997) and the industry's great traditions in the IT-sector (Bloch and Segev, 1996; Standing et al., 1999).

Consumers are likely to derive many advantages, including price reductions, from the commercial opportunities offered by the Internet. There are, however, many hindrances to a mass-market adoption of online shopping solutions even in the highly e-suitable travel industry. Making self-bookings on the Web may prove to be too difficult and time-consuming for most consumers as travel arrangements, especially complex ones, tend to consist of a number of problematic elements that inexperienced travelers may not consider. Consequently, many industry representatives believe that even educated customers are no threat to the future livelihood of the travel agency community (Miller, 1999).

Agent technology has been suggested as a potential way to reduce or eliminate the most obvious impediments to consumer self-bookings in travel (Turban et al., 1999; Anckar and Walden, 2000). Today, there are many practical hindrances to designing an optimal Web agent solution to serve the needs and purposes of prospective travelers. However, although agent applications are unlikely to be able to compete with the convenience and security offered by human agents in travel bookings, they may still offer consumers savings in time and money, and can certainly reduce their uncertainty as to whether the price of the journey is reasonable or not. Moreover, software agent solutions may offer prospective travelers a much greater choice of travel service providers than traditional or Web-based travel agencies can offer. This research highlights the need for agent assistance in Internet bookings, presenting the structure, behavior and the operating environment of a multi-channel software agent application, FareTracer, which has been designed to assist consumers in making their travel arrangements on the Web.

2. AGENT TECHNOLOGY IN TRAVEL: A BRIEF OVERVIEW

The concept of intelligent or software agents has been around in the IS world for some time, indicating that the field of agents is rich and diverse. According to Jennings and Wooldridge (1998), most agent researchers would find themselves in broad agreement with the following key principles in the definition of software agents and agent-based systems: Software agents are computational programs or entities situated in a computing environment and assisting users with computer-based tasks. They act to accomplish specialized tasks on behalf of users and act towards reaching certain user-specified or automatically generated goals with a certain degree of autonomy and flexibility (Maes, 1994; Jennings et al., 1998; Jennings and Wooldridge, 1998). Agent-based systems refer to systems in which the key abstraction used, either in conceptualisation, design, or implementation, is that of an agent.

According to Negroponte (1997), the future of computing will be 100% driven by delegating to, rather than manipulating computers. A fruitful application area for software agents is in e-commerce, where potential buyers can easily be overwhelmed by the flood of information that is available, thus potentially making less than optimal purchasing decisions (Sproule and Archer, 2000). Chun et al. (2000) argue that the heterogeneous presence of information and the exponential growth of the Web is a factor that has impeded the progress and proliferation of e-commerce, and that agent-based e-commerce can solve these problems. Intuitively, the advantages of agent solutions seem especially appropriate in the information-intensive travel industry: as vacation choices are high-involvement decisions, travelers tend to engage in active information gathering (Hruschka and Mazanec, 1990).

Much work has been done on software agents in the recent years, but only a few studies concentrate on agent applications for the travel industry. Also in this area of agent-related research, the dominating approaches have been agent framework proposals or descriptions of agent prototypes. Using the ZEUS collaborative agent-building toolkit, Ndumu et al. (1998) developed an agent-based travel assistant demonstrator providing integrated travel assistance based on combining services from disparate sources. The most work has been done in the area of automated reservation assistants that interactively learn about travelers' preferences in a problem-solving process aimed at suggesting services fitting the users' special needs (see e.g. Linden et al.,

1997). Völksen et al. (1997) describe an agent application for integrating several distributed travel-oriented services such as hotel and flight reservation systems, restaurant information systems, motorway and local traffic information systems, and parking management systems. A somewhat similar approach for electronic travel planning is presented by Camacho et al. (2000), whereas Merlat (1999) investigates the use of mobile agents to perform multiservice negotiations on the behalf of the consumer, using the travel agency application as a test scenario.

3. CONSUMER BENEFITS OF SELF-BOOKINGS: FOUR MYTHS

The consumer benefits of e-commerce have been widely cited in the academic literature and the popular press. Potential advantages for travelers who plan and book their journeys on the Internet include: *greater convenience*; greater amounts of multimedia *destination information* and *real-time information* on price and availability (e.g. last-minute deals); increased opportunities for *comparison shopping* and *price comparison*; and *personalization benefits* (where personalized relationships between suppliers and customers can be achieved through customer profiling). Additional suggested consumer benefits, which are particularly relevant for the e-travel industry and this study, are: (i) *time savings* resulting from the rapidity of the entire purchasing process; (ii) *price reductions* resulting from increased competition as more suppliers are able to compete in an electronically open marketplace (Turban et al., 1999), as a result of reduced selling prices due to a reduction in operational costs (Brynjolfsson and Smith, 2000), and manufacturers internalizing activities traditionally performed by intermediaries (Benjamin & Wigand, 1995); (iii) *ease of transaction*, e.g. ease of bookings as the travel reservation-making process can be automated by EC technology (Chircu and Kauffman, 2000); and (iv) a *wider selection* of products/vendors (e.g. travel service providers). These four benefits certainly deserve some special attention due to their contradictory, and partly interrelated nature. Although these consumer benefits certainly may be derived even in the travel industry, we nevertheless present the suggested benefits as four myths in order to highlight some important issues.

3.1. Myth 1: Time Savings

Although some travel industry representatives and authors have suggested that direct bookings are creating tremendous savings in time as travelers no longer need to spend much time on the phone talking with travel agents (Valle, 1996; Resnick 1997; Miller 1999), the results of studies done by Anckar and Walden (2000, 2001) indicate that self-bookings in travel tend to be highly time-consuming - irrespective of the complexity of the journey. There are multiple reasons for this: First, *finding service providers* (i.e. locating Web sites offering the services needed) might take time and perseverance, especially as it is often not possible to book travel directly online or to buy the separate parts of a trip through the same supplier (Bloch et al., 1996). Second, many travel sites do not even allow consumers to check prices and availability unless they have completed the time-consuming *registration procedures*, which often include profiling information. Likewise, the availability check (and the booking process) usually involves entering (and re-entering) many search parameters (dates, destinations, etc.), which can be a lengthy procedure. Fourth, although the potential for *making price comparisons* often has been mentioned as a great consumer benefit of e-commerce, it is no doubt a time-consuming task. As is pointed out by Reedy et al. (2000) and Turban et al. (1999), comparing prices from site to site could certainly ensure the lowest expenditure for the consumer, but the cost in time and effort might not be worthwhile. Still, most travelers, exhibiting normal consumer behavior, are likely to tirelessly make price comparisons prior to making an Internet booking.

3.2. Myth 2: Price Reductions

Although the suggested consumer benefit of lower prices on electronic markets may seem intuitively realistic, it is becoming increasingly evident that getting a good travel deal on the Internet is no easy task. Research by Anckar and Walden (2000, 2001) indicated great variations in price of offered online fares, and showed that even experienced Internet users are unlikely to be able to compete on price with physical travel

agents, who offer experience, knowledge and intuition that cannot be found in an online service (Wilson 1997). The traditional, intermediary approach may still be the cheaper than booking online since (i) most consumers do not know where to find low-fare Internet service providers, and also lack the basic knowledge about and the pricing principles of the travel industry and the strategies travel agents use to get a low fare (Wilson, 1997; Keizer, 2000); (ii) special fares with restrictions are not always advertised on the online travel sites (Harris, 1997); (iii) travel agencies have ways around airline reservation systems that are technically "sold out" (Keizer, 2000); (iv) consumer do not have access to travel agent negotiated rates (Sheldon, 1997); and (v) multilegged journeys typically carry outrageously high prices on the Web, since online fare finders tend to assemble these trips by piecing together one-way tickets, which are always more expensive than round-trip fares (Keizer, 2000). At the very least, the effort to get a fair deal is likely to be time-consuming (cf. section 3.1.). It should, however, be pointed out that consumers perceive costs of search activities as resource expenditures - the time and money required to undertake search - as well as the cognitive effort required to process the information required (Fodness and Murray, 1999), meaning that the indirect search costs should be taken into consideration when assessing the total costs of a journey.

3.3. Myth 3: Ease of bookings

Although there certainly is a potential for automating the travel reservation-making process with EC technology, it has turned out to be a very complex software problem to give consumers online tools to shop for travel, particularly in the insanely volatile fare marketplace (Maddox, 1997). Many industry representatives feel that the complexity of international flights and GDSs (global distribution systems, also known as computerized reservation systems, CRSs), with many confusing explanations of terms, will render consumer online reservation systems impractical for all but the most sophisticated users (Hart, 1995). According to Chircu and Kauffman (2000), many companies using online reservation systems have documented great knowledge barriers in the case of complicated travel arrangements, as making reservations in international markets is very complicated. Hence, Turban et al. (1999) suggest that complex trips, which require specialized knowledge and arrangements, must be made by travel agents. It should be noted, though, that some studies indicate that even experienced Internet users tend to fail to make even low complexity travel arrangements on the Web (Anckar and Walden, 2001).

A journey consists of many *problematic elements* that an inexperienced traveler may not consider. As a result of the feeling of uncertainty associated with self-bookings, many people want to interface with human travel agents (Cooper and Brown, 1997), patronizing them to lower the risks involved in travel and to take advantage of the convenience that an agency has traditionally provided (Valle, 1996). Although the online booking approach has been seen as a highly convenient way to make travel reservations, it should nevertheless be stressed that contacting a human travel agent by phone or e-mail in most cases remains the most convenient way to make one's travel reservations.

3.4. Myth 4: A Wider Selection of Service Providers

With the boundaries of e-commerce not being defined by geography or national borders, Internet users could benefit from a large, global choice of travel service providers. Three facts, however, inhibit consumers from deriving these advantages in full: First, small and medium-sized tourism enterprises (SMTEs) remain under-represented in most large, established GDSs (Buhalis, 1996; Werthner and Klein, 1999). The vast majority of tourism enterprises around the globe can, in fact, be classified as SMTEs (Buhalis, 1996, 1999), which means that a great many tourist service providers' services are unavailable to e-bookers, especially since most SMTEs cannot afford a Web presence (at least not real-time reservation services) of their own. As a result of this limitation of the GDSs, not only the SMTEs that are outside this infrastructure are at a disadvantage, but also the prospective tourists, whose choice of service providers is heavily restricted. Second, online booking travel sites on the Internet offer, as a rule, a Web interface to the one GDS to which they subscribe. Consequently, their selection of service providers is limited to the ones that are represented in

that particular GDS, meaning that potential travelers will have to locate and browse numerous Web sites, all connected to competing GDSs, in order to obtain the largest possible choice of service providers, fares and itineraries. Third, although the Web does offer an enormous selection of service providers that are not represented in the GDSs, but nevertheless can be reached through the Web sites they operate, this approach may, in practice, be too time-consuming for most e-bookers. Nevertheless, providers using the Web as their primary tool to reach the global tourist market are likely to represent the most attractive target for bargain seekers, as they have eliminated the intermediaries in their distribution channel.

4. TRAVEL INDUSTRY ACTORS ON THE WEB

As an arena for travel service providers, and as the operating environment of the FareTracer, the Web is full of nuances, offering a wide range of suppliers and intermediaries with business models that are not always obvious to the customer.

4.1. Web-Based Travel Agents

Within the academic literature, the hypothesized disintermediation effect in the travel industry, i.e. the bypassing of intermediaries as a result of e-commerce, has received much attention (Lewis and Talalayevsky, 1997; Chircu and Kauffman, 1999; Standing et al., 1999; Anckar and Walden, 2000, 2001). Up to this point, however, Internet self-bookings have rarely been characterized by a complete disintermediation, as individual travelers do not have direct access to the GDSs, but have to use e-intermediaries, i.e. third-party online agencies as gateways to these immense systems, through which reservations can be made for flights, hotels, cars, etc. The travel agencies operating on the Web are either virtual extensions of physical travel agents or virtual start-ups. The former generally accept inquiries and submit offers by e-mail, whereas the latter as a rule offer automated online booking services.

4.2. WWW-Services of Individual Travel Service Providers

Airlines and hotel chains, many of which offer online booking services on their Web sites, would like to sell tickets and rooms directly to the customers via their own Web sites to eliminate commissions and maintain control over customer relationships (Hibbard, 1998). From the customer's point of view, however, this is a time-consuming task in comparison to the one-stop-shop services offered by Web-based travel agencies. Moreover, the benefits are questionable as airline Web sites have been criticized for not posting special deals that are not accessible through GDS-connected Web-based travel agencies (Korhonen, 2000). Nevertheless, when looking for inclusive (charter) tours, the Web sites of individual tour operators tend to be the only channel for online bookings.

4.3. Web Reservation System Alliances

In response to the dramatic growth of online travel sites such as Travelocity and Expedia, airlines have recently banded together to create new reservations sites on the Web. Examples include the Orbitz project by a large number of American air carriers, and a corresponding venture between 11 dominant European carriers - including many fierce rivals (Middleton, 2000). The aim of these high-stake efforts is to give air carriers a more direct line to the consumers, disintermediating e-intermediaries, of which some have grown to the point where their market position is getting dangerously strong (McCartney, 2000). Within the hotel industry, corresponding online reservation consortia have been accessible by individual customers already for quite some time. For consumers, online travel consortia may offer opportunities for complete disintermediation, with no commissions being paid to middlemen. Moreover, the airlines backing the sites have announced that special deals that are not available through any travel agencies will be offered through the systems. GDS-external Web reservation systems may especially benefit the numerous small hospitality

organizations, which otherwise lack resources for a Web presence, as well as prospective tourists, whose choice of service providers becomes significantly increased.

4.4. The Agent Environment

Travelers tend to show little or no brand loyalty (Warren and Ostergren, 1990; Robinson and Kearney, 1994; Baloglu et al. 1998), but instead require a travel product at the lowest price and of the highest quality - consistent with their own value judgments and preferences (Buck, 1988). According to Malley (1999), the Web has unleashed a torrent of customers who are increasingly fleeting and irreverent towards brands: If there is a better deal on somebody else's Web site, they go for it. Bearing this fact in mind, it can be assumed - as a general rule - that customers have no distinct preferences for travel service providers or middlemen. If we rule out frequent flyer programmes (FFPs) and other regular customer discounts, the primary priority of travelers is likely to be (i) the price of the journey, and (ii) the convenience of the itinerary. The traveler will choose the journey that best satisfies his travel needs and preferences, irrespective of whether the transaction is characterized by a complete disintermediation or not. Hence, he certainly has an interest in searching through all the options available, meaning that travel software agents should operate within a broad environment, scanning a large number of sources within each of the actor categories presented above.

The *FareTracer* is an autonomous multichannel software application, which has been planned and implemented as a cooperative effort between a university and a software company. The agent is a pure Java2 application that will run on any platform with a Java Virtual Machine (JVM) that conforms to the Java2 specification. The application can use any SQL database that offers a JDBC driver. The user interface is implemented with Java Servlet technology and runs on any Web server with a Servlet-runner that conforms to the Servlet 2.2 standard. The application uses threads to handle the user requests and utilizes multiprocessor systems.

5. AGENT PERFORMANCE

5.1. Search Parameters

The key to finding a journey that satisfies the traveler's requests is in the agent search parameters that are specified by the user. The tourist product is a composite product, meaning that a specification of a large number of parameters may be necessary even in low-complexity bookings in order to coordinate the components of the journey and to obtain a journey that meets the user's personal travel preferences. The agent search parameters can be classified according to their (i) *nature;* journey-dependent (non-static) or journey-independent (static), and (ii) *importance* (primary or secondary). Primary importance parameters are customer travel demands that by necessity must be satisfied, whereas secondary importance parameters do not necessarily have to be satisfied in the journey/itinerary, although this would be desirable from the user's point of view. With this categorization, 4 different parameter levels can be identified (Table 1), which essentially form the basis of the search logic and the ranking of search results of the FareTracer It should, however, be noted that this parameter classification is in no way depicted in the user interface.

The level-1 input, which is required by the user, includes the most essential information needed by the agent, e.g. the departure and return dates, point of departure, destination(s), the number and age of travelers, etc. The level-2 input is likewise of primary importance, although required only in queries placed through a mobile device. However, the specifications are intrinsically static, and hence included in the user profile (explained in more detail in section 5.2.), which is designed to make the parameter specification process faster. The level-3 input (secondary importance) encompasses optional parameters that override the static basic preferences if the user wishes to deviate from his saved profile for a certain journey. The level-4 specifications are included in the customer profile, where the user has ranked these parameters as low in

importance. Hence, FareTracer user can define - according to his individual preferences - the importance of a certain parameter. The search criteria set as high in importance in the user profile are interpreted as level-2 input by the agent.

PARAMETER NATURE	PARAMETER IMPORTANCE: Primary	PARAMETER IMPORTANCE: Secondary
Non-static	**LEVEL 1** **required input**	**LEVEL 3** **optional input** - overrides user profile data -
Static	**LEVEL 2** **optional input** **(required for SMS-queries)** **-** user profile data -	**LEVEL 4** **optional input** - user profile data -

Table 1. *The Four Levels of Agent Search Parameters*

5.2. Agent Structure and Behavior

The FareTracer consists of five building blocks (Figure 1): (i) the user interface; (ii) the knowledge base; (iii) the user profiles; (iv) the data sources; and (v) the agent itself. The building blocks of the *FareTracer* agent are the same as they would be for any kind of information collecting agent application. The responsibilities of the different building blocks are described below.

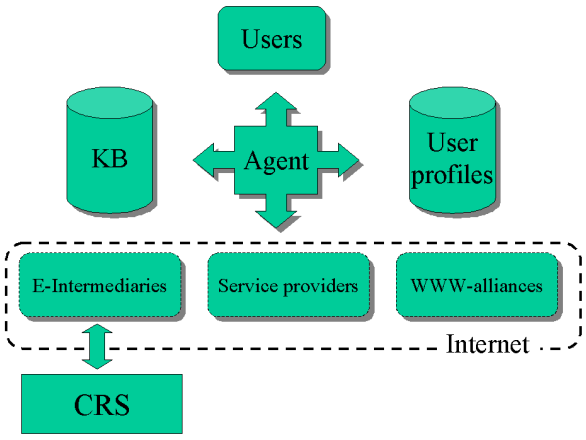

Figure 1. *The FareTracer building blocks and the agent environment.*

The *user interface* (UI) controller monitors the UI and analyses all the input and output between the agent and the user. The UI is the only connection between the user and the agent. When the user wants to consult the *FareTracer* for travel assistance, he needs to activate the interface and enter the required search parameters in an input form. The information in the different fields of the form is then used to populate a predefined XML document, which is actually where the user profile is defined. The same XML document is used to store the information retrieved by the agent. The FareTracer is a hybrid application that can process queries placed through Web interfaces as well as through mobile devices (WAP, SMS). A prerequisite for placing SMS-queries is, however, that the user has completed his user profile (level-2 input) prior to the search in order to limit the number of alternatives to be retrieved.

The FareTracer stores its knowledge of the environment in the *knowledge base* (KB), which contains information about airlines, hotels and airports, etc. (Figure 2). The information in the KB is entered by the agent (automatic retrieval) or manually. The information in the KB is used to compare the information in the user profile with the information collected from the different data sources. The agent uses the information in the KB to select journey components that best match the specified parameters and the user profile.

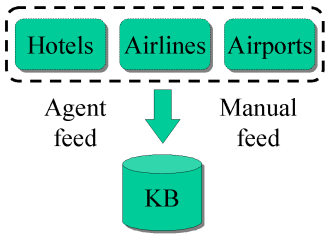

Figure 2: *The KB information content.*

The *user profiles* consist of information stored about the user's standard preferences (not journey-specific information). A login process allows the agent to identify the user, after which it fetches his personalized user profile. The user enters these preferences when he registers with the FareTracer application. In accordance with the search parameter classification (Table 1), the agent can handle profiles that are incomplete by skipping the blanks and using only the available preferences. The user can enhance his profile and add information at any time. The user profile is, in fact, defined by the same XML document that is used to define searches. Since the format of the profile is identical to the input form, a user can easily update his profile just by saving the information contained in the input form when conducting a query. The information stored in the user's profile is also used to populate the input form when the user has logged in.

The last building block of the FareTracer consists of the *data sources* that the agent scans for information. This is the most challenging part. The look-and-feel of the data sources can differ quite a bit, and the services that they provide may range from the company logo with static information to advanced interactive travel planners. Some of the prices offered may be real-time prices with discounts, whereas other prices may be valid only under certain conditions, or the availability may be unknown. The agent needs to be very intelligent to extract the right information from all the different types of data sources. The best way to solve this problem is to divide and conquer. The *FareTracer* has different *modules* for the different data sources from which it collects information. This allows the agent to, through the modules, know where the important information is located in the data source, and also how it can be collected.

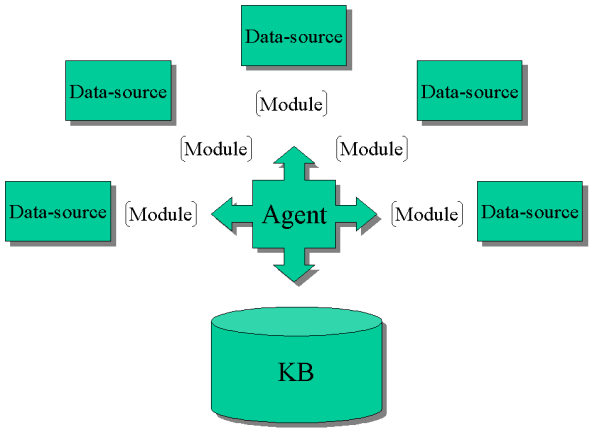

Figure 3: *The FareTracer Information Retrieval Process*

The advantage of using a one-by-one mapping of data sources and modules is significant compared to the generic approach with one module for all data sources. By using specific modules for every site it is possible to collect exactly the needed information, and nothing else. The modules can be instructed to collect prices and other important information that is needed in the KB. The agent can insert the information into the KB, since it understands the content of the information that it has collected. A generic module that collects information from different data sources can only, at best, guess that the data that it collected is a price for a one-way flight. There is one major drawback with using source-specific modules instead of a generic one: The modules must be updated whenever the data source is restructured. As soon as one important part changes there is a high possibility that the agent fails to retrieve information from the data source. This is, however, the price that has to be paid since this is the only way, in practice, to make the agent fully understand the collected information, and hence pick out only the essential parts.

The retrieved information is temporarily stored until the agent has scanned all the data sources. When the retrieved information has passed the first filter (the user profile), it is sorted according to the price of the journey (the default primary priority) or the profile fit (the preferences of the user). The information extracted by the modules is stored in the same predefined XML format that is used in the input form and the user profile. As a result, the information collected by the agent and the parameters specified by the user have an identical format, meaning that it is easy for the agent to compare the retrieved information with the user's profile and rank the alternatives based on the weights assigned to the different parameters. The 'best' alternatives are listed on top, whereas the poorest alternatives are dropped. The user can specify the amount of hits the agent should show. Due to differences in the search engines and the range of information provided on different Web sites, some modules are unable to conduct searches based on all the parameters specified in the user profile. This fact is, however, taken into account when comparing the alternatives as to their profile fit, and presenting the search results to the user, which is done in different ways depending on the medium/technology used. If the user wants to proceed with a booking, the FareTracer, which can be characterized as a semi-booking agent, repeats the search in the module that retrieved the chosen itinerary, after which the user completes the booking manually with the agent's assistance.

6. ADVANTAGES OF AGENT-BASED TRAVEL ASSISTANCE

Although many practical obstacles, e.g. the strong position of the GDSs on the Web, make the implementation of an ideal personal travel assistant impossible, the FareTracer agent application offers prospective travelers a number of significant benefits by turning the proposed four mythical consumer advantages of e-bookings into reality:

First, any human user is unable to compete with the *rapidity* of the FareTracer, which scans all the data sources simultaneously, retrieving the best fares/itineraries to any destination in a matter of seconds/minutes. Hence, using the FareTracer, the time-consuming price comparison process is totally eliminated from the e-looking/booking process. This is no doubt a significant benefit especially as the agent is not restricted to certain or a few Web sites, but can work through an unlimited number of data sources. Furthermore, the agent works autonomously and can repeat the search at any given intervals to get the current situation (prices and availability), and alert the user of updates by e-mail or SMS. This is an important feature for time-critical or limited availability travel arrangements such as last-minute deals.

Second, the consumer is likely to can obtain *better prices* with the FareTracer. It is a fact that for any particular journey, there are a multitude of ticket prices. Different Web sites house different search software and access different GDSs (Pachetti, 2000), and hence they do not always come up with the same fare even for the same flight. Moreover, the FareTracer scans Web sites of individual service providers as well as Web reservation system alliances in order to find GDS-external deals matching the specified criteria. As a result, not only the price comparison, but also the *selection* of service providers and itineraries is much broader than that of any other travel agent, physical or Web-based. Moreover, one should bear in mind that the time to be invested on each booking is highly limited for human travel agents, which means that the price offered or the

terms provided are not always the most competitive, especially as most travel agencies do not use the Web to search for service providers for their client due to the time-consuming nature of this task.

Studies show that travelers seem to prefer to make their purchases with human travel agents they know and trust (Miller, 1999). Although travel agencies are likely to represent the most convenient way for consumers to make their bookings even in the future, personal travel assistants such as the FareTracer represent the first technological tools that can compete against human agents in terms of booking convenience. In the e-marketplace, the ease of booking is highly dependent on the functionality of the available reservation systems. The FareTracer does, however, show no knowledge barriers as to the usability of different reservation systems. With add-on features to the FareTracer KB, it could also become less risky to make bookings. Although Web reservation systems are unlikely to retrieve unrealistic itineraries, the agent could, for instance, be instructed to check the convenience of the retrieved itineraries by analyzing the length of each intermediary landing based on criteria specified manually for each major airport.

7. CONCLUSIONS

Despite promises of lower prices and a wider selection of travel service providers, a mass-market adoption of self-booking services on the Internet seems unlikely, in the short term, due to a number of practical obstacles. Major impediments are, for instance, the time-consuming nature and the complexity of the task, the great variations in price of offered online fares, and the difficulties to locate cheap and trustworthy online service providers without getting lost in cyberspace. Most of the online booking barriers, can, however be eliminated using software agent technology.

The FareTracer multi-channel software agent application has been designed to serve as a personal assistant for self-bookers. Based on a dynamic modular design, the FareTracer can scan any number of pre-defined and ill-structured data sources on the Web to pick out and retrieve only the essential information in a matter of seconds/minutes.

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