FUTURE SMART-ORGANIZATIONS: 
A VIRTUAL TOURISM ENTERPRISE

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Abstract:

To remain competitive in the aggressive global market, Tourism industry and service providers face the necessity to strongly collaborate and share their expertise and resources, as well as their costs and risks. The paradigm of Virtual Enterprises (VEs) and smart organizations addresses the necessary base horizontal infrastructure needed to support such a collaboration framework. Designing a Web-based Tourism Information System (WTIS) as a virtual enterprise, requires the proper provision of: (1) enterprises inter-operation and task sharing, and (2) federated information management. Enterprises need to inter-operate, share the task execution, and collaborate towards the distributed processing and coordination of their joint activities. Furthermore, federated management of information is required in order to support their sharing and exchange of information, while preserving their autonomy and individual rights to proprietary information. These two aspects, strongly present within the recently initiated EC-funded 5FP project FETISH\(^1\), are addressed in this paper. The paper discusses the requirements and research challenges, and describes an innovative reference architecture for the WTIS, focusing on a novel horizontal infrastructure supporting the Virtual Tourism Enterprise. It further addresses how vertical value-added-services can be developed on top of this base WTIS infrastructure. In specific, the paper describes an example distributed business process for a value-added-service “booking a journey plan” through the WTIS, that both presents the role of a temporary VE in supporting this service, and addresses necessary subtasks to be executed by different VE enterprises.

1 INTRODUCTION

Advances in the information and communication technologies (ICT), namely the continuous growth in Internet availability, introduces a structural change in both production and service providing industries, accelerating and evolving business processes, as well as the user / client interaction. This trend induces a shift in the roles and the ways of work of traditional business actors, and consequently on the way their information has to be organized and managed.

For instance, in the manufacturing industry, the manufacturing process is not carried out by a single enterprise anymore. Manufacturers feel the need to focus on their core competencies, but when necessary join efforts with others in order to fulfill the requirements of the new products demanded by the market. In a cooperative network of organization, every enterprise is just a node that adds some value to the process - a step in the manufacturing / supply chain. Although most

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classic examples of networked organizations can be found in some particular production business domain, such as the automotive industry, nowadays this tendency is spreading to many other production areas, including the food and agribusiness industry. This need for highly dynamic networked organizations and supporting their specificities leads to the new paradigms of Smart Organizations and Virtual Enterprise.

Similar to the production industries, the need to remain competitive in the open market also forces the service providing companies to seek “world class” status. In the case of Tourism industry, companies remain concentrated on their core competencies, while realize the need to look for alliances, when additional skills / resources are needed to fulfil business opportunities. Cooperation among the actors / entities in Tourism industry is not a new phenomena. For instance, travel agencies typically offer aggregated or value-added-services composed of components supplied by a number of different organizations. But to provide an on-line value-added-service for “booking a complete journey plan” that may include several means of traveling, several hotel bookings, car rentals, leisure tour bookings, etc., a networked cooperation must exist among many different organizations. Thus, what is really challenging in this sector is the extensive use of available and new ICT. On one hand, ICT facilitates the way these organizations cooperate, by giving them the opportunity to be more reactive and timely to the market challenges. On the other hand, ICT provides a different level of information availability and accessibility to the clients, and simultaneously induces the new need for more comprehensive services.

When resorting to the ICT to support their interaction and cooperation, an alliance of tourism organizations constitutes a virtual organization. A virtual organization in tourism is then a temporary consortium of different organizations (service providers such as traveling agencies, accommodation providers, organizers of leisure programs, or public tourism organizations, etc.), that join their skills and resources in order to either offer an integrated and aggregated service or to better answer to a business opportunity, and whose cooperation is supported by the computer networks.

Although clearly, certain characteristics and requirements are of a different nature when comparing the provision of products with services through the virtual enterprises, there are still many base components that are common to both areas. Basic functionalities for safe communications, distributed/federated information management, and coordination of activities mostly build the base horizontal infrastructure supporting the creation, operation, and dissolution of virtual enterprises [5], [6] while the value-added-services constitute the vertical developments on top of such base infrastructures.

Members of a virtual tourism organization need to:

- Inter-operate, share the execution of tasks, and collaborate towards the coordination and distributed processing of their joint activities, in order to achieve the common goals of the virtual tourism organization, e.g. tailor a specific service to the existing expertise in the virtual tourism organization, so that it also best suits the needs of the particular client.
- Share and exchange necessary information, that is spread over geographically distributed areas, and that is heterogeneous in nature (both in its representation and its classification format), while preserving enterprises’ autonomy and individual rights to proprietary information.
Several characteristics must be carefully supported in such cooperation. Typically these organizations use heterogeneous legacy systems as their internal information systems (with an associated culture and with specialized human skills), and use specific data models and different computational platforms. Furthermore, enterprises are autonomous nodes in the network. They are mostly developed and, except for the case of the common goal of the virtual enterprise, run independently of each other, and may be even competitors. They may evolve in terms of their technologic infrastructures in different ways (depending on many internal and environmental factors, and not only of the technological nature), and have their own distinct internal behavior and rules. The network may also consist of a mix of private and public organizations of different sizes.

In this context, the information sources are clearly distributed, heterogeneous, autonomous, and continuously evolving. The dimension and nature of these information sources represent a tremendous obstacle to a harmonized integrated information system organization to support enterprises cooperation.

The remaining of this paper is organized as follows. Chapter 2 introduces the main challenges and current research efforts in tourism information systems as well as the most promising emerging technologies that can impact the sector. Chapter 3 introduces a reference architecture for a federated web-based tourism information system (WTIS). Chapter 4 discusses some approaches and examples of business process definition and management to support the creation of valued-added services in the context of virtual organizations for tourism. Finally Chapter 4 presents some conclusions.

2 EMERGING TECHNOLOGIES AND RESEARCH EFFORTS

Information is clearly the essential “raw material” for tourism service providing industry. The quality and complexity of services offered by any tourism organization depend on where the information is gathered, how it is classified, and what is the level of trust in the information being accurate and up-to-date. Even today, and certainly much more in the future, both the sources of information and the clients in this sector represent a wide network of geographically distributed and even mobile, heterogeneous, and autonomous entities, a determining characteristic to be considered when designing a Web-based Tourism Information System (WTIS).

Most tourism information available through the Internet consists of static pages, mostly made available through the travel agencies. These pages are user-oriented (in HTML format) and it is difficult to process and interpret their content by application software. This is an obstacle for implementing intelligent value-added-services that generate an aggregated “service” by assembling contributions from different sources of information. However, some classes of information available through HTML pages on the Internet are in fact dynamically derived from heterogeneous databases first (for instance accessible via CGI interfaces), and then made available through the HTML dynamic pages. That is for example the case of information about the hotel rooms or flight seats availability.
On the other hand, a large number and wide variety of terminology (not necessarily representing real new concepts) are constantly introduced in this sector for the modeling and management of information. This in turn makes any harmonization attempt for the sake of collaboration difficult, particularly considering the level of autonomy that each organization wishes to preserve.

The tourism industry, in the current context, strongly depends on the advances in the Information Systems Technology area, specifically tailored to the particular specificities of this sector. There is a need to combine ongoing experiences and results from the tourism sector with mechanisms defined in the industrial Virtual Enterprises and Electronic Commerce areas. This merge is necessary in order to move towards new and open architectures supporting seamless expansion (due to the global market changes), reliable intelligent (value-added) services, and ease of administration (e.g. guarantee of service quality). Some example areas of research and advanced technology related to this effort include: Federated database management systems, Multi-agent systems and mobile agents, Advanced workflow and coordination models, XML and advanced multimedia technology, advanced inter-operation support software (e.g. JINI), Safe communications and authentication mechanisms, Distributed business processes management.

While the electronic commerce initiatives advances in certain necessary areas, e.g. the electronic payment, etc., several other areas of development play a major role in this direction, among which the areas covered in the following subsections need to be emphasized.

The EC-funded 5FP project FETISH, addresses and benefits from the advances in the areas described below. More specifically, FETISH has roots in two other European funded projects, The ESPRIT project PRODNET II (1996-1999) [5], and the TELEMATICS project InTouriSME [7]. The PRODNET project has focused on the development of an open platform and advanced IT protocols and mechanisms to support virtual industrial enterprises. The InTouriSME project focuses on building an Internet-based Tourism Constituency for SMEs in the less favored regions of Europe.

### 2.1 Federated Information Management

Considering the wide variety of information and the huge number of information sources, attempts to create shared global schemas to be used by all tourism information systems (WTIS), although in the short term may assist the development of some information standardization, but as the ultimate solution are bound to fail. A similar attempt was followed for many years in other sectors, e.g. manufacturing, with no successful results. A more promising approach would be the one that tries to create *federations* of collaborative sites as information sources, preserving their desired levels of autonomy, namely in terms of the local information representation, and authorized visibility rights on shared information [8]. At the same time, nodes in the federation are supported with their access to the local and remote information within the federation, with complete data location transparency. The DIMS module in the PRODNET project represents one such example federated database system developed for virtual enterprises in the area of industrial manufacturing [1], [2], [3]. The federated database support for the FETISH project concentrates on the information management requirements among different actors in the Tourism sector. This effort will be based on existing infrastructures at tourism organizations (e.g. the static and dynamic HTML pages and information systems), and attempts at providing an integration and harmonization of the wide variety of data and operations handled by these organizations, while preserving their autonomy and securing their proprietary information.
2.2 Activity and Process Coordination

Within a virtual tourism organization, a value-added-service is best represented by a distributed business process, which needs to be jointly executed by the involved enterprises. Coordination of joint activities is a determining element in Virtual Organizations. Proper coordination policies supported by flexible coordination mechanisms are necessary to ensure the cooperation among partner enterprises. When properly “orchestrated”, the combination of various processes will lead to the achievement of the global goals of the virtual organization. A main approach, typically found in the workflow management systems, and the work on the coordination languages, focuses on the separation between the coordination and computing (or service processing). At the same time, sharing and exchange of information in a cooperative virtual organization is always inter-related to both the business processes running at each enterprise, as well as the distributed business processes that run at different sites. Therefore information management aspects cannot be independent of the business process coordination issues. For the virtual organization, a properly integrated architecture merging the workflow-based coordination and federated information management was introduced within the PRODNET project [4] and proved to be extremely effective. A similar approach is being designed for the FETISH project. However, in FETISH the emphasis on this development is redirected into providing a strong and novel basic platform to support advanced value-added services.

2.3 Configurability

Trust is a key issue in any cooperation process. The level of trust between two partners depends on their past experiences (if it exists), and therefore it is a dynamic variable. A main consequence of trust building between enterprises is on increasing the level of information sharing. At the same time, enterprises are autonomously evolving in terms of their infrastructures, culture, and internal business practices. In order to cope with the necessary dynamism in enterprises and in their cooperation patterns with other enterprises, there is a need for highly flexible and configurable mechanisms allowing for the dynamic definition and modification of the information visibility and authorization rules as well as the infrastructure evolution. Similar dynamism in configurability is required for the definition / modification of the joint virtual enterprise activities, monitoring their status, and supporting their coordination in the VE.

2.4 Multi-agent approaches

Multi-agent systems and in particular the mobile agents technology is currently under investigation and being thoroughly explored as a vehicle for information brokerage in networked environments, and a possible approach for implementing the federated systems. The mobile agent approach, such as the use of crawlers seems promising in supporting the “intelligent” assembly of data and contributions required from different partners (information sources) to a target node. However, several barriers still exist such as the security (protection against intruder agents / virus), provision of facilities to host and support the task execution requests from a mobile agent at the receiving nodes, and the lack of appropriate interfaces for the information sources. As mentioned above, most information sources have a non-normalized HTML-type of interface, which becomes an obstacle against the automation of the data access by a mobile agent. Another aspect requiring clarification is the relative positioning of the agent technology and other middleware technologies such as CORBA in this approach.
2.5 Data and services brokerage, using inter-operation protocols and standards

Considering that the main goal of the WTIS is provision of information and services to clients, investigation of the advances in this area of IT is necessary. In this direction Java and Java-based tools address the support software environment for brokerage of information among heterogeneous platforms and environments. Furthermore, recent advances offered, for instance through the JINI technology [9], offer a generic Java-based infrastructure that can be applied to deploy and use a wide variety of services (also including the data provision services) in any distributed computer network. For the development of the WTIS, technologies such as JINI facilitate the management, interoperation, and execution of different computing services offered by the tourism enterprises, by simply "plugging" them into the WTIS.

2.6 Data exchange/interchange standards

New data exchange means, such as the XML, are becoming important alternatives to HTML, overcoming some of its limitations. However XML alone for instance, is not sufficient. In order to handle and interpret the exchanged information, besides its structural aspects, it is mandatory to know about its semantics, and how it relates to the local structures and semantics defined at the receiving nodes. One possibility that is generating large interest is to combine the XML with the standard definitions of information exchanged in the domain. For instance, EDI can be suggested here, due to lack of other existing sector dependent standards. Namely, combining the data structuring constructs of XML, without loosing its multimedia aspects, with the data dictionaries / ontology provided for instance by EDIFACT. A specific investment in this direction is necessary for the tourism industry, similar to what is being done in other sectors.

2.7 Basic ontology

The impossibility of creating one large comprehensive set of data descriptions (schemas) representing all the data in the field, to be commonly used by the entire tourism community, is a clear issue. In several other sectors, for instance manufacturing, for which the need for IT-related data integration was felt long ago, this goal was pursued for many years through the standardization bodies (e.g. STEP), and still continues without reaching the end any time soon. Nevertheless, starting efforts in the direction of standardization of definitions and concepts are now becoming essential for the Tourism sector, and beneficial to its IT-related developments. It is necessary to invest in the development and dissemination of some basic ontology that can strongly contribute to reducing the semantic gap among different information sources and assist the required developments by multi-disciplinary areas.

3 DESIGN OF A WTIS REFERENCE ARCHITECTURE

This section describes the design of a global reference architecture for the WTIS. Here we address the general application requirements for this design, but first there is a need to make some basic assumptions and introduce some terminology and definition of concepts in order to reach a common view, when describing the general WTIS reference architecture.
3.1 Basic assumptions

From the clients’ point of view, in principle a service offered by tourism enterprises and other related organizations, called TOSP – Tourism Service Provider in this context, may either refer to an information-retrieval service or a requested-action service. As these names represent, the information-retrieval services support users (being client end-users or other agencies) with their information retrieval requests. Similarly, the requested-action services are users’ requests for an action, e.g. booking a seat on a plain or a train.

At the same time from the service providing agencies point of view, an actual (real) service provided by an enterprise is referred to as an end-point service, while the services that can be supported “not by but through an enterprise”, are referred to as the front-end service. At present through the Internet, many services (both front-end and back-end) are provided by TOSPs. These services are typically made available and offered by service directories (or the lookup-services) on the Internet.

In an ideal case, enterprises should be simply able to plug/unplug their services to/from the WTIS service directories. Furthermore, WTIS must provide a “standard” service-interface to support the interoperability among enterprises, regardless of the heterogeneity associated with the actual implementation of the services themselves or their location. This means that no matter how the service is actually implemented (in terms of the computer platform, operating system, programming language, internal modules, etc.), there should be a client service-interface to assist interfacing to WTIS services. We will address this subject again at the end of section 3.3.

At a lower level of details, the front-end services constitute two main categories of services:

1. Basic Services (BAS)s, are related to the basic “products” (end-point services) offered by tourism organizations such as the travel, accommodation, catering, etc. Examples of requested-action services that fall in the BAS category include: hotel_booking, flight_booking, telechecking, car rental, etc. Examples of information-retrieval services that fall in the BAS category include: tours descriptions, hotel prices request, etc. A BAS is typically provided by a tourism organization, that we refer to as BASP – Basic Service Provider, e.g. an airline or a hotel organization.

2. Value Added Services (VAS)s, are composed of either some basic services and / or other value added services. In other words, complex services can in principle be built on top of other simpler services, while a simple service can in fact be provided by several different providers. A value added service is typically provided by a travel agency, that we refer to as VASP – Value Added Service Provider. For example, a holiday package service is composed of a number of basic services, such as arrangement of flights, accommodations, museum visits, local tours, etc. When composing a VAS, besides the BAS and VAS, some other functions specifically provided by the WTIS, here called the generic services, can also be used. Examples of generic services may include monitoring functions, statistic functions, and other generic information retrievers, such as checking the credibility of an enterprise etc.

Processing a value added service itself involves several activities, what in fact defines a business process (BP), i.e. a VAS is always implemented as a BP. Later on in this section we also describe the distributed BPs.
In terms of the computational infrastructure, and in order to overcome the difficulties induced by heterogeneity and geographical distribution, a JINI type of client service-interface (independent of the actual implementation language of the service) can represent both the basic and value added services. In the case that a service is implemented by a legacy application, it is the responsibility of the TOSP to build a wrapper around it, in order to “declare it” to (or “register it” at) the lookup service according to the WTIS guidelines. This approach enables a “uniform view” for all service provisions (independent of their provider), what greatly reduces the heterogeneity problem, a typical obstacle when federating autonomous distributed components. As such, the services provided through the WTIS can also uniformly represent both the basic and value-added services. The success of this approach however, depends on the adherence to the WTIS services and service format approach by all involved TOSPs. For a web-based system, the approach to make all results available as “public domain”, can certainly contribute to this “adherence”, but other factors have to be also carefully considered, for instance:
- Extension and usefulness of the services included in the WTIS platform.
- Good initial collection of a representative set of demonstrative services.
- The market success of the adopted inter-operation support software technology (e.g. JINI).
- The “marketing” and dissemination strategy.
- The post-project support services assumed by some public/private organization.

3.2 Proposed architecture for a federated network of tourism services

Every scenario using WTIS services prefers a specific configuration of the service providers and a certain architecture to fulfill its activities best, which is in most cases different than the configuration and architecture supporting another scenario. By definition a reference architecture for WTIS can support typical WTIS events, in the line of the requirements set forward earlier in this paper. The diagram in Figure 1 represents a four-tier reference architecture (or reference model) proposed for this WTIS, that supports the web-based federation of tourism services, including mechanisms for the creation of business processes that define value-added-services, and the creation and operation of virtual organizations among networked tourism agencies. We will describe this reference architecture and its four tiers, while going through the steps that need to be taken for processing WTIS events. Afterwards, we will address and discuss some exceptional cases, and in specific we will discuss more complex business processes and go through their execution steps. Below we first describe the function of each tier and give an example of the elements that represent it.

- Tier 1 – The **Client Tier** represents the nodes from which in fact the processing of a service (BAS or VAS) is initiated. These nodes typically constitute the human users who need a tourism service.
- Tier 2 – The **Service requesting Tier** typically represents the VASPs nodes, who receive an order from the previous step. A node here plays the role of an intermediary broker of services, that “request services from the WTIS node” in order to finally reach the actual providers of the end-point services.
Tier 3 – The WTIS Tier represents a federation of nodes, called the WTIS Promoter Nodes (WPNO)s that can potentially provide access to end-point services. Please notice that here we state potentially, since in principle and considering the architecture planned for this WTIS, it is possible to have value-added services hierarchically defined on top of each other, however at certain point the access to the end-point services will end this iterative process. The WPNOs can operate at regional level, i.e. a WPNO may represent (or offer) the services on behalf of several tourism organizations active in a given region. Various WPNOs are also interconnected, and thus supporting the federation of all services to be seamlessly accessed by the service requesters.

Tier 4 – The Service Provision Tier typically represents nodes such as the BASPs who provide the end-point services. However, again considering the potential hierarchic definition of services on top of each other, it is of course possible that a node at this level also represents another intermediary broker of services, namely a VASP. In this case, the VASP itself becomes a service requester to a WPNO, and thus becomes a member of both Tier 2 and Tier 4, while processing certain WTIS events.
Handling exceptional cases

One important point to be considered when defining the nodes in each tier is the “complexity” of the functionality provided by the nodes, and the variety of roles that they can play in the WTIS. For instance for WPNOs, if a WPNO in Tier 3 is itself also a provider of certain front-end services, it can also play the role of a VASP in Tier 4, and thus for certain WTIS events, the tiers 3 and 4 collapse into a single Tier. Further, if it also offers the proper interface to client tier, then a node in the client tier can also directly access the WPNO, and as such for certain WTIS events, the tiers 2 and 3 collapse into a single tier. Similarly, if WPNO provides certain end-point services, e.g. the retrieval of some common information on hotels, then again the tiers 3 and 4 may collapse into a single tier for certain WTIS events. Also for Tourism enterprises, one enterprise can at the same time play many roles, at different tiers, in this architecture. For instance a hotel may provide several end-point services such as room reservation, as well as certain value-added services such as reservation of tickets for the museums and local tours. The reference architecture presented in Figure 1 is comprehensive enough to support all these potential events that require the WTIS involvement. Please notice that BASP nodes do not appear in Tier 2 of the WTIS reference architecture, since those events are not WTIS dependent.

3.3 Further details on the four tiers

In this section some more detail information is provided in order to better illustrate and describe every tier and the nodes in every tier.

About Tier 1 – Client nodes. End customers (tourists) at this tier can have access to both VASPs (via the front ends offered by the VASPs) and to those BASPs provided by a WPNO (via certain web-based interfaces).

About Tier 2 – Service Requesting nodes. The nodes in this tier in fact, represent the end-users of the WPNOs (in Tier 3). The tier 2 nodes are mostly tourism agencies that would like to make available and add their services to the WTIS federation, and that at the same time wish to gain access to the wide variety of the services offered in the same way by other companies. These enterprises can be classified as the Local or Regional Service organizations (for instance the LRSs resulted in the InTouriSME project [7]) or constitute either a large or even a Small/Medium size Enterprise (SME). In most common scenarios, the end-user (a person) accesses a VASP enterprise, connected to a WPNO. Another example scenario may include users accessing the WTIS system directly, for other requests that perhaps only the WPNOs can provide, such as checking on the credibility of an actual BASP enterprise.

About Tier 3 – WTIS Promoter Nodes (WPNO)s. A network of WPNOs could be established, possibly one for each region, to provide fundamental services to the TOSPs (and their customers). Following is a list of some functionalities that can be provided by a WPNO:

- Registration and management of services and service interfaces.
- Lookup services (for the region covered by this WPNO).
- Graphical business process (BP) editor and service selector. This is by itself a service that can be used by VASPs whenever they want to prepare a new BP template (as described below).
- Catalog of defined BP templates.
- BP executor (a workflow engine). The execution itself may take place at the clients’ site (who downloads the executor from the WPNO) or at the WPNO. A variant of the workflow executor developed in PRODNET [4] is being reengineered to be used for the WTIS.
- Registration and management of profiles.
- Federated information management services.
- Generic services (e.g. monitoring service for BP execution).
- Collaborative consortia (VE) definition services (as described below).
- Agreements / contracts definition service.
- Log of all activities (for future statistical analysis, data mining, and further extraction of information about different TOSPs, their activities, and their customers).
- Etc.

In general, the actual creation of a VAS (the definition and management of the BP representing it) is done by a VASP and not by the WPNO. The WPNO however, can provide the infrastructure and the policies to support the federation of services and data and the creation of the necessary cooperation consortia to execute the VAS.

Once a BP (representing a VAS) is created, its creator may wish to keep its definition (as a template) for future use. The WPNO can offer, as examples, a collection of **BP templates** for some possible VASs. A TOSP could then for instance download one of these templates and edit it to suite its particular goal, before submitting it as its own service to the WPNO. The federated information management functionality provides the support to store these templates and make them available to authorized clients.

An important aspect to bear in mind during the design of the WTIS architecture is the need for some kind of “profile management”. In principle, profiles can describe all elements involved in the system, namely the customers (human-users), the enterprises (VASPs and BASPs), and the services (VAS or BAS). The profiles are necessary to be maintained in WPNO, for the main users (requesters from tier 2) and service providers (from tier 4) involved in the system. For instance, for every WTIS member enterprise there should be a profile containing general information about the enterprise (name, address, kind of organization), business areas, service categorization, etc. Similarly, the information about the services and “quality of the services provided through WTIS” should be associated with the profile of services (BASPs and VASPs) and its service provider, which may even be used *against* the profile of the service requester, to select the best service, among many, to offer. These aspects are quite varied in nature and include for example:

1. the service reliability, for instance if the service is always successfully located and properly executed,
2. the acceptable response time, for instance if the company replies promptly and on-time to faxes, emails, etc., and
3. the quality of the ultimate real service, for instance if the booked hotel really matched the expectations of the client.

There is also a need for “logging information about all accesses through the WPNO”, representing the flow of all kinds of events, task accomplishments, activity progress, etc. This information can be used later to provide useful information related to the profile information and quality of service, as described in the points above, as well as for potential data mining purposes. These are other information that will be properly managed by the federated information management functionalities of the WPNOs, while supporting the authorized access rights and
information visibility required by TOSPs. Furthermore, the WPNOs at this Tier constitute a federated database system, sharing and exchanging all necessary information among them and seamless to the nodes in other tiers.

**About Tier 4 – Intermediary and end-point service provider nodes.** The BASPs are the actual implementers of the end-point services that can register their services in WPNOs. Typically, for the well known services, WPNOs can normalize the *service interface* and impose it on the service providers, where all BASPs have to comply with such service interface rules. However, for new VASs, service interface specifications may be proposed either by the BASPs providing a new service, or by the VASPs themselves. In the later case, the VASP may "impose" the kind of interface it requires from the BASPs in order to accept them as the provider of its VASs.

4. Business processes and Value Added Services

A value added service (VAS) can be properly defined by a BP, while the activities of the BP can be supported (executed) by several other services (local or remote). A BP can be represented by a *workflow plan*, as defined by the WfMC [10]. Figure 2 below illustrates an example workflow plan for a BP template that implements the value added service “Booking of a journey plan”.

![Figure 2 – A workflow plan for the BP template representing a VAS](image)

This example uses a graphical representation language (developed in PRODNET II project [4] and illustrates some of the main mechanisms to describe the involved processes:
- Sequence of activities (activity = box, flow = arc).
- Splits and joins; parallel activities.
- Conditional branches.
- Loops and temporized activities.
- Sub-processes.
- Data-flow management (for the relevant data involved in the process control).
Figure 3– Example of a graphical language for BP definitions

Sub-activities included in a value added service might themselves be performed by other BPs, making the BP template a nested BP. This is the case, for instance, for the sub-activity “Plan a trip by plane” represented in Figure 4.

Figure 4 – Example of sub-activity workflow plan

In principle, a BP can be defined within a WPNO, Figure 1 shows the BP editor, BP executor, monitor and notifier components within the WPNO. Figure 5 below represents the relationship between these BP handling elements and the services (BAS and VAS) supported through them.

Figure 5 – Relationship between the BP Editor – BP Executor with the Services
The BP monitor supports the human administrator of the WPNO, in order to follow up the activities of the BP executor. The BP event notifier will notify either the VASPs or the clients (depending on the system configuration) of all relevant events, namely problems, conflicts, and/or success of execution at each step.

4.1 Dynamic creation of cooperative consortia – Virtual Enterprises

Typically, once a value added service is requested, the execution of its BP involves provision of services by several different TOSPs. For WTIS, and considering the future of Tourism industry, the TOSPs involved in a given BP, usually need to dynamically establish a temporary cooperative consortium (a virtual enterprise – VE) to achieve a requested value added service. Besides these dynamic consortia established to execute each BP, long-term cooperation agreements are also sometimes established among enterprises to jointly support certain services. When a customer contacts a travel agency, he/she frequently notices that the agency shows clear preferences for certain specific providers, probably those that are involved in long-term cooperation agreement (formal or tacit), or those with whom the agency had good past experiences in other temporary cooperations. Some other types of consortia may have a more permanent “institutional” organization, with or without a common ownership, for example the Best Western hotel chain. The three types of consortia (temporary, long-term, and permanent) require flexible common mechanisms that must be provided by the horizontal infrastructure of the WPNO for supporting the Virtual Tourism Enterprises. For instance, one necessary functionality for the WPNO is the provision of an editor to define the structure / topology of a consortia / VE, the roles of different partners, and their cooperation agreement. A simple prototype is developed in PRODNET project to support this functionality [5]. The set of BAS registered within a given WPNO, also represents one kind of virtual organization.

4.2 Configurable service lookup management

Considering the need for dynamic cooperative consortia to support the virtual tourism enterprises, it is important for the WPNO to accommodate and manage certain associations of the offered services either to their service providers and/or to certain consortia of service providers. Therefore, diversified and configurable structures and management of lookup services are required. Furthermore, a service may be offered in multiple lookup services (possibly with different access rights). For instance, not all service providers are equally acceptable by all clients, and there are usually certain preferences in such choices. These requirements justify the need for a lookup service management component in the WPNO. The federated information management component of the WPNO supports this configurability.

4.3 Dynamic Consortia cooperation agreement

The cooperation agreement (or contract) regulates the responsibilities and liabilities of involved enterprises, and the form of the cooperation consortia of TOSPs. Furthermore it defines the access rights to services (and in turn to the information). This means that not all services registered in a lookup service are necessarily available to all clients, rather special agreements and associations usually exist that over-ride such generality. This is in fact the counter-part to the client’s preferences described in previous section. Therefore, the WPNO must also support the flexible (dynamic) functionality required for such configuration of rights. Similar to the
configurability requirement in section 4.2, here also the federated information management component of the WPNO supports the required flexibility.

4 CONCLUSIONS

The tourism industry is facing structural and cultural challenges with the rapid introduction of web-based technologies in this sector. Tourism industry has gone through an initial period of individual initiatives, in which each organization tried to "register" its presence on the web by creating individual sites (and HTML pages) with little interactivity. There is now a need for an infrastructure that supports the creation of Virtual Tourism Organizations, and the proper support (horizontal infrastructure) for management of their cooperation. The horizontal infrastructure provides then the base for supporting the creation of value-added services (vertical applications) through the aggregation of simpler services offered by different tourism organizations. This paper contributes to the identification and characterization of the information system requirements in Tourism sector, and proposes an innovative reference model and architecture for a federated web-based tourism information system.

REFERENCES

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