The Software Business of Semantic Web in E-Government

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Abstract: - This study presents an attempt to identify the software business of Semantic Web technology in E-Government by appealing to a survey concentrated on citizens' needs. The survey represents an approach of citizens' needs oriented to information usefulness in terms of potential applications of Semantic Web. We studied the search, navigation and inter-linked data features in terms of 1) direct access to useful information, 2) searching useful information, and 3) offering easy access to e-services. We present our contribution and valuable remarks.

Key-Words: - semantic web, E-Government, software business, Open Data

1 Introduction

This study presents Semantic Web solution's performance for E-Government. It proposes a framework for analyzing the success of Semantic Web into the area of E-Government.

Social Media, Smart Cities and E-Government call for a new generation of solutions in gathering information.

There are several fields of activity which are described in the literature in relation to the term Smart City: industry, education, participation, technical infrastructure, various "soft" factors.

Most local governments are using Web 2.0. and social media tools to enhance transparency but, in general, the concept of corporate dialog and the use of Web 2.0. to promote e-participation are still in their infancy at the local level. [1]

The challenge is to implement E-Government systems that allow fluid communication with the general public, thereby achieving a greater degree of participation; the key to success for e-government. The desired progression from a purely innovative service into a democratic process that provides efficient citizen-friendly support and communication depends on: information, interaction, transaction and integration. [12]

Some of the most important technological challenges for future evolution of E-Government are: 1) access technologies to ensure e-Government for all, 2) specific technologies for a knowledge-based networked e-Government, 3) new models for interoperability, 4) open source tools for e-Government applications development, 5) quality monitoring tools. [3]

E-Government usually relies on providing public services mechanisms that suffer from lack of knowledgeable availability: although E-Government solutions are available, users are not aware of their existence, of their possible use or of their informative value. In many countries, the legislation and the administrative system are changing frequently. This fact leads to a significant decrease of E-Governmental solutions' use in practice and to a difficulty to offer real-time updating.

In a previous paper, we addressed the question if whether or not do we need a powerful E-Government. There are huge disparities in the access and use of information technologies, and that these disparities are not likely to be removed in the near future unless a concerted action is taken at the national, regional and the international levels. [2]

Several E-Governmental solutions are experimentally adopting semantic web technologies to select the items that may best fit the preferences or needs of each user. These solutions deal with two components: an ontology that formalizes the semantic annotations of the available web resources, and service profiles that formalizes semantic annotations of public services. The matching between the two components leads to more accurate personalization process but its use in E-Governmental solutions finds an important limitation: many E-Government web sites publishers are not willing to annotate a huge amount of items.

The success of e-government requires fundamentally changing how government works and how people view the ways in which government helps them. [4]

The limit access to IT and to the Internet and the usual slow adapting to the real software world characterizing public services represent a set of other existing limitations in implementing Semantic Web E-Government systems.

The scope of this study is to present the potential factors that affect Semantic Web implementation's success. The motivation is given by the lack of understanding Semantic Web potential benefits among citizens.

Specific contributions of the paper include: 1) the presentation of a framework for analyzing Semantic Web implementation's success, 2) the analyze on empirical data.

The work presented in this paper includes the study of the actual needs of citizens which can be addressed by semantic web technologies, the study of available implementations and limits and the study of future software business of semantic web in E-Government domain. Section 2 describes the main Semantic Web concepts treated in conjecture with E-Governmental problems. Section 3 discusses the methods used. Section 4 discusses actual implementations and limits. Section 5 studies the future of software business in this area and Section 6 ends with final conclusions.

2 Semantic Web and E-Government

Semantic web is a collaborative environment meant to integrate data from the www space. Considering the fact that, at present, the web is full of documents that contains unstructured data, Semantic Web is a promising and in the same time a challenge to describe all these unstructured data and putting data in a format that not only humans can understand but also the machines.

For any domain or problem one can build an ontology or otherwise saying a schema for the data that belongs to that domain. But an ontology is far more than a simple database. It contains specifications for entities that exist or may exist in the domain. It contains classes and properties for those classes. Once the ontology is defined anyone can use the defined ontology to describe data without being forced to give values to any class or property from the ontology.

We have a lot of governmental data that is unstructured. Although available, data is not so easy to find or use by another computer-based application.

Government 3.0 is a Semantic Web-based government that personalizes and 'intelligenizes' all government services according to the conditions and preferences of each individual. [6]

As the Semantic Web (sometimes called Web 3.0) emerges, the US government agreed to imply in this trend and, therefore, created data.gov which is hosting demonstrations and documents that will help familiarize Data.gov users with this new technology, and that will let citizens and developers work with the government in creating a new generation of "linked data" mash ups. Data.gov now hosts a set of Resource Description Framework (RDF) documents containing triples created by converting a number of the Data.gov datasets into this format, making over 6.4 billion triples of open government data available to the community.

The recommended standard format for representing data from www is Resource Description Format (RDF) proposed by World Wide Web Consortium [10], [11]. Every web resource must have a unique Uniform Resource Identifier (URI) and it must be described in the form of a triple subject-predicate-object. The subject is the resource which is described. The predicate is the URI of a property that belongs to a public vocabulary. The object is either a literal or an URI which belongs to another resource described in the same way. In order for a developer be able to dispose RDF data he/she must have a triple store which contains triples described as subject-predicate-object. The developer must access public vocabularies/ ontologies available in Open Linked Data and/or the developer must publish a vocabulary at a public address and to develop a SPARQL endpoint in order to query RDF data.

The main idea is that the developed ontology must be related to other ontologies from the Open Linked Data.

3 Methods

The framework of this research shown in Figure 1 was developed according to our research objectives. This conceptual framework consists of two constructs (E-Government solutions' performance and Semantic Web success application factors in E-Government) and claims two sets of relations (*H1* and *H2*) among those constructs.

Hypothesis 1: among users surveyed, there is a significant difference in the mean E-Governmental solutions' performance between users which used E-Governmental solutions and users which did not

used, with respect to each of the following functionality measures: 1) direct access to useful information, 2) searching useful information, and 3) easy access to e-services.

Hypothesis 2: among users surveyed, there is a significant difference in the mean Semantic Web potential successful applications factors between users which used E-Governmental solutions and users which did not used, with respect to each of the following functionality measures: 1) searching information that is linked to other information, 2) obtaining answers to conceptual queries, and 3) filtering and sorting information that is linked to other information.

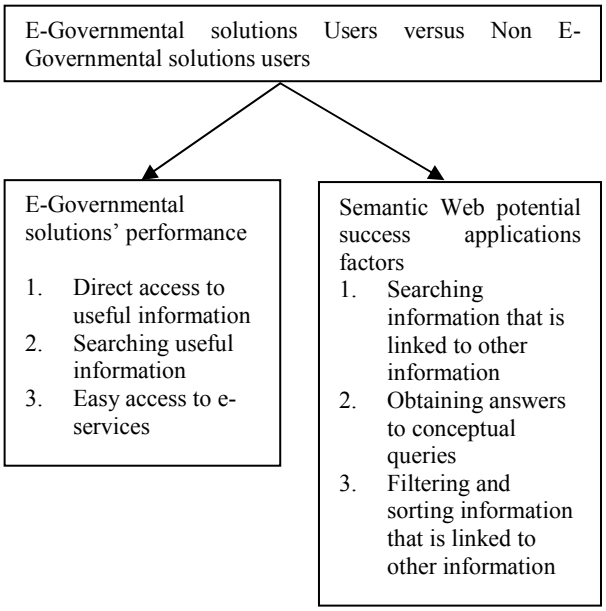

Fig.1 The research model

Each set of hypotheses can be described as follows:

To test H1 we would like to evaluate whether there are significant differences between users which have used E-Governmental solutions and users which did not used. The construct consists of the following indicators: 1) direct access to useful information, 2) searching useful information, and 3) easy access to e-services.

Each indicator was examined to understand the value of Semantic Web implementation for E-Government. One of the important reasons why this hypothesis was proposed for further investigation is that users prefer to use E-Governmental solution but the practical applications are not confident to the intended implementations and we tried to identify is by using Semantic Web their trust could improve.

We emailed online questionnaires to 182 users. The questionnaire was supposed to be completed by users capable of answering the questions it contained. We received a total of 143 usable responses, given a 78,57% response rate. 33,35% of respondents did not used E-Governmental solutions while 52,13% rarely used E-Governmental solutions to find the necessary information, and 14,52% used E-Governmental solutions to find the necessary information and for some available e-services solutions.

We asked the respondents to evaluate each indicator based on a five-point Likert scale. For construct validity we realized a thorough survey of literature. We derived important dimensions for this construct, in which all items were scored on a five-point Likert scale ranging from 1- very unimportant to 5- very important.

If users used E-Governmental solutions, we asked the respondents to rate the degree of importance for each factor based on their experience. We asked the same questions to non E-Governmental solutions users with the only difference to rate these factors based on their perceptions or related experience.

To analyze *H1* we conducted a *t*-test for equality of means between the two groups. We used Levene's test for equality of variances to determine whether equal variances should be assumed for the t-test.

In the end of our research, we conducted a study of using semantic web functionalities in E-Government and we explicitly presented some implementations.

4 Results

H1 compares the difference of E-Governmental solutions' performance between the two groups. H2 compares the differences of semantic web potential application success factors between the two groups.

Table 1 indicates that on average the users which have used E-Governmental solutions have more trust than users which have not used E-Governmental solutions.

The results indicate that there is still room to improve users' trust on searching information and offering access to information and services. Non E-Governmental solutions' users valued higher than E-Governmental solutions these indicators.

Related to direct access to useful information users were asked to evaluate: navigation, categorization and filtering of information.

Table 1. E-Governmental solutions' performance evaluation between the two groups

E-Governmental solutions indicator	Average score		*t*-statistic	p-value
	Users	Non-users		
Direct access to useful information	3.88	3.72	0.62	0.5
Searching useful information	3.92	4.12	0.56	0.60
Easy access to e-services	4.12	3.82	0.99	0.33

Related to searching useful information, users were asked to evaluate: the presence of the search functionality and the functionality of searching using keywords related to E-Government service's characteristics.

Related to easy access to e-services, users were asked to evaluate: the possibility to filter information that is linked to other information and the possibility to select E-Government services depending on users' need.

Our results showed that none of the *t*-statistics is significant which means that there are no differences between the two groups. The dimensions and factors chosen by us seem to have the same importance for the two groups and that it is still room to work at least to convince the non E-Governmental solutions' users.

5 The Actual Implementations and Limits

The use of information technologies in public administration means primarily providing improved services to citizens and organizations. E-Government development was possible due to the emergence of Internet and its use spread rapidly. The first use in public administration has meant presenting information on a site, followed by allowing downloading necessary forms in relationship with the public.

Successes and potential of E-Government are already clearly visible in several EU countries (Europa's official documents, 2012). Electronic invoicing in Denmark saves 150 million euros of taxpayers' money and 50 million year business money. If electronic billing would be introduced across the EU, annual savings could add up to over € 50 billion. Disabled people in Belgium can now access their dedicated resources in seconds, whereas previously it was 3 or 4 weeks. At the data.gov [9] and data.gov.uk[5] we may study semantic web applications build for e-Government. Also on the official site of W3C we can study the semantic web case studies and use cases. As references in this field we have some scientific papers which belong to the Ontology Engineering Group from the Technical University of Madrid [8].

The spread E-Government applications include: information / portals, administrative use, finding useful legislation, answers questions of general interest, area guide, receiving applications and petitions, the presentation of various online forms and surveys, attracting activities for the disabled or elderly, C2A, vote via the Internet.

Web 2.0 technologies are used in [7]: 1) social networks like MySpace, Facebook, LinkedIn and Second Life, 2) blogs belonging to public figures and through which they interact with those who voted for them, 3) pictures and movies: Service payment of taxes in the U.S. has launched a YouTube channel www.youtube.com/irsvideos, 4) interactive online survey, 5) internal and external Wikis, 6) blogs and wikis for Customer Services and Feedback.

6 The Future of Software Business for Semantic Web in E-Government

A possible model of success in the area of Semantic Web implementation in the E-Government would consist in creating channels through which citizens may participate and collaborate effectively.

Our study showed that users are willing to find useful information categorized, rated and evaluated somehow for their better use.

The first step in realizing this movement would be to make available to use proper technologies. Social Media channels represent an effective way in enabling citizens' participation.

Providing integrated access to information that is semantically linked with web resources tagged in Social Media might get help from using the following: 1) commonly accepted ontologies and web standard formats like RDFa, 2) portal-platform access, and 3) publicly available data in standard format like RDF.

A good public policy to follow for better achieving of Open Data requests would have to

mean making available web services for every E-Government service to benefit from integrating and visualizing data.

Enabling Semantic Web e-services is a mixt obtained from prior engagement of the two parties: the government and the citizens into consuming provided published e-services.

7 Conclusions

This study presented the possibility to extend software business market of E-Government solutions to the adoption at a large scale of Semantic Web technologies. Currently there are cost limitations and limits that come from the administrative systems, digital divide and access to technologies.

Being closely related to citizens does not have to mean increasing costs but a concrete way to adapt to new technological trends. Semantic web has a lot of potential in this area and it will consist in a proved support for developing Smart Cities and Open Data.

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