Chapter XXXIX
Social Networks Applied to E-Gov:
An Architecture for Semantic Services

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ABSTRACT
The technological advances establish new communication forms between people and have also reached the government sphere and its activities, improving access to information and allowing greater interaction between citizens through C2C (Citizen to Citizen) Services. Based on these aspects, this chapter presents a proposal for software architecture, using a social network to map the relationships and interactions between citizens, accounting and storing this knowledge in a government ontological metadata network. Using UML notation (Unified Modeling Language) for Software Engineering process and Java platform for development, a software prototype was modeled and developed in order to manage and handle e-Gov-driven social networks, using ontological metadata to computationally represent the social ties. This prototype is also capable of providing graphical display of social networks, enabling the identification of different social links between citizens, creating a tool intended for government agencies, since it allows a quantitative analysis of information in the social network.
INTRODUCTION

The accelerated advances of Information and Communication Technologies (ICT) have facilitated information exchange among people, geographically separated or not. The availability of faster, computer-mediated interaction devices and technologies enabled the emergence of new kinds of relationships among people, establishing the concept of virtual communities (Rheingold, 2000).

Similarly, governments have been following the above mentioned technological trends, as a way to improve the services they are meant to make available to their citizens, or even for training civil servants in order to improve the decision-making process. This progress enabled the emergence of a new concept for such strategies of computer-mediated governance, often called e-Government (briefly, e-Gov).

These new strategies of using computer-based solutions for improvement of governmental actions have led governments to look for digital convergence through the integration of different systems (G2G), providing faster and clearer information to citizens (G2C), creating solutions to a more participatory politics with the community (C2G) and promoting interaction and integration among citizens (C2C). The development of such structures should take into account the ability to provide high-quality services, besides facilitating an efficient integration between citizens and government agencies, thus making them each time more similar to CRM (Customer Relationship Management)-based systems (Sang et al., 2005). Such e-Gov systems must also handle massive volumes of data, a considerable number of actors, as well as the multiple variables involved in procurement and financial transactions in a similar way to SCM (Supply Chain Management) systems. Another aspect that must be implemented efficiently is the standardization and management of operations and processes, similarly to the functionalities normally found in an ERP systems.

Figure 1. e-Gov as a merge of CRM, SCM and ERP systems
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(Enterprise Resource Planning). Figure 1 shows how the merging of such different systems could result in more efficient e-Gov systems.

E-Gov systems that are targeted directly to citizens must promote social integration and must also have tools to help people to meet their needs. A possible way to achieve this goal is through the implementation of adaptive systems that are able to modify themselves according to each information and data inserted into them. Through the use of technical analysis (Hanneman, 2005), each citizen could be represented as an actor in a network; interactions and relationships among them could be represented as relational ties, thus forming an one-mode network.

Knowledge distributed among citizens of a network could also be classified and categorized through metadata, and stored into ontological databases. Thus, ontology-driven computational agents would be able to make inferences about such data and, with this kind of semantic analysis, dynamically expand the social network, consequently extending the relationships of each actor.

Based on the information available through the network, each citizen connected to the system will be able to search and find people which have common needs and interests to discuss possible solutions for individual or common problems. In this context, a social network could be easily viewed in its graphical form, making easier the task of creating groups of citizens, which would be a useful tool for governments to examine the issues discussed in society, and to assist in the creation of more effective public policies.

In this sense, this chapter is organized as follows: first section presents the concept of electronic government, as well as the related stages, platforms and services. Second item deals with definitions, organization and usage of Social networks in the context of electronic government. In the third section it is presented a proposal of an ontology-driven representation and extraction of knowledge in social networks. Fourth item details the development and application of a methodology to implement the previously proposed architecture, showing some tests and results. Finally, last section presents some final comments and indications of future work.

STAGES AND SERVICES IN E-GOV PLATFORMS

As previously stated, ICTs provide new tools and solutions that are changing the processes of governing. Through these innovations, governments are able to create ways to reduce bureaucracy in their processes, modernizing legislation and making faster and clearer the actions of executive, legislative and judiciary branches. These strategies, investments and concepts are commonly grouped under the name of e-Government (e-Gov), as before mentioned. Analyzing the presence and development of e-Gov in several countries, it is possible to identify four main stages, commonly numbered from 1st to 4th (Layne & Lee, 2001).

The first stage, called Presence or Cataloguing, is characterized by the assembly of electronic information in an unstructured way, with no interactive elements. Each government agency publishes the information on web sites, forming a sort of online catalog. There is no integration among such information, which often leads to the problems of misinformation or, at least, information replication.

In the second stage, named Interaction or Transaction, information is presented better integrated and organized. In this stage, it is possible to download forms and other types of documents, access links to related pages, among other common functionalities. Citizens are also able to submit suggestions and questions to the responsible for the information, creating a bidirectional way of communication.

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The third stage, Exchange of Values (Information) or Vertical Integration, is characterized by a set of processes that can be performed completely
online. This is available to citizens in online systems, which enable, for instance, the payment of accounts, taxes, electronic registration in public education systems and some sort of tools for distance learning. Due to the volume of information system’ processes required by this stage, these are also elements that promote the integration of different databases, as database management systems that are optimized to operate with distributed databases, components and distributed objects, among others technologies.

In the last stage of development of e-Gov, Integrated Services or Horizontal Integration, the changes are increasingly more visible and more complex. The government has usually many portals organized by functions or themes. In this stage all governmental bases are integrated and each change in a system must be propagated to other systems.

To achieve each one of these stages of development in the e-Gov-platform, it is necessary to achieve different service’ levels in order to update governmental actions, leading to more effective participation of citizens and corporations.

Sang et al. (2005) divide e-Gov systems into six major areas of focus:

- **Government to Citizen (G2C):** Addresses on-line services provided by the government with the aim of providing to citizens pieces of information on procedures for legal proceedings, request and make requests for documents, among others.
- **Citizen to Government (C2G):** Refers to the provision, by the government, of services that enable citizens to introduce a flow of information from them to govern agencies.
- **Citizen to Citizen (C2C):** In this kind of service, the government acts as a provider of integration and interaction between citizens, this occurs through the provision of services and systems that facilitate the exchange of information and interaction.
- **Government to Business (G2B):** Relies on the provision of business services that usually are focused on facilitating and expedition and shipments of documents and information labor and tax, thus promoting more transparent, agile processes.
- **Government to Government (G2G):** It is intended for integration of governmental agencies, thus unifying and facilitating data transfer and internal processes between them. This sort of service could be also be used to promote cross-country integration, for instance, in common market-based economies or political block, as European Union or Unasul, in South America.
- **Government to employer (G2E):** Involves features intended to facilitate the work and enable public services to dialogue with employers, in order to expand the job offers, discuss labor taxes and so on.

In general, the organization of governments is often based on a hierarchical structure, with subdivisions, agencies, ministries and departments. All this structure is barely conducive to solve the real needs citizens have in a timely fashion. One possible solution to this problem is to provide citizens the necessary tools, based on C2C services, so they could establish relationships, though virtual, with other citizens. Through this integration, it is possible to create social networks of cooperation, thus facilitating each citizen to find other people who have, or already have had, the same needs and so being able to collaborate with them.

Next section will explain this kind of collaboration.

**SOCIAL NETWORKS OF CITIZENS**

By considering the relationships and interactions between people, organizations, groups, institutions, etc., besides establishing a parallel
with methods, theories, models and applications normally used for networks analysis, it was coined the term Social networks (Wasserman, 1994). These networks have nodes (or “actors”) and specific types of connections. Actors can represent citizens (or social groups), and the relationships between each of these elements may be represented by the connections or relational ties. These social ties between actors could symbolize different kinds of relationships or even the flow of information and resources. Thus, individuals connected to the network could gain and provide access to information or other resources, expanding the opportunities for interact, share or learn (Knoke, 1982).

In order to conduct a more detailed analysis (and at different levels), some key concepts of social networks must be observed: actors, relational ties, dyads (a pair of actors and their relational ties), subgroups, groups, relationships and the network itself (Wasserman, 1994).

**Actors** refer to any social entities tied together through social relationships and could represent citizens, social groups, cities, countries, government agencies, and so on. This definition allows the grouping of actors into clusters in order to facilitate the study and use of specific analyses. **Relational ties** represent the connections and relationships between the actors of a social network. With the definition of the characteristics of each link, it is possible to define the types of relationships between actors, such as the feelings one person has about another (such as affection, friendship, etc.), or the flow of resources between actors (economic transactions, information exchange, etc.). Physical connections between individuals, cities, states or countries (streets, roads, bridges, etc.) could also be represented by these ties.

**Dyads** are considered the fundamental social networks’ units, formed by two actors and the ties between them. Its study is of utmost importance in the context of the relational aspects in social networks. Through the study of the links and dyads it is possible to identify and classify the relationships of actors in a network, describing them sometimes as central actors, who are involved in many relations with other actors. These central actors are more visible to others, and thus have a higher degree of prestige, identified through the number of links that arrive on and depart from it.

In this context, social networks can be categorized into two groups: Whole and Ego-centered networks. Whole networks can be studied in accordance to the actors involved and the nature of the relationships that they have: one-mode networks or two-mode network.

One-mode networks are formed by a number of actors of the same type, as individuals, organizations, communities, nations, countries, etc. The relational ties among these networks are commonly represented by an index of relationships between dyads of different network levels.

On the other hand, two-mode networks have the focus of study in the relationship between two different types of actors, or between one set of actors with a type of event. The first performs an analysis of links between actors of different types. The types of actors studied in these networks may be the same ones described in one-mode networks.

By analyzing actors and their relations, it can be observed that there is a flow of information and knowledge in the social network. Actors that are part of more than one community could have a continuous learning and benefits from all these communities (Hannerman, 2005), creating a continuous information flow between them.

The knowledge inherently present in social networks can be organized and stored through ontological metadata. By structuring this knowledge in an ontology-driven manner, it would be possible to provide members of a social network different ways of solving problems more effectively, using only the information already made available by other members, and semantic processing to refine that knowledge.
ONTOSTY: PROPOSAL OF KNOWLEDGE REPRESENTATION FOR E-GOV PLATFORM

The term Ontology has been used in Computer Science from the beginning of the 1990’s (Russell & Norvig, 2004) in Artificial Intelligence area, for computational knowledge representation, knowledge engineering and natural language processing. More recently, the notion of ontology has been expanded to the areas of information retrieval on the Internet (as Semantic Web, for instance), knowledge management and development of intelligent educational systems. Therefore, it is computationally possible to represent a particular area through ontological databases, so that communication between people and computers could take place automatically (Swartout, 1999). In this sense, computational agents can share knowledge increasing the relationship that they might have.

To better understand the Ontology concept, several researchers have made their contribution in order to improve this definition, describing concepts and creating new categories to facilitate the construction and use of ontologies. Gruber (1993, p. 3) says that “an ontology is a explicit specification of a conceptualization”; Swartout (1999) also refers to ontology as a shared concept and explicit phenomenon of some thing in the world, described by relevant concepts. Thus it is understood that an ontology describes a field of knowledge in an explicit way, using the relationships that exist between the concepts.

Similarly, an ontology can also be a specialized vocabulary in any field (Chandrasekaran, 1990). However, these vocabularies qualify only the concepts present in a given ontology, which means that this definition makes clear that an ontology is independent of the language in which it was modeled, so that you can translate the concepts of an ontology from English to Portuguese, for example, without changing its essence. In another sense, the ontologies refer to the knowledge base that describes a field.

Besides, according to Berners-Lee (2001), to have a proper knowledge representation, it is necessary to achieve three types of interoperability:

- **Structural interoperability**: Provides the representation for different data types, allowing specify types and possible values for each form of representation;
- **Syntactic interoperability**: Provides precise rules to promote the exchange of data on the Web;
- **Semantic interoperability**: Enables the understanding of data and their associations with other data.

In that sense, it is also possible to classify an ontology in different ways and classifying it in different levels in order to refine the analysis and enable the acquisition of knowledge in a more precise way (Araújo, 2003), as shown below:

- **Generic or top-level ontologies**: Describe general concepts such as space, time, matter, object, event, action, etc., which are independent of a particular area or problem;
- **Field ontologies**: Express conceptualizations of particular fields, describing the vocabulary related to a generic field such as medicine and law;
- **Task ontologies**: Express conceptualizations on the resolution problems regardless of the area where they occur, that is, describe the vocabulary related to an activity or generic task, as diagnose or sales;
- **Application ontologies**: Describe concepts dependent on the field and the particular task. These concepts are often the roles played by entities in the field when carrying out certain activities;
• **Representation ontologies:** Explain the underlying conceptualizations of the formal representation of knowledge.

Complementing this classification, it is also possible to identify five basic elements that define ontology (Perez, 2002): concepts, relationships, functions, axioms and instances.

The wider use of ontologies has made it possible to address different types of problems in various areas of knowledge as Semantic Web, data mining and e-Government systems (Natalie, 2008). The e-Government applications that are from the second stage of development have repositories of data and data-processing capacity with volume of information and knowledge in proportion to the size of the population that uses these services.

An example of these applications is the internationally recognized and rewarded Brazilian system of income tax collection. This system has about 600 million records, powerful security features, tools for decision making, identification of fraud and access of approximately two million users. According to the Coordination of Technology-General of Revenue, it is considered the largest database of the world (Receita, 2006).

The development of ontologies for governmental area must produce shareable structures and must provide interoperability in the semantic level. For this, it is necessary to create metadata with vocabularies specific to the context, structuring the field, to allow computational agents to infer new facts and enlarge the knowledge base.

As governments’ computational systems will be reaching higher levels of development, complexity and an on-growing base of knowledge, a fertile field for new technology projects appears, including those ones that rely on semantics to perform their tasks. One example is the use of an ontology field of e-Government to store and represent knowledge in a social network formed by citizens. A computational agent committed to this ontology could, through semantic analysis, help citizens to find other citizens in the social network that could, in a collaborative manner, assist to the solution of various issues.

A related work can be found on the OntoGov project, which specifies a platform composed of meta-ontologies with the objective of promoting the development of systems for e-Government services (Ontogov, 2007). In this platform, the domain ontologies consider a high-level ontology, building, in this way, meta-ontologies. From that basic meta-ontological base, it is possible to define information ontologies to represent the knowledge related to flows in services that provide pieces of information to citizens.

It is also possible to use ontologies to establish interoperability between different systems, processes and services. This is the proposal of another related work, the SmartGov platform (2007). In this platform, it is possible to achieve the integration of various areas and government departments, through a knowledge-based system available on, Internet, and directed to the public as end user (Smartgov, 2007).

This type of semantical analysis of knowledge in the social network can work to identify central citizens in a network. This identification can still identify and define characteristics such as degree of influence and importance of each citizen in a social network, creating a tool of social analysis to recognize the leaders of a city, state or country.

Based on theoretical references and on this overview on the use of computational tools in e-Gov, the next item describes a proposal for a system based on C2C social networks and ontology.

**DEVELOPMENT OF ADAPTIVE SYSTEMS FOR C2C BASED IN NETWORKS AND ONTOLOGY**

Solutions developed for C2C services must manage a large set of variables, besides every information from every citizen. With that, databases are expected to be each time more complex, making
harder the task of extracting and handling, in an optimized way, the knowledge inside. Such a context encourages the use of ontologies and different ways to represent knowledge, as a manner to process such data efficiently.

**Tools Used**

This section shows the possibility of developing an e-Gov low-cost, design pattern-based, scalable, easily maintainable system which would be able to communicate to others systems. In this sense, a technology-independent architecture was modeled, according to UML (*Unified Modeling Language*), looking for platform-independence, programming language-independence, easy customization to different requirements from each government, besides being easily expandable.

The diagram shown in Figure 2 presents the proposed architecture for a C2C services-based system. Such architecture is composed by three tiers, allowing the development and integration to diverse platforms, making easier the component reuse.

All parts of the system were developed on the Java platform. Such a platform provides a layer between application and operating system, named Java Virtual Machine (JVM). JVM is responsible by interpret the pre-compiled source code, manage memory and threads, intermediate communication and system calls, so providing platform-independence for applications.

Java platform also specifies Java programming language, which follows the object-oriented paradigm, thus allowing faster actualizations, motivating programming practices with high levels of reusability, promoting the use of design patterns and offering a large amount of APIs with diverse functionalities (SUN 2008).

Regarding to Figure 2, Ontologic Layer defines a metadata base and mechanisms used to knowledge representation, providing methods and inference logic that could be used by any computational agents. This data repository stores metadata using a set of OWL namespaces (used

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**Figure 2. Proposed architecture**
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to facilitate the properties description), based in XML-Schema (W3C, 2004). With this structure, it is possible to represent explicitly vocabulary terms and semantic relationships among them.

In order to obtain a better expressivity of metadata, while keeping integrity and computational decidability, it was used the OWL-DL sub-language, which has all characteristics referred above. Due to the strategies of modularization used, based on design patterns, it is possible to implement the application in any other language or tools that are metadata-aware.

This layer also has a module responsible for semantic analysis, using Jena API. This API has a handler for RDF triples: (subject, predicate, object), as well as a processor for ontological information expressed in RDF-Schema and OWL. With the use of inference mechanisms, as well as tools for metadata creation, representation and handling that are provided by Jena API, knowledge present in the network is meant to be represented by syntactical, structural and semantical interoperability, allowing the reuse of resources and semantical properties, making easier the sharing of information among computational agents that are committed to the ontology.

Utility algorithms are implemented in Social network layer as tree search algorithms, as well as structures responsible to stores and handle the social network, the citizens and their relationships. This layer allows the implementation of various algorithms, as graph search and minimal path generators, for instance, in a easy and quick way, depending on the specific necessities of each government.

Persistence layer uses different strategies and APIs to store data from other layers, as utilities for creating image files, specialized libraries for XML files and so on. Through a unique interface, it is provided a transparent access to the other layers, in order to store and retrieve necessary data to the system.

By keeping a consistent encapsulation, Presentation layer defines strategies and access interfaces, allowing different system and client applications to have access to specific system’s modules, in a platform-independent way.

With this architecture, citizens and governments would have access to social tools provided by the system, through different applications.

Description of Application Operation

Based on typical characteristics and services of an e-Gov platform, this section shows an implementation of a C2C service, aiming to exemplify a real-world application.

The application uses information as addresses, professional activity, marital status, language, educational level, family income, and so on, which are provided by a citizen when he/she logs in the system. Such data are dealt as ontological elements, used to build an ontological database. After the building of this metadata repository, it is possible to dynamically expand a social network.

Figures 3 and 4 shows the dynamics of a social network when a new citizen logs in the system.

Figure 3 exemplifies in detail a particular example geographically located in São Paulo, Brazil, where it is possible to observe a citizen named ‘Leandro’ that lives in ‘Casa Verde’ neighborhood. This neighborhood is located in a region named ‘Zona Norte’ (north zone). The relationships among neighborhoods and zones of the city are stored in an e-Gov domain ontology. In this way, it is possible to assign proximity levels among different regions and neighborhoods of a city.

In Figure 4, when the citizen ‘Diego’ logs in, informing that he lives in ‘Santana’ neighborhood, the system, through the domain ontology, identifies that ‘Santana’ is part of ‘Zona Norte’ in São Paulo city. After this semantic processing, the social network is augmented, with the creation of a link of ‘interacting’ type among ‘Leandro’ and ‘Diego’, due to the fact of living in the same region of the city.
Still in Figure 4, citizen ‘Vanessa’ logs in the system informing that she lives in ‘Ipiranga’ neighborhood. By a semantic search on the ontological base, the system identifies that such neighborhood is part of the region known as ‘Zona Sul’ (south zone). Figure 5 shows a map of São Paulo city’s neighborhoods, in order to clarify this example.

Since ‘Vanessa’ does not live in a neighborhood in the same region as to other registered actors, the social network controller, after using the information provided by ontological layer, don’t create an ‘interacting’ relational tie among ‘Vanessa’ and the other citizens presents in the network. Nonetheless, this does not forbid that other information provided by citizen ‘Vanessa’ would allow her to establish other types of connection to other citizens.

This example also shows the multi-dimensionality of the social network graph. Looking in a dimension, there are actors of the same type (citizens), and their relationships, thus forming an one-modal social network. In a second dimension, there are actors from different types (citizens and neighborhoods) and their relationships, thus forming a bi-modal network.

**Exemplification of Results Obtained**

In order to exemplify the usage and flexibility of the system, it was created an Web-based interface, as seen in Figure 6, which shows the form for citizens’ registering. Data obtained after the fulfilling of this form are refined by ontological layer, and afterwards the citizen in inserted in the social network and connected to other citizens according to the information provided.

Only after registering, citizens have access to search functionality (Figure 7), developed in order to allow him/her to perform a search for information in the social network. System is meant to refine the information given by a semantic search in ontological database, looking for citizens that have in their records some information that have some semantical kinship.

With target citizens identified, social network layer, by using Dijkstra’s algorithm (Cormen et al., 2001), looks to find the shortest path among these target citizens and the citizen that realized the search. This algorithm was adapted to find the shortest path from only one origin and equally-
Figure 5. Map of São Paulo city showing geographic proximity among actors
weighted edges. JUNG (2007) – a Java-based API made to deal with graphs and social networks, is used to generate an applet that exhibits the path to be taken by the citizen to those citizens that could be collaborating to solve his/her questions.

The developed system has also functionalities directed to public administrators, providing different views for the same social network, which was implemented by the before mentioned applet. A JPEG image can also be generated.

Figure 8 shows an example of a complete social network, with different links established, categorized by different labels to make visualization easier.

Figures 9 and 10 shows different kinds of views a government agent could have over a social network, being able to select only the social links of interest. With these specific views, the public administration is able to perform more precise analyzes, by observing social network from the viewpoint of a specific social link. With this, it is possible to observe different social groups presents in different regions of a city, state or country, which could be used to assist in the planning of more effective public policies.

In order to simulate the execution of the system, some tests were performed with fake and real data. In the first experiment, the system was made available in a Web-based environment, running under a servlet container (Tomcat 5). All the system was packed in a single .war file. Fifty citizens registered themselves with their own information. None of the pieces of information was mandatory, and the time spent for each citizen to register was stored.

With semantic refining of each piece of information, a search for citizens with semantic proximity was performed each time a new citizen signed in, in order to find citizens to be connected to him/her. Figure 11 shows the time spent for each registering process (average time was 59 sec).

In a second experiment, other fifty records were fulfilled, but in this time all fields of information were required. This was done in order to simulate a more complex scenario for the social network layer, as well as for ontology layer. This experiment produced a complete graph, with every citizen connected to all others. In a similar way, the total time spent for each citizen registering was calculated, with average time of 85 sec. Figure 11 shows the results.

After these experiments, the ontological module was disconnected from the rest of the system and a new experiment was realized with
Figure 8. Complete Social network (Natale, 2008)

Figure 9. Social network with Professional Activity (‘Atividade Profissional’) ties (Natale, 2008)
the same amount of data, but with no semantical refining. Average time in this case was 10 ms for each record, showing the huge amount of time that is needed for semantic establishment of the social network.

Finally, the last experiment consisted in performing a search for information in a real-world social network, created by real citizens. In this experiment, the system validated the provided information and refined them using the methods available in the ontological layer, which allowed the performing of a breadth search in the social network in order to find the citizens that had some desired information. After their identification,
Dijkstra's algorithm, provided by social network layer, was applied, generating the path a citizen must follow in the network.

**FUTURE TRENDS, FINAL CONSIDERATIONS AND FURTHER WORK**

E-Gov future trends related to C2C services involve the improvement of ontological databases techniques. In the same way, with Web 2.0 development, it is relevant to point out the need for proposals that adhere to this concept. Regarding to the expansion and easiness of access by multiple platforms, as mobile and desktop, it is necessary also taking into account different ways to present information, according to the device being used. Another trend that must be noted is the dynamic refreshing of information in a way that they could be easily geo-referenced, making easier the integration with GPS systems, for instance. Finally, there is the important necessity of security policies regarding to citizens' information, avoiding information replication or leaking.

Through the studies and comparisons that were shown, it is possible to identify citizens as the main interested in governmental technological advances. Thus, it is extremely relevant to develop e-Gov solutions that follow a service-oriented model. In the case of the present chapter, it was focused the development of a C2C architecture driven to citizen dwelling in a certain area, providing low-cost, easy-maintaining tools to help quotidian information search and problem solving.

In e-Gov context, this work presents the possibility of creating a social network that was built and is able to be expanded using a domain-oriented governmental ontology.

Such structure asserted the possibility of building robust low-cost systems that are able to help citizens to reduce bureaucracy in electronic environments. The governmental strategies used to e-Gov system development must be evaluated and carefully implemented since they are meant to deal with people's lives and thus reaching a meaningful social effect.

Academically, the present work contributes in the sense that it presents solutions and analysis that are based in a social-governmental context. It dealt with social network analysis, computer-based knowledge representation and retrieval, as well as software design patterns.

As a recommendation for further works, there is need of deeper analyses of the previously mentioned social networks, as well as new implementations based on these new analyses. Such implementations could present some improvements by optimizing the ontology-based mechanisms through multi-thesaurus structures or parallel or distributed engines for inference. These engines could also be internationalized, being language-sensitive. Analyzing the interfaces made to citizens, it is necessary to look for elements that make them more user-friendly, thus improving the access and straightforwardly the utilization of the system.

Another issue to be pointed out is the fact of handling and storing private information, which is meant to be kept in a secure way. Security solutions must be discussed, including basic cryptography, in order to guarantee the privacy and safety of this information in governmental platforms, improving systems' reliability. Other possibility is to apply techniques related to distributed agents to manage the information traffic on the digital e-Gov social network and analyze package exchanges.

Furthermore only authorized users can perform searches by the system. The data of users should also be stored on servers protected by the guidelines of network security organizations, with access only released to authorized analysts.
REFERENCES


KEY TERMS AND DEFINITIONS

Adaptive Systems: Systems characterized by the possibility of adapting themselves according to the behavior of user or some other environmental changes.
**Graphs:** Structures formed by nodes and edges that connect pairs of vertices, allowing the study of relations between elements belonging to determinate data set.

**Knowledge Representation:** Abstract model of a knowledge domain that permits the construction of computer-based systems, knowledge databases or expert systems.

**Metadata:** Characterization/description or information about data. It is commonly used to describe, manage, and localize some data in a data store.

**Ontology:** Formal specification of entities’ representation (as objects, concepts and so on), making possible to establish relationships among terms and attributes through the use of semantic approaches.

**Social Networks Analysis:** Interdisciplinary area that combines Math, Computer Science and Sociology, among other aspects (as psychological, geographical, and so on) to determinate kinds of relationship between actors – like people, groups, communities and organizations.

**Virtual Communities:** Groups of people determined by similar interests that establish contact and interact through use of online communications tools and/or virtual environments.