Towards effective Tourism Dynamic Packages

Luís Ferreira[1], Goran D. Putnik[2,3], Maria Manuela Cruz-Cunha[1,3], Zlata Putnik[3]

[1] Polytechnic Institute of Cávado e Ave, School of Technology, Lugar do Aldão
4750-810 Vila Frescainha S. Martinho – Barcelos, Portugal

[2] University of Minho, School of Engineering, Campus de Azurém, 4800-158 Guimarães, Portugal

[3] CITEPE Research Centre, University of Minho, Campus de Azurém,
4800-158 Guimarães, Portugal

lufer@ipca.pt, putnikgd@dps.uminho.pt; mcunha@ipca.pt; zlata.putnik@gmail.com

Abstract. This paper describes the Open Tourism Initiative (OTI) as a framework to support tourism activities, following the Tourism Virtual Enterprise (TVE) organizational model and pragmatics based collaboration decisions. To assure the better alignment among tourism services providers and client's expectations, the framework (and its architecture) must support reliable interoperability and dynamic networking reconfiguration as well as the (co-) creation of the tourist's activity regardless of information systems and using real-time collaboration mechanisms. When a member of the TVE scheduled to provide a given service is somehow conditioned, unable to participate, or has to be disentailed from the network, or due to events not necessarily measurable or deterministic, the it is necessary to reconfigure the VE in almost real time. The need to reconfigure could result from changes in controlled (measured) parameters as well as from uncontrolled (contextual and pragmatic) ones. OTI enhances dynamic tourism packages management under the requirements of reconfigurable environments and human direct participation. This article proposes a logical model for TVE organizations as well as an UML formalization for its supporting architecture.

Keywords: tourism, web services, web processing service, tourism virtual enterprises, tourism dynamic packages, market of resources, pragmatics, real-time collaboration, interoperability, integration.

1 Introduction

1.1 Tourism business is changing

Tourism is an important global industry. International tourism receipts reached US$ 852 billion in 2009, and accounted for a contribution of some 5% to economic activity worldwide (UNWTO, 2010). The contribution of tourism to employment tends to be slightly higher relatively to 2010 and is estimated in the order of 6-7% of the overall number of jobs worldwide (direct and indirect). Tourism ranks fourth as an export category, after fuels, chemicals and automotive products (UNWTO, 2010).

Many developing countries strive for sustainable tourism, as it represents an opportunity of economic growth, high unemployment, and environmental protection (Watson, Akselsen, Monod, & Pitt, 2004).

Information is the lifeblood of tourism and, until recently, information technology was not much more than a tool for managing purposes; with the advent of the Web, ICT progress and tourism have been going "hand in hand"; the Web became a tool to support search, selection and reservations. But today the ubiquity of the Web is clear, and determines the necessary and fast adaptation of processes that took much time to be implemented and assimilated. The emerging need (and ability) to systematically integrate technologies with processes, in order to efficiently and effectively align information variants with its inherent search is certainly a major challenge for computing sciences. In actual economic activities, client-supplier frontier vanished. E-Business, e-Commerce, u-Commerce, transformed business and commerce processes, making them less self and unique, less "ours" and more global (Berners-Lee, 2008; Zabel, Bönke, & Constanta, 2000).

Buhalis (1998) was one of the first authors to offer a framework for the utilization of technology in tourism by adopting a strategic perspective, and (Buhalis & Law, 2008) presents a very comprehensive review of the R&D in the ICT and tourism intersection domain (e-Tourism) during the last 20 years, highlighting the main efforts in the field and the challenges that tourism researchers are and will be facing. The future of the travel agencies is to become virtual tourism enterprises, based on the existence of a flexible virtual travel agent (VTA) information system (Assimakopoulos, Dimitriou, & Sotiriou-Xanthopoulos, 2011).

Since the web has been the main commercial support mechanism for tourism activities, it is natural that promoting companies by one hand, and the customers, on the other, change their way to participate in this process. The distance between the tourist and the service providing company is growing to the point that the important is the service effectiveness, independently of how and who executes it.

Besides the announced ubiquity of services, the present concern is focused on the ability to meet the customers' expectations. Since a tourism activity involves a wide and heterogeneous set of variables and resources, such as time, schedules, traveling, accommodation, food, etc., it will easily appear factors that constrain and introduce changes in the initial plan or specification. Ideally, these changes should not be related to the events that constitute the activity itself, and hence to disturb the client, but be restricted to the way these (events) will be performed, and keep the tourist away from the implications of these changes. In short, these changes should not affect the tourist activity, only the service providers.

Considering the typical tourism business of nowadays, almost all tourism activities are composed by several integrated services (transportation, accommodation, etc.) and are not accomplished by a single enterprise. Several entities work together, each one specialist in a particular service, and the combination of their capacities result in the final activity offer. To archive this cooperation the service providers must be able to be integrated as members of a more complex "enterprise" of other several providers which, as a whole, assure the activity execution. As the tourist request changes or some other factor conditions the normal execution of the activity, the service could also need to change and consequently this new "enterprise" could be different in his capacity, their members, etc. The current tourism enterprises do not cope well with unpredictable factors as usually happens, for instance, when there are strikes (transports, public services, etc.) or environmental disasters that prevent flights between the countries.

In almost any tourism solutions there is a great "distance" between the announced service and the real support of it, especially from the customer point of view. Web sites advertisements and current publicity even well explored are made without tourist participation and focused on estimated tourist interest or motivation. Sometimes that publicity is erroneous. Once disappointed, the tourist needs ever more to have an activity according to his interest and capacities.

Looking at the present and imagining the future tourism activity, it is a fact that the web encouraged and enabled a new way to reach and construct tourism activities, where participants are each day geographically more distant, could be in everywhere and any region. Therefore, could this social activity be completely transformed into a cyber activity? How could it be possible if the tourists still prefer to decide for themselves too according to their preferences or possibilities of tourism complex scenarios?

1.2 – The proposal

The increasing socialization of the web with the new collaboration tools (social network tools as facebook, twitter, etc.) promotes the active participation of people in almost all kind of process of decision and helps the knowledge dissemination. Since the access to and the rights of web utilization is almost completely democratized, the social values are increasingly exposed to be scrutinized or explored.

In the future scenario, the tourist may want to clarify or define his motivation or interest regardless of the information system. The tourist constructs or defines his activity through conversation and or through interpretation of available information. If he needs he can use an information system or other auxiliary "systems" to help him in get the weather forecast, know transit conditions, planning map course, or else. So, the tourist and the "systems" work together to co-construct a tourism activity and to reconfigure its services composition, towards the alignment with tourist's interests. This construction and reconfiguration imply a dynamics which can changes initial requirements. In spite of this dynamics of interests inherent to everyone, and even though they are distant from technical specifications, it is essential that they are considered in the definition, composition or selection of the best activity or even on its change (reconfiguration).

This dynamics requires consideration of all available tourism service providers properly integrated in a single solution. For that, the interoperability of their information systems is crucial. So, the main goal of this work focuses on the development of a platform of interoperability towards dynamic tourism packages[i] support, which is able to: a) integrate and manage all the offers from the multiple available tourism services providers and support the subjective evaluation by the tourist and his way of see and understand "things"; b) answer to the necessary changes (reconfigurations) both by the willingness of the tourist or by implications related to the support to the activities and c) support tourist interactions (communication) and their behavior dynamics, allowing co-construction of the tourism activities.

Considering that the actual information systems are not sufficiently prepared for the above requirements. To deal with that, the Virtual Enterprise model (Putnik & Cunha, 2007) and its inherent capacity to reconfigure, together with integrated real-time collaboration mechanisms is seen as the more adequate model to support these requirements and to keep the permanent alignment with customers (tourists).

1.3 – Document structure

In this article we describe an architecture to support enhanced dynamic tourism packages, based on the Virtual Enterprises model and collaboration mechanisms to assure: 1) the composition of the (virtual) enterprise from the (best) services providers; 2) its dynamic reconfiguration as response to tourist requirements dynamic changes; and 3) the participation of the tourist in the co-creation of his own services, the selection of the suggested services, according to his point of view an preferences in the context where the activity will take place.

The remainder of this article presents a background and literature review for the main architectures, technologies and integration initiatives around tourism as an e-business activity, as well as the emergent collaboration behaviors and tools, on section 2. Section 3 proposes and describes the organizational, logical and technological models of the Open Tourism architecture. The architecture and its main technical components are described and formally modeled in UML on Section 4. Finally, section 5 concludes the article and gives some suggestions for future work.

Throughout the document, the terms user and customer represent tourists.

2 Background and Literature Review

It seems clear that the next generation e-Tourism infrastructure will have to support flexible automation, integration, computation, storage, and collaboration (Jaatun, Zhao, Rong, & Zhang, 2009). This section introduces some supporting technologies and the latest developments contributing to the creation of global e-tourism solutions.

2.1 The Open Tourism Consortium

The emergence of u-commerce, and integration technologies is the backdrop to identifying a series of information products that will improve the searching, management, delivery, and sharing of tourism data. Watson *et al.* (2004) proposed the creation of The Open Tourism Consortium to support the development of several integrated and complementary products, using the open source model.

The Open Tourism Consortium – OTC[ii], is a standby consortium of companies, government agencies, individuals, and universities participating in the open development of publicly available standards and software applications to support tourism activities. Their major goals were to develop a XML based data exchange language for objects and events of interest to tourists (TourML) and an open source parser for this language, able to insert the data into a relational database based on the standard data model. It focuses the capacity to describe touristic information since it could be available in multiple devices. Besides the fact that this initiative promotes u-Commerce and being already supported by a XML Schema, it disables or makes difficult the necessary automatic and agile reconfiguration of a tourism service (Monod, 2004).

2.2 Dynamic Tourist Packages: some contributions

Although emergent, the concept of Dynamic Packaging is not specific of tourism activities. Moreover, the concept is not new, having been mainly explored in computer network area, where the Dynamic Packet Transport (DPT) protocol proposed an optimized transport protocol suitable to deliver fundamental cost and functionality advantages over existing IP network solutions (CISCO, 2000). Efficient use of bandwidth, multiple-service support, optimization of packets

transmission, failure self-healing capabilities, etc. could be some of the features which could inspire software developers and systems architects to adapt the concept to business software applications area.

Considering the current tourism and its computational support, web sites, even being the more common applications in nowadays, are nothing but search tools that offer the tourist some autonomy and new possibilities in defining his vacation schedule.

Cardoso & Lange (2007) provide a study of the strategic opportunities enabled by dynamic packaging, highlighting the key success factors, stating that an appropriate level of integration of tourism information systems is a key factor for further realizing the strategic opportunities of dynamic packaging. This is consistent with the proposal for tourism supply chain management by Zhang *et al.* (2009).

The Collaborative Travel Agent System (CTAS) based on a scalable, flexible, and intelligent Multi-Agent Information System (MAIS) architecture, is a proposal of Chiu *et al.* (2009) to respond to the increasing demands for ubiquitous access to tourist information systems for service coordination and process integration.

Denicolai *et al.* (2010) explore the relationship between the networking approach of tourism firms and the development of tourism core-competencies, reinforcing the need of solutions based on networking.

The dependence on the context where the activity will take place and the tourist interest and preference (Abbaspour & Samadzadegan, 2008), as well as the application of case-based reasoning and multi criteria decision making on tourism activity planning (Alptekin & Büyüközkan, 2011) are more relevant scientific contributions which refer the main subjects of our research.

2.3 Ontologies and Service Oriented Architecture

The increasing webization of applications and platforms implied important changes in the development processes and business paradigms. The service is the main processing units of practically all recent web applications, similar to the class in the object oriented paradigm.

The main difficulty of nowadays is the orchestration and ascertaining the quality of those (web) services (who is the best?), even known that their technological support assures their discovery and interoperability.

To compare and evaluate services, ontologies are needed. Through ontologies it is possible to enhance those services with semantic (meta) information, as done with Web Services Modeling Ontologies (Bruijn, Fensel, & Keller, 2005) and Semantic Annotation for WSDL and XML Schema (Kopecký, 2007).

Considering the interoperability among services providers (enterprises) it is necessary now to “deal with” their own architectures or information systems, some of them legacy. Due to the existence of different internal architectures models (several of them following service oriented models), it is necessary to interoperate among those architectures too (Sprott & Wilkes, 2004).

So, the advantage to explore now is SOA integration and web services enhancement (Erl, 2007). The integration of the services coming from several service oriented architectures, is placed to multiple and continuous contextual changes and so, it must be prepared to react to, and if possible, to be recomposed, according to consequent events. It should behaves like an event

driven architecture, or, as suggested for ontologies (Kopecký, 2007) a context-aware architecture. We should not ignore that events are not all predictable (Hoof, 2006).

2.4 Web "Tourism" Services

After the literature review we are convinced that the tourist profile has been changing as well as his interests or preferences, and the emergence of the winning "team" composed by the amazing handheld devices (mobile smart devices) and the ubiquity of the information that anyone can looks for (GS1, 2008) is a fact! Despite of the potentiality of these devices, it is not easy for the tourist to plan its tourist activity. This is the actual scenario of tourism in the web!

A new P (from Personalized and Pragmatic) should be put on the previous marketing tourism strategies bet on 8P's Morrison's elements (price, product, place, promotion, people, partnership, package and programming) (Ma & Crestan, 2009), since the tourist perception and interpretation of the context will be important criteria on the final decision.

In another perspective, and due to the generalist behavior of existent web search engines, it is not easy enough for the tourist to find the expected and correct information. However, important scientific contributions are still emerging. E-marketplaces did a relevant effort to specialize these processes[iii], The *Travelocity*[iv] service demonstrated the new potentialities of human-computer interaction (Hudge, 2009), Schiaffino in (Schiaffino & Amandi, 2009) explored intelligent agent technology to support travel planning, Huang in (Huang & Bian, 2009) reinforced the personalized recommendations systems of tourist attractions, integrating heterogeneous online travel information and advanced selection and matching algorithms (Bayesian Networks and Analytic Hierarchy Processes); Alptekin (Alptekin & Büyüközkan, 2011) integrated case-based reasoning processes and multi criteria decision making (another Analytic Hierarchy Process) system to enhance efficiency in tourism destination planning. Context-based adaptation (Höpken, Scheuringer, Linke, & Fuchs, 2008) and context-aware services (Abbaspour & Samadzadegan, 2008), are others contributions which evidence the emergent aware with the context of the activity.

After the emergent technological potentialities observation and tourist requirements analysis, we can conclude that tourism is clearly an activity which claims for services virtualization. A common travel agent will be efficient if he is able to offer services packages geographically distributed. He should have predictable and guaranteed quality of the service, but to archive this, he must to be able analyze the historical quality of services. Having this, it is no longer necessary to sub-contract many enterprises or to physically visit several places to make sure that everything is properly planned. As "essential", everything must be integrated.

2.5 Information Retrieval, Searching and Selection Strategies

Literature is providing the information on recent proposals for frameworks and technological support. The common concerns focuses knowledge discovery, its interpretation and preparation to offer the best answer to the tourist.

Agents and web services (to enhance the discovery process), advanced matching algorithms (to enhance the accuracy and efficiency), case-based and context-related inference mechanisms define the generalized and relevant offer of the more recent scientific contributions. A hybrid combination of several of these technologies is the basis for most architectures and frameworks analyzed.

Since the mobile commerce (m-commerce) is prevailed, the tourism activities must to adapt to this new channel of information, requiring new tourism marketing strategies (S. Liu, 2005). Paraphrasing (Ferreira & Putnik, 2008), the "possibility to get useful information depends on the capacity to retrieve, search and interpret it. Considering this and accepting tourist information ubiquity, the actual mobile tourist profile looks real and mobile devices should be the key tool for information retrieval".

In sense to reinforce the previous context importance reference, many others variants must be considered, namely, temporality, user preference, geographical information and pragmatics. Kenteris *et al.* (2007) present personalized online tourism services; (Hill & Wesson, 2008) explores preference-based searching capacities to align searching results with tourist interests; and Lorenzi (2007) explores multiagent knowledge-based recommender system to deal better with disperse information and improve the consistency of recommended results; in (Barta, Feilmayr, & Grun, 2009), modularized ontologies show their capacities to model contextual information, towards semantic alignment between tourism service and user context and support better datamining.

A service-oriented travel portal is being proposed to provide tourists with composite travel packages through dynamic composition among travel-related services from distributed providers and across business domains (Li et al., 2011).

The developments of Dinh & Thi (2010) are conducting to the development of a Conceptual Framework for Service Modeling in a Network of Service Systems conceptual framework for service modeling in a network of service systems, based on network configuration and shared information.

(Alptekin & Büyüközkan, 2011) are proposing a framework integrating case-based reasoning system with the Analytic Hierarchy Process multi criteria decision making technique to enhance the accuracy and speed in search and selection of suppliers in tourism destination planning.

Selecting and ranking several results using collaborative-filtering over previous similar experiences and making intuition on user's past behavior and user's stereotype similarities (Silvia & Amandi, 2009); doing knowledge-based inference on user needs and preferences (Middleton, Shabolt, & De Roure, 2004); applying case-based reasoning and multi-criteria decision making of (Alptekin & Büyüközkan, 2011); delivering relevant content to tourist under location-based systems (Schwinger, Grün, Pröll, Retschitzegger, & Werthner, 2006); data-mining over relational databases with online analysis processes (Chaudhuri & Dayal, 1997); integrating data using patterns and markup languages (Hohpe & Woolf, 2004); adapting context-based multimodal adaptive systems (Höpken et al., 2008); etc. are all well referred technical initiatives, essentially based on events and transactions and applied to concretes and objective scenarios.

However, all these technical initiatives only can "infer" new information from existing and registered information or facts. The information which belongs to tourist perspective is impossible to get before its manifestation (spoken, written, other) neither be interpreted unless by another human. There still exist an important gap between the man and the machine communication.

2.6 Collaborative behaviors and supporting technologies

Although it may look different, the communication model persists today as the three entities Shannon and Weaver model (1949) and follows its inherent transmission pattern. As in the beginning, it is need a transmitter, a receiver and a channel as the medium used to transmit the content of the message to receiver. With obvious different technical support, the systems continue to be classified as discrete, continuous or mixed and suffer with "noise" problems too. The actual agent (foregoing transmitter or receiver) of the communication use the team (mixed), virtual (continuous) or face-to-face (discrete) models to collaborate (foregoing communicate) and the "noise" resides in things like confidence ("men in the middle" pattern), trustiness, etc. So, if in that time these were technical particularities, now we assume the analogy more to the way how and for what they are used for.

As Weaver defended, the accuracy (technical), the precision (semantic) and the effectiveness continue to be the critical levels of actual communication goals. The syntax (form), the semantics (meaning) and the pragmatics (use) of the language, are the essence of these levels, respectively. The terms syntax, semantics and pragmatics were introduced in linguistic and semiotic theory of Ferdinand de Saussure (1916).

This dynamic collaborative behavior might be further enhanced with the emergent technological opportunities. In nowadays information society the persons are focused on common electronic social media as form of collaborative systems. The people are adopting a new social cyber-behavior, motivating them to adopt new habits in working as well in thinking (Mickel, Agosto, Vignollet, & Marty, 2006). We are now better related persons and we can easily share our point of view or send intended information. However, there is an insufficient utilization of this new capacity in actual information systems. The majority of systems were made to minimize the human dependency in the decision making and reduce the complexity (the human being is naturally complex). In consequence of this, the actual systems are "distant" from human being and can hardly be fully functional to him. Although the user can more easily interact it is difficult (almost impossible) to "pass" his interpretation of the context to the system. The system does not need that information to work too. It is a mechanical behavior.

Paraphrasing Giuseppe Begnis "the behavior of the collaborators and the collaborative artifacts are affected by the ability of the infrastructure to facilitate desired and appropriate behaviors"[v].

The increase of technological capacities (considering devices and applications) for real-time social interaction, using on-line meetings, distributed multimedia brainstorms, synchronous and virtual interactions, etc., as evident on *facebook, twitter, skype, twiddla, thinkature*, etc., can be models to follow or to integrate on future applications. Since pragmatics is possible when human beings can share and react directly among themselves, if the information systems support it, the information systems will be (more) aligned with user´s interests and improve the result of the collaborative effort.

2.7 Pragmatics

Pragmatics is one of the semiotic fields and concerns the relation between 'signs' and their interpreters (Morris, 1938). The 'sign' is the foundation of semiotic theory, formulated by Saussure (1916) as a 'dyadic' model: *significant* (the form which the sign takes) and *signifié* (the concept it represents) and by Peirce (1958) as a triadic model: *representamen* (the form which the sign takes), *interpretant* (the sense made by the sign) and *object* (to which the sign refers).

Both authors formulated a theory for the relationship between the elements of their models: *signification* (Saussure) and *semiosis* (Peirce) which results in a different argumentation for the same proof: all elements must behave as a whole. Paraphrasing Saussure *"you cannot have a totally meaningless signifier or a completely formless signified"* and Peirce *"nothing is a sign unless it is interpreted as a sign"*.

For example, in linguistic terms, the word 'full' (used, for instance, when a recipient cannot have more contents) is a 'sign' with: *signifier* (the word 'full') and *signified* (the recipient cannot have more), according to Saussure. But the same *signifier* ('full') could means different *signified* and thus be a different 'sign' ('full' as 'have no patience', for instance). Another example, the semaphore's red light as a 'sign' have: red light (the *representemen*), cars stop (the *object*) the idea that the red light indicates that cars must stop (the *interpretant*), according to Peirce. But how it is perceived the same element of those who know nothing about traffic?

Each one of these examples exposes well the meaning of pragmatics because, and paraphrasing Charles Moris (1995), "deals with the origin, uses and effects of signs within the behavior in which they occur". The fundamental, qualitative, differences between the pragmatics, semantics and syntactic, are virtually the best described by Carnap (1942), based on their degree of abstractness in relation to complete signs and semiosis:

'If in an investigation explicit reference is made to the speaker, or, to put it in more general terms, to the user of language, then we assign it to the field of pragmatics. . . . If we abstract from the user of the language and analyze only the expressions and their designate, we are in the field of semantics. And if, finally, we abstract from the designate also and analyze only the relations between the expressions, we are in (logical) syntax.' (Carnap, 1942, p. 9) (cited in (Recanati, 2004)).

The implication is that any (information) system that aims at considering true needs of a customer, i.e. the needs closest to the real customer's needs, with as less as possible abstractions, should consider pragmatic aspects of communication with him.

Sign interpretations are, thus, context dependent, meaning that actually it is hardly possible to exist an 'absolute', common and universal, interpretation of reality (in our case the reality of the customer needs), but, rather, there are multiple interpretations by multiple communities (i.e. specific for each one customer and by multiple scenarios for satisfying his customer's needs) and in different times (i.e. and in continuous change).

Indeed, the Open Tourism Initiative (OTI), with the Tourism Virtual Enterprise (TVE) as the underlying organizational model, could be seen as a set of semiotic-based models in continuous change, i.e. a set of communication models, or a set of pragmatics based collaboration decisions (following the semiotic-based systems integration (Putnik & Putnik, 2010)).

In the technological perspective the emergence of pragmatic web was a tentative to support pragmatics aspects and complement the syntactic web (common web) and the semantic web. This initiative tried to get relevant information applying human interaction, i.e., concern not only with the form but also with the meaning of the information. Since pragmatics is a field, rather than a discipline (however, there should not be confused with a discipline of pragmatics when applied within the human communication), and, additionally, belonging to the human communication, the tentative to implement the pragmatics in an information system as its part is a paradox.

Other technological initiatives explored several collaborative mechanisms with semiotic frameworks but were no more than technical experimentations to give some intelligence capacity to existing technologies, as happened with agents or web services (Booy, Liu, Qiao, & Guy, 2008; K. Liu, 2008). Once again these attempts tried to "transform" human particularities following to technical requirements towards their integration (utilization) in the information systems.

2.8 – Much more than ICT

The customer's expectation satisfaction must not be seen as an easy and completely defined process. The tourist participates as a customer in a set of complex and unpredictable scenarios where the conditions might be completely unpredictable.

Considering several distinct scenarios we identified three main dimensions of their complex and unpredictable behavior:

1) The *linguistic competence* on communication
2) The *behavior* of the tourist during context evolution
3) The *technological* conditions

Although most of people think that technological problems (legacy systems, not integrated systems, insufficient support, methodologies, etc.) represent the main argument for the deficient alignment among tourism business and IT, we are convinced that personal (tourist) factors represent the strongest argument, most of them related with the ability to well communicate (in sense of to be able to transmit und understand a message) or with the behavior dynamics of the tourist. Let us explore these dimensions better with some possible real practical scenarios.

Considering the language meaning, a subset of linguistic knowledge[vi] (Fromkin, 2000), present in the intra-tourist (or agents) communication, several factors (educational, cultural, social, religious, intends, etc.) can easily respond for the high probability of incapacity, error or failure in the meaning transmission process. This means that any two persons in the context of tourism (tourist agent and customer, for instance), might have difficulties in communicating. Paraphrasing Mey, the ability to understand another speaker's intended meaning is called *pragmatic competence* (Mey, 1993). So, have the capacity to communicate cannot be enough.

In a completely different aspect (dimension) of the scenario, the tourist, as human, could easily change his interest or motivation regarding a given objective, depending on the context where the activity is to take place as well as his new interest or preference. The tourist may have had presented their initial requirements; they were well understood for the tourism Agent (so the first scenario was surpassed), and the activity was prepared according to those requirements. But the tourist can easily change them or have new ones, later on. This is a typical situation where the tourist, independently of any information systems or language problems, changes his behavior or interest. Since the human behavior is not constant (most of the times the behavior is irregular or ambiguous), the patterns of behavior are not more than empirical or just a representation of part of the real information.

In the technological dimension of the problem (and not only informatics) and according to the tourist's requirements, the system will suggest a set of possible activities. In case of doubts or indecisions about what activity to choose, what to do when the activity changes or when his interest diverges, the tourist will need to have more (new or different) information or

even to interact with someone (tourist agent, another tourist, etc.) in order to refine some requirements or to clarify eventual (new) questions. A great effort of interoperability among all tourism services providers are the essence for effective tourist support. If those particular systems are not interoperable and somehow integrated, the “global” system hardly satisfies the tourist expectation.

The regularity with which these scenarios can happen requires agility on the management of tourism service composition, of tourist request as well as the capacity to allow tourists to communicate each other and generate their own activities outside the idiosyncrasy of the information systems.

3 Open Tourism Initiative

This section explores the Open Tourism Initiative (OTI), an architecture proposed to handle dynamic tourism packages under Virtual Enterprises organizational model, viewed as a model with a high reconfiguration dynamics of the inter-organizational structure. This architecture behaves as a middleware among existing tourism technical solutions and will support real-time collaborating and communicational behavior, more adequate to human-to-human interaction, reasoning and decision. Dynamic reconfiguration will also be supported. The architecture must react to external changes and assure to behave as an adaptive information system (Maurino, Modafferi, & Pernici, 2003).

3.1 OTI Organizational Model

In a traditional scenario (see Figure 1) and after getting tourism proposals from suppliers (phase 1), the agency (broker) needs to analyze the tourist request (phase 2) made by phone, email, etc., gets relevant and known tourism information (phase 3) and takes in consideration the existing relevant constraints (external factors such as weather conditions, travel agencies, accommodation availability, etc ...) (phase 4), in order to give the possible "answers" for the tourist initial required “activity” (phase 5).

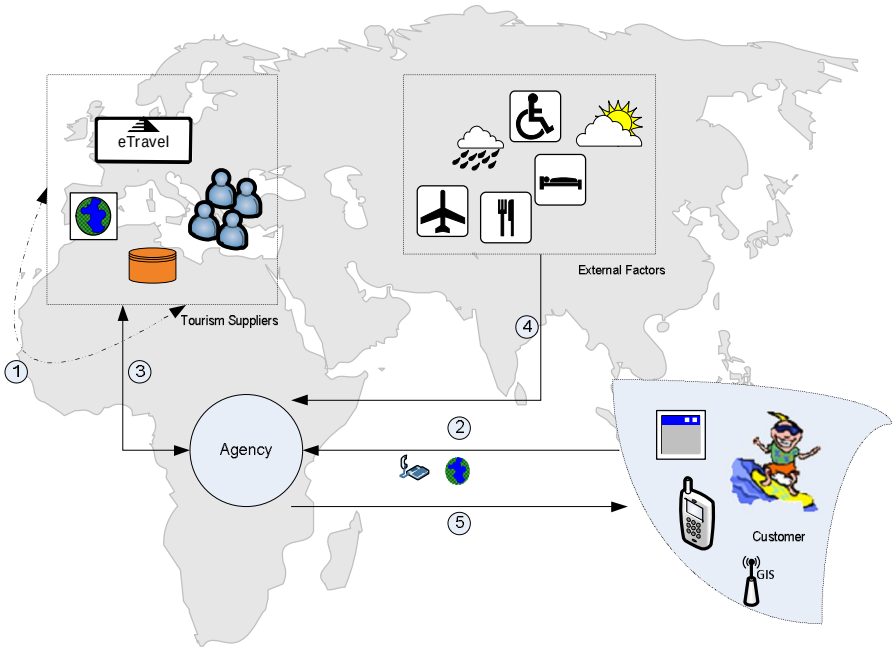

Figure 1 – Traditional Organizational Model

However, this “receipt” does not represent the dynamic nature of this process, where all processes should not necessarily happen in a sequential way. The system should respect to real-time available information and set/configure (reset/reconfigure) other possible solutions. In essence, the system should never respond with a "no" but with a set of answers that satisfy as better as possible the expected interests. Responses should be submitted in compliance with ranking measures and respecting these criteria that the tourist initially defined.

So the new reference scenario is a global (virtual) tourism enterprise which offers tourism services (leisure travels, sport expeditions, cultural visits, social events, etc.). The enterprise or organization members are final tourism services suppliers or intermediary agencies. The users must have all details about all available activities and their characteristics: time, location, logistical requirements, context, etc., and interpret them considering his point of view and reasoning. The interaction with the organization must support real-time collaboration and communication mechanisms, under web or other technical supporting communications.

The tourist can also define his own activity regardless the information system and using only communication processes with any person (other tourist or agent). The capacity to communicate and be understandable must be assured and the real-time video, audio and others auxiliary tools, will contribute for that.

The user must be helped on the creation and interpretation of the results and his point of view must be considered in the final decision. Since several changes can happen in services availability (and mainly quality), as consequence of uncontrolled factors (*external* – relatively to the context, and *internal*– relatively to the person), the organization must reconfigured him-self immediately in sense to assure the same effectiveness for the tourism service. So the organization works around two entities (packages): services and users (see Figure 2). The services will be composed by the pragmatics, brokering and repository sub-systems.

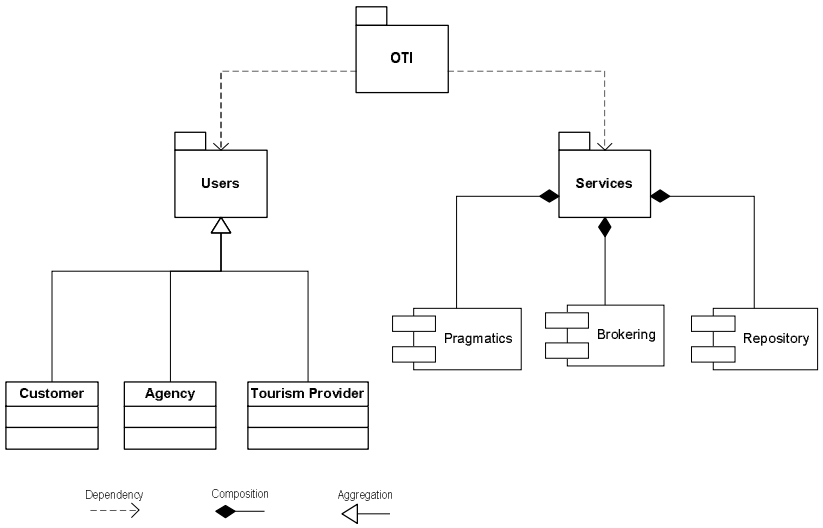

Figure 2 – UML OTI Organizational Model

3.2 Conceptual Model

Considering an *use case* a sequence of interactions between a service requestor (tourist) and one or more services, and *usage scenario* an atomic step in a path through an use case (Zaremba, 2004), we imagine a tourist activity where tourist goes creating, searching and selecting through multiples (virtual) services (scenarios) in order to satisfy its demands (use case).

The Open Tourism Initiative proposed by the authors in (Ferreira & Putnik, 2008) works like a support layer to grant inter-operability among tourism services providers, organized as members of a virtual enterprise, and assure its subsequent reconfiguration inherent to several instances the virtual enterprise suffers along its life-cycle.

Under the conceptual point of view, this architecture represents further than another initiative to centralize tourism activities. The supplier provides and publishes its tourist activity (TA) by using web or other support. The tourist analyzes and selects the better TA in his own perspective using pragmatic supporting processes too. Since a TA represents a model of a real tourist activity, it needs to be described as a service with particular requirements. If the requirements are fulfilled and the services are available, the activity is presented to tourist. If the tourist doesn't like the proposal he must be allowed to try to reconfigure it or event to create a new one.

The measured requirements or formal knowledge could be attributes to which it is possible to set a particular value. Distance, time, duration, are examples of it. Personal requirements behaves as informal knowledge and not possible to measure. At most they can be "estimated" based in similar content-based analysis or event a case-based reasoning. Tourist humor, character, preference, context, etc. are examples of those requirements. So, the evaluation will be obtained by collaboration and interaction processes with the tourist too.

So in a conceptual level, this architecture is composed by a set of services and appropriate technological features which allow their real-time analyses, composition and selection, taking in consideration the user perspective.

3.3 Logical Model

From a logical point of view, we structured OTI architecture with the following components (see Figure 3):

- The Tourism Object (TO)
- The Tourism Service Provider (TSP)
- The Tourism Object Repository (TOR)
- The Tourism Object Broker (TOB)
- The Tourism Pragmatic Engine (TPE)

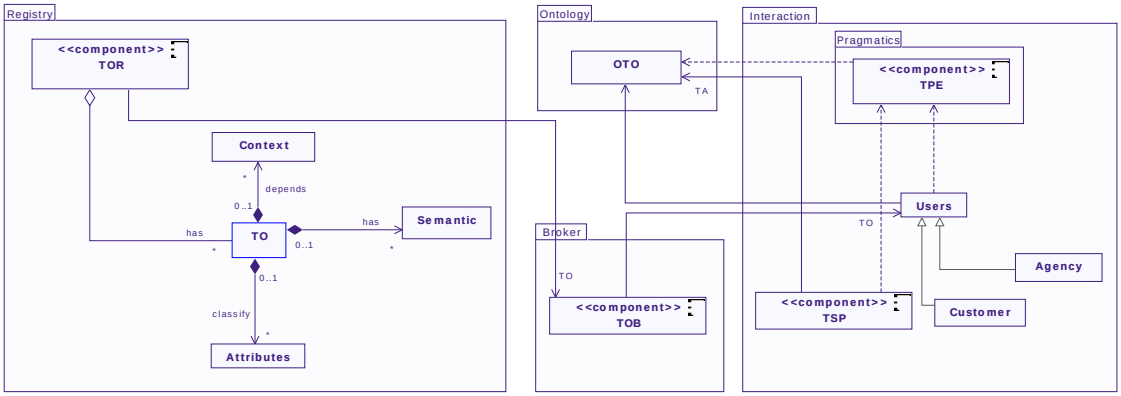

Figure 3 – UML Architecture Logical Model

Each architecture element has its properties and responsibilities. The *Tourism Objects* (TO) are the kernel element (*data type*) of the OTI architecture and its definition should be supported by a tuple of attributes and values, complemented with necessary semantic data. All used terms are according to the domain ontology. For instance, a travel should have a "distance" attribute which could be a numerical value, a mathematical function, etc.

The tourism activity information can come directly from *Tourism Service Providers* (TSP), which are responsible to propose tourism activities (TA), or directly from the tourist who was involved in a co-creation process of his tourism activity. These TO must be pushed in the *Tourism Object Repository* (TOR), a kind of a Market of (Tourism) Resources but, regardless of time or context, they must be automatically or manually (explicitly) registered and correctly classified or "cataloged" previously, using the specific domain ontology meta-information (*Open Tourism Ontology* – OTO) (see excerpt on Figure 4). Much other information will come from other tourism or related official institutions, like regulations, norms, statistics, notices, etc.

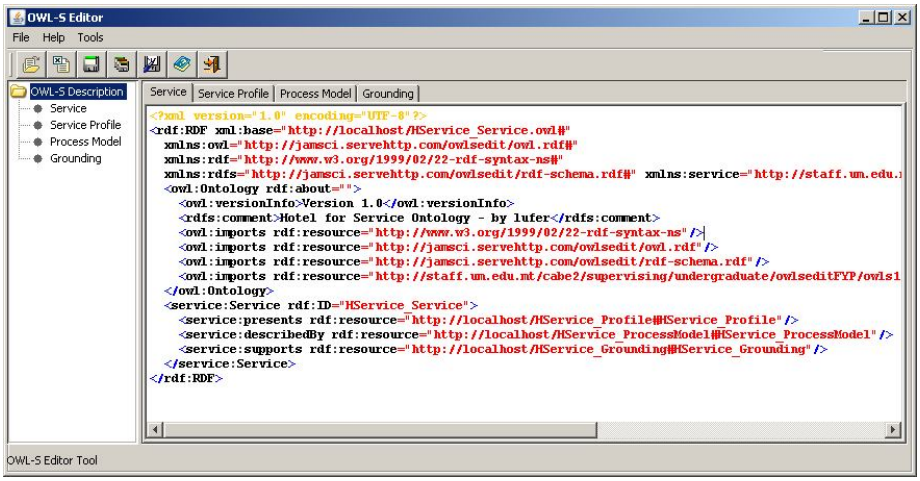

Figure 4 - OTO Touristic Service description

Usually the tourist has no idea or has insufficient information to define exactly his interest or motivation. In these circumstances he usually needs to interact with someone to try to archive a satisfied activity. To support this, the *Tourism Pragmatic Engine* (TPE) will enable pragmatic aspects of the communication, i.e. a feedback, mechanisms with real-time communication (video,

audio, etc. and related auxiliary tools), allowing a natural participation of the tourist on the co-creation of the activity with other agent (human).

Since the activity is defined and registered on the TOR, the *Tourism Object Broker* (TOB) is responsible for the delivery of tourist activity (service) in any subsequent search. The delivery result is affected by service quality and availability, by the context and by the user requirements. Bridging the gap between the tourist and all the information he seeks, the broker needs to be context-aware and user profile-aware. The quality of service (and consequent ranking) is obtained using appropriate measures (or criteria) and applying the tourist point of view.

So the TOB works firstly as a knowledge resource driving the definition of the end-user tourism activity, and designing the system of tourism objects and service providers that "best fit" his requirements or expectations. It is also the supporting tool for the reconfiguration management, assuring the permanent alignment among the VE and the tourism activity. As we could see above, reconfiguration is needed due to following causes: 1) performance or availability of the involved providers, 2) changes in the end-user requirements (and consequently in the tourism activity) and 3) external/ uncontrolled causes.

Although each registered TO has its (meta) information, many other kind of information (semantic, context, etc.) should be needed and its existence should influence the quality of the service.

For a tourist, the main interest is the quality of service, discarding details of how it will be supported. There must be only one entity providing the tourism service (for instance, a travel agency) but its implementation necessarily involves several distinct others entities, each providing its part of the solution (air plane, accommodation, catering, etc.).

But what happens if something goes against planned? An air-plane lost, an activity suspended because the weather conditions, etc.?

Face to unexpected situations (external factors), the system (of providers) must be "reconfigured" to avoid disappoint the expectations of tourists, i.e., to assure the permanent alignment between the tourist request and the proposed solution.

Support decision, backtracking or rollback mechanisms should be used and the tourist (or its agent) should need to moderate the process. From the technical point of view, the reconfiguration requires integration of potential services providers and theirs information systems (IS). The process relies on a properly integrated IS architecture, robust but not rigid.

For the evaluation of the quality of tourism services it is crucial that all TO which compose them be described in the same formal representation. Since a TO can "comes" from different providers, it must be mapped into the OTI ontology.

Once tourism covers multiple areas, this ontology should be able to learn (OLP2, 2006) from multiple and heterogeneous data source formats (even other ontologies), services classification and quality, etc., allowing its enrichment with new concepts and relations (Barta et al., 2009). The expected capacity to learn will require its interaction with existent ontologies, like Open Travel Alliance (OTA), Geography Markup Language (GML), and others (Maedche, 2002).

3.4 – Technological Model

From a technological point of view, the OTI supporting architecture must allow a real-time collaborative participation as well as asynchronous processing and information systems interoperability. The architecture will three layered, based on "Event-Driven SOA", a hybrid participation of an Event Driven Architecture (EDA) combined with Service Oriented Architecture (SOA) (Maréchaux, 2006).

The EDA allows the transmission of events between decoupled components and services, allowing, for instance, the asynchronous pushing of TO on TOR, from tourism providers or, even the reaction to reconfiguration triggers. The SOA supports the TO discovery (brokering) and their (re)composition in tourism activities, assuring IT efficiency, adaptability and agility.

If it comes necessary to integrate the tourist services provider's information systems, it will be supported by an Enterprise-Service-Bus architectural pattern. The agility, reliability and pervasive integration will be supported in this way.

Considering the brokering process, as happen with WSDL/UDDI Web services technological support (Endrei, 2004), it must "discover" the appropriate tourism offer, after "navigate" in the market of tourism resources or tourism objects repository (TOR), trying to match those tourism objects which satisfy a particular criteria. It must filter (well) structured data and must be able to compose several (web tourism) services.

Its behavior will be supported by synchronous (and asynchronous) web services, respecting critical services (time or transaction dependents). They should be "helped" and "improved" by *Web Processing Services (WPS)*, trying to offer better autonomous processing and scheduling capacity (OCG, 2011).

In the case where the tourist needs to interact with other, there will be integrated mechanisms to allow find out tourists, to allow real-time conversation (with video, audio, etc.), whiteboards to help express his interest, recording and seeking tools, etc., assuring the appropriated communication.

4 OTI Architecture

As referred above, the OTI supporting architecture will be structured in three layers as represented in Figure 5. The first layer, Presentation, will allow the tourist request, collaboration and interpretation, as well as the presentation of tourism activity results (answer). All feedback, as pragmatic aspect of the communication process (tourist co-creation) and reconfiguration triggers will be support here as well. The logical constraints coming from tourist perspective must be "translate" to technological ones and "weights" for quality of service evaluation.

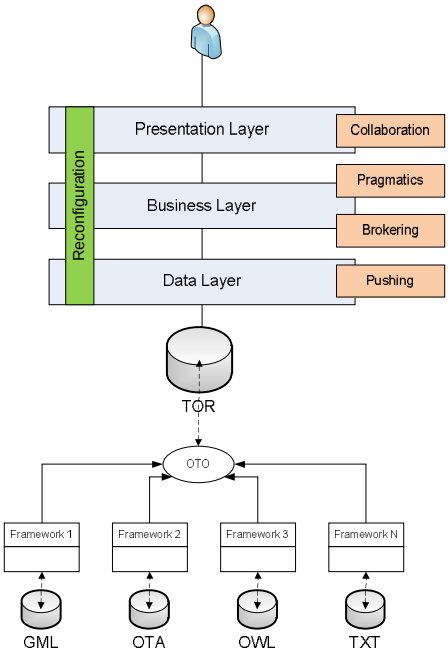

Figure 5 - OTI General Architecture

The conditions for the execution of the request (data integrity and consistency), filter refinement, services ranking, etc., will be support in the next layer: the Business Layer. All processing rules must be defined here, both related to requests or answers. For instance, a request cannot be made if tourist is not registered yet.

All requests are interpreted and executed on tourism object broker module and results in a set of queries to tourism object repository which is supported in third layer, the Data Layer. This repository should have all tourism objects with their meta-information formally described on Open Tourism Ontology.

In previous and parallel processes of TO registration, coming from tourism providers, the distinct (if any) initial ontologies must be mapped to OTO. These registrations must be asynchronous and independent of system initiative. A moderated pushing behavior (similar to FTP protocol communication) must be implemented. Having this, the broker will only need to "search" (discover) TO description language (similar with WSDL) on local TOR and certify its operability and availability.

The proposed architecture, being technologically based on the model-driven, event-driven and service oriented architecture models, assures the interoperability of the several distinct services provider's information systems, as well as the immediate reaction to changes on the initial requirements. The integrated communication and collaborations tools will enhance the human interaction process, allowing the tourist to "behave naturally" in the decision making of service brokerage mechanism, as well as in the tourism activity definition, allowing him to construct his proper activity considering his perception and contextual interpretation. Since there is the intention to deploy a centralized repository of tourism objects (similar to UDDI on web services), it should be implemented an ontology mapping to deal with existing domain specific ontologies.

5 Conclusions and Future Work

The e-Commerce and e-Business forced enterprises to undertake important transformations and reorganizations (intra and inter). This had occurred with the web and will be repeated in the Cloud (as Google CEO Eric Schmidt once said, "better thinking now on WWC – World Wide Computer, that is, what is behind u-Commerce, ubiquity").

The Tourism is a particular case which shows clearly this reconfiguration and demonstrates the impacts of internet acceptance. There are a lot of sites which offer multiple services, from simple information to complete activity planning, including accommodation reservation and travel.

However not everything looks easy indeed. From a point of view it is very difficult to have several (unknown and distinct) entities working together where the global planning conditions has been changed, for any reason; and for another, the personal perspective and preference of tourist are not plenty considered on delivery of the results.

The globalization and easy access (of information and proposal), allows tourists to change constantly their plans. Services reconfiguration and resulting impact on their information systems need to be supported.

The Open Tourism Initiative here proposed and explored, tries to handle tourism service dynamic reconfiguration. The services are provided by Tourism Virtual Enterprises which need to quickly adapt and reconfigure to be aligned with expected tourist service. Each tourist service provider can interact, with rigor and opportunity, using any informatics platform.

After the tourism object description and registration via domain ontology, there should be a brokering mechanism which will support their discovery and orchestration process. It should be possible also to offer a decision support system to orient the tourist in his plan redefinition. Considering this, the forward developments on OTI architecture should enrich the specific domain ontology (*OTO – Open Tourism Ontology*) to describe *Open Tourism Objects (OTO)*, concerning temporality, accessibility and pragmatic characterization. A *Tourism Object Chain (TOC)* will be needed to support TO scheduling and composition.

The pragmatic feedback must be transformed in technological constraints so that it can be used in service co-creation. The natural language processing could be a way to insert that feedback.

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