Personalized E-Government System: Towards an Adaptive Maturity Model

Mohamed R. Zakaria*
Al Ghurair University, Dubai, United Arab Emirates

Abstract
E-government became a standard for improving public sector services in most of the countries worldwide. Various research efforts related to the maturity of e-government services and to the personalization of those services have been conducted. However, there is inadequate concern about defining a maturity model related to the personalization aspect of e-government services. Moreover, there is no defined methodology for conversion from a regular e-government service to an adaptive version. The purpose of this paper is to introduce a novel model that concerns with the personalization maturity with respect to e-government services. Furthermore, the model draws a guideline for transformation to an adaptive e-government solution.

Keywords: Personalization, E-government, Maturity Model

1. Introduction
E-Government is a public system of information and communication technology applications fulfilling different functions such as processing, filing and retrieving of information (Zakaria and Gebba, 2012). Around the globe, several definitions have been given to the term E-government such as the one given by the United Nations (UN, 2002, p. 1) “utilizing the internet and the worldwide-web for delivering government information and services to citizens”. However, each definition is dependent on the basis of national strategies of those governments to achieve superiority based on internet and web technology. Nevertheless, the most common goals among those definitions are government competency, better service to the public and improvement of democratic process (Grönlund, 2002; UN, 2005).

For e-Government to be successful it should develop citizen centric, transparent, effective, and efficient government operations and services (Scholl and Klischewski, 2007). Thus, a model for e-services maturity is required to examine e-government services with respect to different dimensions such as presence of information, interactivity of stockholders with the online services and online transactions. As a result, several maturity models have been developed over the past decades to define the key practices required to evaluate the services delivery capability such as ANAO (ANAO, 2000), ŠAFAD (Statskontoret, 2000) and ESI (Zakaria and Gebba, 2012).

E-government systems have to deal with hundreds of different procedures and huge amount of regulatory changes. Thus, a new type of models is required to examine the level of personalization provided by those systems for citizens to find their way in this massive forest of information.

The purpose of this paper is to investigate various widely accepted e-government maturity models and personalization techniques with the aim to introduce a novel conceptual maturity model that...
identifies key practices required to apply personalization strategies to e-government and draw a guideline for transformation to an adaptive version.

The paper is organized into six sections. The second section explores some of the widely accepted maturity model trends in addition to the concept of personalization in general and in e-government. The third section discusses the research methodology. In the fourth section the researcher presents the Adaptive E-government Maturity (AEM) model. Section five portrays the discussion section. Finally, section six presents the conclusion and future perspectives of this work regarding new approaches that could be used to improve the effectiveness and relevance of e-government development research.

2. Maturity Models and Web Personalization Background

This section reviews key literature related to the current research. The first part explores several maturity models and their characteristics. However, the second section discusses web personalization from two perspectives: a) general view and b) deployment by e-government solutions

2.1 Maturity Models

The early stages of e-government were limited to a collection of agency web sites with individual designs that gave some information about the agency with a possibility of some forms to be downloaded. However, a type of modelling was required to identify the required key practices to increase the maturity of the e-services the agency was providing. Hence, e-government solutions adopted different maturity models and utilized them as a tool to assess their service delivery capability.

According to the characteristics of different maturity models researchers classified them into Normative and Non-Normative types (Zakaria and Gebba, 2012). Normative models are widely adopted by international organizations such as United Nations (UN, 2005; 2010) and European Union (Capgemini, 2010; 2007). These types of models were based on dependent stages methodology and usually composed of four to six sequential stages. The sequential evolution started with online presence stage and progressed gradually to the stage of sharing information among agencies such as ANAO (ANAO, 2000), SAFAD (Statskontoret, 2000), Layne & Lee model (Layne and Lee, 2001) and Hiller & Bélanger model (Hiller and Bélanger, 2001).

Various researchers rejected the idea of sequential evolution of e-services and claimed it has no theoretical validity (Coursey and Norris, 2008; Goldkuhl and Persson, 2006). As a result, Non-normative models have been found. These types of models are more user centric and rely on categorizing e-services with no difference between them in terms of better or best e-service such as Diamond Model (Goldkuhl and Persson, 2006), E-Co model (Lind et al., 2007) and ESI model (Zakaria and Gebba, 2012).

2.2 Web Personalization

The history of personalization can be traced back to the marketing literature in 1870’s where it was concerned with learning from customers’ preferences and past interactions to provide targeted services (Homburg and Dijkshoorn, 2011). Today, the exponential increase in the amount of information presented on the web urges to the borrowing of such concepts from the marketing field to filter information and services as per users’ interest and knowledge.

Many researchers gave different definitions to web personalization such as Eirinaki (Eirinaki and Vazirgiannis, 2003) who stated that web personalization refers to the customization process of the content and the structure of a website based on individual needs of each user. Furthermore, Mulvenna (Mulvenna et al., 2000) defined it as any action that adapts information or service provided by a website as per users’ interest whereas this adaptation is based on information collected about those users such as navigational pattern. Moreover, Guo & Lu (Guo and Lu, 2007) described web personalization as a tailoring relationship between service providers and users based on authorization, profiling and customization. Nevertheless, all the definitions revolve around adapting the presented services according to users’ relevance.

Different practices have been used to provide customization through three main levels: a) Link level: Linking to certain products/information changes as per users purchasing history or naviga-
tional pattern, b) Content level: filtering out unnecessary content as per users’ certain characteristics, such as, his language, educational level, age, etc., and c) Structure level: the structure of the website itself re-organized as per the information the system collected about the user (Guo et al., 2005).

Many application areas that depend on the web to provide their services such as E-Commerce, E-Learning and Recommending systems adopted several personalization techniques such as collaborative filtering, where adaptation was based on similarity among group of users, and content filtering where content filtration was based on each user profile.

E-government as an application area has its own very specific problems such as, vast amount of information, different approaches of doing the same transaction, wide range of clients, variety of heterogeneous systems, etc. Those problems can be tackled through realizing two major issues: First, interoperability, which is explicitly addressed as one of the main challenges for i2010 EU strategy and refers to the integration and co-operation of existing services (Hreno et al., 2011; Gottschalk, 2009). Second, providing classification and meaning for the presented information and services.

Interoperable systems can enable services which cannot be activated through heterogeneous environment such as; updating address for a certain user in one system will reflect the change to all other associated systems. Therefore, for Interoperability to be applicable, heterogeneous systems need to communicate through a middleware such as PANP (Dais et al., 2008) and use a standardized vocabulary to exchange information. Moreover, standardization with respect to the meaning of terms and procedures to be followed on triggering a certain service is essential (Papazoglou et al., 2006). Regularity in the meaning of provided information, terms and services can be achieved through utilizing semantic technology (Berners-Lee et al., 2001)

E-government solutions adopted semantic web technology as a base of personalization by modeling users’ behavior to provide a platform for creating semantically described information and services. (Hreno et al., 2011; Mentzas, 2007) World Wide Web Consortium (W3C – www.w3c.com) defined semantic web as an extension to the current web in which information and services are given a well-defined meaning enabling automated tools and people to work in cooperation. Hence, semantic technology is based on an idea of providing a universal platform where information and services are shared by humans and computers on the web.

Semantic technology use ontologies as a basic mechanism to model domain of interest and to formulate rules that drive adaptation based on a user model (Schmidt et al., 2010). In the field of the Artificial Intelligence (AI), Neches (Neches et al., 1991, p.38) was the first to define ontology as follows: “Ontology defines the basic terms and the relations that include the vocabulary of a specific area, in addition to the rules to combine terms and relations to define extensions to the vocabulary”.

However, Studer (Studer et al., 1998, p.186) has given a much more detailed definition for ontologies as a “formal, explicit specification of shared conceptualization” where formal signifies that ontologies are machine-readable, shared refers to a widely accepted knowledge by a group and not limited to an individual, and conceptualization refers to an abstract model of certain experience. Thus, Ontology is a powerful formal knowledge presentation that model real life concepts in addition to annotation of life events, procedures, services and other concepts from public administration domains such as organizational, legal, economic, business, information technology and end-user concepts (Hreno et al., 2011; Schmid et al.t, 2010; Grandi et al., 2006; Gugliotta et al., 2005). Various research efforts in AI community have contributed to the production of several types of ontologies such as LLD (McCarty, 1989), FOL (Valente, 1995), and LRI-Core Legal Ontology (Breuker et al., 2004).

The combination between interoperability and semantic technology has been exploited as a base for personalization in different e-government researches and solutions such as PANP (Dais et al., 2008), Mexican E-government (Ortiz, 2006), Dutch e-government (Homburg and Dijkshoorn, 2011), FIT (Stojanovic et al., 2006), Access-eGov (Hreno et al., 2011).
3. Research Methodology

This research is an attempt to provide an answer to the following related questions: a) what are the key issues required to build an adaptive e-government system? b) How to convert from an existing regular e-government solution to a personalized version?

The answer for the above questions required detailed investigation and analysis for: a) Well known and accepted e-government maturity models and b) Personalization techniques implemented by e-government research and solutions.

The source of information comes mainly from secondary researches conducted by scholars in the domain, publications from international bodies such as United Nations and European Union commission and analysis for various developing countries’ e-government portals and personalized e-government research.

Based on the collected and analysed literature review, the researcher realized a methodology for creating an adaptation model that addresses the maturity of e-government services from the personalization perspective. Moreover, the model draws a guideline for a transformation to a personalized e-government solution in a controlled fashion.

4. Adaptive E-Government Maturity (AEM) Model

The AEM model is a theoretical model based on sequential multistage methodology, as shown in figure 1. The purpose of the model is to identify the key practices required to make e-government services more user centric through personalization. Additionally, the model aims to define a guideline for a transformation from a regular e-government to a personalized version. The model is composed of the following five stages:

a) **Presence**: Presence stage is considered as the starting point of personalization after reaching a certain maturity level through any chosen maturity models. However, at this stage it becomes very clear as what type of services and information need to be personalized.

b) **Semantic Adoption**: this stage is the backbone of the personalization process. According to the chosen ontology the classification of information and e-services will be identified

c) **User Modeling**: this phase represents the process of building a mechanism to construct a model about users’ behavior and characteristics. User models can be constructed on the fly or maintained through a user profile. However, either mechanism will handle the adaptation process based on the defined semantics

d) **Procedures Planning**: Procedures planning is a strategic stage where designers of the system plan and design triggers of different life scenarios based on the actors of the chosen ontology to reach certain objective such as, renewing a driving license for a handicapped person. Following the mentioned example, the user model belongs to a handicapped group and has an objective of renewing their driving licenses. Hence, this situation triggers information, e-services and procedures to be followed which are different than renewing a driving license for a fit citizen.

e) **Middleware Layer**: this is the final stage where the middleware layer assembles all the provided e-services from different agencies and standardizes a vocabulary for exchanging information amongst them. Moreover, this stage provides a meaning for the provided e-services as per the used ontology. This layer represents interoperability for the provided e-services.

![Figure 1: AEM model sequential stages](image-url)
5. Discussion

Through investigating the literature of maturity models and personalization techniques in e-government solutions, the researcher found inadequate concern about defining a personalization maturity model and a formalized methodology for applying personalization process in a step-wise description as in normative and non-normative maturity models.

AEM model is an attempt to identify e-government personalization maturity model through introducing a logical sequence of dependant stages that start with the presence status and end with fully interoperable e-government system.

Additionally, the model covers a gap of transformation from a regular e-government service to a personalized version by applying two levels of personalization: a) Partial adaptation: through adapting the presented information only, and b) Full adaptation: through adapting the information and services. This Phase-type conversion gives ability to e-government designers for a controlled transformation and to identify which services have the higher priority for change.

The model is not specifying any detailed sub-models such as interoperability maturity models, any specific ontology or user modeling technique. The model draws a linear evolution for the personalization process. Therefore, the model can be used in conjunction with any other models related to any of the evolution stages.

6. Conclusion and Future Work

A conceptual model of maturity levels of personalization in e-governments has emerged out from this exploratory research through introducing five stages: (1) Presence, (2) Semantic Adoption, (3) User Modelling, (4) Procedures planning, and (5) Middleware layer. The stages are dependant and represent a linear evolution for the personalization process.

AEM model draws a guide line for a step wise transformation from e-government solutions to a personalized version. The process of transformation can be very complicated due to the large amount of information and number of services any existing e-government is offering. However, the model provides a controllable conversion because it separates between information and services personalization. Hence, e-government can start with adopting the presented information as an initial stage then move on to the services afterwards.

However, only empirical research can establish the extent to which this theoretical model can be applicable in governments around the world. Therefore, future research needs to identify the best practices and characteristics of each stage to accomplish the overall picture of the transformation in an efficient and controlled manner.

References


Breuker, J. (2004), Constructing a Legal Core Ontology: LRI-Core, University of Amsterdam, Leibniz Center for Law, Amsterdam, the Netherlands


Statskontoret (2000), The 24/7 Agency: Criteria for 24/7 Agencies in the Networked Public Administration, Swedish Agency for Public Management (Statskontoret).


UN (2010), E-government Survey, United Nations Division for Public Administration and Development Management (DPADM)

UN (2005), Global e-Government Readiness Report: From e-Government to e-Inclusion, United Nations Division for Public Administration and Development Management (DPADM)

