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## An Investigation into Ontology-Based Enhancement of Search Technologies for E-Government: Literature Review

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### Abstract

Services provided by E-government are no longer considered as a new topic, there is a continuous evolution of the level of services provided by the E-government that matches the development of the techniques and technologies used. The success or failure of E-government builds mainly on providing different services to citizens in a suitable and effective manner. This research study aims at providing an empirical and evaluation study of the effects and the opportunities of implementing various techniques in the development of E-government. The research focuses on the impact of using ontology technique on the success or failure of the services provided by E-government. The services provided to citizens are expanded from information extraction to vote, tax, and other services. It becomes necessary to provide a detail description of the most appropriate technologies in order to reach to a successful E-government which provides effective services.

**Keywords:** E-government Technique, Ontology, Electronic Service, Semantic Web.

### 1. Introduction

E-government also knew as electronic government, E-go, and the digital government has no longer new. It occupies a growing role in the most business and citizens lives. In [23], Guo Yanqing defined the e-government as "a way for governments to use the most innovative information and communication technologies, particularly web-based Internet applications, to provide citizens and businesses with more convenient access to government information and services, to improve the quality of the services and to provide greater opportunities to participate in democratic institutions and processes".

The expansion of the role of e-government in the provision of various services involves a range of different sectors including citizen, business, and inter-agency (Government). Similarly with the e-commerce which allows companies to interact with each other more efficiently as well as brings customers closer to business [21].

When considering the enormous of the services provided by e-government along with what it takes the system from a variety of operations such as searching and retrieval; made the work of establishment and implementation of e-government project be not an easy but rather conversely requires a lot of effort.

The failure of e-government has different causes which are shown in comprises economic losses, loss of opportunities for enhanced effectiveness, failure to meet targeted strategic outcomes, customer dissatisfaction, and undermines efforts [49].

One of the most important factors for the success of e-government involves on applying modeling techniques and their roles in increasing the efficiency. E-government applies different modeling techniques to improve the efficiency of government services provided to citizens, employees, businesses, and agencies. Web modeling techniques include semantic (ontology) and non-semantic techniques.

In e-government, ontology is assumed to offer a semantic of the search-Using nontraditional search results by matching words, with the capability of matching the concepts and logical relationships [16],[38].

There are some important questions of hypotheses that can be raised which have a strong correlation to this research, such as:

- In Reality, can the ontology technique be considered as the best implementation technique for any e-government project? and,
- To which extent, we can trust implementing ontology technique in order to maximize the efficiency and avoid the failure of e-government?

This research proposes answers to the previous critical questions through describing a framework which depends on an empirical study for evaluating the impact of ontology technique in the development of e-government.

The research studies explore and evaluate the role of the semantic Web techniques and other available techniques to improve the quality and performance of the services provided by e-government.

Section 2 provides the objectives and the contributions of this research. Section 3 explores the growth of the research topic. The state of the art is described in Section 4. Section 5 is identifying the problems on the topic. Research originality and challenges are provided in Section 6. The methodology used in this research is presented in Section 7. Finally, in Section 8 conclusion is given.

## 2. Research Objectives and Contributions

The most important objective of this research aims to introduce a quantitative approach based on an empirical study from which we can get closer to the truth of the real role of ontology technique in e-government. Some the objectives to be achieved are shown below:

1. Examines the impact of ontology technique on e-government.
2. Achieves efficient services in e-government.
3. Evaluates the ontology technique in e-government in terms of efficiency and accessibility.

The contributions of this research can be defined as follows:

1. Utilizing ontology technique in e-government web services.
2. Understanding the critical factors that determine the success or failure of any e-government services, mainly, in terms of efficiency and accessibility.
3. Understanding the currently used techniques, besides that, the probability of using ontology technique in the future.
4. Prioritizing the evaluation factors in order to develop a measured scale which will be used for any e-government web services.

## 3. The Growth of the Research Topic

In the mid to late of the 1990s, e-government appeared as a term and a practice in the literature [42]. The history of computing in government organizations can be traced back to the beginnings of computer history [21].

Nowadays, the differences in the concept and a meaning of ontology have appeared; however in the recent past, most of the researchers had been seen ontology as a philosophical meaning

[30]. But at the moment, and when searching for the meaning of ontology concept, it's likely to see the different impression of meaning which is more concern on practical concepts more than just an absolute philosophical expressing[22].

In computer science, the concept ontology comes in several forms, extended from lexicons to dictionaries. Lexicons supply an integrated dictionary of terms for use over. In any case those forms; ontology is useful because it supports standardization of providing the meaning of terms [30].

In summary, e-government as a term and as a topic for research has grown dramatically. In the last few years, the research carried out in the field of e-government has been increased.

## 4. The State Of Art

### 4.1 The Framework of the Literature Review

The framework of the literature review process divided into two main stages, the first stage attempts to collect relevant information to the research topic. On the other hand, the second stage classifies the methods' approaches found in the literature into either qualitative or quantitative methods.

The sources of investigated researchers are varied include journals, conferences, books, and thesis. However, the priority of the sources was given to those sources which are associated specifically with e-government; similarly, without excluding those associated with existing research domain such as leading information system (IS), or leading public administration journals. Other criteria for the selection of the sources presented as an attempt to create a balancing between the numbers of the various sources, this will help to create a comprehensive and integrated environment for different views and perceptions of the research study.

Sequel of the process, the selection of references paper has been carefully chosen depending on specific standard represent as whether the content of the selected reference paper can satisfy the subject's attentions.

Four queries were used in order to collect relevant information to the research topic. The queries were selected based on the keywords found in the research topic. Most of the references were collected through Summon enterprise which searches the library's resources in Huddersfield University. The rest of the collected references were obtained using Google search engine.

Table 1 shows the queries, references, and the number of collected references for each query. The total number of collected references equals 110; most of the references refer to journals. Query 2 "Evaluation techniques used in e-government" has the highest number of references compared to the others queries.

**Table 1.** Number of collected references for each query

| Reference                         | Query                               |  |                                |                                       | Total |
|-----------------------------------|-------------------------------------|--|--------------------------------|---------------------------------------|-------|
|                                   | E-government concept and definition | Evaluation techniques used in e-government | Ontology concept and technique | Implementing ontology in e-government |       |
| Journals                          | 13                                  | 17   | 14                             | 11                                    | 55    |
| Conferences proceedings           | 4                                   | 10   | 11                             | 6                                     | 31    |
| Thesis and studies                | 0                                   | 3  | 2                              | 5                                     | 10    |
| Books                             | 2                                   | 1  | 1                              | 0                                     | 4     |
| Others (i.e. Web sites, handouts) | 4                                   | 4  | 0                              | 2                                     | 10    |
| Total                             | 23                                  | 35   | 28                             | 24                                    | 110   |

The methods' approaches found in the literature can be classified as either qualitative or quantitative methods. Qualitative methods include case studies, model-based work, and non-empirical research. Moreover, quantitative methods involve an empirical theory. The second stage helps to understand the vision and the direction of the investigated research. However, in the investigation of the researches references shows two different classes of the methods used in the literature; the qualitative methods can be found in 73% of the references while the quantitative methods were used in 27% of these references.

## 4.2 Analysis of the Literature Review

The objective of this section is to show and explore the different methods used and offered by different researchers on the topic of the research study.

Table 2 shows the investigated references, methods used, the evaluation whether is applied or not applied and the limitations of each reference.

**Table 2.** Featured investigated references

| Reference                     | Method                                 | Evaluation  | Limitations  |
|-------------------------------|--|-------------|--|
| Corrêa et al [7]              | Qualitative/model based work           | Not applied | The practical process of the role of ontology in E-government. Use the technique to produce ontology information.  |
| Talens et al [50]             | Qualitative/theory based work          | Not applied | E-government as a basis of description or evaluation. the impact of ontology on E-government   |
| Zhang et al [53]              | Qualitative/algorithm based work       | Applied     | E-government as a basis of the evaluation system. The paper describes an algorithm to optimize technique for searching.  |
| Fonou Dombeu and Huisman [15] | Qualitative/case study based work      | Not applied | Less analysis and discussion or evaluation process. Focus on case study as a basis.  |
| Grandi and Scalas [19]        | Quantitative/empirical theory          | Not applied | Shows only how to transfer from XML to OWL instead of study ontology.  |
| Janev and Vranes [29]         | Qualitative/theory approach based work | Not applied | Research covered in contextual with focusing in analyzing survey and ignoring any implementation in order to find real impact of ontology in e-government.   |
| Delbru et al [9]              | Qualitative/model based work           | Not applied | Ignoring real comparison between traditional web documents and semantic web module, in addition, proposed module is not shown whether it can be implemented in e-government.   |
| Santoso et al [44]            | Qualitative/algorithm based work       | Not applied | The evaluation process is not applicable it focus on one solution defined as processing time , in addition, to supporting with any evident, also research missing the impact of implementing Ontology on e-government. |
| Myrseth et al [40]            | Qualitative/model based work           | Not applied | Focus on the model of the social network to design ontology for E-government rather than evaluation process.   |
| Faqihi et al [12]             | Qualitative/theory based work          | Not applied | Research release a solution of exchanging information based on 2q e-learning system. Does not show ontology in E-government.   |
| Sanati et al [43]             | Qualitative/model based work           | Not applied | Proposed model to generate integrated service it describes how to get rather than what you can do to get. Ignoring evaluation  |

|                           |   |             |   |
|---------------------------|---|-------------|---|
|                           |   |             | process just overview of some model applied.  |
| Abdellatif et al [1]      | Qualitative/model framework based work          | Not applied | Practice study in addition to the evaluation process. The paper shows a framework to create new services to the citizen.                      |
| Mohamed et al [39]        | Qualitative/theory based work                   | Applied     | Ontology and implementation are not described. Research present evaluation for the model in term of efficiency.                               |
| Sedek et al [45]          | Qualitative/theory approach based work          | Not applied | Review some approaches to gain integrated service instead of focusing on ontology or semantic technique to create services.                   |
| Magoutas and Mentzas [35] | Qualitative/model framework based work          | Applied     | Shows evaluation of services using questions based offer to users rather than an evaluation of techniques.                                    |
| Tsai et al [51]           | Qualitative/design process framework based work | Not applied | Only present how to design ontology. More useful on developing ontology system. Ignoring any evaluation impact of technique on E-government.  |
| Sourouni et al [48]       | Qualitative/model framework based work          | Not applied | Model to implement in E-government To gain better services. No evaluation or measures specify.  |
| Huai [28]                 | Qualitative/method theory based work            | Not applied | Theory based work ignoring the role of any technique on E-government. Presenting method to assist E-government based on citizen satisfaction. |
| Hébert [24]               | Qualitative/theory based work                   | Not applied | Evaluate E-government services rather than technique based work.  |
| Heise and Naumann [26]    | Qualitative and Quantitative                    | Applied     | Research is focused on displaying information rather than techniques implemented.   |
| Fei et al [13]            | Qualitative/method theory based work            | Applied     | Evaluate services rather than technology to gain services. Offer method to evaluate E-government services.                                    |

In Table 2, when comparing several of the researches which have been selected; found that most of the researches were lacking the evaluation and measurement process to the success of the model, case studies, theory and technique used.

Also, it has been noted that a lack of assessment process had characterized most of the limitations of the references; moreover, there is the absence of the link between the e-government and ontology or providing a study to the role of ontology in e-government.

In Table 2, it is clear that most of the researches studies in e-government adapted qualitative methods. Despite the importance of the process of assessment of the qualitative researches, most of those researches were lacks a process of evaluation especially for those which applied proposed models.

Considering the researches which are adapted quantitative methods, they have been providing evaluation process, even though they are scarcity, briefly and miniature.

Although both quantitative and qualitative approaches contribute to the science of knowledge, there is a clear need for more studies to accept and apply quantitative research methods which described as emphasis basis to be cover in the proposed research study aim and objectives, in view of the belief that quantitative empirical methods are more precise and objective for this purpose. However, the quantitative methods are closer to practice; these methods will speed up the implementation and the evaluation of the services provided by e-government.

As shown in Table 2, the quantitative methods usually require an evaluation process which includes evaluation measures such as system recall and response time. The qualitative methods rarely require an evaluation, the evaluation processes can be applied in terms of qualitative factors such as website efficiency, interface, citizen satisfaction, and business.

In fact, many advantages of ontology technique are theoretically described and modeled without the state the relationship between the ontology and semantic web. Most of the researches studies assume a positive vision of the ontology technique to e-government, however, few of them had measured the ontology in e-government.

### 4.3 Related Work

In this part, it has been classified and distinguished some researches to be relevant for this research study. Noteworthy that determining a factor for this choice is the compatibility or closely of the related research to the subject the role of ontology in e-government, this corresponds had met with the main objective of this research study. Through that the related researches on the subject of the study are described as follows:

Yang et al. [52] presented a tool that can be used to evaluate semantic web based on the expert information system. The authors did not show the possibility of using the tool in e-government sector.

Martin [37] provided guides on how to evaluate e-government system. The author ignores the measuring process of ontology in e-government.

Adadi et al [2] proposed a technique based on artificial intelligence to improve the citizen-centric of the e-government. The authors didn't -provide any evaluation or measure for the applied technique specifically the validation of the proposed technique.

Eitiveni and Sensuse [11] proposed a way based on semantic web to help e-government manages information semantically. The authors explored services gain rather than technique description.

Klischewski and Jeenicke [33] proposed an approach which examines ontology-driven e-government application based on Semantic Web technologies; with focusing on tasks of information and knowledge management related to e-government service provision. Although the authors provide a description approach, but such of this approach is totally theoretically covered with the assumption of the feature of the ontology techniques structure, the evaluations are suggestions made by administration and developer without a specific evaluation through measurement scale.

According to the objectives of this research study, the related works had met only one or at most two objectives. Based on that, it becomes difficult to make a decision whether to employ ontology in e-government or not.

This research study has a value in terms of providing an integrated study which includes an evaluation and measurement processes of the role of the ontology in e-government, also, the study will help to obtain effective services in e-government.

## 5. Identifying the Problems in the Topic

There is a range of important questions related to the research topic; those questions revolve around the role of ontology technique in e-government, examples of such questions are given below:

- Can the new services provided by the government be offered using the ontology technique?
- Can the performance of services be increased using the ontology technique?
- How much can the ontology technique help e-government?
- Should thing more about new technology (alternate technique) that satisfies the requirements of e-government services?

To provide answers to the previous questions had required introducing an empirical study to evaluate and measure the role of implementing ontology technique in the e-government, and this is the target of this research study.

## 6. Research Originality and Challenges

To the best knowledge of the author of this research study, the research topic is considering an interesting topic; also the concerning of the topic has increased over the years. Considering the stated objectives, there are limited studies that employ the ontology technique in e-government.

The main challenges of the research study fall into the research background and the implementation. E-government is a broad research field in which researchers are belong to different research domains particularly computer science, information systems, public administration, and political science.

The amount of data and information which expects to provide into services is considered one of the challenges face the implementation of ontology. The integration services are huge, divergent, and distributed systems.

Another challenge faces the implementation is represented in the adapted new technology and technique to develop an ontology. The uses of new tools like OWL in the implementation of e-government is not considered an easy task, many of the developers are not fully aware of the language.

## 7. Methodology

Figure 2 explains the methodology followed in this research study. The methodology includes the following steps:

Step 1. The e-government web services will be implemented using two Web modeling languages which are ontology/semantic (OWL) and XML.

Step 2. Both implemented systems will be evaluated and measured using specific criteria.

Step 3. Analyze the results.

Both systems have the same data content and based on common services provided by e-government. Services include personal information, directorate of traffic, payments bills, and election voting service, education environment, taxes, and immigration/residents services. The evaluation and measurement process applies specific criteria on both systems.

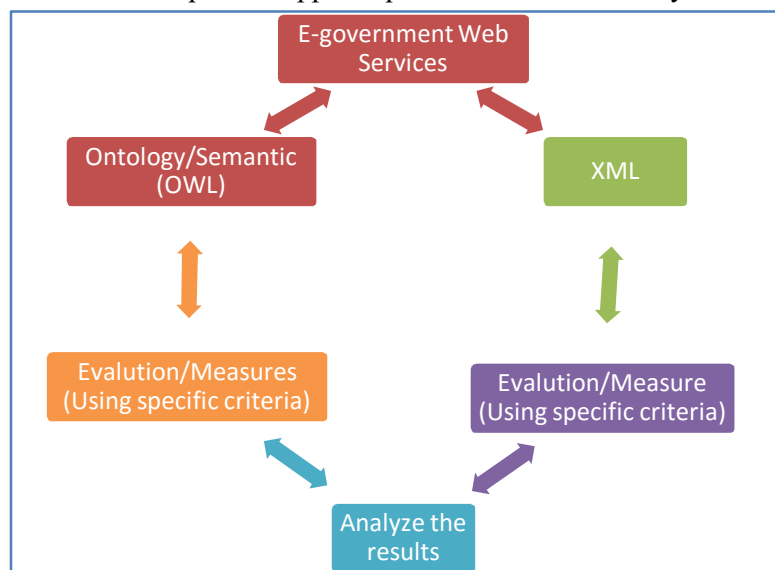


Fig 2. Methodology



## 7.1 Theory Behind the Methodology

The theory based work essentially described as quantitative/empirical theory-based work. So far, both systems would contain information that describes common biography of e-government. Deeply, results would have a contextual analysis of the represented information and knowledge. Analytical process examined the results obtained from the evaluation of the two systems.

The only essential difference between both systems, representing in a way of implementing both systems where the first system structure will implement ontology language/tool to describe web contents while the second simulated system will implement popular language/tool to describe the similar data presented in the first ontology file system. In fact, both systems will present the same information with different document structure based on implementing way either it provides integrated or limited services.

### Prototype Design

Ontology design to some extent is similar to software design. For the purpose of increasing the reusability and the efficiency of the software design, many design patterns are applied. However, the development of ontology process will influence the software development process and be a part of it. So that the lifecycle model has the following phases:

1. Analysis/Requirements
2. Design Module

The proposed architecture of the design process includes defining services provided by e-government, building the ontology, designing using the elements defined in the ontology, and the code.

### Evaluation Process

The most important issue presents the process of the evaluation and measurement method, however, specific criteria will applying in both files systems.

The criteria of the evaluation factors will be more concern in delivering services rather than evaluating the services or website portal. Moreover, the analytical process will specify values for evaluation and measurement the results. However, specifying factors has been selected for the following reasons:

1. Correlation of these factors to the targets set of the research to find a practical study to evaluate and measure process to the role of ontology.
2. The importance of these elements in the process of evaluation in the success or failure of the E-government.
3. Appropriate those elements to conduct the evaluation process through quality method (implementation study) to conduct evaluation process.

Following, describing of the factors that facing e-government system in performing various services:

- A number of correct outcomes (results) of the search process.
- Response time for the process of extracting results.
- Providing electronic services that can be integrated (integrated services).
- Semantic search
- Using the natural, human-like interaction with the computer.

### Technology and Tools Selection

In order to display the contents of the web-based information such as text and graphics, HTML is the language applied; however, the describing of the contents cannot be treated by the

machine. To describe the web contents that can be access to information automatically, the semantic web is a tool chosen to address this case specifically; introducing XML, RDF, and OWL.

OWL is the most widely used of ontology's languages the capabilities of the tool expect to have a great impact on e-government environment, however, its W3C standard ontology language for the Semantic Web [16]; in addition, OWL is a common language employed for semantic knowing in e-government. Also, OWL allows the matching, mapping, composition [23] and searching, of e-government services [23], [14]. Thus, makes the selection of OWL for implementing ontology system in the first file system.

Where XML selected for implementing second file system; XML provides an elemental syntax for content structure within documents, yet associates no semantics with the meaning of the content contained within. However, W3C standard document format for writing and exchanging information on the Web emphasize that XML is not at present a necessary component of Semantic Web technologies in most cases [3].

In information retrieval, JavaScript files were used to retrieve data from OWL file and display the results in web pages format.

Finally, the system will display website to simulate e-government environment which provides a search engine for retrieving data from the file system.

## 8. Conclusion and Future Work

E-government system seeks to raise the performance of services provided for beneficiaries and investors from all segments of society in easily, accurately, and efficiently manner.

Recently, there have been increased numbers of researches that describe ontology technique. It has been noted that most of the researches are missed including critical indicators of practice evaluation to the role of implementing ontology in e-government environment. As a result, the research will attempt to provide and examine ontology-driven e-government system based on semantic web technology. Thus, learn more about the impact of implementing ontology technique.

The evaluation is set by analyzing information in terms of efficiency and accessibility services with using specific factors for the validation of the e-government system.

The Future work focuses on finding a recognized framework which will enhance and implements the proposed methodology. This includes work to find and develop a clear method that establishes to create a framework environment for integrated e-government system. The method might include data collection, development system, and evaluation process.

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