ISSUES OF DYNAMIC TRAVEL PACKAGING USING WEB PROCESS TECHNOLOGY

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ABSTRACT

New trends in the travel industry require the ability to develop e-commerce applications to dynamically compose travel packages from the aggregation and orchestration of distributed services. With the growth of demand for customized travel itineraries, agencies seek technology that provides their clients the flexibility to build unique packages from a selection of choices. Dynamic packages can be created and booked effortlessly with private and published air, car hire, hotels, attractions and insurance rates. This can be accomplished in an efficient, interoperable, and scalable manner through the development of a commonly accepted communication technology using Web services, Web processes and semantics. Semantics and ontologies provide an agreed understanding of data between and among travelers and travel-related businesses. Ontologies encourage the development of interoperable systems that can help create and support new collections of travel services to better meet the demands and expectations of travelers and the travel industry. Our objective in this paper is to discuss the major issues related to the automatic or semi-automatic construction of Web processes managing dynamic travel packaging applications. Important aspects include Web services integration, the use of semantics and ontologies, current standards, and the quality of service of dynamic travel packaging Web processes.

KEYWORDS

Dynamic travel packaging, Web services, Web processes, semantics, workflows, and process quality of service.

1. INTRODUCTION

E-commerce and e-business have been growing at a very fast pace. There is remarkable range for growth in trade through electronic interactions, simply because it can eliminate geographical distances in bringing buyers and sellers together. Therefore, organizations are increasingly faced with the challenge of managing e-business systems, e-commerce applications, Web services, Web processes, workflows, and semantic. The travel industry is one of main sectors that can find enormous benefits from the adoption of these latest Internet technologies.

The travel industry, due to the long-distance interactions it requires, was one of the earliest electronic commerce adopters (Sabre (SABRE 2004) system started operating in 1959). This industry is one of the most important kind of commerce through the Web, representing almost 40% of all global electronic commerce (Filho and Ramos 2003). With the Internet dissemination and the e-commerce growth there is a shift from the traditional off-line distribution process based on operators' catalogs to an on-line promotion and reservation process. A shift that is marked by isolated initiatives guided by the B2C (business-to-customer) promise of increased profit margins and reduced commission values.

This leads us to the present situation where we can find a diverse and numerous groups of on-line reservation systems, most of them focused in one or in a few types of products without an integrated view of vacation planning, that is what the consumer looks for. For this reason, the most recent trend for the travel industry is based on dynamic packaging. Dynamic packaging improves revenues and margins per transaction while offering travelers new opportunities to save by booking flights, hotels or rental cars together in a single transaction.

Our research objective is to help the travel industry to take full advantage of the latest Internet technologies, such as Web services, Web processes, and semantics to develop dynamic packaging solutions.

Semantics allow rich descriptions of Web services and Web processes that can be used by computers for automatic or semi-automatic processing in various tourism related applications. The deployment of ontologies and semantics help articulate a well-defined set of common data elements or vocabulary that can support communication across multiple channels, expedite the flow of information, and meet travel industry and customer needs.

This paper is structured in the following way. Section 2 is extent and represents the major section of this paper. We discuss the current travel industrial trends, the issues and solutions related to the construction of dynamic travel packaging applications. Section 3 presents the current work on this field. Finally, section 4 presents our conclusions.

2. ISSUES OF DYNAMIC TRAVEL PACKAGING

Our research is dedicated to help the travel industry to take full advantage of the near universal access to the Internet. In this section we discuss the latest travel industry trends to motivate the reader for the importance of dynamic travel packages. We explain the challenges and benefits of using Web processes to create and manage dynamic travel packaging applications (workflows). Since the distributed nature of the Web creates interoperability problems between Web services when creating Web processes, we discuss the importance of using semantics and ontologies to develop solutions for the travel industry. Finally, we give a brief introduction to the importance of quality of service metrics implementing Web processes dynamic travel packaging.

2.1 Travel Industry Trends

Current trends include innovative technology solutions for various segment of the travel industry, focusing on dynamic packaging, travel agent tools, travel distribution, inventory management, back-office management, and Web design.

A major trend is the dissemination of dynamic travel packaging technology. The objective of dynamic packaging is to pack all the components chosen by a traveler to create one reservation. Regardless of where the inventory originates, the package that is created is handled seamlessly as one transaction, and requires only one payment from the consumer. These systems allow comparison shopping of packages that can include plane tickets, hotel rooms, rental cars, insurance, leisure tickets and other services.

Expedia has pioneered this concept allowing for the packaging of air, hotel, and car on the fly, either during the research phase or at point-of-sale. Travelocity.com, Hotels.com, and Orbitz.com are aggressively pursuing dynamic packaging as there are tremendous opportunities in this approach.

2.2 Dynamic Travel Packaging Web processes

Interoperability is a key issue in e-Commerce because more and more companies are creating B2C (Business-to-Customer) and B2B (Business-to-Business) links to better manage their value chain. In order for these B2C and B2B links to be successful, heterogeneous systems from multiple companies need to interoperate seamlessly. Automating inter-organizational processes across supply chains presents significant challenges (Stohr and Zhao 2001).

Web services and Web processes promise to ease several of nowadays infrastructure challenges, such as data, application, and process integration. With the emergence of Web services, workflow management system become essential to support, manage, and enact Web processes, both between enterprises and within the enterprise (Sheth, Aalst et al. 1999). Workflow Management Systems (WfMSs) are promoted based on their application integration capabilities by executing Web services and orchestrating Web processes.

Several researchers have identified workflows as the computing model that enables a standard method of building Web Services applications and processes to connect and exchange information over the Web (Chen, Dayal et al. 2000; German Shegalov, Michael Gillmann et al. 2001; Fensel and Bussler 2002).

Once the applications or Web services are identified, a Web process flow model depicting the travel business process is constructed. Based on this model, the WfMS automatically generates the appropriate code to coordinate the flow of data and messaging between the Web applications using standards defined in the

foundational level of the Web Service architecture. At runtime, the WfMS reads the flow model specification and transparently schedules Web services for execution.

2.3 Use of Semantics in Dynamic Travel Packaging

There is a growing consensus that Web services alone will not be sufficient to developed valuable and sophisticated Web processes due the degree of heterogeneity, autonomy, and distribution of the Web. Several researchers agree that it is essential for Web services to incorporate semantics in order to be machine understandable to allow the full deployment of efficient solutions supporting all the phases of the lifecycle of Web processes.

The idea and vision of the "Semantic Web" (Berners-Lee, Hendler et al. 2001) catches on and researchers as well as companies have already realized the benefits of this great vision. Ontologies (Uschold and Gruninger 1996) are considered the basic building block of the semantic Web as they allow machine supported data interpretation reducing human involvement in data and process integration. For the tourism industry, the development of ontologies is fundamental to allow machine supported travel related data interpretation and integration.

Semantic Web services will allow the automatic discovery, composition, integration, orchestration, and execution of inter-organization business logic, making the Internet become a global common platform where organizations and individuals communicate among each other to carry out various commercial activities and to provide value-added services. In the context of tourism, there is a great interest of such powerful capabilities. Major airlines, hoteliers, car rental companies, leisure suppliers, travel agencies and others are interested in creating and implementing industry-wide, open e-business specifications, tools and Web processes involving Web services.

2.4 Ontology for the Travel Industry

Currently, the travel industry has concentrated their efforts on developing open specifications messages, based on eXtensible Markup Language (XML), to ensure that messages can flow between industry segments as easily as within. For example, the OpenTravel Alliance (OTA 2004) is an organization pioneering the development and use of specifications that support e-business among all segments of the travel industry. It has produced more than 140 XML-based specifications for the travel industry.

The current development of open specifications messages based on XML, such as OTA schema, to ensure the interoperability between trading partners and working groups is not sufficiently expressive to guaranty an automatic exchange and processing of information. The development of a suitable ontology for the tourism industry will serve as a common language for travel-related terminology and a mechanism for promoting the seamless exchange of information across all travel industry segments.

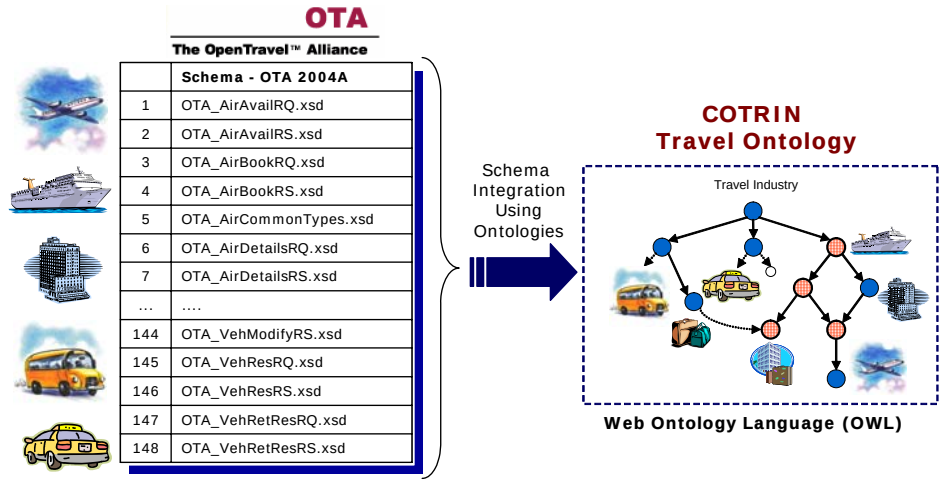

Figure 1. COTRIN Ontology for the Travel Industry

Our research includes the development of a comprehensive and precise reference ontology named COTRIN (Comprehensive Ontology for the Travel Industry), from XML-based OTA specifications, using the Web Ontology Language (OWL 2004) designed by the World Wide Web Consortium (W3C). Our investigation and objective is illustrated in Figure 1.

This ontology can be use it to bring together autonomous and heterogeneous Web services, Web processes, applications, data, and components residing in distributed environments. Semantic Web processes, managing dynamic package determine which Web services are used, what combinations of Web services are allowed or required and specific rules determine how the final retail price is computed (Cardoso, Miller et al. 2004).

2.5 Dynamic Travel Packaging and Quality of Service

In semantic Web processes for dynamic travel packages, suppliers and customers define a binding agreement between the two parties, specifying Quality of Service (QoS) items such as services to be delivered, deadlines, and cost of services (Cardoso and Sheth 2002). The management of QoS metrics of semantic Web processes directly impacts the success of organizations participating in e-commerce. Therefore, when services or products are created or managed using Web processes, the underlying WfMS must accept the specifications and be able to estimate, monitor, and control the QoS rendered to customers. Appropriate control of quality leads to the creation of quality products and services; these, in turn, fulfill customer expectations and achieve customer satisfaction.

We already have developed a comprehensive QoS model that allows the description of Web processes components from a QoS perspective (Cardoso, Miller et al. 2004); it includes three dimensions: time, cost, and reliability. The model is predictive; based on the QoS of Web process components (Web services); the QoS of Web processes can be automatically computed. We have also presented a mathematical model that formally describes the formulae to compute QoS metrics among Web services. Based on these formulae, we have developed the SWR algorithm (Cardoso 2002) to automatically compute the overall QoS of Web processes.

2.6 Impact of our Research

Results from our research will lead to the spearhead and foster the cross-industry consensus needed to establish and maintain the most effective and widely used specifications designed to electronically exchange business data and information among all sectors of the travel industry using ontologies.

Our research has a direct impact on the Portuguese tourism industry, as well as the worldwide tourism industry. Portugal is well known for its tourism. In fact, in 2002 alone, this market has generated revenue of more than $7200 millions (INE 2004).

The deployment of ontologies, semantic Web services, and semantic Web processes for the tourism industry will enable the construction of sophisticated infrastructures to support e-commerce and e-business activities. These ontologies encourage the development of interoperable systems that can help create and support new collections of travel Web services to better meet the demands and expectations of travelers through dynamic packaging. The main sectors of the industry affected include airlines, car rental agencies, hotel corporations, leisure suppliers, tour operators, railways, ferry operators, cruise operators and any other area of travel and tourism.

3. RELATED WORK

Economics were the first to analyze the concept of packaging/bundling (Stigler 1963; Adams and Yellen 1976). It has long recognized that packaging enables savings transaction costs. With low product information access cost, buyers can take advantage of the benefits of travel packaging by performing dynamic composition of Web processes made of services Web services from multiple companies offering heterogeneous products and services (Chang, Li et al. 2003). Chircu et al. (2001) propose an analysis framework to be used in the context of Internet-based corporate travel reservation systems to suggest a

number of recommendations for managers. The framework allows significant cost savings have created interest among travel managers in Internet-based booking systems

Other researchers have also identified the need for the development of semantic Web processes for e-commerce applications (SWSWPC 2004). A good example is the OWL-S specification (OWL 2004; OWL-S 2004), which semantically describes business processes. The use of semantic information facilitates process interoperability between trading partners involved in e-commerce activities.

While a significant amount of QoS research has been done in the areas of networking, real-time applications and middleware, the work found in the literature on quality of service for Web processes is limited. The Crossflow project (Klingemann, Wäsch et al. 1999; Damen, Derks et al. 2000; Grefen, Aberer et al. 2000) has made a major contribution. In their approach, the information about past process executions is collected in a log and used to subsequently calculate the time and the cost associated with process executions. While the research on QoS for WfMS is limited, the research on time management, which is under the umbrella of workflow QoS, has been more active and productive. A significant amount of work can be found in (Pozewaunig, Eder et al. 1997; Reichert and Dadam 1998; Eder, Panagos et al. 1999; Marjanovic and Orlowska 1999; Bauer and Dadam 2000; Gillmann, Weissenfels et al. 2000; Gillmann, Weikum et al. 2002).

4. CONCLUSION

The Web has permanently changed the manner vacation packages can be created. Consumers can now acquire packages from a diversity of Web sites including online agencies and airlines. With the spread of Web travel, a new technology has surfaced for the leisure travel industry: dynamic travel packaging.

This new trend in the travel industry requires the ability to dynamically compose travel packages from the aggregation and orchestration of distributed Web services. With the growth of demand for customized travel itineraries, agencies seek technology that provides their clients the flexibility to build unique packages from a selection of choices. Dynamic packages can be created and booked effortlessly with private and published air, car hire, hotels, attractions and insurance rates.

Current approaches using XML-based specification messages (such as OTA specifications) are not sufficient to enable the creation of dynamic travel packages. One solution is the use of ontologies to overcome semantic problems that arise from the autonomy, heterogeneity, and distribution of Web services. Our research targets the development of a comprehensive and functional ontology relating the terms commonly used by the tourism industry when exchanging data and information to deploy and manage Web processes to dynamically compose travel packages. This cannot be successful without the implementation of methods and algorithms to compute the QoS of the semantic Web processes developed.

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