A case study of semantic solutions for citizen-centered Web portals in eGovernment: the Tecut Portal

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Abstract. Web portals are emerging as significant tools for eGovernment. Portals are the "gateways" between citizens and Public Administrations. Although a number of them have been already developed, shortcomings related to interoperability and usability limit their usage and potential. To improve their performance, we propose a semantic approach based on the so-called "Life Events". This approach provides several advantages related to service automation and enhanced searching. Also, the usability offered to the end users is improved. To validate our techniques, the proposed approach has been applied to a real case study: the Tecut Portal.

1 Introduction

Web portals are playing an important role in the provision of digital services for citizens and Public Administrations, here after PAs. The evolution from the old-fashion Web sites to the current Web portals has allowed the development of new ways of doing business, learning, acessing services ... They are referenced, in the modern information society, as eTechnologies. At the same time, PAs noticed the emerging of Web portals as significant tools enabling eGovernment and they introduced them as gateways to interact with citizens. Of course, the introduction of Web portals allow the reduction of time and cost both for Public Administration and for citizens.

A number of eGovernment portals have been already developed even though, in several cases, shortcomings related to interoperability and usability limit their usage and potentiality. Due to the unavoidable need for service integration, interoperability concerns must be solved. This issue involves concerns at administrative, operational, technical, semantical, legal and cultural level [1]. Thus, PAs must perform a long-term study to evaluate how to deploy their solutions. These ones must provide the highest possible level of satisfaction to really increase the level of interaction with citizens.

This paper intends to show the implementation of a solution offering customer-oriented services and the integration of the former in a Web portal. A semantic-based approach on the so-called "Life Events" is followed to drive proposed features. Our proposal allows several advantages such as automatic services composition, advanced searching mechanisms, new functionalities as well as a better usability from the point of view. Summing up, our approach provides a more friendly users support for eGovernment services. To validate our techniques, a real case study has been developed: the Tecut Portal [2].

The rest of the paper is organized as follows. Firstly, we present the eGovernment state of the art. Secondly, we introduce the Tecut Portal, the study case we are dealing with. Next section introduces the concept of Life Event as it is going to be considered in the proposed framework. Later on, we introduce semantics in the system to model in a formal way the use of LE and to support its invocation. Finally, some future work and conclusions are yielded.

2 State of the Art

Web portals represent integrated gateways for government service between PA and users to provide a single point of contact for services. The goal of eGovernment services is to conduct complete end-to-end solutions for citizens whenever it is possible. As portals integrate services, they certainly improve access to government, reduce service-processing costs, and enable PAs to provide a higher quality of service.

The development of Web application for eGovernment services has benefits for both government and citizens. Allowing the access to information and services by means of Web interfaces, citizens and businesses can now access and interact with PAs under a 24/7 model.

We can also make a distinction related to the level of possible interaction in eGovernment solutions[3].

1. Emerging presence (stage I). Just information is presented and documents are available only for download.
2. Enhanced presence (stage II). Citizen can search for documents and perform more advanced operations; nevertheless, citizen can submit very little amount of information to PAs.
3. Interactive presence (stage III). Interactive services are available and government officials can be contacted by email, fax and telephone.
4. Transactional presence (stage IV). Two-way interaction is supported and complex services (such as taxes, fees and postal services) are available.
5. Networked presence (stage V). Final level that integrates all services under ICTs platforms and support a two-way open dialog between citizens and PAs.

The highest functioning Web portals show a complete system integration across agencies whereas portals with the lowest level of functionality provide little more than access to forms and static bits of information. High-functioning portals

create a true one-stop shop for citizens[4]. In particular usability, customization, openness, and transparency represent the key aspects of portal functionalities[5].

As matter of fact, Web portals from PAs can take advantage of semantic solutions to solve issues related to organizational heterogeneity, interoperability and information accumulation. Information and services can be provided by different governmental agencies in different locations and the user does not necessarily know the organizational structure and who is responsible for each service. In these contexts, semantic is expected to play a relevant role. In literature we can find some interesting initiatives, at different levels, that make use of semantic:

- e-GIF (eGovernmentInteroperability Framework) [6] is the technical guidance for deploying eGovernment in the United Kingdom. Among many other national initiatives, it is relevant for our case because of they support for semantic features as in e-GSM (eGovernmentMetadata Standard)[3].
- Several projects supported by the EU through the Framework Program must be cited:
  - OntoGov[7]. This project deals with the problem of services in eGovernment under a semantic point of view and it is aimed to provide an ontology to model the problem in a maintainable way.
  - Terregov[8]. This project's main goal is to provide an interoperable layer that allows citizen to access eHealth services in a transparent manner by means of web services.
  - The SemanticGov project[9]. This project aimed developing a software infrastructure to provide support for PAs by means of semantic. Currently, it is an ongoing project.
- Suomi.fi[4][10]. The Finnish portal for eGovernment services that provides a taxonomy for the classification of services.
- EIP.AT[5][11]. A project developed in the University of Linz, Austria, that addresses integration problems and tries to solve them by means of semantic modeling.

3 The Tecut Portal

Several Italian Regions were suggested to develop eGovernment solutions aimed at increasing interactions between Public Administrations and citizen by means of ICTs infrastructures. In order to accomplish this high level goal, several issues related to key aspects in the eGovernment domain have to be taken into account, such as authentication and authorization, service publishing and discovery as well as composition. As results of these considerations and according to a recent study about skills for the case[12], it was developed the Tecut Portal[2] (see Fig. 1), a fully integrated government portal for shared and standardized services within the Marche Region.

[3] http://www.govtalk.gov.uk/documents/eGovMetadataStandard%2020040429.pdf
[4] http://www.museosuomi.fi/suomifi
[5] http://eip.at

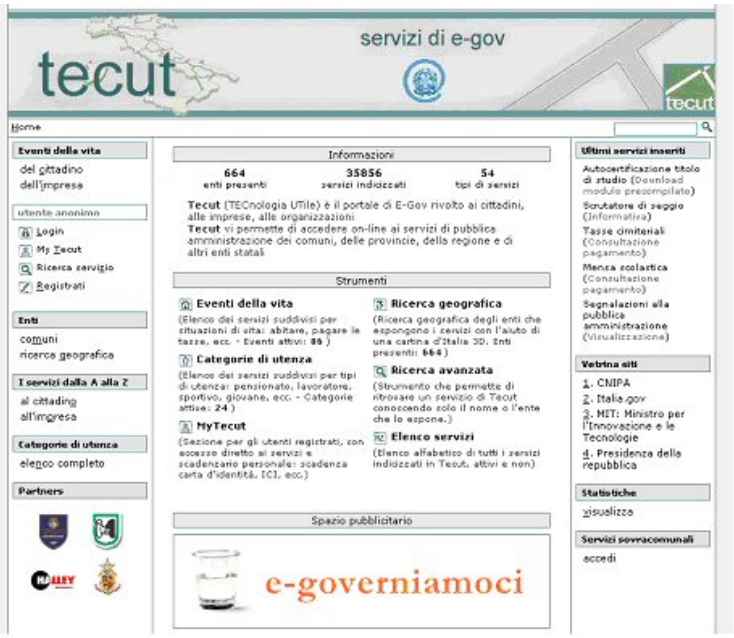

Fig. 1. Tecut Portal home page.

This study case is aimed at supporting activities of small and medium enterprises. Besides, the adaptability due to changes on political, social and economic conditions is a leading feature in the system.

A global vision of the Marche Region comprising further financial arrangements and aggregations, enterprises, banks and citizens is provided. This clearly boosts the national and international chances to increase relations with PAs and drive advanced ways to improve standards of living. As a matter of fact, the Marche Region is among the first places in Italy as far as welfare, cohesion and competitiveness are concerning.

Even a lot of issues deserve a special attention, we would like to devote attention to a few of them. The authentication process plays a main role in Tecut. It represents the instant when the system determines the association between the digital identity and the user. The recent proliferation of digital services has raised concerns about a lot of authentication mechanisms. Marche Region supports the realization of a central authentication solution through Cohesion[13]. It is an infrastructure that provides solutions for complex technical problems and a set of common standard services predisposed to realize applicative cooperation as the national eGovernment plan states.

Authentication services for centralized management access in private areas are provided by Single Sign On (SSO) [14] and Profiling system.

- The SSO's tasks are predisposed for the transfer of credentials between authenticated users and access portal. In particular, the authentication on the framework is possible with different levels: via weak registration using username and password and via strong registration using services regional cards "Raffaello"[15]. Furthermore, SSO allows a transparent access to the portal's reserved areas without further authentications and it allows that authentication credentials and user profiling are made available to different application domains. Indeed, the user authentication check is delegated to the service. It uses a regional services register to validate the profile in respect to the access roles.
- The profiling system is dedicated to the coordinated management of credentials information, logically divided in a static subsystem and in a dynamic one, containing a series of attributes able to indicate the user's preferences when accessing the services. A part of user base profile will be requested during the registration phase, and another part is communicated after explicit request, when a service is used.

Processes related to discovery and composition of services were designed by means of LifeEvents, as explained later on. This new approach brings several advantages in the design and planning of solutions as shown in next sections.

Therefore, the portal is expected to offer a holistic support for on-line operations regarding Public Administrations within the Marche Region. Provided interfaces and information are expected to make easier citizen's life. At the same time the portal has become a reference point at organizational level providing back office governance. Currently, the portal is a gateway for 531 agencies, provides 65 different kinds of services and 34.515 digital services.

4 LifeEvents as organizer

The provision of advanced services and the so tight constrains related to interoperability lead us to the search of a common paradigm to build up facilities in an interoperable and effortless manner. From the study of the domain and the requirements of the former, an approach based on Life Events is proposed. Within the context of this proposal, Life Events (here after LEs) are those situations that drive the citizen to interact with the administration in order to fulfill an obligation or execute a right. Thus, we can consider as "Life Events" situations such as getting certifications, paying a fine, getting married, moving, ...

The first time the concept of LE about eGovernment was used is related to the eGovernment project[16]. In that context, Life Events were defined as "situations of human beings that trigger public services". That definition is the starting point for our semantic definition of LE. This idea is reused in different official pages such as the Ontario's Official Site[6], Nova Scotia's one[7], the Irish

[6] `http://www.gov.on.ca/`
[7] `http://www.gov.ns.ca/snsmr/lifeevents/e/`

eGovernment initiative[8] and others. Those pages make use of the concept of LE to index and locate services according the citizen requests.

We make a step forward towards the definition of LE. By mean of semantic definitions and properties, an entire system is proposed to catalogue, search, discover, and orchestrate services in the domain. In the definition of LEs, documents play a relevant role. In any democratic administration, documents are the only prove that an operation has to been done and must be supported.

Taking into account the former considerations, we establish a semantic based definition for LE. These elements are going to play a main role in our case and they are expressed using semantic terms shared by the whole system. The definition of a LE includes the following items.

- **Task**. Title for the considered operation. Folksonomies can play an interesting role as they provide support for semi-automatic enhancements of discovering services.
- **Description**. High level description of the desired operation expressed in natural terms from the point of view of the citizen.
- **Input Documents**. As previously stated, all operations carried out by the administration require some input document. Citizen is requested to provide a signed form in order to invoke the operation. This element plays a role similar to *preconditions* in some environments. In the considered case, we can identify as inputs documents, the current certification
- **Output Document**. Of course, as a result of any performed operation, the PA in charge must provide an output expressed in terms of the ontology. This information will be put together into one or several documents. This output will vary its content from the expected document (i.e., a certification, a license, ...) to information about the failure to get the expected document.
- **Scope**. We must identify the scope of the operation (local, national, international, ...) where we want the operation to be recognized.
- **Security Conditions**. This is intended to express the conditions for the security mechanism involved during the whole process. This includes the identification of both parties, citizen and PAs, and also the way is stored by any agent involved that could be able to use it.
- **Cost**. This will express the amount you have to pay for the requested operation and/or also the time it will take for the completion of the operation.
- **Version**. Life Events can be modified and changes from one version to another one must be tracked.

These elements will be defined using the power of semantic expressions that will allow us to provide advanced services for discovering and orchestrating them. LifeEvents can also be tagged using well-know metadata standard already proposed and endorsed by relevant organizations such as [17], [18] and [19] from the CEN.

So, we propose the transformation of final services as they are requested into new LEs expressed in terms of the semantic definition using the former items

[8] `http://www.oasis.gov.ie/siteindex/by_life_event.html`

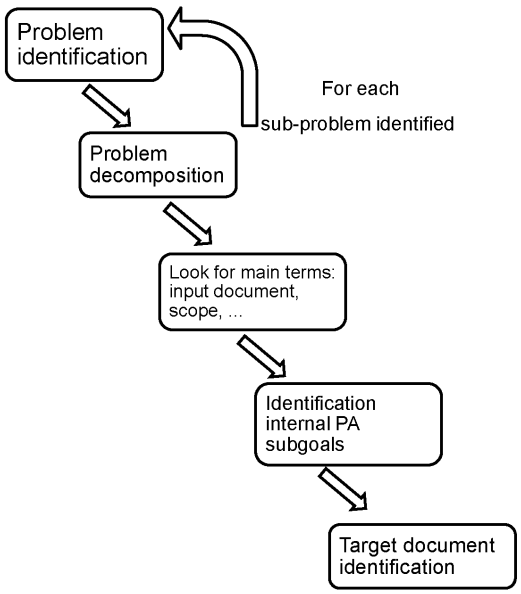

Fig. 2. Schema for the defintion of LE.

presented. Thus, the goals presented in the previous section about Tecut can be achieved. This schema is suitable for eGovernment field, or at least more suitable than in other environments, due to several reasons: all operations require some input document, the most common output in the service is a new document, there is no need (opportunity) for bargaining about services, there are limits and conditions very explicit about the data managing in terms of trustability and security (non-repudiation, privacy, integrity and confidentiality) and operations does not have real time constrains.

In order to transform common services into LE, expressed in the proposed terms, we must follow a simple methodology. For the sake of clarity, we are going to show the former by means of an example: the situation in which a citizen has to move to a new residence. This operation may require the collaboration of several different PAs and several processes the citizen does not have to be aware of. Thus, we propose the following schema (see Fig. 2).

1. Identify the problem and dealing features as PAs involved.
   Applied to our practical case, the task we are dealing with is the change of address for a citizen. The involved PAs are the cities council, of course, they should involve several offices or divisions but that should be transparent for the citizen.
2. Decompose the problem into different problems that may be solved in a single step, i.e., each step must produce as output a document meaningful for the citizen.

The considered operation in the example may involve one single operation and no subprocesses are relevant to the citizen.

3. For each identified subprocess, look for the input documents, scope and cost. These ones must be expressed in terms of the LE ontology.
   The input document required in our case is the certification of the current citizen address, the document to prove the new address and the signed request for the change. The scope for the operation is national. No cost is put on the citizen and no limitations are related to it.
4. Identify internal partial aims for citizens and PAs. These steps usually involve internal documents. They can be meaningless for the citizen but relevant for the administration.
   In our example, several steps can be identified: check for the correctness about the former address data, look for pending payments, update internal data, notify related PAs, and, finally, generate the certification for the new address.
5. Identify possible documents as possible final steps of the operation.
   In our case, the target document is the certification for the new address. Nevertheless, if problems arise, mainly related to some internal step, documents to notify those errors may be generated. Those documents will inform about problems due to pending payments, problems with legal constrains, ... These documents must be included in the ontology.
6. Update all services and agents that may be aware of the new service.

Once all this information has been gathered and codified properly, it can be presented to the end user.

As a result we can identify in Tecut a classification of LE that enhances the accessibility from the point of view of the citizens. Navigating from the home page of the Portal, users can easily access a list of LE classified according to a taxonomy to choose the one best fits in their interests.

5 Semantic Life Events

Semantic plays a relevant role in this solution. By means of ontologies[20] we are addressing a higher level of abstraction than the one based on raw data. To undertake the provision of an ontology we may use different languages[21]. OWL (Ontology Web Language)[22] a W3C Recommendation is the chosen one for our proposal. By using OWL, we are addressing a standard, solid and interoperable platform for the provision of this solution. Proposed approach takes advantage of the power of OWL to express the information relevant for the system. Nevertheless, we must keep in mind that OWL is just a tool to express knowledge with all its potential and limitations. Thus, following Methontology[23], a FIPA recommended process to develop ontologies, one has been developed.

In this ontology, we have reused former already defined data representation. For example, for the definition of the citizen, one main class in the system, FOAF[24] has been reused, and, to mark documents in the system, metadata in

[18] has been taken into consideration. This is part of a general philosophy leading toward the maximum possible agreement and reusability both of ontologies and software derived from the former.

On the other hand some limitations on the possibilities of OWL to express knowledge have been faced. In particular, OWL does not support relations that involve properties whose range is a class itself, just an individual from a particular class. This leads us into shortcomings in the definition of some relations (for example, we would like to establish a relation between an individual from the class LE and a subclass of "document", not an individual from that class). This situation was overcome using a higher level of abstraction implicit in a single individual (the use of individual document belonging to the class document as a generic one with no information by itself).

Additionally and for the sake of consistency of current and future information in the system, some rules has been defined (see Fig 3): all LEs generate some Document (Rule 1), all LEs are supported by some PA (Rule 2), all Documents are issued by some PA, ... Of course, lower level details about the conformance to local or national laws regarding document and legal procedures are not considered at this point and further implementations of the system should take care of it.

Once the ontology that describes the system is provided, the development of support for the access to these LEs must be faced. As the only possible interface is the Web page, all the logic and semantic processing is put on the Web Server. Nevertheless, the chosen approach is based on wrapping LEs with Semantic Web Services to define and to support them. The reasons for this decision are due to the wishes to provide a standardization of these definitions and the use of already developed software packages to deal with the information. The current state of art regarding this topic in the present moment it is quite unstable. Thus, we can find technologies designed to introduce semantic in Web Services that are emerging and others that may be in process of obsolescence. To meet our requirements, we decided to make use of WSDL-S[25]. Main reasons to choose this option among other available possibilities are due to its simplicity but semantic power to express all required information. Other options were dismissed because of different reasons. OWL-S[26] was seriously considered but it introduced a lot of overhead and it did not provide any clear advantage on WSDL-S, a much lighter technology. WSMO[27] was also considered but the use of mediators does not really fit in the aim of this project.

Each LE drives the generation of a WSDL-S file describing it. *Inputs* and *outputs* in each *operation* included in the system, are defined in terms of the ontology developed. As the preconditions and effects are implicitly provided, respectively, by the inputs and the outputs, it is enough if the latter are stated. Thus, in our example, the LE *"moving"* is defined using a WSDL-S file. This one declares, as inputs, documents identified previously. Accordantly, the output of the operation is defined also in terms of the same ontology and, in this case, involves the already indicated documents. Thus, it is quite simple to make

Fig. 3. Rules defined in the system

Rule	Definition
Rule 1 $R_1 = \{\forall LE \exists Doc,$ $generates(LE) = Doc\}$	<owl:Class rdf:about="#LifeEvent"> <rdfs:subClassOf> <owl:Restriction> <owl:onProperty> <owl:FunctionalProperty rdf:ID="generates"/> </owl:onProperty> <owl:someValuesFrom> <owl:Class rdf:about="#Document"/> </owl:someValuesFrom> </owl:Restriction>
Rule 2 $R_2 = \{\forall LE \exists PA,$ $isSupportedBy(LE) = PA\}$	<owl:Class rdf:about="#LifeEvent"> <rdfs:subClassOf> <owl:Restriction> <owl:someValuesFrom rdf:resource="#PA"/> <owl:onProperty> <owl:InverseFunctionalProperty rdf:ID="isSupportedBy"/> </owl:onProperty> </owl:Restriction> </rdfs:subClassOf>

compositions using a semantic reasoner as it only will have to link outputs and inputs expressed in the same terms from the same ontology.

Anyhow, we must keep the perspective that WSDL-S is just another tool to introduce semantic on LE and many others can be used. As a matter of fact, if required, it is possible to extend the WSDL-S to other technologies with little effort. In fact, some transformations can be done easily[28].

As a result of these design decisions, advanced ways for the composition and the discovery of services are possible within the project Tecut.

6 Conclusions and Future works

In general, eGovernment Web portals are evolving towards a semantic distributed and cooperative approach. In particular, the Marche Region presents a federate community where the discovery of services play a main role. This federated reality allows the sharing of digital services. The fair distribution of the latter saves time and costs. Regarding to the discovery processes, we propose a richer semantic description of services, this proposal considers also metadata to introduce a flexible and extensible LE representation.

Therefore, this paper presents an in deep review of how semantic can be applied to the provision services in the domain of eGovernment. Thus, using a Web portal to provide support for citizen needs, a LE-based approach has been provided.

Currently, two working lines within the frame of this project are under design. The first one is related to the enhancement of semi-automatic discovery mechanisms. In this way, a wiki-like tool is planned to support the construction of a folksonomy to tag services with human friendly information. On the other hand, a digital repository of LEs defined by external PAs is to be designed. In order to obtain full potential from semantic Web Services, also it is planned to provide mechanism to allow that other PAs may upload their own definition of LEs. This would turn out Tecut into a common repository of services from a widespread group of PAs. All LEs in the pool would also be available for citizen through Tecut.

The transformation of common services into LE-based ones has been proofed to be a not too complex process that clearly increases the functionalities and capabilities of the entire system. To unleash all possible functionalities, from the presented work, semantics are called to play a main role in the process of describing and accessing information and services.

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