

A FRAMEWORK FOR ASSESSING STRATEGIES AND TECHNOLOGIES FOR DYNAMIC PACKAGING APPLICATIONS IN E-TOURISM

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Dynamic packaging has been introduced as an innovative technology allowing for the automated online configuration and assembling of packaged travel products for individual customers. While dynamic packaging has been widely accepted by customers in UK and US markets, the possible strategic impacts enabled by dynamic packaging technologies are still uncertain. This article provides a study of the strategic opportunities enabled by dynamic packaging, highlighting the key success factors. Current dynamic packaging applications of the three major online travel agencies are evaluated on the basis of the developed analysis framework. The results show that an appropriate level of integration of tourism information systems is a key factor for further realizing the strategic opportunities of dynamic packaging. We then discuss Web services and semantics as a possible solution for overcoming the interoperability problems that (current) dynamic packaging applications face.

Key words: Dynamic packaging; Tourism information systems; Integration and interoperability

Introduction

In 2004, the Travel Industry Association of America (TIA, 2005) estimated that 30% of the US adult population used the Internet to get travel and destination information. Of that group, 70% actually booked at least one travel service or product online. Despite the increasing Internet usage for travel information and online bookings, the high expectations of the online travel markets could not be fulfilled. Early hopes on the efficiency of electronic markets focused on the increased transparency and lower information search

costs leading to more efficient price levels and price dispersion (Werthner & Klein, 1999). Various studies have shown that booking travel products over the Internet is relatively time consuming and the achieved prices and package configurations are not satisfying compared to using a travel agency (Anckar & Walden, 2000; Öörni, 2003). Different authors report that their study groups had difficulties due to the limited availability of price and product information—because a reservation or phone call was required for detailed information and because of their limited knowledge about pricing and configuration principles (Anckar

& Walden, 2000; Öörni, 2003). Another factor is the huge number of websites that has been established providing access to all kinds of tourism products leading to a more and more intransparent e-tourism market. To allow for better comparability of prices and conditions as well as reduced searching costs, some “reintermediation” functionality or service is necessary.

Travel agents are faced with changes in the tourism industry that have led to reduced commission revenues. For example, in 1997, the major US airlines reduced the commission rate payable to traditional travel agencies and online travel agencies from 10% to 8%, and from 8% to 5%, respectively. In addition, since 1998, many airlines have implemented a zero commission (Joystar Inc., 2005). Additionally, vacation providers are expected to follow the airlines and eventually apply zero commissions (Forrester Research, 2005, <http://www.forrester.com/>). As a result, travel agents have to look for new ways to increase their profit margins. One way is to acquire tools to offer their own services to dynamically package their clients’ holiday requirements. This added value allows travel agents to earn their margins through a combination of reduced commission and booking fees.

According to PhoCusWright (<http://www.phocuswright.com>) one third of online travel buyers purchased a vacation package last year. This stands in contrast to the number of online travel buyers who purchased prepackaged tours, which declined in 2004 to 13% from 19% in 2003. Clearly, consumers prefer to create their own packages rather than purchase prepackaged offers.

With the growth of demand for customized tourism itineraries, agencies seek technology that provides their personnel and clients the flexibility to put together unique dynamic packages from a range of alternatives, without having to be aware of the intricacy of contract rules and pricing issues. The concept of dynamic packaging can be characterized as the automated online configuration and assembling of individual travel products. The travel products are selected by the traveler to produce one reservation. In spite of where the inventory originates, the package that is created is treated as one operation, and entails only one payment from the customer. Dynamic packaging applications have the following characteristics:

- They are fully automated through an online application.
- They take into account up-to-date (up-to-the-minute) travel product information.
- They produce a single price for an entire package.
- They guide the customer in the selection of travel packages, taking into account already selected products.

Dynamic packaging is already supported—to some extent—by the three major online travel agencies: Expedia, Travelocity, and Orbitz. While the dynamic packaging approach has been widely accepted by customers in the UK and US markets, the possible strategic impacts enabled by dynamic packaging technologies are still uncertain and have—so far—not been investigated thoroughly. In order to analyze the current status of strategic use of dynamic packaging it is necessary to develop a framework highlighting the strategic opportunities enabled by dynamic packaging and critical success factors. To this end, we have adapted the strategy framework developed in the ECOMOD research project (Frank & Lange, in press).

Current dynamic packaging applications are developed using a hard-coded approach: interfaces among various systems allow the interoperability of decentralized, autonomous, and heterogeneous tourism information systems. However, such an approach for integration does not comply with the highly dynamic and decentralized nature of the tourism industry. Most of the players are small or medium-sized enterprises with information systems with different scopes, technologies, architectures, and information structures. This diversity makes the interoperability of information systems and technologies very complex and constitutes a major barrier for emerging e-marketplaces and dynamic applications that particularly affects the smaller players (Fodor & Werthner, 2004–5).

New technologies, such as Web services, and conceptual approaches that allow for semantically enriched descriptions can enable the deployment of a more integrated solution to develop dynamic application. As opposed to the hard-coded approach, Web services take a loosely coupled software components approach, which can be dynami-

cally located and integrated on the Web. Web services are flexible to easily design processes that model dynamic packaging applications. Semantics are important to dynamic packaging applications because they provide a shared and common understanding of data and services of the tourism information systems to integrate. Semantics can be used to organize and share tourism information, which allow better interoperability and integration of inter- and intracompany information systems.

This article is structured as follows. The second section starts with the description of the dynamic packaging concept in the tourism industry. We present the business models by which dynamic packaging solutions can be used to generate revenue. In the third section, we derive requirements for dynamic packaging applications according to online strategies for the tourism industry. The developed analysis framework is then applied to evaluate the three major online travel agencies. The fourth section describes a set of emerging technologies to enable the design of dynamic packaging applications that offer an integrated access to the data that is available in distributed tourism and travel information systems. Finally, the fifth section presents our conclusions and future work.

The Dynamic Packaging Model

Dynamic packaging technology helps online travel customers to build and book vacations. It can be described as the ability for a customer to put together elements of a (vacation) trip including flights, hotels, car rentals, local tours, and tickets to theater and sporting events. In the offline world, such packages used to be put together by tour operators in brochures. The new technology includes the ability to combine multiple travel components on demand to create a reservation. The package that is created is handled seamlessly as one transaction and requires only one payment from the consumer, hiding the pricing of individual components.

The Internet allows providers of tourism products cheap and direct access to consumers, enabling them to book tourism products directly over the Internet (e-tourism). This fact has led to various predictions on radical changes in the travel

industry structure, including the expectation that the importance of travel agencies would decrease significantly (Chircu & Kauffman, 1999). In the meantime, new “cybermediaries” were established, acting as Web portal for accessing travel products of different providers (Chircu & Kauffman, 1999).

To understand how dynamic packaging can support e-tourism strategies it is important to understand the business models (i.e., the mechanism by which a business intends to generate revenue and profits), which can be implemented by a specific dynamic packaging solution. In this section we identify two business models that need to be considered for the deployment of dynamic packaging applications.

The *agency model* relies on supplier commissions of usually 10%. Under the traditional travel agency model, consumers book a hotel using a travel agent and pay the hotel directly, with the travel agency receiving 10% of the base price. So if a traveler were to book a night at a hotel for \$150, the travel agency would receive \$15. According to Starkov and Price (2003), it is expected that this type of commission will disappear over the next 5 years in the same way as it disappeared in the airline and car rental sectors. The next several years the agency commission will decrease from the current 10% and will eventually become a simple flat booking reward payment per reservation (Starkov & Price, 2003).

Nevertheless, there will still be a need for travel agents, because there are consumers who prefer face-to-face contact or who are reluctant to use their credit card online (TOWARD Europe, 2005, <http://www.towardeurope.org>). Agents may need to change focus and specialize more. They will also need to be creators of packages themselves, instead of relying on preset packages, and offer additional services for a sustained competitive advantage compared to online agencies.

The *merchant model* is a wholesale arrangement that involves net rates and room allotments with cut-off dates. The concept is not new: it is the common business model of traditional vacation package providers. Using the merchant model hotel inventory concept, an online travel agency buys a set amount of hotel rooms at a wholesale price. For example, a \$150-a-night room would

cost the travel agency \$120. The travel agency would then resell that room to a consumer for \$140, \$10 less than the \$150 it would cost using the traditional travel agency model. This way, the travel agency would make \$20 instead of \$10 on the transaction. Merchant model hotel inventory involves buying unused hotel rooms at a wholesale rate and reselling them to consumers at retail. The key is that, while entailing higher risks for the agency, the model allows for higher profit margin (Hospitality eBusiness Strategies, 2005).

Under the agency model, an (online) travel agency passes a customer's reservation to the travel supplier receiving a commission. Under the merchant model, an (online) travel agency receives inventory (e.g., hotel rooms, airline seats) from suppliers and then processes the transactions as the merchant. For example, acting as a merchant enables Expedia to achieve a higher level of gross profit per transaction and provide cheaper prices to customers than in the agency model.

Dynamic Packaging to Support e-Tourism Strategies

Starting with the usage of information technology in businesses two decades ago, a general structural change—of traditional competitive structures and value chains—could be observed in many industries (see, e.g., Porter & Millar, 1985). Information about future changes in demand, value chain partners, and competitors has become a critical factor. The ability to offer flexible and individualized services to the customers on the basis of this information has become crucial to achieve competitive advantage. The more and more increasing penetration and usage of the Internet accelerates this structural change. The high availability of the Internet allows information about prices and products to be widely accessible without any geographic or time constraints. A wide variety of strategies that have been suggested and applied targeted at taking advantage of the specific characteristics of the Internet, such as increasing revenues through geographical expansion, improving customer relationships through targeted customer data collection and individualized offers, and decreasing sales costs through fully automating the process of customer interac-

tion and performing transactions (Frank & Lange, 2004).

In the tourism and travel industry, dynamic packaging has been introduced as an approach for achieving competitive advantage, because it aims at providing consumers with individually customized and flexible travel packages.

The dynamic packaging model is not without its own constraints caused by the very transparent nature of the product and content, and also the technology needed to operate it. The main opportunities and challenges of dynamic packaging are listed in Table 1 from the viewpoint of the different (traditional) industry participants (i.e., travel service suppliers, customers, and travel agencies).

In the following sections we will discuss the requirements, opportunities, and challenges of applying dynamic packaging in e-tourism from a strategic perspective. To this end we have adapted a differentiated structure of e-commerce strategies (Frank & Lange, 2004, in press). First the basic strategies are introduced. Subsequently, we introduce a framework for analysis and apply it for the evaluation of existing dynamic packaging applications.

General Strategies

Focusing on the sales perspective in the value chain, we distinguish four basic strategies that can be supported when implementing dynamic packaging: geographic market expansion, customization of products and processes, added value (new information products), and cost reduction.

Expansion. The opportunity to reach a geographically wider market is one of the strategic chances through the Internet most frequently mentioned (see, e.g., Jutla, Craig, & Bodorik, 2001; Venkatram, 2001). Hence, increasing the number of customers through allowing global access to travel service booking and information is a fundamental strategy in e-tourism. Online travel agencies and travel product and service providers in general take advantage of this opportunity by allowing access to their services over the Internet.

Customization. Customizing travel products and services is the main objective of dynamic packaging. This includes assembling customized

Table 1
Overview of Opportunities and Challenges of Dynamic Packaging Applications for Different Industry Participants

Market Participants	Opportunities	Challenges
Suppliers	<p>Flexibility: integrated systems allow short-term adaptation of offers and prices to changes in markets and environment</p> <p>Market expansion: new ways of combining a supplier's product with other travel services can expand the market and in this way increase revenues</p>	<p>Initial investments: in order to support an integrated IS infrastructure, additional investments are necessary</p> <p>Increasing dynamic markets imply the necessity for quick adaptations of offers and prices</p>
Customers	<p>Targeted offers: the assembled travel packages are better targeted to the individual customer's needs</p> <p>Better service: consequent collection of customer data allows for better customer service</p>	<p>Less transparent pricing: it is more difficult for the customer to compare prices if only one price is given for an entire package of travel products</p> <p>Unasserted quality: individually assembled packages make quality assurance of the entire package difficult</p>
Traditional travel agencies	<p>Better customer service: more targeted consulting of (prospective) customers</p> <p>Flexibility: dynamic packaging allows to present prices representing current market conditions</p>	<p>Initial investments: in order to support an integrated IS infrastructure additional investments are necessary</p> <p>Increasing competition: Web portals applying dynamic packaging enter the market as new competitors</p>

travel packages as well as individual pricing on the basis of customer preferences and taking into account current market conditions. Furthermore, using the Internet as sales channel allows the search and selection process to be customized according to customer preferences.

Added Value. Tourism and travel products are "confidence goods," because they cannot—in general—be tested before purchase (to some extent, travel products are "experience goods," e.g., car rental and hotel chains). For this reason, travel agents have frequently been expected to visit various locations in order to be able to describe and recommend the travel products to the customers. In general, using the Internet for communicating with customers entails the danger that communication becomes worse from a social perspective, because it is reduced to the exchange of digital data. However, it also offers new opportunities of informing the customer about the different tourism products in cost-effective ways. This can include providing information in different digital formats, such as textual descriptions, photographs, and videos. Furthermore, using Internet technology allows making the search and booking process more transparent. Building a community of travelers is

another approach to add value through providing information about the tourism products, because online communities allow the exchange of vacation experiences between customers.

Cost Leader. Using the Internet as a customer contact channel significantly decreases transaction costs, including the costs of negotiation, as well as the costs of individualizing (digital) products. Considerable cost reductions are one of the main opportunities of providing online booking services. The savings are due to decreased transaction costs and the unlimited temporal and geographic availability of the system. Dynamic packaging entails two vital strategic orientations: individualization and customization of travel packages, and maximized cost reductions through completely automated packaging processes.

Framework of Critical Success Factors and Requirements

Having introduced the basic strategies for dynamic packaging we will develop a framework of critical success factors for each basic strategy. In order to allow the evaluation of existing systems in the following section, we will additionally derive operational criteria for evaluation.

We start with discussing the geographic market expansion; here we will not discuss the opportunities and threats of providing online transactions in general (see Frank & Lange, 2004), but we will focus on the specific implications of *internationally* extending the target customer group. Subsequently, we discuss different ways of supporting customization and personalization of travel products as well as the search and booking process. After the discussion of ways for providing information about travel products, the last subsection discusses requirements for the cost-effective implementation of dynamic packaging.

(International) Market Expansion. Considering target group-specific requirements—such as language, cultural issues, as well as tax- or law-related aspects—is essential for the success of international market expansion. Supporting multilingual communication is predominantly important, because the ability to communicate is a fundamental prerequisite for interacting with customers on new international markets. Here, it is crucial to use terms and concepts in ways appropriate for the target group (simple examples are different date formats and temperature units). Furthermore, the multilingual communication has to be thoroughly implemented, including information on terms and conditions and contracts in multiple languages. Besides the provision of multilingual content, people working at customer touch points should be sufficiently capable of speaking the required language.

Customization. Customized products and processes is a core objective of dynamic packaging applications. There are a number of necessary steps and requirements for successfully implementing a customization strategy, which are discussed in this section.

Cooperating with a critical mass of suppliers from the various travel industries—such as airlines, hotels, car rental, insurance, local tours, train/bus, etc.—is an essential prerequisite for providing customized travel products. In order to allow for access to up-to-date information in real time it is crucial to integrate data formats and information systems of suppliers (see next section). Furthermore, in order to allow for reliable and customer-satisfying product packages, information on relationships between suppliers of different tour-

ism service or product types in one region has to be collected. This includes, for example, bundling prices and information on distances between different locations.

In order to allow the configuration of individualized products and to support the customer in the selection process, it is vital to improve knowledge about customers. This can be achieved by gathering and evaluating data on customer background and preferences. The information that can be used to tailor individual packaging can be differentiated in general information—such as personal dates (birthday, wedding day) and lifestyle information—and travel-related information including personal travel preferences as well as previous booking and vacation data (Amerongen, 2003; Nyheim, McFadden, & Connolly, 2004). The data can be gathered actively by providing online questionnaires (for preferences and vacation feedback) or—without the customers direct input—by automated click-stream analysis, through collecting data of previous booking and peer group analysis. When collecting customer data in order to support customization a number of critical success factors have to be considered: from the customer's view point it has to be clear which data are being stored for internal usage only and which are passed on to third parties (*privacy*); the data models should be sufficiently detailed and sophisticated in order to adequately support data analysis (*sophisticated data model*); the data gathered should be up to date to reflect the current customer preferences as well as feedback of recent vacation experiences (*up-to-date information*).

On the basis of collected and analyzed customer data, interaction with the customer can be individualized through adaptations of the search and booking process, individual offers (and pricing), or through consideration of customer-specific events:

- Individualized processes should allow for flexibility and personalization of the packaging process. For example, certain preferences are preset or preselected (e.g., preferred hotel class, leisure activities) or the order of searching for offers can be customized (e.g., the order of selecting a time frame, price range, and a specific destination region or country).
- The product packages should be customized

based on the price range and the requirements specified by the consumer.

- Another approach for individualizing interaction with the customer is to handle customer events. This includes assembling travel offers for certain personal events as well as handling travel events themselves by, for example, reminding the customer of up-coming events and notifying him/her about relevant developments in the destination region.

Typical vacation catalogues are printed far in advance of the real booking season and include detailed fixed package prices. This significantly restricts a tour operator's ability to adapt selling price later in the season, based on booking volumes and market changes. To overcome these restrictions, some tour operators publish up to five or six editions of one brochure for the same booking season, so that they can reflect updated selling prices. This practice has proved both expensive and confusing to operate. One advantage of dynamic packaging is the opportunity for real-time pricing. The main drawback of traditional catalogues does not hold anymore, because the package price can be determined at the point of booking, taking into account the current market situation. Studies have shown that customer access to current prices and availability information has been the major impediment for booking online (Anckar & Walden, 2000; Öörni, 2003). Overcoming this drawback requires not only access to discount or merchant rates through cooperation with suppliers but an appropriate level of integration with the information systems of suppliers. System integration is critical to allow up-to-date information on prices and availability.

Added Value. Travel products, being mostly confidence goods, require appropriate ways of informing the customer about the product characteristics. We introduced two approaches that can be supported in dynamic packaging: using multimedia to describe the travel products and establishing a community of travelers for exchange of travel experiences.

Using different media for describing travel products can include textual descriptions, photographs, videos of the product in general or of selected experiences from other customers. In order to achieve a more personal communication, for ex-

ample, statements from the local staff can be provided. For a successful strategy of added value through multimedia information, the following success factors should be taken into account: performance (i.e., considering bandwidth of customer Internet access), professionalism (i.e., it is expected that bad marketing videos and interviews have a more negative image effect than using only traditional ways of product description).

An online community adds value in two ways: customers can get personal information about potential travel destinations, in this way allowing for information about the "confidence travel goods." Additionally, it can facilitate emotional retention, because it provides infrastructure for building social networks with other customers. Software for building communities on the Web is freely available (e.g., many Web-based Document Management Systems support some community features).

Therefore, in order to achieve a long-term sustained competitive advantage through customer communities, differentiation must be achieved through the specific topical structuring and additional community supporting actions (Williams & Cothrell, 2001). Apart from using the Web community for emotional customer retention, it can be used for retrieving better information about customer preferences and attitudes related to booking and vacation experiences. In particular, at the beginning of building up a Web community user feedback should be taken seriously and considered for further aligning the community with the needs of current and future customers (Williams & Cothrell, 2001). A community of travel customers is likely to be rather complex, allowing discussions on particular destinations, types of vacations, or the booking process itself. Hence, the community design should provide options for selecting certain functionalities and contents in order to allow the customers to individualize their view onto the community according to their personal preferences (Raisch, 2001).

Cost Leader. The travel industry is characterized by a high degree of internationality, a high dynamic of suppliers and customers, and, therefore, the requirement of quickly reacting to changes in the market. Dynamic packaging is targeted at achieving the goal of better and faster reaction to market changes. However, in order to

cost-effectively implement dynamic packaging as a fully automated process controlled through customer interaction it is mandatory to support an appropriate level of integration with the information systems of value chain partners.

We differentiate two aspects of integration. (1) Integration on the data level or on the level of terminology can be achieved by referring to a semantic framework of common terms explicating the meaning and relationships between concepts as well as providing a syntactical base for their description. (2) Integration on the functional level can be achieved by providing a standardized communication protocol as well as functions for retrieving or calculating certain information. Agreement on standardized data formats supports less media breaches, less misunderstandings and errors, and in this way a faster and reliable update of information. Furthermore, standardized data formats and semantics offer more opportunities for cost-effective reuse of information (e.g., for assembling advertisements and alerts using other types of media, such as e-mail newsletters or brochures). Integration on the functional level supports efficient exchange of information as well as secure data transaction. Besides the general opportunities of cost reductions through standardization, agreement on standardized data formats and functional integration reduces switching costs for dynamic packaging providers when suppliers have to be changed and makes it easier to add new suppliers (confirming to the standards).

Analysis of Online Travel Agencies

The industry's most dominant three online agencies, Expedia, Travelocity, and Orbitz, are leading the development of dynamic packaging technology and they continue to put significant investment into systems technology to provide an efficient and sophisticated booking experience.

The Three Major Online Travel Agencies. *Expedia* is the largest online travel agency. Expedia follows the merchant model (i.e., it consigns hotel rooms at a wholesale rate and resells them to consumers). Expedia's use of dynamic packaging is one of the best among the competition. Using Expedia's website, consumers can book airline tickets and hotel rooms, and also book a shuttle to

pick them up at the airport and set up prepaid restaurant meals.

Travelocity is now the second largest online travel agency. Travelocity launched a new merchant model hotel program offering advantages so compelling that more than 2,000 hotels signed agreements to participate. Travelocity made a strategic acquisition of Site59.com, whose dynamic packaging technology allows Travelocity to respond to the growing popularity of Expedia's dynamic packages.

Orbitz has already completed the implementation of its dynamic packaging engine. One major characteristic of Orbitz strategy is that the customer relationship doesn't end when a customer buys a travel product. Orbitz is the only travel site with a Customer Care Team that monitors nationwide travel conditions for travelers. The Care Team gathers and interprets FAA, National Weather Service, and other data, providing the latest information on flight delays, weather conditions, gate changes, airport congestion, or any other event that might impact travel via mobile phone, pager, PDA, or e-mail.

Evaluation. In order to show the applicability of the developed framework we performed an analysis of the three major online travel agencies aimed at assessing their dynamic packaging strategies. The evaluation is based on the contents available on the respective websites. We agree that a thorough evaluation should take into account an internal view inside the respective information systems, particularly with respect to the level of integration. However, analysis of the website already gives fundamental insights into the "maturity" and potentials of current dynamic packaging implementations. The dynamic packaging approaches are named differently by the three online travel agencies: Expedia names it "vacation package" (on the .com site); Travelocity and Orbitz do not give the dynamic packaging functionality a specific name but indicate the types of suppliers that can be put together in one package (e.g., Flight + Hotel + Car). In order to get access to the complete functionality one of the authors registered for an account. The dynamic packaging functionality was tested searching for a trip from Frankfurt, Germany, to Madrid, Spain, including

flight and hotel as well as other offers, such as car, theater, and restaurant, if available. The multiple language features were evaluated with respect to the support of German and English.

The evaluation results can be summarized as follows. With respect to *international market expansion*, Expedia and Travelocity fulfill all given criteria: all descriptions and customer contact channels are provided in multiple languages. However, Orbitz does not support multiple languages—neither on the website nor at customer touch points. Orbitz does consider specific requirements of citizens from EU member countries, because different privacy regulations apply. It does recommend a European travel agency (www.ebookers.com) for all those who do not want to agree to the Orbitz privacy statement (“to complete purchases on our site, you must agree to allow your information to be transferred outside the European Union (EU). If you are unable to accept this agreement, consider using ebookers.com on www.orbitz.com”).

Customization options provided for dynamic packaging vary significantly across the different online travel agencies. Expedia offers the most variety of types of suppliers that can be combined in one package, including rental car, flight, hotel, sightseeing, restaurant, tours, and theme parks. Travelocity and Orbitz restrict the types of suppliers to flight, car, and hotel. All three evaluated agencies offer travel cancellation insurance. The data collected about the customer differ for Orbitz, allowing customers to express their interests in terms of activities and destinations. This information is then used to customize e-mail alerts, newsletters, as well as the offers posted on the Orbitz website (the actual usage could not be verified, only the intention as written on the website). Additionally, Orbitz provides travel event alerts, such as alerts on flight delays. Pricing and availability information are given by all of the evaluated online travel agencies; Expedia makes the savings explicit (in \$) while Orbitz and Travelocity only advertise the packages to be cheaper.

The *multimedia description* is provided only for hotels and all three agencies provide textual descriptions, photographs, and maps (additionally, Travelocity provides “virtual tours,” i.e., surround pictures giving the illusion of videos). None of the

evaluated travel agencies provides an *online community*. Information on hotels is provided using an internal star rating (all three travel agencies) and hotel reviews by customers, including a description and a quantitative assessment (Expedia and Travelocity). Orbitz additionally provides a differentiated city destination guide; however obviously not linked or integrated with the search/booking system.

The evaluation of data formats and *integration* levels provided by the three online travel agencies is based on each company’s statements available on the respective websites. All three enable the exchange of supplier information using XML-based exchange formats. Orbitz supports different formats (including XML-based formats) and holds a competitive advantage through an individual supplier link technology that allows bypassing existing Global Distribution Systems (GDS, see next section). In this way, Orbitz saves the fee that usually has to be paid for accessing information through GDS, enabling them to pass *cost savings* to customers in form of lower prices.

Orbitz enables *functional integration* with suppliers through a Jini enabled Service Oriented Architecture (see <http://java.sys-con.com/read/43774.htm>). Expedia and Travelocity use Web Services for functional integration. Service-oriented architecture (SOA) expresses an architecture for dynamic discovery and use of services over a network. In a SOA environment, loosely joined and highly interoperable services are available to other participants in the network as independent elements that the participants access in a standardized way. Currently, most definitions of SOA identify the use of Web services in its implementation; however, a SOA does not necessarily need to use this standard to become “service oriented” and can use any service-based technology. Web services and Jini technology have taken the concept of services introduced by SOA. While Expedia and Travelocity have selected Web services [which use Web Services Description Language (WSDL) (Chinnici, Gudgin, Moreau, & Weerawarana, 2003; Christensen, Curbera, Meredith, & Weerawarana, 2001), Universal Description, Discovery, and Integration (UDDI, <http://www.uddi.org/>), and Simple Object Access Protocol 1.1 (SOAP, <http://www.w3.org/TR/SOAP/>) standards], Orbitz has selected

the Jini framework. Both technologies define a standard way for describing software components to be accessed and methods for accessing these components. They provide interoperability at the interface level. This allows for an easier intra- and interorganizational integration. Tourism applications can talk to each other independently of their hardware and software platforms.

Based on the website analysis, we can summarize the strategies of the three market leaders with respect to dynamic packaging as follows (see Table 2). There are two issues that could not be solved using a mere website analysis: (1) the number of suppliers (of each type) determining the market size and product variety each online agency provides and (2) the level of semantics supported by the XML-based exchange formats used for integrating the respective travel information systems.

Expedia's strategy is characterized by a high level of customization and consequent international market expansion. Travelocity provides only limited customization capabilities while following a strategy of international market expansion. Orbitz focuses on the US market but achieves competitive advantage through highly customized communication with customers and a flexible integration architecture independent from existing GDS, in this way allowing for cost advantages.

Emerging Technologies for Dynamic Packaging

By integrating tourism-related data into one transparent information distribution process, modern travel agencies can offer better support to dynamically compose travel packages for their customers. Dynamic packaging applications are characterized by the combination and integration of distributed tourism information systems, each with their own intended purposes and goals. The

goals of these information systems are independent and the integrated information system reuses the information from the local systems for new purposes and new goals.

Current dynamic packaging applications are developed using a hard-coded approach to developing interfaces among various systems to allow the interoperability of decentralized, autonomous, and heterogeneous tourism information systems (see Dell'Erba, Fodor, Ricci, & Werthner, 2002; Fodor & Werthner, 2004–5).

Web services, an emerging technology, and semantics, a conceptual approach that allows for semantically enriched descriptions, can enable the deployment of a lightweight solution to integrate and allow the interoperation of different tourism information systems. As opposed to the hard-coded approach, Web services take a loosely coupled software components approach, which can be dynamically located and integrated on the Web. Web services are flexible to easily design processes that model dynamic packaging applications. Semantically enriched reference models are important to dynamic packaging applications because they provide a shared and common understanding of data and services of the tourism information systems to integrate. Semantics can be used to organize and share tourism information, which allow for a better interoperability and integration of inter- and intracompany information systems.

Current Tourism Information Systems

Tourism information systems provide travel agencies and customers with crucial information such as flight details, accommodation, price, and the availability of services. Dedicated and specialized information systems are indispensable to provide real-time tourism data to travel agents, cus-

Table 2
Strategies of Major Online Travel Agencies for Dynamic Packaging

	Market Expansion	Package Customization	Customization of Communication	Community Information	Costs/Integration
Expedia	International	High	Low	Reviews	n.a./XML
Travelocity	International	Limited	Low	Reviews	n.a./XML
Orbitz	National	Limited	High	—	Low/XML, SOA

tomers, and other organizations. Four information systems—Computerized Reservation Systems (CRS), GDS, Hotel Distribution Systems (HDS), and websites—are a fundamental infrastructure to provide access to tourism information.

A CRS is a travel supplier's own central reservation system (Inkpen, 1998). A CRS enables travel agencies to find what a customer is looking for and makes customer data storage and retrieval relatively simple. These systems contain information about airline schedules, availability, fares, and related services. It is estimated that 70% of all bookings are made through this channel (European Travel Agents' and Tour Operators' Associations, http://www.ectaa.org/ECTAA%20English/Areas_dealt_with/Air_transport.htm#crs).

A GDS is a super switch connecting several CRSs. The airline industry created the GDS concept in the 1960s. A GDS integrates tourism information about airlines, hotels, car rentals, cruises, and other travel products. It is used almost exclusively by travel agents. Prior to the introduction of GDSs, travel agents spent a considerable amount of time manually entering reservations. The use of these systems is expensive because they charge a fee for every segment of travel sold through the system.

HDS work closely with GDSs to provide the hotel industry with automated sales and booking services. A HDS is tied into a GDS, allowing hotel bookings to be made in the same way as an airline reservation (Inkpen, 1998).

Recently, companies, such as the airlines, have chosen the strategy to sell tickets on their own websites to avoid using a GDS (Dombey, 1998). This is the simplest and cheapest strategy to sell tickets because they don't have to pay a fee to the GDS. A recent survey (O'Connor, 2003) revealed that over 95% of hotel chains had a website, with almost 90% of these providing technology to allow customers to book directly.

Integration as Key Characteristic

Dynamic packaging applications require linkages to diverse numbers of suppliers including the management of these business-to-business (B2B) links. In order for networks of B2B linkages to be operated successfully, heterogeneous systems

from multiple companies need to be integrated and interoperate seamlessly. Automating related inter-organizational processes across supply chains presents significant challenges (Stohr & Zhao, 2001). These processes are often complex and involve more varieties of systems than enterprise-wide integration.

Information system integration is a critical area of concern and the cause of many failures. Recently, Gateway wrote off \$140 million due to its failed effort to run its online store with a purchased software system (Hopkins & Kessler, 2002). The software did not work well with Gateway's existing systems. Another example is the candy maker Hershey Foods. They installed three software application packages, part of a \$112 million system, with disastrous results due to incompatibilities with other application programs (Hopkins & Kessler, 2002). The development of dynamic packaging applications for the tourism industry suffers from the same type of problems. Therefore, special care needs to be taken when developing this type of applications.

Figure 1 illustrates the integration of various tourism information systems to support the concept of dynamic packaging. As can be seen, new communication links are established among the various participants of the distribution model to integrate tourism products.

Most of the approaches to integrate tourism information systems have been based on the development of syntactic standards defining a set of syntax rules to structure data and protocols for the exchanged messages between distributed tourism information systems (Fodor & Werthner, 2004–5). Examples of syntactically based standards include:

- United Nations rules for Electronic Data Interchange for Administration, Commerce and Transport ' Travel Tourism & Leisure (UN/EDIFACT TT&L, <http://www.unece.org/trade/untdid/welcome.html>): This international agreed standard aims at facilitating the electronic exchange of business structured data between partners. It describes the syntax for data exchange and the description and structuring of data elements.
- Open Travel Alliance (OTA, <http://www.open-travel.org/>): The OTA aims at promoting the

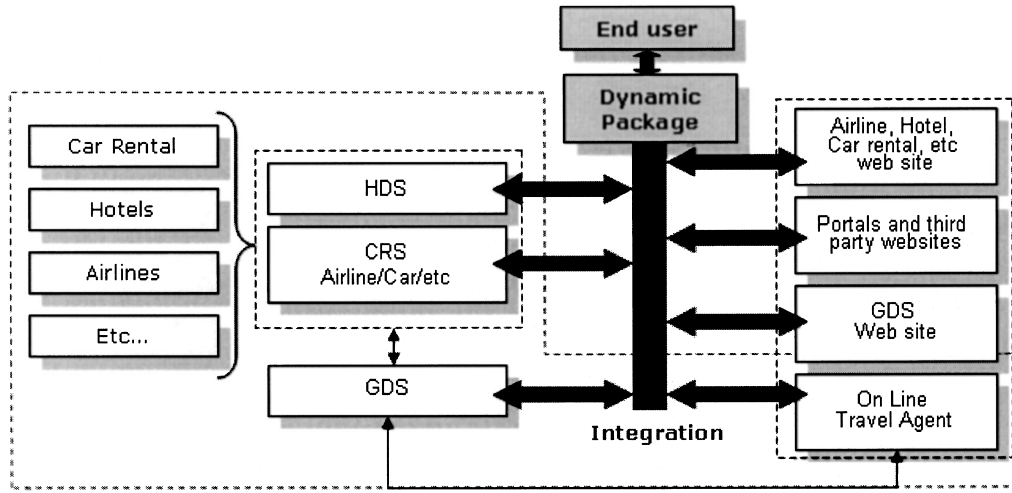


Figure 1. Integration of tourism information systems.

flow of XML-based messages through multiple distribution channels. The objective is to provide a vocabulary and grammar for communicating travel-related information as tags implemented using XML (Pühretmair & Wöß, 2001) across all travel industry segments.

- Hospitality Industry Technology Integration Standards (HITIS, <http://www.hitis.org/>): The HITIS focuses on developing function- and object-oriented application programming interface standards for the expressed purpose of reducing the cost and risk associated with the implementation of new information technology within the hospitality industry.

Integration Using Web Services and Semantics

A few years ago, e-tourism applications were mainly focused on handling transactions and managing catalogs. Applications automated only a small portion of the electronic transaction process (e.g., taking orders, scheduling shipments, and providing customer service). e-Tourism was held back by closed markets that could not use each other's services, due to the use of incompatible protocols.

Business requirements of dynamic applications, however, are evolving beyond transaction support, including the interoperability and integration of heterogeneous, autonomous, and distributed ser-

vice, such as CRSs, GDSs, and travel agents websites. The objective is to provide a global and homogeneous logical view of travel products that are physically distributed over heterogeneous tourism data sources. However, in general, tourism information systems are not designed for integration. For example, GDSs were developed in the 1960s when the integration of systems was not a major concern. Currently, the variety of tourism data formats limits the interoperability of different tourism information systems—travel agencies use several different systems that are not connected, making almost impossible the development of dynamic packaging applications.

When integrating tourism information systems, several kinds of heterogeneity have to be considered. Four types of information heterogeneity may arise: system heterogeneity, syntactic heterogeneity, structural or schematic heterogeneity, and semantic heterogeneity. The problems that might arise due to heterogeneity of the data are already well known within the distributed database systems community (see (Kashyap & Sheth, 1996; Kim & Seo, 1991).

- System and syntactic heterogeneity:** The first type of heterogeneity arises from the use of different hardware platforms and operating systems. The latter is concerned with differences

in the representation and encoding of data used by the information sources. Syntactic interoperability can be achieved when compatible forms of encoding and access protocols are used to allow information systems to communicate.

- b) **Structural heterogeneity:** Different information systems store their data in different data models, data structures, and schemas.
- c) **Semantic heterogeneity:** Semantic conflicts arise because the meaning of the data is formalized in different ways.

(a) Most tourism information systems were not designed to be integrated within a more global system, such as dynamic packaging applications. They possess a high degree of autonomy because they do not provide the necessary interfaces, encoding, and access protocols to enable integration. Earlier middleware solutions proposed to solve the integration of tourism information systems were based on tightly coupled, hard-coded, point-to-point software components that require high investments in terms of capital and human resources. This approach is not satisfactory because it is static in nature. It is difficult, costly, and time consuming to integrate new tourism information systems. Dynamic packaging applications require an alternative to this approach that would allow seamlessly and dynamically integrating new information systems based on customer's requirements.

(b) Tourism information systems' data structures can use different formats and structures to represent their data (i.e., they are structurally heterogeneous). For example, a GDS can be based on a database and use relational tables (structured data), a travel agent website would use HTML files (unstructured data), while a CRS may rely on XML for its data model (semistructured data). The integration of heterogeneous data models requires a common data model to map information coming from the various travel data sources (Bertino & Ferrari, 2001).

(c) Semantic integration is another issue that an infrastructure to leverage dynamic packaging applications needs to address. Once there is an agreement on a common data model for integration, it is necessary to reconcile the entities (instances) presents in the data sources. For example, consider two tourism data sources that model the

entity Hotel. One of the data sources uses only one relational table to store Hotel information, while the other stores this information across more than one table. As a result, the different schema needs to be semantically integrated so that dynamic packaging applications can have access to a uniform schema.

Recently, enabling technologies and business-centered design methodologies have addressed the shortcomings of contemporary e-tourism systems and can be effectively used to support dynamic packaging applications. Web services refer to a set of technologies that can universally standardize the communication of applications in order to connect systems, business partners, and customers cost-effectively through the World Wide Web. Semantics provide an agreed understanding of data between and among Web services. Semantics encourage the development of interoperable systems that can help create and support new collections of Web services to better meet the demands of dynamic packaging applications.

Web Services and e-Tourism IS Integration. Many tourism-based companies continue to face major integration problems and see Web services as a way to handle these problems (Overby, 2003). In terms of integration, Web services provide a core architecture that allows any two Web applications to talk to each other. In this way it provides a solution for integrating heterogeneous systems with lacking interfaces and differing data formats. Thus, it offers an important solution to dynamic packaging application integration.

The biggest providers of computer software and services are making large investments to support and promote Web services (Hagel & Brown, 2001). What they are promoting is a whole new approach to information systems (IS) and IS architecture. Web services are rapidly becoming the industrial standard for integrating distributed systems. Web services promise to enable organizations to integrate and reuse software already built and reduce the hassle and expense of systems integration. This technology provides a standard exchange mechanism across diversified platforms, systems, and networks. Web services present an efficient solution to reduce efforts and to quicken the process of creating interfaces that allow the

communication between heterogeneous, autonomous, and distributed systems, in this way supporting dynamic packaging systems. For dynamic packaging application, Web service-based solutions have the following advantages:

- Loosely coupled integration of tourism information systems leading to reduced switching costs and more flexibility.
- Reduced dynamic packaging applications' complexity and costs due to standardized interfaces.

Web services are easier to design, implement, and deploy than any other traditional distributed technology. At the foundation of Web services architecture are software standards and communication protocols, such as XML, SOAP, HTTP, UDDI, and WSDL (Christensen et al., 2001), which allow information to be accessed and exchanged easily among different programs. These tools allow applications to communicate with each other regardless of the programming languages they were written in or the platform they were developed for. Web services are not used to build monolithic systems; they are a set of tools used to stitch together existing applications to create new distributed systems.

The three major online travel agencies—Expedia, Travelocity, and Orbitz—already use either Web services or another type of distributed architecture (e.g., Service Oriented Architecture). The current implementations use WSDL (Chinnici et al., 2003) descriptions, which specify the structure of message components using XML schema constructs. One major limitation of these technological approaches is the lack of semantic descriptions. By mapping concepts in a Web service description to ontological concepts, users can explicitly define the semantics of Web services for a given domain.

While the major online travel agencies already use Web service technology, it should be noticed that most of the players in the dynamic packaging arena are small or medium-sized online travel agencies. These organizations have information systems with different scopes, technologies, architectures, and information structures and most of them are not using Web service technology yet. Web services—especially Semantic Web services—are emergent solutions that can help small

or medium-size players to integrate their information systems to develop flexible dynamic packaging applications.

Semantic Integration of e-Tourism IS. While Web services are important for the integration of tourism information systems, to achieve a better and easier integration, the use of semantics is indispensable. One big challenge of developing dynamic packaging applications is to find a solution to cope and integrate the nonstandard way of defining e-tourism products and services. There are no standards based on semantics to express transportation vehicles, leisure activities, and weather conditions when planning for a vacation package; several ways can be found among all the existing tourism information sources.

Recently, the travel industry has concentrated its efforts on developing open specification messages, based on XML, to ensure that messages can flow between industry segments as easily as within. For example, the OpenTravel Alliance (OTA, <http://www.opentravel.org>) 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 guarantee an automatic exchange and processing of information to develop dynamic applications. The development of suitable ontologies for the tourism industry can serve as a common language for tourism-related terminology and a mechanism for promoting the seamless exchange of information across all travel industry segments.

Ontologies are the key elements enabling the shift from a purely syntactic to a semantic interoperability. An ontology can be defined as explicit, formal descriptions of concepts and their relationships that exist in a certain universe of discourse, together with a shared vocabulary to refer to these concepts. With respect to an ontology a particular user group commits to, the semantics of data provided by data sources for integration can be made explicit.

Depending on the approaches, models, or methods used to add semantics to terms, such as controlled vocabularies, taxonomies, thesaurus, and ontologies, different degrees of semantics can be achieved. Controlled vocabularies are at the weaker end of the semantic spectrum. A controlled vocabulary is a list of terms that have been enumerated explicitly with an unambiguous and non-redundant definition. A taxonomy is a subject-based classification that arranges the terms in a controlled vocabulary into a hierarchy without doing anything further. A thesaurus is a networked collection of controlled vocabulary terms with conceptual relationships between terms. A thesaurus is an extension of a taxonomy by allowing terms to be arranged in a hierarchy and also allowing other statements and relationships to be made about the terms, such as equivalence, homographic, hierarchical, and associative (National Information Standards Organization, 2005). Ontologies are similar to taxonomies but use richer semantic relationships among terms and attributes, as well as strict rules about how to specify terms and relationships. Compared to other approaches, ontologies provide a higher degree of expressiveness. Furthermore, standards have already been developed [e.g., Web Ontology Language (OWL, <http://www.w3.org/2004/OWL/>)] and are being used in practical applications. For these two reasons, ontologies can be applied in the area of dynamic packaging to explicitly connect data and information from tourism information systems to its definition and context in machine-processable form; that way, semantic services, such as semantic document retrieval, can be provided. Ontologies can be used to bring together heterogeneous Web services, Web processes, applications, data, and components residing in distributed environments. Semantic Web processes, managing dynamic packages, 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.

Several researchers (Cardoso, Bussler, & Sheth, 2005; Fensel, Bussler, & Maedche, 2002; Patil, Oundhakar, Sheth, & Verma, 2004; Sivasanmugam et al., 2003) have pointed out that Web services should be semantically enabled. Semantics allow rich descriptions of Web services

that can be used by computers for automatic or semiautomatic processing in e-commerce applications.

Related Work

At this point we intend to complement the technical issues discussed in this article by a brief overview of related research efforts targeted at overcoming the challenge of integration in tourism information systems.

An ontology-based approach for supporting interoperability of different information systems in the tourism industry through semantic mapping has been described in Fodor and Werthner (2004–5). Even though the described Harmonise project does not aim at supporting dynamic packaging, the developed ontology can serve as basis for the semantic integration of several suppliers in dynamic packaging applications. The Harmonise project targets the interoperability at the information layer for the tourism industry and supports the translation and sharing of data between organizations. The project included the development of the Harmonise mediator, which had the objective of defining mappings between the schemas of participating distributed systems and standards. Harmonise is an ontology-based solution for semantic mapping and data reconciliation making use of Semantic Web and Web services standards in order to maintain compatibility and facilitate integration. The ontology developed, called Interoperable Minimum Harmonization Ontology (IMHO), was implemented using RDFS with the objective of reducing conceptual and terminological confusion and to reach a shared understanding within the travel and tourism domain.

Pühretmair and Wöselig; (2001) describe an architecture in the context of the tourism information system TIScover (Pröll, Retschitzegger, Wagner, & Ebner, 1998). It includes comprehensive tourism information on countries, regions, villages, and diverse destination facilities. Their approach provides an integrated data collection from distributed and heterogeneous tourism information systems and supports flexible data interchange mechanisms. This integrated information is transformed into a metadata structure represented by XML DTDs. The main advantage of this concept

is that if changes of the data interchange specification to other tourism information systems are necessary, it is sufficient to update the corresponding metadata information. However, the level of integration achieved is limited by the low level of semantics of the concepts available in DTDs.

The SATINE project (Dogac, Kabak, Laleci, Sinir, Yildiz, Kirbas, et al., 2004; Dogac, Kabak, Laleci, Sinir, Yildiz, & Tumer, 2004) is a platform to develop and deploy semantically enriched services in the travel domain. One objective of this project has been to develop concepts and corresponding tools that allow the usage of ontologies for semantic mapping between different message formats using service registries like UDDI and ebXML and through peer-to-peer networks. It also provides a tool for tourism organizations supporting the creation of Web services from their existing enterprise applications.

While SATINE produces a middleware architecture to deploy semantically enriched Web services for the travel industry, their work does not target the creation of dynamic packages. It does, however, supply a fundamental building block for dynamic packaging applications. The next step would be to extract travel information from semantic Web services to complete a dynamic packaging data model represented with an ontology. From the dynamic packaging ontology, information on flights, logging, and itineraries can be inferred.

Conclusions

With the growth of demand for customized tourism itineraries, (online) agencies seek technology that provides their personnel and clients the flexibility to put together unique dynamic packages from a range of alternatives, without having to be aware of the intricacy of contract rules and pricing issues. The concept of dynamic packaging is to bundle all the components selected by a traveler to produce one reservation. In spite of where the inventory originates, the package that is created is treated as one operation, and entails only one payment from the customer.

Even though the idea of dynamic packing has to some extent already been implemented by major online travel agencies, its strategic impact and opportunities have not yet been investigated. We

presented a framework of e-tourism strategies with a particular focus on dynamic packaging functionality including critical success factors and analysis criteria. The performed evaluation of the three major online travel agencies (Expedia, Travelocity, and Orbitz) reflects the differentiated picture of the current strategic usage of dynamic packaging, highlighting the individual advantages and potentials for improvement. On the one hand, the analysis can serve as a benchmark for other travel agencies who intend to engage in dynamic packaging. On the other hand, analysis results indicated clearly that the strategic potential of dynamic packaging technologies is currently limited due to interoperability and integration problems of existing information systems.

Hence, one big challenge to successfully develop dynamic packaging applications is finding a solution to cope and integrate the nonstandard way of defining e-tourism products and services. We therefore suggested Web services and semantics as emerging technologies that can be used to deal with the lack of standard and enable data integration. These two technologies have already been recognized in the Semantic Web and can considerably improve e-tourism systems.

Biographical Notes

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Carola Lange received her Diploma degree (summa cum laude) in Computer Science from the University of Koblenz, Germany, in 2003. Since then she has been working at the research group for Enterprise Modeling, headed by Prof. Dr. Ulrich Frank, now at the University Duisburg-Essen, Germany. Carola has published a series of research reports as well as selected journal articles and international conference papers in the areas of conceptual enterprise modeling and e-commerce.

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