CONCEPTUAL MODEL OF OPEN ARCHITECTURE FOR OPEN GOVERNMENT

Darko Petrušić

Ministry of Science, Podgorica, Montenegro

Abstract

"Open Government" is a concept where society believes that the business of government should be open, efficient, and exposed to public scrutiny and monitoring. With developments of Internet technologies and e-services Open government idea is now a platform which promotes transparency, participation and collaboration. Information and data are now presented in an open, reusable format so that users can manipulate it in an effort to create new values. Main components of the Open government are Open Architecture, Open data and Open standards. This research proposes conceptual model of the Open Architecture (OA) in the context of the Open government. Main aim of this paper is to provide OG system designers with general guidelines for implementing OA with special attention on use of semantic technologies.

KEYWORDS**:** *Open architecture, Open government, Ontology*

1 INTRODUCTION

Roots of Open Government idea can be found in debates on how to organize newly created civil society within European humanism movement. Since then main idea evolved in modern theories on Open Government are now is more focused on engaging citizens in political, economic and legal aspects of public service. At the beginning of third millennium research and investments in the area of Open Government and e-Government gain popularity because of the fast pace technology developments and increased use of electronic services by citizens and enterprises. With development of Internet technologies and new paradigms such as Web 2.0, e-Government and Government 2.0, Open government evolved in technological platform that publishes Open government data in open digital format for public (re)use. Open Government Data is data and information produced or commissioned by government or government controlled entities and can be freely used, reused and redistributed by anyone (Open Knowledge Foundation, 2010). Open government data realize significant economic benefits by enabling businesses and non-profit organizations to build innovative applications and websites using public data [20]. Official support and recognition for the Open Government initiatives first came in 2003 with EU Public Sector Information Directive [1]. However first political and practical support came at 2009 in USA with Memorandum for Transparency and Open Government [16][15]. During the same period there were increased interest for the open and linked data [21][14] in context of Open Governement [4] and in later years there are more emphasis on Semantic Web in the same context.

Main goal of the reasearch work presented in this paper is to develop the model for ICT support of Open Government initiatives and services. This model is influenced by emerging trends in civil society, public sector development and semantic internet technology. One part of this model is a development of the Open Architecture ontology as an example of implementation of the proposed model.

2 OPEN GOVERNMENT

Open government has been described as “the use of technology – especially the collaborative technologies at the heart of Web 2.0 – to better solve collective problems at a city, state, national and international level” [28]. Governments have strived for long time to provide more information and services to their constituents including the public, businesses, and other governments through their efforts there have been struggles given policy, resources, technology, capability, and other issues which have provided significant challenges to achieving the desired goals [27]. Developments of Internet technologies and e-services offered governments perhaps the best opportunity to realize Open government idea by providing information and services while meeting the demands for transparency, participation and collaboration. The new interactive potential of ICTs allows for more innovative sharing

of information and greater collaboration both within different government departments and among different branches of government, as well as with citizens and private sector. Main components of the proposed and commonly accepted model of Open government are Open Architecture, Open data and Open standards.

3 RELATED WORK

Enterprise Architecture (EA) is perceived as a key enabler of the business transformation and technological modernization in many organizations around the world. Many governments recognize significance of EA and they try to use it as a powerful toll to replace government bureaucracy with service oriented public sector dedicated to serve citizens and businesses. The key goal of EA in government organizations is to make them citizen-centered, results oriented and market-based [26]. EA is now platform for connected government which enables governments to connect seamlessly across functions, agencies, and jurisdictions to deliver effective and efficient services to citizens and businesses [18]. Government Enterprise Architecture (GEA) is generally based on existing EA frameworks despite the fact that EA have been criticized for taking technologist view and do not highlight the role of the institutions and capabilities critical of enabling the governance, adoption and diffusion of GEA [32].

At present countries use currently available government EA frameworks (e.g. Zachman, TOGAF, DoDAF and IAF) to plan and design their architecture developing proprietary frameworks specific to the purpose (FEA). Nonetheless, government EA efforts are generally piecemeal and often lack the necessary firepower. A major application area for the GEA practice, Electronic Government (EGOV) is defined as strategic use of Information and Communication Technology (ICT) by governments to enable transformation in service delivery, relationships with key stakeholders, and internal working and management in government [25]. EA is now platform for connected government which enables governments to connect seamlessly across functions, agencies, and jurisdictions to deliver effective and efficient services to citizens and businesses [18]. The target of EGOV encompasses four main groups: citizens, businesses, governments (other governments and public agencies) and employee [31].

Many of the leading EGOV countries have ongoing GOA programs: Australia, Belgium, Canada, Denmark, Estonia, Finland, Germany, Korea, Netherlands, New Zealand, Norway, Singapore, South-Africa, Sweden, Switzerland, United Kingdom and United States [25]. Also there is pan-European e-Government services (PEGS) program [34] based on the Integrated Architecture Framework (IAF).

Connected government as a goal is gaining acceptance and popularity. The primary reason for focusing on connected government is because this is the area where GEA has the highest potential for influence and as a result the highest levels of benefits derivation. The dimensions of connected government are: citizen centricity, common infrastructure &interoperability, collaborative services & business, public sector governance, networked organizational model, social inclusion and transparent & Open government [26]. Also Enterprise Architecture Assessment Framework for Connected Government (EAAF-CG) [26] has been developed for a qualitative evaluation of the role of GEA programs in achieving connected government (Fig 1). It is obvious that general impact of EA on connected government has mixed results across dimensions and countries. So far there is no country which has been able to utilize government EA to achieve connected government.

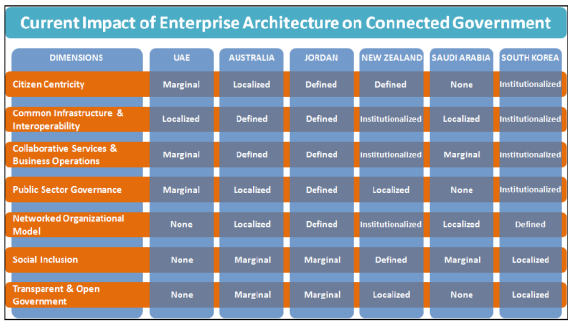

Fig 1. Current Impact of EA on Connected Government in Selected Countries [26].

Relevant work on architectures which enables Open Government can be found in work on an architecture called Delivering Information of Government (DIGO) to allow access to primary data by machines in open data so that citizens interested in doing so can combine them (linked open data) and produce new information and mashup applications, consequently, enabling OGD and data fusion on the Linking Open Data (LOD) cloud. Although the implementation of the open data vision may offer great advantages to information and knowledge management, the problems related to knowledge acquisition techniques and bottlenecks in software engineering are inherent in ontology engineering. A large amount of standardization work will be required before an ontology can be defined that can support the DIGO

architecture [22]. Also some important elements that are related to machine power and conceptual architecture can be found in work on Roadmap of linked open government data [1].

The usage of ontologies as an information system independent enterprise architecture description language brings several advantages especially when an organization is planning to alter its actual structure and processes reported in the baseline EA. In addition to advantages in describing semantics between information concepts, ontologies also provide a shared vocabulary and point of reuse when collaborative information systems are developed based on derived architecture descriptions. This stems from the fact that formal ontologies are, in contrast to EA, executable entities, describing EA from different points of view. Thereby, the use of ontologies in EA descriptions makes them truly valuable, not just as general blueprints of reference after completing the architecture but also in actual implementation of solutions to achieve greater efficiency. In practice, ontologies in architecture descriptions seem to bind the soft and hard sides of an organization closer together and, consequently, to decrease the possibility of the traditional business/IT alignment problem [24].

The most important work related to architectures and their ontologies is a Federal Enterprise Architecture Reference Model Ontology (FEA-RMO) which is a domain specific ontology of the Federal Enterprise Architecture Reference Models. FEA-RMO directly translates the Performance, Business, Service Component, and Technical reference models into their executable representation in OWL-DL (http://notes.3kbo.com/fea-rmo) [21] built the FEA-Reference Model Ontology (FEA-RMO). FEARMO semantic model provides guidance for a description of the EA of a government agency. The model has to mediate the simultaneous challenges of providing centralized advice for the development and maintenance of an EA while allowing a degree of autonomy for the agencies. Therefore combination of RDF and OWL can be used to satisfy these requirements. Using RDF/OWL transitive and sub-properties enables new information to be inferred.

An ontology-based system can answer questions such as [33]:

- Who is using what business systems to do what?
- Who is using what technologies and products to do what?
- What systems and business processes will be affected if we upgrade a software package?
- What technologies are supporting a given business process?
- Where components are being re-used or could be re-used?

Since original FEA-RM was expressed in English language one of the challenges of recasting an informal model (expressed in natural language) into a formal model (e.g., expressed in OWL) is sorting out the ambiguities in the informal model.

However EA cannot transform government by itself. Fundamental transformation to the tasks performed in organizations is only achieved if the institutional force promotes transformation [23]. As per Fig 1 it is obvious that current impact of EA on connected government is not showing the best results in enabling transparent and Open Government.

Therefore there is a need to address requirements for ICT enabled tranformation of public service towards open, transparent and colaborative government having in mind citizens and business sector. Answers to those needs are delivered with Open Architecture model and its ontology, wich is integral part of the Open Government paradigm.

4 OPEN ARCHITECTURE FOR OPEN GOVERNMENT

Open Architecture is Architecture for Open Government. Open Architecture should enable transformation from e-government and connected government to Open Government. Open Architecture is mainly influenced by Open Government paradigm, EA/GOA and business intelligence frameworks. OA main purpose is to facilitate realization of Open Government by enabling seamless delivery of Open Data and creation of Linked Open Government Data. Linked data is essential to actually connect the semantic web [35].

Conceptual presentation of the Open Architecture (OA), which is main focus of the research in this paper, is shown In Figure 2. Classification of the components of the OA are similar to those developed in Roadmap of linked open government data [1], with addition of 'influence' classification in the presented OA model.

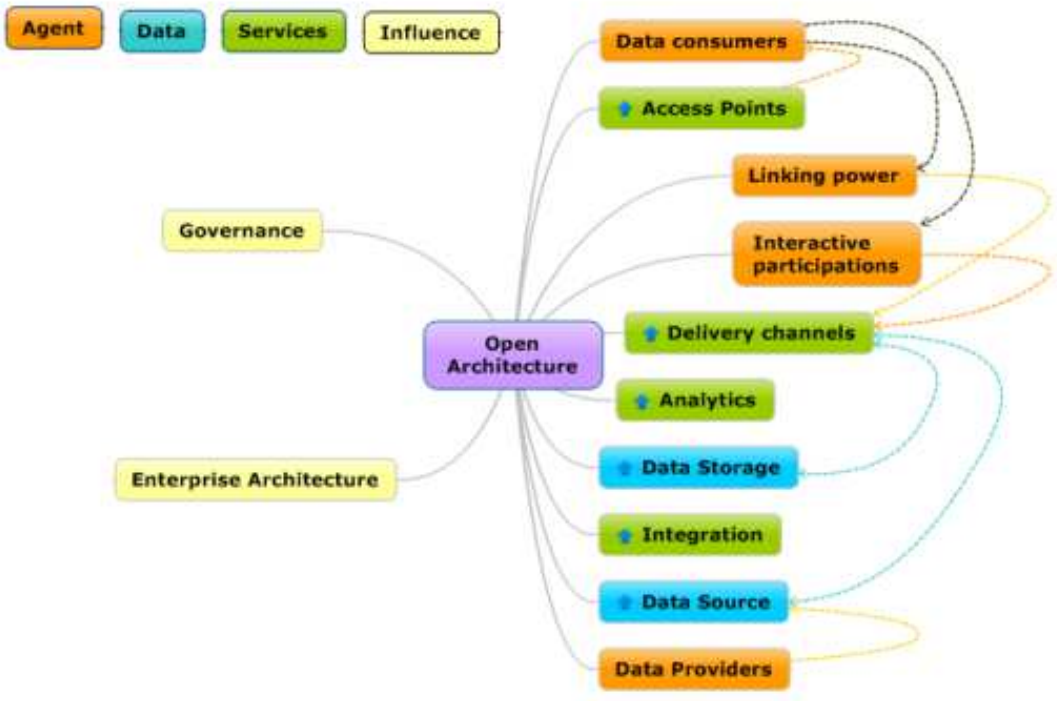

Fig. 2 Open architecture for Open government

Short descriptions of the classification and its components of the presented model are as follows.

1. *Agents* are the entities that are providing, using and enhancing the data.
   Agents can be *Data providers*, *Data consumers*, *Linking powers* and *Interactive participants*.
   a) *Data providers* are government(s), industry and/or citizens that are providing data in various formats which are then stored in information systems (*Data source*).
   b) *Data consumers* are recipients of the government services [37], and they can be part of the human power and/or human participation as part of external forces that are providing value-added services and improving quality of the ODG. This relation is presented in olive green dotted lines. Data consumers are end user of the OG applications and OGD/LOGD and they can be enterprises, citizens, other governments or international agencies.
   c) *Linking power* is a combination of machine power (natural language processing, machine learning, information retrieval) and human power (Web, crowd, authority etc.) and delivers higher-quality data to a wide range of data consumers via Delivery channels such as visualizations, mashups, portals etc. Human power and machine power can be used to generate additional declarative links and value-added services.
   d) *Interactive participations* are mostly Web 2.0 services that can be used to enhance quality of OGD and its applications. These services can be based on human participation such as blogging, micro-blogging, ratings, reviews, social networking; or automatized services such as web crawling, web robots and others used for page rankings, statistics etc.

2. *Data* is the entity that represents *Data source* and *Data storage* in different formats and different level of business maturity.
   a) *Data sources* are entities aimed for keeping data, collected by Data providers, in digital form. Different

types of Data sources can exist such as Enterprise, Unstructured, External and Informational.

b) *Data storages* are mainly data bases with transformed, merged and cleaned data from Data sources. This process (data transfer from Data sources to Data storages) is made possible by using Integration services.

3. *Services* are the entities that are transforming and integrating data can be *Integration services*, *Analytics*, *Delivery channels* and *Access points.*

   a) *Integration services* [38] are enabling extraction, transformation, merging, cleansing, filtering and integrating data from Data sources or other Data storages and loading them into Data storages. This service is crucial in quality assurance for the OGD. Also this is the service where Governance, as one of the influencers, plays important part especially in the area of security and privacy.

   b) *Analytic service* is responsible for creating information out of data from Data sources, often by using visualization tools and publishing the results via Delivery channels. Once we have data in Data storages it is possible to prepare the data for publication by using Analytics.

   c) Delivery channels [37] allow publishing OGD from the Analytic services, Also if raw data is satisfying requirement for the OGD it can be published directly from Data source or Data storage via Delivery channels. Delivery channels are group of services such as portals, mushups, online catalog of the raw data, cloud computing etc., that are enabling presentation of the OGD and OG applications to Data consumers.

   d) *Access points* are hardware and software platforms and services that are enabling Delivery channels services to be accessible by Data consumers.

4. Influencers can be *Governance* and *Enterprise Architecture*.

   a) *Governance* includes area of privacy, policies, IT governance, processes and procedures, and standards.

   b) *Enterprise architecture* has strong influence on overall OA for the OG and it is embedded in many domains of OA. Implementing OA is very much dependent on existing state of EA within particular government organizations. It is important to emphasise that in OA model Security Architecture is a part of the EA.

The most straightforward way to publish Government Data i.e. make data available on the Internet is to publish the well-structured data in its raw form. Structure or formats (XML, RDF, CSV etc.) allows others to successfully make automated use of the data [36]. On Fig 2 this dataflow can be presented as follows: raw data is created or collected by Data providers and then transferred to Data sources and then raw data is delivered to Data consumers via Access points using Delivery channels.

However often it is necessary to prepare raw data before publishing it, therefore workflow in this case is as follows: raw data is created or collected by Data providers and then transferred to Data sources. Sometimes there is a need to integrate data from different sources into Data storage using Integration services. Once data is in Data storages it is possible to prepare the data for online publication by using Analytics tools or if data is satisfying requirement for the OGD it can be directly delivered to Data consumers via Access points using Delivery channels.

Next step in this process is for Data consumers to use tools of Linking powers and Interactive participations to create added values (quality assurance, adding content, linking of open government data, etc,) for published data.

Also, integral part of the OA is governance (e-governance) which will provide and improve the effectiveness, efficiency, transparency and accountability of informational and transactional exchanges within government, between government and government agencies, citizen and businesses and to empower citizens through access and use of open data [36].

Using this OA conceptual architecture Open Architecture Ontology (OAO) has been developed as a semantic model which provides guidance for a description of the OA. So far this was a conceptual

approach in describing OA in context of OG, however by using ontology and OWL descriptive language it is possible to fully describe OA.

5 CONCLUSION AND FUTURE WORK

In this paper we introduced a concept of the Open Architecture Ontology as a semantic model for the ICT support for the Open Government paradigm. Generally there is a need to address requirements for ICT enabled tranformation of public service towards open, transparent and colaborative government. Some of the answers to those needs are delivered with Open Architecture conceptual model and corresponding ontology. Open Architecture Ontology has been described by OWL descriptive language using Protégé and RDF Graph tools. Practical implementation of OA ontology was considered beforehand and OAO, as an example, is used for the system architecture mapping for the software development of Montenegrin Semantic Science Network (MS^2N) portal. However there are a lot of other opportunities for the OAO implementation in context of Linked Open Data and Open Government. Since main components of the Open government are Open Architecture, Open data and Open standards, future work focus should be on Open data ontology and Open standards ontology developments.

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