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CHALLENGES OF APPLYING SEMANTIC WEB APPROACHES ON E-GOVERNMENT WEB SERVICES: SURVEY

ABDULLAH ALSHEHAB[1],NASER ALAZEMI[2], MOHAMMED YOUSEF[3],ALI ALFAYLY
[1 2 3] Computing Department, College of Basic Education, Public Authority of Applied Education and Training, Kuwait
aj.alshehab@paaet.edu.kw[1], nn.alazemi@paaet.edu.kw[2], ma.yousef@paaet.edu.kw[3] , ah.alfayly@paaet.edu.kw

ABSTRACT

Accessibility of information on the web is the main feature of knowledge acquisition. E-government is the civil and political practice of the government, which requires the use of information and communication technologies (ICT). E-government meets major challenges in accomplishing interoperability and integrating regulations, services, and administration. One reason for the challenge is the different languages spoken or barriers across different regions and countries. This paper presents an overview of the challenges in implementing semantic web approaches on e-government web services. The paper identifies the main challenge categories as sociotechnical and technical. Subcategories of challenges were recognized, namely, human, social, technical, economic, and data quality. This article identifies challenges facing the improvement of the Semantic Web and acknowledges the need for further advances in academia and industry.

Key words: e-government; services;semantic; web; challenges;

1. INTRODUCTION

One definition of e-government is the approach of governments [1] to use state of the art information and communication technologies to provide convenient access to government information and increase the quality of the services. The Semantic Web represents information in machine-readable format making e-government processes fully automated. The semantic Web contains meta-data, whichis data about data.

E-government web service integration can be achieved with the help of ontological descriptions of web services. In this respect, there are many challenges for e-government [2], which are:

- How do e-government services exchange information and messages meaningfully?
- How are e-government services integrated from several governmental systems, while guaranteeing semantic accuracies?
- How do government intranets interact and use the knowledge about the government itself e.g., services, resources, etc.?
- How are government services configured dynamically based on the specification of citizen and business needs?

To achieve the expected services of e-government in terms of enhanced e-service productivity and pipelines it requires an increased generation of data to produce transparency of information in the e-governance process [3].

In this work, we present the main challenges of implementing semantic-web approaches on e-government. The review presents the different challenge categories, such as human, social, technical, economic, data quality, and political. Improving knowledge sharing means that the citizen can benefit more from using semantic web applications in e-government.

In section 2 e-government web services are presented, section 3 offers a Semantic description of web services, section 4 presents Semantic Web models and a framework for e-Government and section 5 discusses the main challenges of the Semantic Web.

2. E-GOVERNMENT WEB SERVICES

The web Service architecture was designed to overcome the problematic issue of the "information isolated island" of e-government information, to facilitate the government information resource sharing system model as a distributed architecture, which seamlessly integrates existing heterogeneous platforms. It organizes a shared platform based on a Web Service [4].

The issue of e-government information sharing can be resolved by using the Web Service effectively and conveniently. The Web Service application in e-government will enhance the current deployment and decrease the cost of information integration. Web Service designing and development on distributed systems are playing important roles by making them adapt according to the modern web with massive everyday online tasks [4].

The Web service aims to achieve orchestration between web servers by using existing technologies; this is done by building blocks to enable the integration of web services, which are referred toas composition constructs [5]. [6] presents an approach for enhancing the composition of semantic Web services by diagramming the user's/organization's requirements with Business Process Modeling Notation (BPMN) and semantic descriptions using ontologies for functional requirements and non-functional requirements [7].

Indeed, we can see that, through E-Government implementation, we can witness enhanced honesty in inner workings, a reduction in corruption, increased revenue, and higher accessibility, amongst other benefits. Indeed, as a tool to enhance its effectiveness and keep it up-to-date, public sector reform has made E-Government an integral aspect after acknowledgement of the fact that it has the potential to considerably support the government in its journey of improvement [6],[8].

There are two basic data passing paradigms defined by [9]. The blackboard paradigm stores data centrally in shared variables that are used as sources and targets by Web service activities. The explicit dataflow paradigm makes dataflow an integral part of the composition model by means of dataflow connectors.

Data transformations are other types of constructs ensuring the data exchange between various and diverse Web Services [10]. This is done with the aim ofavoiding incorrect output and input data formats; proper data transformation constructs are needed [11].

3. SEMANTIC DESCRIPTION OF WEB SERVICES

The primary concept of the Semantic Web is to make information understandable by humans and also by machines [12]. The Semantic Web builds an additional layer on top of the existing World Wide Web, enabling it to become a worldwide standard for data, information and knowledge exchange.

In e-government the web service application enhances the current deployment and decreases the cost of information integration [13]. Web Service designing and development are playing important roles by making them adapt according to the modern web with massive everyday online tasks [14].

Figure1. shows the scenario where e-government have applied semantic web services [15] [2].

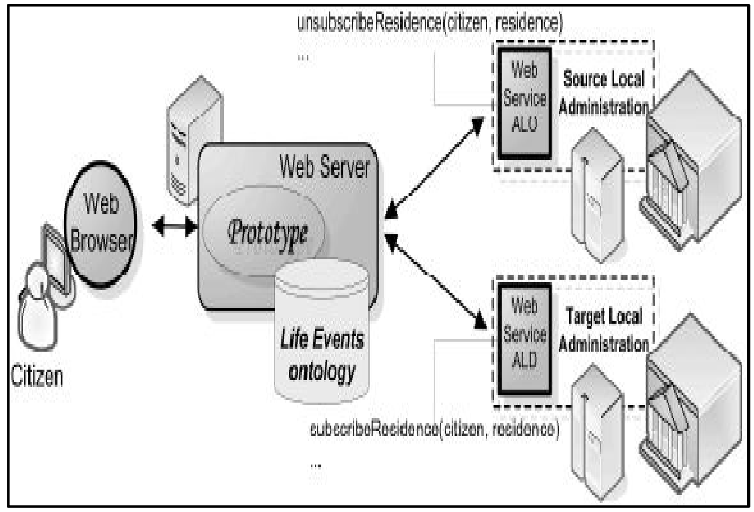

Figure 1. E-government Scenario (Adapted from [57])

3.1 Ontology

Ontology, as defined (in Gruber 1993), is "a formal, explicit specification of a shared conceptualization of some domain knowledge". It is a valid description of domain knowledge while having an agreement among domain members for describing domain concepts [15].

Ontology is expressed in a language expressing declarative, i.e., concepts, attributes, relations and procedural knowledge and implicit knowledge or rules [12]. Ontologies are used to enable citizens to express their viewpoint of the application and provide ease of navigation through the different services. Ontologies enable the use of vocabulary about a certain domain in a coherent and consistent manner [16], [17]. In short, ontologies are tools to formalize knowledge and encode higher-level data models, such as life events, procedures and services.

In this respect, there are two main ways to build an ontology: the first is the "specific domain ontology", which represents the specific meaning of terms as interpreted in the specific domain. The second is „upper or Top-Level ontology", which represents the public concepts that are the same across all knowledge domains [15]. There are two types of building ontology: Manual developing and automatic developing. This process aims to build the domain ontology in a semi-programmed or programmed process.

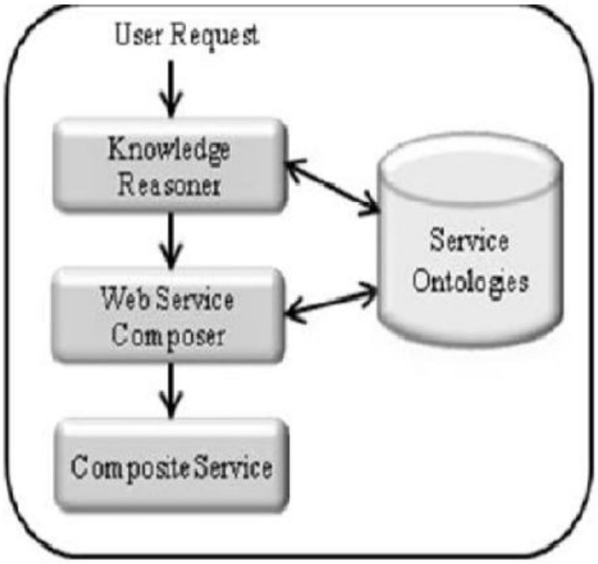

Figure 2: Ontology based web service composition (Adapted from [16])

The process starts by extracting the terms and concepts from the documents and ontology. Figure 3 shows the pipe-line for ontology based web services and Figure 4 shows the semantic services for OWL.

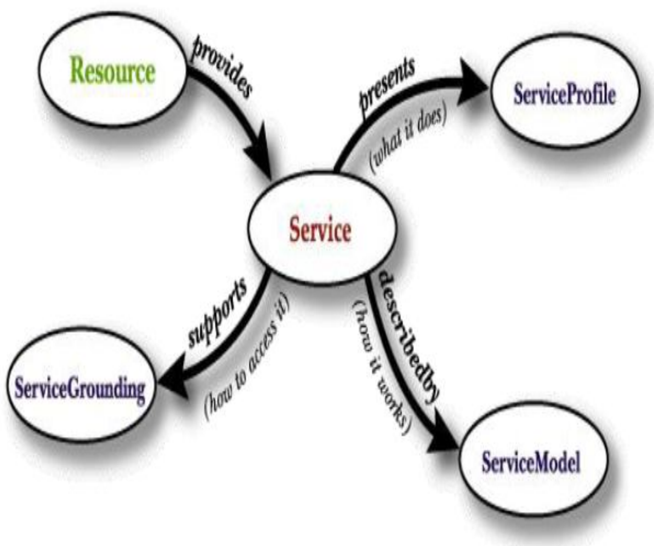

Figure 3 semantic services for OWL-S

4. SEMANTIC WEB MODELS AND FRAMEWORKS FOR E- GOVERNMENT

The e-government domain is a rich field of applications for ontologies. Further, knowledge has a large extent and its definition is shared by stakeholders, as seen in figure 5.Thismakes the use of ontologies a viable choice.

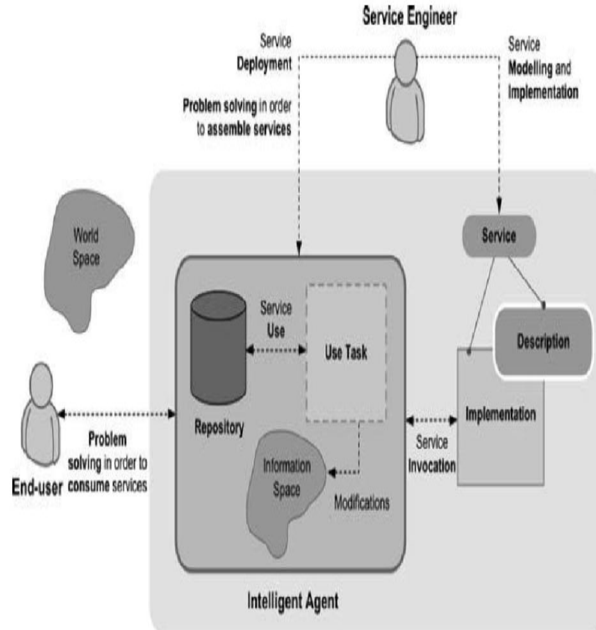

Figure 4: Semantic Web Services environment (adapted from [57])

Various approaches have been proposed for developing and designing e-government projects to ensure the delivery of successful e- government services to citizens. One e-government project [18] proposes an architecture which enables “one-stop government”. To describe the services, a markup language (GovML) has been developed [18]. That is, GovML defines a set of metadata describing public administration services and life events.

The (EU-PUBLI.com) project [19] defines a Unitary European Network Architecture. a middleware solution to connect and cooperate heterogeneous systems of different public administrations. Further, the FASME project [18] has been designed to support citizen mobility across European countries through integrating administrative processes. FASME was done by providing a smart card for storing all personal information where the services are provided with kiosk devices.

The ONTOGOV project [20] designed a platform to facilitate the consistent composition, reconfiguration and evolution of e-government services. The e-POWER project [3] has employed knowledge modeling techniques for inferences like consistency check, harmonization and consistency enforcement in legislation. The SmartGov project [14] developed a knowledge based platform to assist public sector employees in generating on-line transaction services. Figure 6 shows other projects for techniques and frameworks which are used in semantic web services for e-governments.

An ontological approach was presented by [21],which demonstrates simple phrases expressing citizens' needs in the form of simple phrases for e-government service integration. This was done by using a semantic objective and a service discovery technique. The derived e-service ontologies were represented in OWL and the Web Service Modelling Language (WSML).

Another ontological approach was presented in [22] for semantic interoperability in e-government by using a shared hierarchal ontology. It is done by organizing knowledge at different levels by local ontologies. Mapping described a semantic bridging process methodology; the integration and merging of local ontologies was represented in OWL syntax.

In [23], e-government services were presented in the form of a customer-oriented e-government Web portal hosted on an intelligent platform. This was achieved by presenting the notion of an intelligent document and a Life Event service, both of which are semantically modelled with the OWL ontology to enable services and related public administrations' interoperability. These allow automatic services composition, advanced searching mechanisms and better usability from the user's point of view.

A software engineering platform was proposed by [24] for the development and management of e-government services, namely ONTOGOV. The ONTOGOV platform practices Semantic Web technologies using OWL-S and Web Service Modelling Ontology (WSMO) to build eight kinds of ontologies, describing the e-government domain; they include: organizational ontology, legal ontology, profile ontology, domain ontology, web service orchestration ontology, service ontology, life-event ontology and life-cycle ontology. The public administrators use these ontologies to describe and compose its services. The life-cycle ontology is used to achieve the maintenance of e-services (and the software components) and service ontology integration, done by web service orchestration ontology [25].

In [26], authors presented life-events for e-government services integration of a multilevel abstraction. Life-event is defined as a collection of actions required to deliver thesatisfaction of the requirements of the citizen in a real-life scenario. This approach uses three types of ontology: e-government ontology, regulatory ontology and service ontology. These ontologies are represented in OWL to allow the integration of dynamic services via semantic searching and the matching of concepts[27].

An Ontology-based approach for semantic interoperability in e-government was presented by [25]. An E-government Business Ontology (EG-BOnt) was used to describe the business process of e-government services in terms of its output, input, logical relations and resource limitations with other related businesses. Afterwards, each class of the EG-BOnt is defined using the OWL language for its resilient semantic and logic relation expressiveness [28].

[29] Presented a framework for generating semantic model ontologies in OWL syntax from a government service domain. This was done by analyzing government services and then contracting domain ontology to get its semantic content to facilitate the design of e-government systems. This resulted in the provision of a usable framework for semantic knowledge representation in e-government processes.

Table 1 shows a survey of the techniques and frameworks which are used in semantic web services for e-governments.

Table 1: Comparison of the e-government used Semantic-web Technique

Ref.	Method	Domain	Application-
[30]	a case study, combining building an ontology and two Semantic Web platforms methodology, namely Protégé and Java Jena ontology API for semantic ontology development in e-government.	Uschold and Kind	development of government domain ontology
[31]	Proposed an e-Government KB for Morocco. It is based on a set of ontologies (domain, legal, service, SitCtx).	Legal ontology consisting of organizational, domain, service ontology, and situation/context ontology	KB of Moroccan e-Government
[32]	Proposed a model for the classification of such concepts. The model was built based on a literature review on Gov-IS and Software Engineering principles. -introduces an extensive list of	-Implemented in four countries- Australia, Estonia, New Zealand and USA.	Government sharing

	benefits, barriers and benefits, extracted from the conducted survey on the state of the art on Gov-IS		
[33]	Proposed an approach based on formal ontologies and shows how they can provide a great enhancement in this direction.	booking medical examinations, Payment service for medical fees	Local Italian Public Administration
[34]	Proposed a framework to monitor the compliance of Services-based system (SBS), for which a set of requirements has been pre-specified.	Use Case	Monitoring system
[35]	Discussed how Linked Data has been used in government data provision and described architecture enabling the provision of integrated government data in a decentralized manner.	Use Case: Public agencies and schools in Greece.	Open Government Data
[36]	Presented an evaluation and an adaptive, semantic-based framework for monitoring citizen satisfaction from e-government services.	Use case Hypothesis , opinion	Monitoring the degree of citizen satisfaction from e-government services.

5. CHALLENGES OF APPLYING SEMANTIC APPROACHES IN E-GOVERNMENT

Budget scarcity, institutional arrangements, socio cultural customs, and behavior patterns amongst the public have been just some of the things preventing government initiatives, thus meaning that E-Government innovation in terms of public services has, thus far, been rather slow-moving and cautious. [32] In the next sections there is a discussion on some issues relating to semantic web adaptation, divided into two sections: first, sociotechnical issues relating to human, economic, social issues and how humans interact with the technology of the semantic web. In addition, there are technical issues relating to hardware, software, and design methods of semantic web.

5.1 sociotechnical issues of semantic web.

a. the semantic web human issue

[33] And [34] argue that most users are interested in searching for individual webpages, opinions, social matter, rather than searching for complex enquiries on more accurate content from multiple sources. The current search engines, e.g. Google, provide most of the help needed by the majority of users and can provide a tremendous amount of information on individual webpages, however.The Semantic Web idea is to address the more difficult categories of enquiries that require a search for information from numerous sources on the Web.

b. the semantic web depends intensely on reliable sources of information

Originally, the Semantic Web was based on the impression that machines would inevitably process organized content on the Web [36], [37]. This processing could be predominantly fragile in the face of both unintended errors and deliberate deception due to the untrustworthy source of information.

The Semantic Web recognizes that sources of information are not necessarily accurate nor reliable, which highlight the issue of data quality as a major challenge [38]. Two features to be considered are the source of reliable information, and methods on how to measure the level of reliability. These methods such as para consistent reasoning [39],authoritative and quarantined reasoning [40] need to be researched more.

c. the semantic web dependency on ontological agreement

Modeling a domain to produce an ontology lacks a unified model to follow, which could be problematic.

Further, different stakeholders could have different views about semantic or contradictory claims [36], [41]which could lead to lack of global certainty. Various stakeholders in the domain may consider different semantics for terms or even hold contradictory claims, which leads to weak and differing views.

d. the semantic web standards

Standards of the Semantic Web were mostly designed by group, therefore expecting applying use-cases that to be fully understood, sometimes focusing on academic objectives rather than industry objectives. It is argued that it is difficult and complex to understand. Numerous calls were made to simplify the standards, of features in the RDF standard [42]. For example, JSON has become more popular than its more complex XML cousin [36], [43].

e. the semantic web lacks tools

Practitioners attracted to implementing Semantic Web technologies are rapidly isolated by the lack of usable tools for their use-cases [36].

5.2 technical issues about the semantic web

a. the semantic web vs machine learning advances

It is assumed that the current (HTML-based) Web lacks machine-readable capabilities. However, machine learning is improving and increasingly advancing, challenging this assumption. By the time the Semantic Web is able to reach the maturity needed that could have an impact on the Web, Machine Learning will have advanced to a point that will make practitioners lose interest in Semantic Web technologies. [35].

b. the semantic web advocates decentralization, which is too costly

The innovative idea of the Semantic Web is to be decentralized (where, e.g., "individual health care providers host their own website with their own structured content"). On the other hand, on the current Web, a centralization system has become the predominant paradigm (considering Google, Facebook, etc.). That is, decentralizing the Semantic Web could be costly [43].

c. incentives for adopting semantic web technologies

The Semantic Web requires infrastructure for publishing data which requires, in the first place, exploiting data to be developed[44]. However, the Linked Data community have partly resolved this problem by convincing a number of stakeholders to publish data on that applications arrive to justify the cost, and as a result, some related services went offline. For example, [45] estimated, in 2013, "that around 29% of the 427 public SPARQL services found had gone offline" [46], [47], [48].

d. high cost for publishing semantic web content

There is an excessively high cost for publishing the data by using the Semantic Web standards compared to data in a legacy format, a relational database, JSON, CSV, etc. Publishing Semantic Web content in an appropriate way – e.g., Linked Data principles [44] – requires expertise. Even if the data exist in a structured format, conversion to RDF is not easy, especially when problems such as offering IRIs, adding links, etc., are needed [45]. While there are types of data that are simply conceptualized as RDF graphs, others involve multiple forms of prevarication (e.g., reification [46]) to be accurately represented. [36].

e. the semantic web scalability and performance

Complexity results are not designed to Semantic Web proposals, where for example the complexity of SPARQL query assessment is equivalent to that for SQL [49], [50]. And/or Critique: Retrieving data published using this requires algorithms with poor scalability and/or performance. Researchers [51], [52], [53], [54], [55], [56], [57] show that the Semantic Web has poor scalability and/or performance. Furthermore, [53] indicates that, in some situations, MySQL can perform 13 times more queries in the assigned time period than the best SPARQL store examined (Sesame) by using comparable queries.

The discussion above has presented different challenges that have been identified in the literature when applying semantic web services toe-government. As was presented in the above section, it was noted that some challenges in implementing the semantic-web in e-government involved various factors, namely, human, social, technical, economic, and data quality. This raises the issue of the need to bear in mind these challenges and present solutions prior to developing and applying semantic web services toe-government.

CONCLUSION

In this paper, we have presented the main challenges of applying semantic-web approaches toe-government web services. The review presented the different challenge categories in sociotechnical and technical terms. Subcategories of these challenges were human, social, technical, economic, and data quality. Citizens can improve their knowledge and share it through benefitting from using semantic web applications in e-government.

This research concludes that there is a lack of existing governmental service types, and there is a need to dramatically change/reengineer these services. The presented approaches for e-government services show that there is gap between the e-government services needed to provide information and the adequate adaption in terms of format and methods of delivery according to the users' requirements. The semantic web solution is ontology-based for e-government service integration, and interoperability. Finally, the Semantic Web lacks maturity to be recognized as a solid artifact, which calls for more focus in academia and industry.

REFERENCES

[1] S. Zaidi, A Cross-language Information Retrieval Based on an Arabic Ontology in the Legal Domain, proceedings Int. Conf. Signal-Image Technol. Internet-Based Syst., pp. 8691, 2005.

[2] http://what-when-how.com/information-science-andtechnology/ semantic-web-in-e-government-information-science/ (Accessed Date Aug 2016)

[3] Van Engers T., Patries J.M., Kordelaar J., Den Hartog J., Glasseee E. (2002). Available at http://lri.jur.uva.nl/epower/

[4] W. Ning, B. He, L. Hui, W. Xuehua, and W. Yanzhang, The Application of Web Service Technology in Government Information Resources Sharing System, 2009 IEEE/WIC/ACM Int. Jt. Conf. Web Intell. Intell. Agent Technol., vol. 3, pp. 373376, 2009.

[5] Driss, Maha, et al. "Servicing your requirements: An fca and rca-driven approach for semantic web services composition." IEEE Access 8 (2020): 59326-59339.

[6] Q. Guo, H. Zheng, G. Chang and J. Li, "High Availability and Flexibility of Web Services in the E-government System," 2009 WRI World Congress on Software Engineering, Xiamen, 2009, pp. 372-376.

[7] Dieter Fensel and Christoph Bussler. 2002. The web service modeling framework WSMF. Electronic Commerce Research and Applications 1, 2 (2002), 113137.

[8] Y. Jinhua, L. Yong and Z. Peng, "E-government Evaluation Based on Citizen Satisfaction and its Implementation," 2010 International Conference on E-Business and E-Government, Guangzhou, 2010, pp. 535-538.

[9] Gustavo Alonso, Fabio Casati, Harumi Kuno, and VijayMachiraju. 2004a.Web Services: Concepts, Architec- tures and Application.Springer- Verlag.

[10] Lemos, A. L., Daniel, F., & Benatallah, B. (2015). Web service composition: a survey of techniques and tools. ACM Computing Surveys (CSUR), 48(3), 1-41.

[11] Rodrigo Mantovaneli Pessoa, Eduardo Silva, Marten van Sinderen, Dick A. C. Quartel, and Lus Ferreira Pires. 2008. Enterprise interoperability with SOA: Survey of service composition approaches. In EDOC Workshops. 238251.

[12] Vitvar, T., Peristeras, V., & Tarabanis, K. (2010). Semantic technologies for e-Government: an overview. Semantic technologies for e-government, 1-22.

[13] W. Ning, B. He, L. Hui, W. Xuehua and W. Yanzhang, "The Application of Web Service Technology in Government Information Resources Sharing System," 2009 IEEE/WIC/ACM International Joint Conference on Web Intelligence and Intelligent Agent Technology, Milan, Italy, 2009, pp. 373-376, doi: 10.1109/WI-IAT.2009.304.

[14] SmartGov Project Website: http://www.smartgovproject.org

[15] Vitvar T., Peristeras V., Tarabanis K. (2010) Semantic Technologies for E-Government: An Overview. In: Vitvar T., Peristeras V., Tarabanis K. (eds) Semantic Technologies for E-Government. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-03507-4_1

[16] Roberto, V., Rowlatt, M., Davies, R., Gugliotta, A., Cabral, L., & Domingue, J. (2005). A semantic web service-based architecture for the interoperability of e-Government services.

[17] The FASME Project Website: http://www.fasme.org/index-org.html

[18] eGOV Project Website: http://www.egovproject.org

[19] The EU-PUBLI.con Project Website: http://www.eu-publi.com

[20] OntoGov Project Website: http://www.ontogov.com

[21] P. Salhofer, B. Stadlhofer and G. Tretter, Ontology Driven E- government, Electronic Journal of E-government, Vol. 7, No. 4, pp. 415-424, 2009.

[22] S. Muthaiyah and L. Kerschberg, Achieving Interoperability in Egovernment Services with two Modes of Semantic Bridging: SRS and SWRL, Journal of Theoretical and Applied Electronic Commerce Research, Vol. 3, No. 3, pp. 52-63, December, 2008.

[23] L.M.A. Sabucedo, L.E.A. Rifon, F. Corradini, A. Polzonetti and B. Re, Knowledge-based Platform for E-government Agents: A Web-based Solution Using Semantic Technologies, Journal of Expert Systems with

Applications, Elsevier Inc., Vol. 2010, No. 37, pp. 3647-3656, 2010.

[24] D. Apostolou, L. Stojanovic, T.P. Lobo, J.C. Miro and A. Papadakis Con- figuring E-government Services Using Ontologies, IFIP International Federation for Information Processing, Springer Boston, Vol. 2005, No. 189, pp. 1571-5736, 2005.

[25]Y. Xiao, M. Xioa and H. Zhao, An Ontology for E-government Knowledge Modelling and Interoperability, In Proceedings of IEEE International Conference on Wireless Communications, Networking and Mobile Computing, (WiCOM 2007), Shanghai, pp. 3600-3603, 21-25 September, 2007.

[26] F. Sanati and J. Lu, Multilevel Life-event Abstraction Framework for E-government Service Integration, In Proceedings of the 9th European Conference on E-government 2009 (ECEG 2009), London, UK, pp. 550- 558, 29-30 June, 2009.

[27]Fadhel, Ben Jafar, and Mamadou Tadiou Kone. " An e-Government Web Services Platform on the Semantic Web." In EGOV (Workshops and Posters), pp. 143-149. 2005.

[28] J. Vincent, F. Dombeu, J. F. Dombeu, and M. Huisman, A Framework for Semantic Model Ontologies Generation for E-government Applications, ICDS 2011, Fifth, no. c, pp. 152158, 2011.

[29] Dombeu, Jean Vincent Fonou, and Magda Huisman." Combining ontology development methodologies and semantic web platforms for e-government domain ontology development." arXiv preprint arXiv:1104.4966 (2011).

[30] The Jena Ontology API I Dickinson – URL: http://jena. sourceforge. net/ontology/index. [accessed 20 March 2021]

[31] Hind Lamharhar, Dalila Chiadmi, and Laila Benhlima. 2015. Ontology-based knowledge representation for e-government domain. In Proceedings of the 17th International Conference on Information Integration and Web-based Applications & Services (iiWAS '15). Association for Computing Machinery, New York, NY, USA, Article 51, 1–10.

[32] Karla Mendes Calo, Karina Cenci, Pablo Fillottrani, and Elsa Estevez. 2014. Government information sharing: a model for classifying benefits, barriers and risks. In Proceedings of the 8th International Conference on Theory and Practice of Electronic Governance (ICEGOV '14). Association for Computing Machinery, New York, NY, USA, 204–212.

[33] Anna Goy, Diego Magro, Matteo Casu, and Vittorio Di Tomaso. 2013. How Semantic Knowledge Can Enhance the Access to PA Online Services. In Proceedings of International Conference on Information Integration and Web-based Applications & Services (IIWAS '13). Association for Computing Machinery, New York, NY, USA, 714–718.

[34] A. K. Tripathy and M. R. Patra, "An event based, non-intrusive monitoring framework for Web Service Based Systems," 2010 International Conference on Computer Information Systems and Industrial Management Applications (CISIM), Krakow, Poland, 2010, pp. 547-552.

[35] Evangelos Kalampokis, Efthimios Tambouris, and Konstantinos Tarabanis. 2013. On publishing linked open government data. InProceedings of the 17th Panhellenic Conference on Informatics (PCI '13). Association for Computing Machinery, New York, NY, USA, 25–32.

[36] Magoutas, B., & Mentzas, G. (2010). SALT: A semantic adaptive framework for monitoring citizen satisfaction from e-government services. Expert Systems with Applications, 37(6), 4292-4300.

[37] C. Doctorow, Metacrap: Putting the torch to seven straw- men of the meta-utopia (2001), https://people.well.com/user/ doctorow/metacrap.htm.

[38] A. Zaveri, A. Rula, A. Maurino, R. Pietrobon, J. Lehmann and S. Auer, Quality assessment for Linked Data: A Survey, Se- mantic Web 7(1) (2016), 63–93. doi:10.3233/SW-150175.

[39] F. Maier, Y. Ma and P. Hitzler, Paraconsistent OWL and related logics, Semantic Web 4(4) (2013), 395–427. doi:10.3233/SW- 2012-0066.

[40] A. Polleres, A. Hogan, R. Delbru and J. Umbrich, RDFS and OWL Reasoning for Linked Data, in: Reasoning Web, Springer, 2013, pp. 91–149. doi:10.1007/978-3-642-39784-4.

[41] T. Berners-Lee, J. Hendler and O. Lassila, The Semantic Web, Scientific American 284(5) (2001), 34–43.

[42] T. Berners-Lee, The Future of RDF, 2010, https://www.w3.org/DesignIssues/RDF-Future.html.

[43] S. Target, Whatever Happened to the Semantic Web?, 2018, https://twobithistory.org/2018/05/27/semantic-web.html.

[44] J. Rochkind, Is the semantic web still a thing?, 2014, https://bibwild.wordpress.com/2014/10/28/is-the-semantic- web-still-a-thing/.

[45] C.B. Aranda, A. Hogan, J. Umbrich and P. Vandenbussche, SPARQLWeb-Querying Infrastructure: Ready for Action?, in: International Semantic Web Conference, 2013, pp. 277–293. doi:10.1007/978-3-642-41338-4_18.

[46] P. Mika, What Happened To The Semantic Web?, in: ACM Conference on Hypertext and Social Media (HYPERTEXT), 2017, p. 3. doi:10.1145/3078714.3078751.

[47] A. Hogan, J. Umbrich, A. Harth, R. Cyganiak, A. Polleres and S. Decker, An empirical survey of Linked Data conformance, J. Web Semant. 14 (2012), 14–44. doi:10.1016/j.websem.2012.02.001.

[48] A. Hogan, P. Hitzler and K. Janowicz, Linked Dataset descrip- tion papers at the Semantic Web journal: A critical assessment, SemanticWeb 7(2) (2016), 105–116. doi:10.3233/SW-160216.

[49] M. Bergman, Scalability of the Semantic Web (2006), http://www.mkbergman.com/227/scalability-of-the-semantic-web/.

[50] J. Pérez, M. Arenas and C. Gutiérrez, Semantics and complexity of SPARQL, ACM Trans. Database Syst. 34(3) (2009), 16:1–16:45. doi:10.1145/1567274.1567278.

[51] Erhard Rahm and Philip A. Bernstein. 2001. A survey of approaches to automatic schema matching. VLDB Journal 10, 4 (2001), 334350.

[52] Hogan, Aidan. "The semantic web: two decades on." Semantic Web Preprint (2020): 1-17.

[53] Vaishnav, R. S. (n.d.). Integration of web 2 technologies for ODL (Vol. 3). IGI Global.

[54] D. Hernández, A. Hogan and M. Krötzsch, Reifying RDF: What Works Well With Wikidata?, in: International Workshop on Scalable Semantic Web Knowledge Base Systems (SSWS)

[56] T. Heath and C. Bizer, Linked Data: Evolving the Web into a Global Data Space, Synthesis Lectures on the Semantic Web, Morgan & Claypool Publishers, 2011.

[57] F. Garc, R. Mart, J. M. Go, and R. Valencia-garc, Applying intelligent agents and semantic web services in eGovernment environments, J. Knowl. Eng., vol. 28, no. 5, 2011.

[58] H. Tran, U. Zdun, and S. Dustdar, View-Based Integration of Process- Driven SOA Models at Various Abstraction Levels, in Model-Based Software and Data Integration, Berlin, Heidelberg: Springer Berlin Heidelberg, 2008, pp. 5566.

[59] W. Dong, "Construction and Test of Web Service Solution for E-government," 2009 International Conference on Computational Intelligence and Natural Computing, Wuhan, 2009, pp. 221-224.

[60] Kavadias G., Tambouris E.: GovML: A Markup Language for Describing Public Services and Life Events. Working Conference on Knowledge Management in Electronic Government, 2003.

[61] Alotaibi, Sara Jeza. "Internet Application and Technology for E-Government Public Services." (2020).

[62] D. ter Heide, three reasons why the Semantic Web has failed, 2013, https://gigaom.com/2013/11/03/three-reasons-why-the- semantic-web-has-failed/.

[64] J. Cabeda, Semantic Web is Dead, Long live the AI!!!, 2017, https://hackernoon.com/semantic-web-is-dead-long-live-the- ai-2a5ea0cf6423.

[65] K. Cagle, Why the Semantic Web Has Failed, 2016, https://www.linkedin.com/pulse/why-semantic-web-has- failed-kurt-cagle.