E-GOVERNMENT MATURITY MODELS: A COMPARATIVE STUDY

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ABSTRACT

Many maturity models have been used to assess or rank e-government portals. In order to assess electronic services provided to the citizens, an appropriate e-government maturity model should be selected. This paper aims at comparing 25 e-government maturity models to find the similarities and differences between them and also to identify their weaknesses and strengths. Although the maturity models present large similarities between them, our findings show that the features included in those models differ from a maturity model to another. Furthermore, while some maturity models are covering some features and introducing new ones, it seems that others are just ignoring them.

KEYWORDS

E-government, portal, maturity model, comparison, best practices, e-services, maturity stages

1. INTRODUCTION

An e-government e-portal's maturity model is a set of stages (from basic to advanced ones) that determines the maturity of the e-government e-portal. The main benefit of those maturity models is to offer a way to rank e-government portals. Maturity models can also serve as a guide to help agencies enhance their e-government portal's quality. Concha *et al.* [1] divided e-government maturity models into the following three types:

- The governmental models: those models are developed by governments, consultants and academics to help agencies identify and improve their level of e-government maturity. An example is the "Canadian e-Government Capacity Check" [2] which consists of a capacity diagnosis set of tools used to assess the capability of public agencies to deliver electronic services to citizens.
- The holistic approach models: those models are designed to be applied in public services development projects to help agencies identify if an e-government project will be successful or not. An example is the "Capacity Assessment Toolkit" [3] which is a model that determines whether an e-government project will be successful by examining capabilities through 180 indicators.
- The evolutionary e-government maturity models: those models focus on the evolution of e-government using sequential steps, for instance from immature to mature e-government with

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improved quality. From an academic perspective, the most famous maturity models are - for example - the Layne and Lee [4] model and the Andersen and Henriksen [5] model.

In this paper we are concerned about the third category which is the evolutionary e-government maturity models. The purpose is to investigate all the existing maturity models provided in the literature related to this category and to figure out their similarities, differences, weaknesses and strengths. Such output will be useful in building a new maturity model related to e-government portals.

This paper is structured as follow: Section 2 provides an overview of the collected maturity models from literature. Section 3 provides a comparison of those maturity models. Section 4 concludes the paper and gives directions for future work.

2. E-GOVERNMENT MATURITY MODELS - AN OVERVIEW

This section presents a description of e-government maturity models available in literature. This includes the following models: Layne and Lee [4], Andersen and Henriksen [5], United Nations [6], Alhomod *et al.* [7], Hiller and Belanger [8], Almazan and Gil-Garcia [9], Cisco [10], Gartner group [11], West [12], Moon [13], World Bank [14], Deloitte and Touche [15], Howard [16], Shahkooh *et al.* [17], Lee and Kwak [17], Siau and Long [19], Wescott [20], Chandler and Emanuel [21], Kim and Grant [22], Chen *et al.* [23], Windley [24], Reddick [25], Accenture [26], the UK National Audit Office [27], and Netchaeva [28].

2.1. Layne and Lee Maturity Model

Layne and Lee [4] developed a four stages maturity model of e-government. The model is developed based on observations on e-government initiatives in the US. The maturity model is defined as follows:

- The 1st stage is “catalogue”: At this stage, the public authority is presented on the web.
- The 2nd stage is “transaction”: The citizen at this stage can make transactions with the government.
- The 3rd stage is “vertical integration”: This stage, involves integration with higher level systems within similar functionalities or jurisdictions.
- The 4th stage is “horizontal integration”: Systems at this stage are integrated across various government jurisdictions, the e-portals are real one stop shops for citizens.

2.2. Andersen and Henriksen Maturity Model

Andersen and Henriksen [5] developed a four stage maturity model of e-government. The maturity model was used in Denmark in an assessment of 110 state agencies. The authors noticed low scores for Danish agencies. The maturity model is defined as follows:

- The 1st stage is “cultivation”: At this stage, horizontal and vertical integration is present along with the use of intranet by governments.
- The 2nd stage is “extension”: At this stage, there is an extensive use of intranet. The stage also features customized Web interfaces and extensive use of intranet.
- The 3rd stage is “maturity”: At this stage, there is an abandoning of intranet. The organization is mature and the processes are transparent.

- The 4th stage is “revolution”: At this stage, data can be shared between organizations and also applications can be shared across vendors.

2.3. United Nations Maturity Model

The United Nations [6] developed a four stage maturity model of e-government. The maturity model was used for ranking the UN member states. It is defined as follows:

- The 1st stage is “emerging information” services: In this stage, e-government Web sites provide static information.
- The 2nd stage is “enhanced information services”: In this stage, the presence is enhanced with one way or simple two way communication.
- The 3rd stage “transactional services”: In this stage, a two way interaction with citizens is possible.
- The 4th stage is “connected services”: In this stage, Web sites are proactive in requesting citizens’ feedback via Web 2.0 tools. Government agencies are citizen centric and services are customer centric.

2.4. Alhomod Maturity Model

Alhomod *et al.* [7] developed a four stage maturity model of e-government defined as follows:

- The 1st stage is “presence on the web”: At this stage, the e-portal provides only information.
- The 2nd stage is “interaction between the citizen and the government”: At this stage, the user can download and email forms to the concerned authority.
- The 3rd stage is “complete transaction over the web”: At this stage, citizens are able to complete entire tasks over the internet.
- The 4th stage is “integration of services”: At this stage, various departments share information with each other.

2.5. Hiller and Belanger Maturity Model

Hiller and Belanger [8] developed a five stage maturity model of e-government defined as follows:

- The 1st stage is “information”: It represents the most basic form of Web sites i.e. posting information.
- The 2nd stage is “two way communications”: It involves communication between the citizens and the government.
- The 3rd stage is “transaction”: At this stage, online services and financial transactions are available for use by citizens.
- The 4th stage is “integration”: At this stage, all services are connected. A single e-portal can be used to access all e-government services.
- The 5th stage is “participation”: It features political participation, posting comments and voting.

2.6. Almazan and Gil-Garcia Maturity Model

Almazan and Gil-Garcia [9] developed a six stage maturity model of e-government. The maturity model was used in Mexico in a systematic analysis of 32 state portals. The authors concluded that Mexican state portals are in the initial stages of electronic government. Besides that the authors provided weaknesses of those e-government portals. The maturity model is defined as follows:

- The 1st stage is “presence”: At this stage the Web site contains static and limited information.
- The 2nd stage is “information”: At this stage, information is frequently updated and there is a greater number of available webpages.
- The 3rd stage is “interaction”: At this stage, the users can download forms and communicate with the government by mail.
- The 4th stage is “transaction”: This stage features secure online Web services with the possibility of payments.
- The 5th stage is “integration”: This stage offers a one stop shop to the citizens.
- The 6th stage is “political participation”: At this stage users can vote and participate in opinion surveys and public forums.

2.7. Cisco Maturity Model

Cisco [10] developed a three stage maturity model of e-government defined as follows:

- The 1st stage is “information interaction”: This stage features departmental Web sites, legislative posting, public notices, online forms, webcasting and personalized e-portals.
- The 2nd stage is “transaction efficiency”: it is a citizen self-service e-portal that can include electronic payments like online taxes and e-procurement.
- The 3rd stage is “transformation citizen centric”: The administrative services at this stage are consolidated and shared across various government jurisdictions.

2.8. Gartner Group Open Government Maturity Model

Gartner group [11] developed a four stage maturity model of e-government defined as follows:

- The 1st stage is “Web presence”: At this stage, the Web site is static and used to provide basic information to the citizen.
- The 2nd stage is “interaction”: This stage features tools for interaction with stakeholders like search engines, documents downloading and emails.
- The 3rd stage is “transaction”: At this stage the user can perform complete transactions online. This includes payments like buying and selling.
- The 4th stage is “transformation”: At this stage, the processes are integrated and personalized.

2.9. West Maturity Model

West [12] developed a four stage maturity model of e-government. The maturity model was used in a content analysis of US state and federal governmental Web sites. This included 1,813 government Web sites in 2000, and a follow-up study of 1,680 government Web sites in 2001. The authors concluded that many government agencies have mastered the first and second stage, while few government Web sites have achieved the 3rd and 4th stage. The maturity model is defined as follows:

- The 1st stage is “bill-board”: At this stage, Web sites are just billboards mainly used for posting information.

- The 2nd stage is “partial-service-delivery”: At this stage, users have the ability to search for data via search engines with limited online services.
- The 3rd stage is “portal or the one stop shop portal”: At this stage, all information and services are located in a single place.
- The 4th stage is “interactive democracy”: The e-portal at this stage offers personalization, push technology and feedback forms.

2.10. Moon Maturity Model

Moon [13] developed a five stage maturity model of e-government. The authors examined the current state of municipal e-government initiatives in the US based on data from 2000 e-government surveys for municipalities. The authors concluded that e-government was adopted by municipalities but it is still in an early stage. The maturity model is defined as follows:

- The 1st stage is “simple information dissemination” (one-way communication): At this stage, governments are simply posting data and information on the Web sites.
- The 2nd stage is “two-way communication” (request and response): This stage features an interactive mode between the governments and the stakeholders. Email systems and data transfer technologies are also present at this stage.
- The 3rd stage is “service and financial transactions”: At this stage, the users can execute self-services with the possibility of electronic payments.
- The 4th is “integration” (horizontal and vertical integration): This stage features horizontal and vertical integration which help data sharing between various departments.
- The 5th stage is “political participation”: This stage features surveys, forums and online voting. It also focuses on political activities.

2.11. World Bank Maturity Model

World Bank [14] developed a three stage maturity model of e-government defined as follows:

- The 1st stage is “publish”: This stage features a variety of information published in the Web site. This includes rules, regulations, documents and forms.
- The 2nd stage is “interact”: In this stage, the users can provide feedback and submit comments on legislative or policy proposals.
- The 3rd stage is “transact”: In this stage, the users can complete secure transactions online.

2.12. Deloitte and Touche Maturity Model

Deloitte and Touche [15] developed a six stage maturity model of e-government. The model was used in the following countries: Australia, Canada, New Zealand, the United Kingdom and the United States. The authors concluded that the majority of governments are at least in stage 1. The maturity model is defined as follows:

- The 1st stage is “information publishing”: The Web site at this stage serves as a static way to provide information.
- The 2nd stage is “official-two way transaction”: This stage features transactions and exchange of information between the citizens and the governmental agencies.
- The 3rd stage is “multipurpose portal”: The e-portal at this stage is a single point of entry to provide services to the citizen.

- The 4th stage is "portal personalization": At this stage, the e-portal can be personalized according to the citizen's needs.
- The 5th stage is "clustering of common services": At this stage, the services and processes are clustered to provide unified services to the customer.
- The 6th stage is "full integration and enterprise transaction": At this stage, the e-portal is fully integrated and the services are personalized to customer needs.

2.13. Howard Maturity Model

Howard [16] developed a three stage maturity model of e-government defined as follows:

- The 1st stage is "publish": At this stage, the government just publishes information about itself and its activities.
- The 2nd stage is "interact": At this stage, the users can interact with the government via e-mails and chat rooms.
- The 3rd stage is "transact": Where the users can complete transactions over the web.

2.14. Shahkooh Maturity Model

Shahkooh *et al.* [17] developed a five stage maturity model of e-government. The stages are defined as follows:

- The 1st stage is "online presence": At this stage, information is published online.
- The 2nd stage is "interaction": At this stage, citizens can interact with governments by emailing officials and downloading forms.
- The 3rd stage is "transaction": The users at this stage can conduct secure transactions like payments and tax filling.
- The 4th stage is "fully integrated and transformed e-government": At this stage government services are organized as a single point of contact.
- The 5th stage is "digital democracy": This stage features online voting, public forums and opinion surveys.

2.15. Lee and Kwak Maturity Model

Lee and Kwak [18] proposed a five stage maturity model of e-government which focus on open government and the use of social media and Web 2.0 tools. The model was developed based on case studies from US Healthcare Administration agencies. It is defined as follows:

- The 1st stage is "initial conditions": This stage is a one way static interaction with the citizen. It is only used for broadcasting information to the public.
- The 2nd stage is "data transparency": At this stage, the use of social media is limited. Feedback is get from the public on usefulness and data quality.
- The 3rd stage is "open participation": This stage features social media tools to increase open participation. Input from the public is welcomed and used in policy decisions. This stage includes also e-Voting and e-Petitioning.
- The 4th stage is "open collaboration": This stage features interagency collaboration by sharing data and public input. Public contests are organized and data is analyzed for obtaining new insights and improving decision-making.
- The 5th stage is "ubiquitous engagement": At this stage, data is easily accessed by mobile devices and tablets. Data is vertically and horizontally integrated. Besides that, data analytics is

used for decision making processes. The agencies are focused on enabling continuous improvements.

2.16. Siau and Long Maturity Model

Siau and Long [19] developed a five stage maturity model of e-government defined as follows:

- The 1st stage is “Web presence”: Web sites at this stage contain only static information.
- The 2nd stage is “interaction”: This stage provides a simple interaction like forms download and features basic search engines and email systems.
- The 3rd stage is “transaction”: In this stage, the users can perform complete transactions over the web.
- The 4th stage is “transformation”: This stage includes vertical and horizontal integration. The governments provide a single unified e-portal.
- The 5th stage is “e-democracy”: This stage features tools for online voting, polling and surveys to enable political participation and citizen engagement.

2.17. Wescott Maturity Model

Wescott [20] developed a six stage maturity model of e-government that focuses on the development of e-government in the Asia-Pacific region. The authors concluded that most of the Asia-Pacific countries are still in the initial phases of e-government. The maturity model is defined as follows:

- The 1st stage is “setting up an email system and internal network”: This stage features e-mail systems to improve information sharing, coordination and feedback.
- The 2nd stage is “enabling inter-organizational and public access to information”: At this stage, information is department centric, shared between organizations and can be accessed by the public over the internet.
- The 3rd stage is “allowing 2-way communication”: This stage features online services. The citizens can make suggestions using emails or ask questions in forums and receive answers.
- The 4th stage is “allowing exchange of value”: This stage features applications such as tax assessments and license renewals. At this stage, the citizen can make secure payments on the Web.
- The 5th stage is “digital democracy”: This stage focuses on empowering the civil society (ex. increasing awareness of government corruption) and allowing citizens to vote and express their opinions and feedback.
- The 6th stage is “joined-up government”: At this stage, citizens can execute services without knowing which government agency is responsible for. Vertical and horizontal integration is present at this stage.

2.18. Chandler and Emanuel Maturity Model

Chandler and Emanuel [21] developed a four stage maturity model of e-government defined as follows:

- The 1st stage is “information”: This stage features the availability of online information about government services and policies.
- The 2nd stage is “interaction”: This stage features basic level of interaction between governments and citizens such as email systems.

- The 3rd stage is “transaction”: At this stage, the user can conduct transactions online.
- The 4th stage is “integration”: This stage features integrated services across various departments and agencies.

2.19. Kim and Grant Maturity Model

Kim and Grant [22] developed a five stage maturity model of e-government defined as follows:

- The 1st stage is “Web presence”: This stage features simple and limited information available on the web.
- The 2nd stage is “interaction”: This stage features search engines and downloadable forms.
- The 3rd stage is “transaction”: This stage features online transactions with the possibility of electronic payments.
- The 4th stage is “integration”: This stage features horizontal and vertical integration. Moreover, performance can be measured at this stage using statistical techniques.
- The 5th stage is “continuous improvement”: This stage features political activities. Besides that, there is a great focus on continuous improvements.

2.20. Chen Maturity Model

Chen *et al.* [23] developed a three stage maturity model of e-government. The model was proposed based on theoretical research and the authors’ experience in China’s regional e-government. It is defined as follows:

- The 1st stage is “catalogue”: At this stage, there is an online presence on the web. The stage features presentation catalogue and downloadable forms.
- The 2nd stage is “transaction”: This stage features working databases supporting online transactions. Services and online forms are also made available at this stage.
- The 3rd stage is “vertical integration”: This stage features vertical integration with higher levels within similar jurisdictions.

2.21. Windley Maturity Model

Windley [24] developed a four stage maturity model of e-government. The model was applied to the ‘Utah.gov’ state portal in the US. The author concluded that the portal is solidly at the second stage of maturity. The maturity model is defined as follows:

- The 1st stage is “simple Web site”: This stage features static pages with downloadable forms.
- The 2nd stage is “online government”: This stage features interaction mechanisms such as emails, Web forms, help and FAQs.
- The 3rd stage is “integrated government”: This stage features end to end transactions. Moreover, information is shared between departments at this stage.
- The 4th stage is “transformed government”: At this stage, the services are customer centric and organized according to citizens’ needs and segmented according to population groups and life events. Vertical and horizontal integration is also present at this stage.

2.22. Reddick Maturity Model

Reddick [25] developed a two stage maturity model of e-government. The model was used in the US context in examining the current stage of municipal e-government in the American cities. The

author concluded that the G2C Websites are in the first stage of maturity. This maturity model is defined as follows:

- The 1st stage is “cataloguing”: At this stage, information about the government and its activities is presented on the web.
- The 2nd stage is “transactions”: At this stage, citizens can make transactions over the web. Furthermore, one stop shops are considered as a desired feature at this stage of maturity.

2.23. Accenture Maturity Model

Accenture [26] developed a five stage maturity model of e-government. The model was used to rank the following countries in e-government: Canada, Singapore, United States, Denmark, Australia, Finland, Hong Kong, United Kingdom, Belgium, Germany, Ireland, France, The Netherlands, Spain, Japan, Norway, Italy, Malaysia, Mexico, Portugal, Brazil, and South Africa. The maturity model is defined as follows:

- The 1st stage is “online presence”: At this stage, information is published online.
- The 2nd stage is “basic capability”: At this stage, security and certification is developed. The online presence is broad.
- The 3rd stage is “service availability”: At this stage, many services are available in the e-portal. This stage also features cross agency cooperation. Moreover, the services are designed to meet customer needs.
- The 4th stage is “mature delivery”: At this stage, the services are clustered. There is a clear ownership and authority – CIO (Chief Information Officer) or central agency. The customer is involved in the process of e-government and the services are marketed.
- The 5th stage is “service transformation”: At this stage, improved customer service delivery is the target. This stage also features multichannel integration.

2.24. UK Maturity model

The UK National Audit Office [27] presented a report to the House of Commons, in which an e-government maturity model was developed using five stages as the following:

- The 1st stage is “basic site”: At this stage, few pages are available in the Web site which give basic information about the agency.
- The 2nd stage is “electronic publishing”: At this stage, the Web site contains many pages.
- The 3rd stage is “e-publishing”: This stage features personalization options and customizable search tools. Some forms can be submitted online and others can be downloaded. Moreover, at this stage there is an extensive use of emails and the responses are timely. Besides that, email alerts to notify the users about new content is an offered functionality.
- The 4th stage is “Transactional”: At this stage, the users make secure transactions over the Web.
- The 5th stage is “joined-up e-governance”: This stage features one stop shops and joined up governments (vertical and horizontal integration).

2.25. Netchaeva Maturity Model

Netchaeva [28] developed a five stage e-government maturity model without giving names to designate each stage as follows:

- The 1st stage features online Web sites with department information.
- The 2nd stage features FAQs and email systems.

- The 3rd stage features forums and opinion surveys.
- The 4th stage features online services such as: license renewals and payment of fines.
- The 5th stage features one stop shops. The citizens can vote, contribute in online discussions and make comments on policy and legislation proposals.

3. COMPARISON AND DISCUSSION OF THE E-GOVERNMENT MATURITY MODELS

Several authors have conducted a synthesis based on existing maturity models and then provided their own maturity model. Examples of these studies are as follows:

- Almazan and Gil-Garcia [9] provided their six stage maturity model after a synthesis of 5 theoretical models (out of the 25 in this study) including the United Nations and the American Society for Public Administration [29], Hiller and Belanger [8], Layne and Lee [4], Moon [13], and Holden *et al.* [30].
- Shahkooh *et al.*[17] presented their five stage maturity model after reviewing 9 (out of the 25 in this study) maturity models including Deloitte and Touche [15], UN [6], Layne and Lee [4], Accenture [26], Gartner [11], World Bank [14], Wescott [20], West [12], and Hiller and Belanger [8] maturity models. The authors provided a mapping between their maturity model and the compared maturity models.
- Siau and Long [19] compared 6 (out of the 25 in this study) e-government maturity models including UN [6], Hiller and Belanger [8], Deloitte and Touche [15], Layne and Lee [4], Moon [13], and Gartner [11] before introducing their model. The authors applied a quantitative meta-synthesis approach to integrate those maturity models into a new synthesized one.
- Kim and Grant [22] provided their 5 stage maturity model after making a literature review of seven maturity models (out of the 25 in this study) including Layne and Lee [4], the United Nations [6], the American Society for Public Administration [29], Moon [13], Siau and Long [19], Anderson and Henriksen [5], and Hiller and Belanger [8]. However, in those studies the authors did not provide weaknesses and strengths of each maturity model. Besides that, the authors did not compare the maturity models between them based on some criteria such as stages focus, features and names etc. Moreover, the fact of missing many e-government maturity models from literature could yield into missing best practices in their new maturity models.

Compared to the above studies, the comparison conducted in this paper takes a large number of e-government maturity models that is 25 (see previous section). Moreover, we highlighted 4 main issues related to the e-government maturity models:

- Maturity models' stage names.
- Maturity models' stage numbers, year and country.
- Maturity models' stage focus.
- Maturity models' stage features.

The result of this comparison and discussion is useful in order to identify the strengths & weaknesses of the existing maturity models and to figure out what is missing in these maturity models in order to take them into account in the new e-government maturity model dedicated for e-government e-portals.

3.1. Maturity models' stage names

From our investigation of the 25 e-government maturity models, we have noticed that (see table 1):

Table 1. Maturity models' stage names.

Model \ Stage	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
Layne and Lee [4]	Catalogue	Transaction	Vertical integration	Horizontal integration	NA	NA
Andersen and Henriksen [5]	Cultivation	Extension	Maturity	Revolution	NA	NA
United Nation [6]	Emerging information services	Enhanced information services	Transactional services	Connected services	NA	NA
Alhomod *et al.* [7]	Presence on the web	Interaction between the citizen and the government	Complete transaction over the web	Integration of services	NA	NA
Hiller and Belanger [8]	Information	Two way communication	Transaction	Integration	Participation	NA
Almazan and Gil-Garcia [9]	Presence	Information	Interaction	Transaction	Integration	Political Participation
Cisco [10]	Information interaction	Transaction efficiency	Transformation citizen centric	NA	NA	NA
Gartner group [11]	Web presence	Interaction	Transaction	Transformation	NA	NA
West [12]	Bill-board	Partial-service-delivery	Portal	Interactive democracy	NA	NA
Moon [13]	Simple information dissemination	Two-way communication	Service and financial transactions	Integration	Political participation	NA
World Bank [14]	Publish	Interact	Transact	NA	NA	NA
Deloitte and Touche [15]	Information publishing	Official-two way transactions	Multipurpose portals	Portal personalization	Clustering of common services	Full integration and enterprise transaction
Howard [16]	Publish	Interact	Transact	NA	NA	NA
Shahkooh *et al.* [17]	Online presence	Interaction	Transaction	Fully integrated and transformed e-government	Digital democracy	NA
Lee and Kwak [18]	Initial conditions	Data transparency	Open participation	Open collaboration	Ubiquitous engagement	NA
Siau and Long [19]	Web presence	Interaction	Transaction	Transformation	E-democracy	NA
Wescott [20]	Setting up an email system and internal network	Enabling inter-organizational and public access to information	Allowing 2-way communication	Exchange of value	Digital democracy	Joined-up government
Chandler and Emanuel [21]	Information	Interaction	Transaction	Integration	NA	NA
Kim and Grant [22]	Web presence	Interaction	Transaction	Integration	Continuous improvement	NA
Chen *et al.* [23]	Catalogue	Transaction	Vertical integration	NA	NA	NA
Windley [24]	Simple Web site	Online government	Integrated government	Transformed government	NA	NA
Reddick [25]	Cataloguing	Transactions	NA	NA	NA	NA
Accenture [26]	Online presence	Basic capability	Service availability	Mature delivery	Service transformation	NA
The UK National Audit [6]	Basic site	Electronic publishing	E-publishing	Transactional	Joined-up e-governance	NA

- All the maturity models present large similarities between them; for instance, there are large similarities between the Moon's model and the Hiller and Belanger's one as stated in [31].
- According to Andersen and Henriksen [5], the Layne and Lee model focus more on the bias of the international institutions promoting e-government. They argued that e-government should move beyond the actual benefits it is making and focus more on reaching the citizen in a more efficient way. For this purpose, the authors see that the first stage should include horizontal and vertical integration [5]. However, this is an advanced feature and should be considered at the last stages like in the other maturity models.
- Lee and Kwak [18] focus more on open government, e-participation and political participation. This model is introducing important aspects such as measuring performance and analytics for decision making.

In fact, although the maturity models' stage names are different from one maturity model to another; their content may have some similarities and differences. For instance, the first stage for Layne and Lee is named "Catalogue" where the public authority is presented on the web, while for United Nations this stage is named "Emerging information services" where government websites provide static information, and for Lee and Kwak [18] this stage is named "Initial conditions" and is about broadcasting information to the public. Moreover, almost all of them contain:

- A stage related to the availability of the portal in the Web (presence).
- A stage where the citizens can interact with governments (interaction).
- A stage where the citizens can transact with governments (transaction).
- An advanced stage that covers advanced features such as information sharing between agencies (integration).
- Etc.

3.2. Maturity models' stage numbers, year and country

From the investigation of the 25 e-government maturity models, we have noticed that these maturity models have different number of stages as the following (see Table 2):

- Only one maturity model has two stages which is the Reddick model.
- Four maturity models have three stages, which are: Cisco, World Bank, Howard and Chen.
- Eight maturity models have four stages, which are: Layne and Lee, Andersen and Henriksen, United Nations, Alhomod, Gartner, West, Chandler, and Emanuel and Windley.
- Nine maturity models have five stages, which are: Hiller and Belanger, Moon, Shahkooh, Lee and Kwak, Siau and Long, Kim and Grant, Accenture, UK, and Netchaeva.
- Three maturity models have six stages, which are: Almazan and Gil-Garcia, Deloitte and Touche, and Wescott.

Moreover, concerning the years of the maturity models, we could notice that:

- Two maturity models are in 2000, which are: Gartner, and Deloitte and Touche.
- Four maturity models are in 2001, which are: Howard, Layne and Lee, Hiller and Belanger, and Wescott.
- Five maturity models are in 2002, which are: Chandler and Emanuel, Windley, Moon, UK, and Netchaeva.
- Two maturity models are in 2003, which are: World Bank and Accenture.

Table 2. Maturity models' stage numbers, year and country.

Maturity model	Number of stages	Year	Country
United Nations	4	2012	UN member state countries
Alhomod	4	2012	-
Lee and Kwak	5	2012	US
Chen	3	2011	China
Kim and Grant	5	2010	-
Almazan and Gil-Garcia	6	2008	Mexico
Shahkooh	5	2008	-
Cisco	3	2007	-
Andersen and Henriksen	4	2006	Denmark
Siau and Long	5	2005	-
West	4	2004	US
Reddick	2	2004	US
World Bank	3	2003	-
Accenture	5	2003	Canada, Singapore, United States, Denmark, Australia, Finland, Hong Kong, United Kingdom, Belgium, Germany, Ireland, France, The Netherlands, Spain, Japan, Norway, Italy, Malaysia, Mexico, Portugal, Brazil and South Africa
Chandler and Emanuel	4	2002	-
Windley	4	2002	US
Moon	5	2002	US
UK	5	2002	UK
Netchaeva	5	2002	-
Howard	3	2001	-
Layne and Lee	4	2001	US
Wescott	6	2001	Asia Pacific
Hiller and Belanger	5	2001	-
Gartner	4	2000	-
Deloitte and Touche	6	2000	Australia, Canada, New Zealand, the United Kingdom and the United States

- Two maturity models are in 2004, which are: Reddick and West.
- One maturity model is in 2005, which is the Siau and Long model.

- One maturity model is in 2006, which is the Andersen and Henriksen model.
- One maturity model is in 2007, which is the Cisco model.
- Two maturity models are in 2008, which are: Shahkooh, and Almazan and Gil-Garcia.
- One maturity model is in 2010, which is the Kim and Grant model.
- One maturity model is in 2011, which is the Chen model.
- Three maturity models are in 2012, which are: United Nations, Alhomod, and Lee and Kwak.

Furthermore, concerning the countries of the maturity models, we could notice that:

- Six maturity models were developed and/or used in the US context, which are: Reddick, Layne and Lee, West, Windley, Moon and, Lee and Kwak.
- Four maturity models were developed and/or used in many countries, including: United Nations, Accenture, Deloitte and Touche, and Wescott.
- One maturity model developed and/or used in the China's context, which is the Chen model.
- One maturity model was developed and/or used in the UK's context, which is the UK maturity model.
- One maturity model was developed and/or used in the Mexican context, which is the Almazan and Gil-Garcia model.

3.3 Maturity models' stage focus

Regarding the focus of the maturity models, we have grouped the stages of those maturity models according to their focus (as discussed in the sub section related to the maturity models' stage names): presence, interaction, transaction, integration, etc. Table 3 presents the grouping of the maturity stages according to their focus.

The first stage of all the maturity models is mainly concerned with "presence on the Web" except Andersen & Henriksen and Wescott maturity models. In fact the maturity models used different words while they all focus on the same aspects (present, emerging information, presence on the web, information, presence, information interaction, Web presence, bill-board, simple information dissemination, publish information publishing, online presence, initial conditions, catalogue, cataloguing and basic site).

The second stage of all the maturity models is mainly concerned with allowing citizens to find enhanced information in the portal and to interact and transact with the government. We have grouped such information into three categories as the following:

- "Interaction": This means that the citizens can interact or communicate with the government. This includes, Alhomod, Hiller and Belanger, Gartner, Moon, World Bank, Deloitte and Touche, Howard, Shahkooh, Siau and Long, Chandler and Emanuel, Kim and Grant and Windley.
- "Enhanced information": This means that the quality of information is enhanced. This includes the UN, Almazan and Gil-Garcia and UK.
- "Transaction": This means that the citizen can make complete transactions over the web. This includes Layne and Lee, Cisco, Chen and Reddick.

The third stage of all the maturity models is mainly concerned with allowing citizens to interact and transact with the government and making the e-portal a real one stop shop. We have grouped such information into three categories as the following:

Table 3. Focus of the e-government maturity stages.

Maturity stage	Focus	Maturity models
1	Presence	All models expect Andersen and Henriksen and Wescott
2	Interaction	Alhomod, Hiller and Belanger, Gartner, Moon, World Bank, Deloitte and Touche, Howard, Shahkooh, Siau and Long, Chandler and Emanuel, Kim and Grant and Windley.
	Enhanced information	UN, Almazan and Gil-Garcia and UK.
	Transaction	Layne and Lee, Cisco, Chen and Reddick.
3	Transaction	UN, Alhomod, Hiller and Belanger, Gartner, Moon, World Bank, Howard, Shahkooh, Siau and Long, Wescott, Chandler and Emanuel and Kim and Grant.
	Interaction	Almazan and Gil-Garcia.
	Integration (transformation, single point of entry)	Layne and Lee, Cisco, West, Deloitte and Touche, Chen and Windley.
4	Integration (transformation)	Layne and Lee, Andersen and Henriksen, UN, Alhomod, Hiller and Belanger, Gartner, Moon, Shahkooh, Siau and Long, Chandler and Emanuel, Kim and Grant, and Windley.
	Transaction	Almazan and Gil-Garcia, UK and Netchaeva.
	Personalization	West, and Deloitte and Touche.
5	E-participation (political participation)	Hiller and Belanger, Moon, Shahkooh, Siau and Long, Wescott, Kim and Grant and Netchaeva.
	Integration	Almazan and Gil-Garcia, Deloitte and Touche and UK.
6	Political participation	Almazan and Gil-Garcia.
	Integration	Deloitte and Touche, and Wescott.

- "Transaction": This means that the citizen can make complete transactions over the web. This includes the UN, Alhomod, Hiller and Belanger, Gartner, Moon, World Bank, Howard, Shahkooh, Siau and Long, Wescott, Chandler and Emanuel, and Kim and Grant.
- "Interaction": This means that the citizens can interact with the government. This includes Almazan and Gil-Garcia.
- "Integration": This includes transformation and single point of entry portals. This means that systems and e-portals are interoperable and work in harmony. An example is one stop shop e-portals. This includes Layne and Lee, Cisco, West, Deloitte and Touche, Ken and Windley.

The fourth stage of all the maturity models is mainly concerned with allowing citizens to transact with the government and making the e-portal integrated and personalized according to citizens' needs. We have grouped such information into three categories as the following:

- "Integration or Transformation": This means that systems and e-portals are interoperable and work in harmony. An example is one stop shop e-portals. This includes Layne and Lee, Andersen and Henriksen, the UN, Alhomod, Hiller and Belanger, Gartner, Moon, Shahkooh, Siau and Long, Chandler and Emanuel, Kim and Grant and Windley.
- "Transaction": This means that the citizen can make complete transactions over the web. This includes Almazan and Gil-Garcia, UK, and Netchaeva.
- "Personalization": This means that the e-portal can be personalized according to the citizens' needs. This includes West, and Deloitte and Touche.

The fifth stage of all the maturity models is mainly concerned with e-participation and making the e-portal integrated. We have grouped such information into two categories as the following:

- "E-participation": including political participation, this means that the citizens can participate in forums, online votes and surveys. This includes, Hiller and Belanger, Moon, Shahkooh, Siau and Long, Wescott, Kim and Grant and Netchaeva.
- "Integration": This means that systems and e-portals are interoperable and work in harmony. This includes, Almazan and Gil-Garcia, Deloitte and Touche and UK.

The sixth stage of all the maturity models is mainly concerned with political participation and making the e-portal integrated. We have grouped such information into two categories as the following:

- "Political participation": This means that the citizens can vote and participate in opinion surveys. This includes the Almazan and Gil-Garcia model.
- "Integration": This means that systems and e-portals are interoperable and work in harmony. This includes Deloitte and Touche and Wescott.

To summarize, we can see from Table 3 that almost all the maturity models focus on presence in the first stage. Furthermore, interaction is present at stage 2 and 3. Besides that, transaction is present at stage 2, 3 and 4. Moreover, integration and advanced features such as: transformation, e-participation and political participation are all present in the final stages 3, 4, 5 and 6. What can be concluded is that the most important stages of maturity can summarized into the following: presence, interaction, transaction and integration.

3.4 Maturity models' stage features

Regarding the maturity models' stage features, most of the e-government maturity models have been built without any input from the others, with the exception of Almazan and Gil-Garcia, Shahkooh *et al.*, Siau and Long, and Kim and Grant maturity models. In such situation, different terms have been used to express the same features, or similar feature has been expressed in different terms. Therefore, bringing a convergence and consensus on maturity models features would facilitate both the built and the use of the maturity model. Therefore, among the important features proposed in the 25 maturity models presented in section 2, we have chosen a set of important features and compared them with the 25 maturity models in terms of coverage per each model. Those features are defined as the following:

- "One stop shops": This means that the e-portal is a single point of entry for all e-government services.
- "Customer centricity": This means that the services or the e-portal are designed from a citizen perspective and not an organizational one.

- "Interoperability": This means joining up governments to work together and exchange information.
- "Personalization": This means offering the possibility to the citizen to personalize and customize the e-portal's functionalities according to his/her needs.
- "Payment": This means offering the ability for citizens to pay in the e-portal via credit/debit cards or electronic banking.
- "E-participation": This means the involvement of the citizens in the e-government process using various tools such as comment forms, surveys, e-voting, and e-petitioning.

Table 4 shows a comparison between the coverage of those features in each maturity stage of the 25 maturity models.

As we can notice from Table 4 regarding the set of 6 important features that an e-government maturity model should have, we can see that out of the 25 compared maturity models:

- "One stop shop" feature is covered by 11 maturity models. This includes: Layne and Lee, Hiller and Belanger, Almazan and Garcia, West, Deloitte and Touche, Shahkooh, Siau and Long, Wescott, Reddick, UK and Netchaeva maturity models.
- "Customer centricity" feature is covered by 6 maturity models. This includes: Andersen and Henriksen, United Nations, Almazan and Garcia, Deloitte and Touche, Windley and Accenture maturity models.
- "Interoperability" feature is covered by 20 maturity models. This includes: Layne and Lee, Andersen and Henriksen, United Nations, Alhomod, Hiller and Belanger, Almazan and Garcia, Cisco, Gartner, Moon, Deloitte and Touche, Shahkooh, Lee and Kwak, Siau and Long, Wescott, Chandler and Emanuel, Kim and Grant, Chen, Windley, Accenture and UK maturity models.
- "Personalization" feature is covered by 8 maturity models. This includes: Andersen and Henriksen, Almazan and Garcia, Cisco, Gartner, West, Deloitte and Touche, Siau and Long and UK maturity models.
- "Payment" feature is covered by 17 maturity models. This includes: United Nations, Alhomod, Hiller and Belanger, Almazan and Garcia, Cisco, Gartner, Moon, Deloitte and Touche, Howard, Shahkooh, Siau and Long, Wescott, Kim and Grant, Windley, Reddick, UK and Netchaeva maturity models.
- "E-participation" feature is covered by 17 maturity models. This includes: Layne and Lee, United Nations, Hiller and Belanger, Almazan and Garcia, Cisco, West, Moon, World Bank, Howard, Shahkooh, Lee and Kwak, Siau and Long, Wescott, Kim and Grant, Windley, Accenture and Netchaeva maturity models.

Moreover, while some features are included in most of the maturity models such as interoperability (20 maturity models), payment and e-participation (17 maturity models), there are other features that are covered by few maturity models such as customer centricity (6 maturity models) and personalization (8 maturity models).

It is clear that the focus of the studied models differs from a maturity model to another. While, some maturity models are covering some features and introducing new ones, it seems that others are just ignoring them. Besides that, there are some new features such as measuring performance and analytics for decision making introduced by the Lee and Kwak model and not raised by the other maturity models.

Table 4: Features coverage per each maturity model

Stages / Features	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5 and above
One stop shop			West MM, Deloitte & Touche MM	(Layne & Lee, 2001), (Hiller & Belanger, 2001), (Shahkooh *et al.*, 2008), (Siau & Long, 2005)	(Almazan & Gil-Garcia, 2008), (Wescott, 2001), (N.A.O., 2002), (Netchaeva, 2002)
Customer Centricity			Deloitte & Touche MM, Accenture MM	(Andersen & Henriksen, 2006), (United-Nations, 2012), (Almazan & Gil-Garcia, 2008), (Windley, 2002)	(Rohleder & Jupp, 2003)
Interoperability	Andersen & Henriksen MM		(Layne & Lee, 2001), (Cisco IBSG, 2007), (Chen *et al.*, 2011), (Rohleder & Jupp, 2003)	(United-Nations, 2012), (Alhomod *et al.*, 2012), (Hiller & Belanger, 2001), (Baum & Di Maio, 2000), (Moon, 2002), (Shahkooh *et al.*, 2008), (Lee & Kwak, 2012), (Siau & Long, 2005), (Chandler & Emanuels, 2002), (Kim & Grant, 2010), (Windley, 2002), (Layne & Lee, 2001)	(Almazan & Gil-Garcia, 2008), (Deloitte Consulting & Deloitte & Touche, 2000), (Lee & Kwak, 2012), (Wescott, 2001), (N.A.O., 2002)
Personalization	Cisco MM	Andersen & Henriksen MM	(Andersen & Henriksen, 2006), (Almazan & Gil-Garcia, 2008), (Cisco IBSG, 2007), (Siau & Long, 2005), (N.A.O., 2002)	(Almazan & Gil-Garcia, 2008), (Baum & Di Maio, 2000), (West, 2004), (Deloitte Consulting & Deloitte & Touche, 2000), (N.A.O., 2002)	(Deloitte Consulting & Deloitte & Touche, 2000)
Payments		Cisco MM, Deloitte & Touche MM, Windley MM, Reddick MM	(United-Nations, 2012), (Alhomod *et al.*, 2012), (Hiller & Belanger, 2001), (Baum & Di Maio, 2000), (Moon, 2002), (Howard, 2001), (Shahkooh *et al.*, 2008), (Siau & Long, 2005), (Deloitte Consulting & Deloitte & Touche, 2000), (Kim & Grant, 2010)	(Almazan & Gil-Garcia, 2008), (Wescott, 2001), (Windley, 2002), (N.A.O., 2002), (Netchaeva, 2002)	(Wescott, 2001)
E-participation		Layne & Lee MM, Hiller & Belanger MM, Moon MM, World Bank MM, Howard MM, Lee & Kwak MM, Windley MM	(United-Nations, 2012), (Almazan & Gil-Garcia, 2008), (Cisco IBSG, 2007), (Lee & Kwak, 2012), (Wescott, 2001), (Netchaeva, 2002)	(United-Nations, 2012), (West, 2004), (Lee & Kwak, 2012), (Rohleder & Jupp, 2003)	(Hiller & Belanger, 2001), (Almazan & Gil-Garcia, 2008), (Moon, 2002), (Shahkooh *et al.*, 2008), (Siau & Long, 2005), (Lee & Kwak, 2012), (Wescott, 2001), (Kim & Grant, 2010), (Netchaeva, 2002)

To conclude, since most of the maturity models have been built without any input from the existing maturity models, this can explain why they are not covering all the existing features available in the literature.

4. CONCLUSION

In this paper we have presented and compared e-government maturity models available in the literature. The comparison conducted includes 25 e-government maturity models and the discussion is conducted according to 4 issues:

- The 1st issue includes maturity models' stage names. In this part, we can see that although the maturity models' stage names are different from one maturity model to another; their content may have some similarities and differences.
- The 2nd issue is about maturity model's stage numbers, years and country. In this part, we have noticed that the maturity models' stage numbers varies from 2 to 6 stages, while, the maturity models' year range between 2000 and 2012. In addition, the country that occupies the first position where the maturity models were developed and/or used is the US.
- The 3rd issue is the maturity models' stage focus. In this part we can see that the most important stages of maturity can summarized into four distinct stages as the following: presence, interaction, transaction and integration.
- The 4th issue is the maturity models' stage features. In this part we concluded that some maturity models are ignoring some important e-government features. This could be justified by the fact that many maturity models have been built without any input from the existing models.

To sum up, it is clear from the above that there is a need for a maturity model that includes all the best practices of the compared maturity models in the literature. The maturity model may include other e-government portals best practices which are not included in those maturity models. In this way, the model would be holistic and cover all the aspects of e-government e-portals.

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