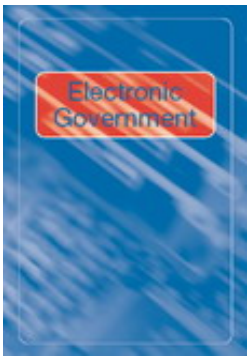

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Analysing e-government maturity models

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Abstract: This paper aims at assessing the current e-government maturity models to identify their strengths and limitations. In doing so, a systematic literature review has been used to examine the existing e-government maturity models during the period 2000–2021. Our analysis indicates that despite the fact that e-government-maturity models provide potentially useful tools for e-government evaluation, there are significant differences across the existing e-government-maturity models in terms of the number of stages, what users can do at progressive stages, and particular perspectives underscored at specific stages. However, the shift from 'stage-based maturity models' to 'dimensional-based maturity models' is clearly observed. The new wave of e-government maturity models (2012 onward) sees e-government as a path for pursuing digital, resilience, equal, and inclusive societies rather than only as a mechanism to deliver e-services. Additionally, the existing e-government maturity models reached their possibilities to demonstrate the advanced maturity levels of e-government such as smart government.

Keywords: e-government; smart government; maturity models; maturity stages; e-services.

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1 Introduction

Since the inception of e-government, an interesting subject for e-government research area has been e-Government maturity (Iannacci et al., 2019; Almuftah et al., 2016; Fath-Allah et al., 2014; Chatfield and Alhujran, 2009; Hujran, 2012). This interest is still triggered by the necessity needs for both researchers and practitioners to measure and benchmark the progress of e-government initiatives (Barcevičius et al., 2019; Renteria et al., 2019). Such maturity models and their related publications are supposed to assess the e-government projects as-is situation, discover the strength and weaknesses aspects of ongoing projects, prioritise improvement aspects and measures, as well as it provides a snapshot for countries to compare where they are standing in relation to other countries e-government projects (Anderson et al., 2012). Maturity models are commonly applied to control the current progress and then to lead and aid the planning for more advanced and successful future e-government services.

The maturity models in general (Poeppelbuss et al., 2011) and specifically for e-government has been the subject of numerous studies (Iannacci et al., 2019; Almuftah et al., 2016; Nielsen, 2016; Fath-Allah et al., 2014; Hujran, 2012; Lee and Kwak, 2012; Andersen and Henriksen, 2006; Layne and Lee 2001). This is evidenced by the plethora number of maturity models proposed by international and regional organisations and consortia, consulting firms, think tanks, and individual countries and researchers (Almuftah et al., 2016; Fath-Allah et al., 2014; Nielsen, 2016). At least, there are 25 to 30 e-government maturity models suggested between the years 2000 to 2012 (Fath-Allah et al., 2014; Nielsen, 2016), and around a dozen others more maturity models that have been developed in recent years, as we will discuss later in this paper. This number of maturity models and the continuous interest strongly indicates that there is a challenging variety of views, and sometimes discrepancies, as to what purposes, scope, stages, context, terms, measurement categories, criteria, and indicators that should be in e-government maturity models.

This huge bundle of maturity models enforced the urgent need for understanding and reviewing those models, aiming to spotlight the commonalities, differences, and drawbacks among them. Those efforts resulted in the initial wave of literature on e-Government maturity models (2000-2012) such as those presented by (Almuftah et al., 2016; Chaushi et al., 2015; Fath-Allah et al., 2014; Gronlund, 2010; Nielsen, 2016).

The demand for new models for the maturity of e-government have become crucial. For some scholars, this not only due because many maturity models are outdated for a number of digitally advanced countries, but also because that the substantial evolution and changes needed in e-Government processes and catching up with the development of ICT development increase required more advanced, comprehensive, and more evolving maturity models to adequately explain the reality of e-government evolution (Anderson et al., 2012; Barcevičius et al., 2019; Nielsen, 2016). Thus, new wave of maturity models has been suggested since the year 2013 onward.

Based on the above discussions, this paper aims to briefly explore the maturity models presented from the years 2000-2012. Then, the study provides comprehensive analysis for recent maturity models that have been proposed since 2013. This paper proceeds as follows. Section 2 describes the research methodology. Section 3 presents the findings of the systematic literature review. Discussion of the existing e-government maturity models is presented in Sections 4. Finally, Section 5 draws the study's conclusion.

2 Research methodology

Since the aim of this research was to analyse the existing e-government maturity models, a systematic review approach was adopted. A systematic review approach is a structured approach that mainly aims to collect, identify, assess, syntheses, and critically appraise relevant research of a determined subject or field of study (Levy and Ellis 2006; Webster and Watson 2002). This review process followed the set of guidelines proposed by (Levy and Ellis 2006; Webster and Watson 2002) for carrying out a systematic literature review as listed in the following steps.

Table 1 Major E-government maturity models

Model	*Stages*	*Model*	*Stages*
Gartner group Baum and Di Maio (2000)	1. Web presence 2. Interaction 3. Transaction 4. Transformation	Howard (2001)	1. Publish 2. Interact 3. Transact
Deloitte research Deloitte (2001)	1. Information publishing 2. Official two-way transactions 3. Multipurpose portals 4. Portal personalisation 5. Clustering of common services 6. Full integration and enterprise transaction	Layne and Lee (2001)	1. Cataloguing 2. Transaction 3. Vertical integration 4. Horizontal integration
Hiller and Bélanger (2001)	1. Information 2. Two-way communication 3. Transaction 4. Integration 5. Participation	Word Bank (2001)	1. Publishing 2. Interactivity 3. Completing transactions 4. Delivery
Moon (2002)	1. Simple information dissemination 2. Two-way communication 3. Service and financial transactions 4. Vertical and horizontal 5. integration 6. Political participation	Reddick (2004)	1. Cataloguing 2. Transactions
Siau and Long (2005)	1. Transact 2. Web Presence 3. Interaction 4. Transformation 5. democracy	Andersen and Henriksen (2006)	1. Cultivation 2. Extension 3. Maturity 4. Revolution

Table 1 Major E-government maturity models (continued)

Model	*Stages*	*Model*	*Stages*
Almazan and Gil-García (2008)	1. Presence 2. Information 3. Interaction 4. Transaction 5. Integration 6. Political Participation	Shahkooh et al. (2008)	1. Online presence 2. Interaction 3. Transaction 4. Fully integrated and transformed e-government 5. Digital democracy
Chatfield and Alhujran (2009)	1. One-way information flows 2. Two-way interaction 3. E-payment transaction 4. E-democracy	United Nations (2012)	6. Emerging presence 7. Enhanced presence 8. Transactional presence 9. Connected presence
Lee and Kwak (2012)	1. Initial conditions 2. Data transparency 3. Open participation 4. Open collaboration 5. Ubiquitous engagement	Janowski (2015)	1. Digitalisation 2. Transformation 3. Engagement 4. Contextualisation
Gartner group 2017 Di Maio et al. (2017)	1. E-government 2. Open government 3. Data-centric government 4. Fully transformed government 5. Smart government	Deloitte digital government model Eggers and Bellman (2015)	1. Early government 2. Developing government 3. Maturing government
European commission eGovernment benchmark	The four benchmarks of EU eGovernment are: user-centric government, transparency, cross-border mobility, and key enablers	OECD) digital government model (OECD, 2014)	The OECD frame work identifies six key dimensions of digital government: User-driven, Government as a platform, digital by design, data-driven, pro-activeness, and open by default
E-Government maturity model for sustainable E-government services Joshi and Islam (2018)	Implementation (supply side) Adoption (demand side)		

2.1 Collecting relevant publications

This step includes developing a specific set of search keywords and terms to find relevant publication (such as e-government, digital government, smart government, maturity model, and framework) and determining the electronic scientific databases to search the relevant research papers. We decided to base our search on Scopus and Emerald databases. The identified databases are among the largest indexing database and both provide access to high-quality peer-reviewed journals in related research areas such as e-Government, information systems, and public administration (Levy and Ellis, 2006). Additionally, a search through Google scholar was also performed. The search was restricted to find the relevant publications (studies or reports) based on appearing the keywords in either the title or the abstract of each potential relevant publication. Thus, the final search criteria were: (TITLE-ABSTRACT (e-government OR digital government OR smart government) AND TITLE-ABSTRACT (maturity model or framework). The search was conducted for the years (2000–2021) and retrieved approximately 38.

2.2 Selecting the final set of relevant publications

This step aims to select the perfect related publications for inclusion in the review. Thus, all 38 publications retrieved from the previous phase were scanned for their details. The selection process was based on adopting one major criterion that is each publication should have proposed/developed an e-government maturity model or extended the existing models. Therefore, the practical papers that only applied or empirically used any of the maturity models to assess e-government projects were excluded. We highlight that this study does not duplicate findings of previous e-government maturity models literature reviews such as (e.g., Almuftah et al., 2016; Fath-Allah et al., 2014, 2015; Lee, 2010; Nielsen, 2016), However, we built on them, enriching their findings with latest results. Based on the above filtering process, 21 publications were having met our criteria have been listed in Table 1.

3 Findings

3.1 E-Government maturity models 2000–2012

Several previous reviews conducted a synthesis evaluation and provided a beneficial analysis and comparison among different maturity models (e.g., Almuftah et al., 2016; Fath-Allah et al., 2014, 2015; Lee, 2010; Nielsen, 2016). Other scholars also made helpful review of maturity models in a way to propose their own models (e.g., Almazan and Gil-García, 2008; Hujran, 2012; Joshi and Islam, 2018; Kim and Grant, 2010). Briefly, we can summarise the following conclusions based on previous reviews and also inspired by our own general insight on maturity models that presented until 2012.

In the period 200–2012, various e-government maturity models have been developed to measure and benchmark the progress of e-government initiatives. These maturity models were introduced and developed by academic scholars (e.g., Andersen and Henriksen, 2006; Chatfield and Alhujran, 2009; Hiller and Bélanger, 2001; Layne and Lee 2001; Lee and Kwak, 2012; Moon, 2002; Reddick, 2004); international institutions, such the UN (United Nations, 2010), the European Union Commission, and

the World Bank (World Bank, 2001); and IT consulting companies, such as Gartner's e-government model (Baum and Di Maio, 2000) and Deloitte's digital government model (Deloitte, 2001b). Layne and Lee (2001), for example, developed a four-stage e-government maturity model focusing on complex technical and functional issues of e-government, including both vertical and horizontal integrations across different government levels, functions, and services. This model encompasses the following e-government development stages:

Stage 1 (Cataloging)

Stage 2 (Transaction)

Stage 3 (Vertical integration)

Stage 4 (Horizontal integration).

Different e-government researchers extended Layne and Lee's (2001) model in different directions (Iannacci et al., 2019). For instance, Andersen and Henriksen (2006) proposed an activity and a citizen-centred e-government maturity model, moving away the focus from integration and back-end issues to the front-end e-government. Along the same lines, Hiller and Bélanger (2001) created a maturity model comprising five stages:

Level 1 information

Level 2 two-way communications

Level 3 transaction

Level 4 integration

Level 5 political participation.

The model is based on the previous four-stage models but adds a fifth stage of political participation that includes e-voting and receiving public feedback.

West (2004) also created a four-stage model of e-government development:

1 the billboard stage, where e-government websites are merely billboards that mainly serve the function of posting information

2 the partial-service-delivery stage, where citizens can access a limited number of online services

3 the portal stage, where e-government services are fully integrated and delivered via a one-stop shop

4 the interactive democracy, where e-government systems are equipped with accountability-enhancing techniques and public engagement tools.

Gottschalk (2009) proposed a new e-government maturity model to address interoperability in digital government. The model comprises five levels of interoperability:

Level 1 interoperability of the computer

Level 2 interoperability of the process

Level 3 interoperability of the knowledge

Level 4 interoperability of the value

Level 5 interoperability of the goal.

Gottschalk believed that attaining interoperability across public agencies and with private organisations at these five levels was key to making an e-government more successful. Focusing on the open government notion, Lee and Kwak (2012) created the open government maturity model comprising five maturity stages:

Stage 1 initial conditions

Stage 2 data transparency

Stage 3 open participation

Stage 4 open collaboration

Stage 5 ubiquitous engagement.

However, this model is not an inclusive e-government maturity model as it is explicitly intended to evaluate open government data platforms that are mainly based on social media technologies.

In addition to the models described above, global organisations and consulting firms have also developed their own e-government maturity models. For instance, Gartner's (2000) e-government model has four maturity stages: presence (information), interact, transact, and transform (Baum and Di Maio, 2000). Likewise, the UN established one of the earliest e-government maturity models in 2001. Over the last few decades, the UN's e-government maturity model has become a sound and accepted model among e-government researchers and practitioners (United Nations, 2012). The model is primarily used to assess public service delivery. It describes four stages of maturity: emerging information services, enhanced information services, transactional services, and connected services (United Nations, 2012). First, the emerging information services stage focuses on the online presence of governments (government websites or portals provide only static content). Then, the enhanced information services stage measures the level of delivering basic two-way communications between the government and the public, such as allowing citizens to download forms and/or submit applications. Next, the transactional services stage is when the public successfully completes end-to-end online transactions with the government, including information exchange and financial payments. Finally, the highest stage, the connected services stage, concentrates on the governance change required in terms of the shift toward a citizen-centric approach that includes tailor-made services and empowers citizens to be more engaged and offers them greater opportunities to participate in government decision-making. According to the model, this is the optimal stage of maturity that all governments should aspire for. Similarly, in 2001, the Deloitte consulting group proposed a digital government maturity model that included six stages:

1 information publishing

2 two-way transaction

3 multipurpose portal

4 portal personalisation

5 common services clustering

6 full integration (Deloitte, 2001a).

The recent modification of the model in 2015 focused on measuring the impact of the transformation of digital technology on different types of government organisations (Eggers and Bellman, 2015). The revised model explains how government organisations behave with respect to five dimensions (digital strategy, leadership capabilities, workforce skills development, user focus, and cultural norms), and accordingly, the model categorises government organisations into three groups of the digital transformation journey: early, developing, and maturing.

3.2 E-government maturity models 2012–2020

This section comprehensively discusses the most related e-government maturity model 2012–2020. Specifically, Janowski's digital government evolution model, Gartner's digital government maturity model, United Nations e-Government model, Deloitte digital government model, European commission eGovernment benchmark, The OECD digital government model, and E-government maturity model for sustainable E-Government services from the perspective of developing countries.

3.2.1 Janowski's digital government evolution model

The model of Janowski (2015) introduces a unique perspective at government evolution beyond what is traditionally understood as e-government to reach digital government evolution (Janowski, 2015). The author introduces digital government evolution model entails four complex stages/phases; digitisation (technology in government), transformation (electronic government), engagement (electronic governance), and contextualisation (policy-driven electronic governance). The model sees the digital government evolution as a vehicle toward addressing various pressures on governments. Consequently, this digital evolution cannot succeed or achieved without fundamental re-engineering structural and process to prepare government organisations for technology innovation adoption.

The four stages of the model are; Digitalisation (Technology in Government) – digitising of government exists information, and services - making them available to be accessed and used in digital form – and automating existing government processes and routines; Transformation (Electronic Government, technology impacting government organisations) – improving and reforming government structure, internal processes, and working practices through the application of digital technology; Engagement (Electronic Governance, technology impacting government stakeholders) – transforming the government relationship with related constituencies or stakeholders (e.g., citizens, business, and other non-government actors) using digital technology for more engagement in government policy decisions making. This phase is a part toward implementing open government principles of transparency and accountability; and Contextualisation (Policy-Driven Electronic Governance, technology impacting sectors and communities) – this phase concerns with the capability of digital government to act as a vehicle for create a good condition to regions, cities, communities, and sectors to

peruse the sustainable development objectives by themselves. Contextualisation defines its objectives far and beyond the needs of government itself.

According to the model, each stage is a result of on pressures on government and how governments apply digital innovation to address such pressures. That is, at each stage in the evolution, governments face social, economic, political, ecological challenges, which put governments under pressures. Consequently, government organisations in the 'short-term' have to provide innovative digital solutions, mainly relay on leverage the available and latest digital technology at the time (e.g., cloud computing, big data, data mining, mobile platforms, and wearable devices), to potentially help them to address such pressures. Then, over time (long-term), such digital solutions become prevailing practice embedded in the governmental processes.

In order to capture different aspects of the digital government evolution distinctive phases: digitisation or technology in government, transformation or electronic government, engagement or electronic governance and contextualisation or policy-driven electronic governance. The study applied three main analysis variables on 292 digital government studies published in government information quarterly between 1992 and 2014 as follows;

1 internal government transformation

2 transformation affects external relationships

3 transformation is context-specific.

Each variable is expressed as a binary true (yes)/false (no) question. When all three variables return true, this refers to contextualisation stage; when the last variable returns false and the rest true, this refers to engagement stage; when the first variable return true and the rest false, this indicate to the transformation stage; and finally, when all three variables return false, this indicate to the digitisation stage (See Table 2)

Several remarks could emerge from the analysis of Janowski's model. First, the model views evolution stages in incremental, intersected, and interconnected in nature instead of discrete relationship or independent of each other. The model views the digital government as a process (rather than an end) toward addressing social, economic, political, and cultural challenges in line with the needs of people at national, regions, and local levels. Second, the model asserts the crucial importance of stimulating sectoral development while applying digital government. Consequently, the transformation accompanying the process of digitisation should comprise various sectors and levels of government; state, province, local, and sectors. Third, the transformation efforts should be tailored to specific contexts and sectors with the stakeholders' needs involved in each sector or domain. Somehow, the model asserts to not leave any sector behind in the transformation journey with given attention to the sector- context-specificity and development objectives. Finally, unlike the stage of growth models, the digital government evolution model is aimed to replace the focus on benchmarking digital government maturity, to considerate on how governments leverage advances in technologies innovation trends to address various social, economic, political, ecological and other pressures on governments, and how such innovations result in new forms of technology-enabled public governance to pursue sustainable development.

Table 2 Digital government evolution model

Phase	*Characterisation*		
	Internal government transformation	*Transformation affects external relationships*	*Transformation is context-specific*
	'digitisation transforms the internal working and structures of government'	*'internal working and structure of government as well as its relationships with citizens, businesses and other stakeholders'*	*'transformation depends on a particular application context, e.g., of a country, location or sector, or is context-independent'*
'Contextualisation (Policy-driven electronic governance'	Yes	Yes	Yes
'Engagement (electronic governance'	Yes	Yes	No
'Transformation (electronic government'	Yes	No	No
'Digitalisation (technology in government)'	No	No	No

Source: Janowski (2015)

3.2.2 Gartner's digital government maturity model

Started in 2000, Gartner's e-government maturity model suggested four maturity stages; presence (information), interaction, transaction, and transformation (Baum and Di Maio, 2000). In the following two decades, the model has been repetitively evolved to reflect the technology development on government operations transformation (Di Maio et al., 2017). Gartner's e-Government model assess five stages of digital government maturity, namely, initial (e-government), developing (open government), defined (data-centric government), managed (fully digital government), and optimising (smart government). As shown in Table 3, each of the five levels is qualified using the seven themes or dimensions; drivers, service model, digital system, ecosystem and users, technology focus leadership, and key metrics (Di Maio et al., 2017; Williams, 2018). The model asserts the role of technology to simplify and foster the creation of new, collaborative and more efficient service delivery for end users (citizens, businesses and government agencies), reduce costs, create efficiencies and improve outcomes (e.g., transparency and openness), and thus better quality of life (Di Maio et al., 2017; Williams, 2018). The model also considers social, technological, economic, environmental, and political trends that impact the constituents.

The main strength of the model that focuses on promoting the top trend in government strategic planning. Gartner's model, along with related reports and publications, aims to provide government CIOs with the top strategic technology trends and tools that are convenient for government transformation, which is expected to help

government organisations to effectively respond to pressing public-policy goals and business needs.

Table 3 Gartner's glossary digital government

	e-Government	*Open government*	*Data-Centric government*	*Fully transformed government*	*Smart government*
Drivers	Compliance , efficiency	Transparency and openness	Citizen value	Insight – driven transformation	Self-defining
Service model	Reactive	Intermediated	Proactive	Embedded	Predictive
Digital system	IT-centric	Citizen-centric	Data-centric	Thing – centric	Ecosystem-centric
Ecosystem and users	Government - centric	Service co-creation	Aware	Engaged	Evolving
Technology focus	Service oriented Architecture	API enabled architecture	open any data	Thing as data	Intelligence
Leadership	Technology	Data	Business	Information	Innovation
Key metrics	% services online	Number of open datasets	Number of data -driven services	% of new and retired services	Number of new delivery models

Source: Williams, (2018, p.21)

3.2.3 United Nations (UN) model (2012-onward)

The United Nations (UN) maturity model is one of the earliest e-government maturity models since 2001. During the last decades, the UN's e-government maturity model becomes a sound and very accepted model among e-government researchers and practitioners (United Nations, 2012). The UN maturity model focuses primarily on public service delivery and suggests four stages of maturity; namely, emerging information services, enhanced information services, transactional services, and connected services (United Nations, 2014, 2012). Emerging stage focus on the online presence of government (government website or portal provide static information). Enhanced stage measures the level of delivering enhanced one-way or simple two-way e-communication between government and citizen (some limited e-services provides such as downloadable forms for government services and applications). Transactional stage concerns successfully complete end-to-end transactions online between government and citizens including exchange information and financial payment. Finally, the highest stage, enhanced stage concentrates on the governance change required in terms of the shift toward the citizen-centric approach includes tailor-made services provided and empowers citizens to be more involved in government decision-making. According to the model, this is the optimal stage of maturity at which all governments should pursue to aspire.

Although the evaluation framework of the UN model has remained consistent, the internal components have been updated to reflect new trends in public administration strategies (Bertot et al., 2016) and new trends in technology (e.g., Block chain, location data and location based technologies, internet of things, and big data). More specifically,

it was observed that the model has been widely undergone many modifications during last decade to gradually shifted from e-Government (as e-services providers) towards 'open government' (transparent and accountable), going through 'digital government' (the using of technologies to transform the organisational structures, documents, and the way services are provided), and 'smart' government (using digital technologies to address the social, economic, organisational and service challenges facing public sector organisations). While the UN model does not specify smart government as a distinct stage, instead, the model considers government that achieves accumulated high scores in its e-Government development index (EGDI) as a 'smart' government. The UN EGDI includes human capital index, telecommunication infrastructure index, online service index, and e-participation index (United Nations, 2018).

It worth mentioned that the UN four-stage e-services measuring is highly linked e-government projects to realise sustainable development goals (SDGs). For instance, the UN surveys until 2015 were linked with millennium development goals, while 2016 survey, onward, linked e-government to support the implementation of the 2030 Agenda for sustainable development including 17 SDGs (United Nations, 2016). The survey focusses on related e-government services which can generate high returns and values to generate better life for people in the most priority areas (e.g., education, health, labour and employment, finance, social welfare, and environment).

3.2.4 Deloitte's digital government model

In 2001, the Deloitte Consulting Group proposed a six stage maturity model of e-government includes; information publishing, official two-way transaction, multipurpose portal, portal personalisation, clustering of common services, and full integration and enterprise transaction (Deloitte, 2001a). The recent modification of the model in 2015 focus on measuring the transformation impact of digital technology on different types of government organisations (Eggers and Bellman, 2015). Based on the model's five dimensions (strategy, leaderships, workforce development, user focus and culture), and how government organisations behave with respect to these five factors, the model categorises government organisations into three groups of the digital transformation journey; 'early,' 'developing,' and 'maturing' government (see Table 4).

According to the survey in 2015 approached more than 1,200 government officials from over 70 countries conducted based on the Deloitte's model, the results reveal that the majority of government organisations are still in the early or developing stages of the digital transformation journey (26% are at early stage, 60% at developing, and 13% are maturing).

This model is noteworthy. First, the model underlying assumption sees the transformation government as seemingly 'interminable' endeavors or process. Thus, no government could reach the end state to be characterised 'digitally mature' rather 'digitally maturing' (Eggers and Bellman, 2015). Second, the model considered measuring or examining the transformation of government organisation by domains or sectors (e.g., defense, education, health, environment, energy, transportation, etc.), as well as government organisations type (e.g., federal, central, state, province, local, city, or quasi-government). This mechanism or approach of measuring digitisation in specific domain is in line with what Janowski (2015) calls for considering the combination of context-specificity and digital transformation when it comes to evaluating contextualisation government maturity (Janowski, 2015). According to the Janowski

(2015), stimulate sectoral development in digital government projects is crucial. This seems critical to understand why some domains perform better than others considering the survey has found that progress varies not only between countries but also between domains within the public sector.

Finally, the model also provides a considerable attention to the factors influencing maturity and how government organisations at each level of maturity behave with respect to these factors. According to Deloitte, factors such as strategy, leaderships, workforce development, user focus, procurement, and culture are critical to make digital government transformation happen.

Table 4 Characteristics of a digitally maturing organisation

	Early government	*Developing government*	*Maturing government*
Strategy	Aimed at cost reduction	Aimed at improving customer experience and decision making	Aimed at fundamental transformation of processes
Leadership	Lacks awareness and skills	Digitally aware	Digital sophisticated
Workforce development	Insufficient Investment	Moderate investment	Adequate investment
User focus	Absent	Gaining traction	'Central ' to digital transformation
Culture	Risk averse ; disintegrated	Risk tolerant ; accommodates innovation and collaboration	Risk receptive ; fosters innovation and collaboration

Source: Eggers and Bellman (2015, p.4)

3.2.5 European commission eGovernment benchmark

European union commission (EU) has its own 'E-government benchmark model'. The EU 'E-Government benchmark model' seeks to measure the status of Europe's digital government transformation annually based on the 'E-Government Framework'. The Framework been has undergone a constructive method update in 2016 to keep up with the European e-government action plan priority areas (2016–2020) and to consist with 2020 European e-government vision, which both represent continuous efforts to remove existing digital barriers to the digital single market and to prevent further fragmentation arising in the context of the modernisation of public administrations.

According the latest benchmark framework, e-government transformation should demonstrate towards several priority areas as stated in 2016–2020 action plan, which are;

1 modernise public administration with ICT, using key digital enablers

2 enabling cross-border mobility with interoperable digital public services

3 facilitating digital interaction between administrations and citizens/businesses for high-quality public services.

The e-government transformation progress on the identified priority areas is measured based on four top-level measures of government, or what so-called 'top-level benchmarks'; user-centric government, transparency, cross-border mobility, and key

enablers. Each of these top-level benchmarks is disaggregated into several components that capture different aspects of each benchmark. The e-government benchmark dimensions (user-centric government, transparency, cross-border mobility, and key enablers) spans a set of four major life events; studying, family, losing and finding a job, and business startup. Such life events cover the most common domains of public services, representative for both businesses and citizens; employment, education, economic, and justice. The EU benchmark dimensions and related indicators are clearly evolved and structured in line with main priority areas (included in the e-government action plan) to ensure a more adequate measurement of progress of e-government service in such areas.

3.2.6 OECD digital government model

As a part of the organisation for economic co-operation and development (OECD) going digital project 'making the transformation work for growth and well-being', OECD proposed digital government model based on 12 recommendation calls or principles for the evolution from 'e-government' to 'digital government' (OECD, 2014). The OECD frame work identifies six key dimensions of digital government with the aim of fostering more open, participatory and innovative government, in turn, bring governments closer to citizens and businesses. The dimensions proposed are; user-driven, government as a platform, digital by design, data-driven, pro-activeness, and open by default. The model application is not be restricted to the ranking rather it aims to help governments implement integrated policy approach to the digital transformation and to advance government efforts to towards becoming 'fully digital'.

3.2.7 E-government maturity model for sustainable e-government

A recent model proposed by Joshi and Islam (2018) introduces the e-government maturity model for sustainable e-government services in developing countries. The model suggests two parallel dimensions of e-Government maturity; implementation (supply side) and adoption (demand side). Each dimension has its own unique stages and measurement. While the implementation stages focus on the efficiency in government operations, the adoption stages focus on citizens' satisfaction and involvement. The both dimensions stage were assessed by set of measurements covering the cost, time, and effort.

While the model tries to link supply side of e-government (the effectiveness service provides) along with demand-side (active citizen involvement) and proclaimed to overcome the exiting e-government maturity models such as a lack of adoption (emphasis on technology), a linear pattern of stages, a lack of detailed processes, and a lack of state-of-the-art technology, however, the model does not provide a clear explanation on the critical changes and innovation required in government culture, policies and practices either for effective implementation of e-government initiatives or for enhancing users adoption. Additionally, the usability, appropriately, and approvability of the model for digitally advanced countries is indeed questionable.

4 Discussion

Briefly, we can provide following discussions based on previous reviews and inspired by our own general insight on the limitations of existing e-government maturity models. Maturity models are a product of how researchers and practitioners understand the concept, directions, and ultimate aims of e-government. Thus, the different perspectives of what e-government is and what its goals are mainly determine the different maturity stages unique to that perspective or consistent with it. This particularly appears in terms of defining the mature or last stage in each model. Therefore, different perspectives of e-government have been reflected in each model's number of stages and features (Chaushi et al., 2015; Nielsen, 2016). Our observation is that while several maturity models focus on the traditional notion of e-governments as ICT-enabled transactional public services starting from delivering information (publish) and to completing transaction services online (transact) and integrating the government's different departments (portals, vertical, and horizontal) (Kim and Grant, 2010; Layne and Lee, 2001; Reddick, 2004), other models consider e-government a sense of e-democracy, and thus, citizens' political participation and engagement in decision-making is the highest stage of e-government maturity models (Bélanger and Hiller, 2006; Lee and Kwak, 2012; Lee, 2010; Moon, 2002; Soliman et al., 2006).

In addition, maturity models have different numbers of stages, mainly ranging from two to six. The major and intersected stages are as follows: presence, interaction, transaction, and transformation (Fath-Allah et al., 2015; Nielsen, 2016). The stages are largely repeated across models, suggesting the models identify similar stages but use simply different labels or designations and different ordering (Almuftah et al., 2016; Fath-Allah et al., 2015). The respective stages of various models are overlapped and ordered differently in a number of models. This is mainly because most models are merely restructurings or adjustments of existing ones (Nielsen, 2016). We observe that a specific feature in a model is considered at one stage, and the same feature is considered in another stage in another model. For example, a one-stop shop is considered the second stage in Reddick's (2004) model, but it is located as the fifth stage in Almazan and Gil-García's (2008) model. The discordancy goes further as one-stop-shop portals do not constitute a form of transaction but are rather an indicator of the degree to which authorities cooperate and integration (Nielsen, 2016).

Moreover, maturity models often treat 'maturity' as a sequence of stages from an initial (simple) stage to a target maturity stage (advanced). E-government maturity models assume a linear progression in the development and progress of e-government stages over time. They theoretically assume, in one way or another, that governments need to pass the former stage to proceed to the later stage; in other words, they move from basic (simple) to advanced (complex) stages. This indirectly implies the certain upper stages are better than the lower stages (e.g., Stage 2 is better than Stage 1 and so on). However, this is not always true in the application of e-government projects (Anderson et al., 2012; Janowski, 2015; Joshi and Islam, 2018). That is, some e-government projects (portals) proceeded and moved to adopt certain features or services corresponding to the later stages without having passed, fulfilled, or completed all features or services that are expected to be provided in the earlier stages (Almazan and Gil-García, 2008; Rakhi and Gupta, 2014; Rooks et al., 2017).

The idea that stages are not necessarily subsequent has been evidenced in India (Rakhi and Gupta, 2014) and Mexico (Almazan and Gil-García, 2008) at the national e-

government level and in the Netherlands at the local e-government level (Rooks et al., 2017). In India, for example, many portals achieve the integration stage before the transaction (Rakhi and Gupta, 2014). In fact, this indicates that following a linear and subsequent progression assumption is questionable to accurately explain the development of e-government projects at the different stages (Almazan and Gil-García, 2008; Rooks et al., 2017). Additionally, it could produce misleading information or conclusions regarding e-government evolution (Barcevičius et al., 2019; Park et al., 2013). Maturity models are often criticised for depicting development and maturity in terms of discrete or distinct stages when, in practice, those stages are not linear but rather intersected and interlinked and occur simultaneously (Anderson et al., 2012; Janowski, 2015; Nielsen, 2016; Renteria et al., 2019); thus, it is more accurate to consider maturity models as open-ended models for the development of the e-government landscape, which contains continuous stages or phases that evolve over time rather than discrete stages with absolute measures (Bertot et al., 2016).

Furthermore, the existing e-government maturity models lack the inclusion of emerging and modern technologies in the e-government development stages (Joshi and Islam, 2018; Lemke et al., 2019). Over the last decade, rapid technological changes have occurred with state-of-the-art technologies such as Artificial Intelligence, Machine Learning, Big Data, Social Media, Internet of Things (IoT), 3D printing, Nanotechnology, and Blockchain. The use of these technologies by public organisations has dramatically increased recently, especially in the developed world. Therefore, e-government maturity models need to be revisited, developed, and extended to reflect the use of emerging technologies.

5 Conclusions

This paper aims to provide a general insight in the current state of maturity model research in the e-government domain. After briefly introduce maturity models proposed until 2012, the paper comprehensively discuss other models, which are: Janowski's digital government evolution model, Gartner's digital government maturity model, United Nations e-government model, Deloitte digital government model, European commission eGovernment benchmark, The OECD digital government model, and E-Government maturity model for sustainable E-Government services from the perspective of developing countries.

The main contributions of this paper are twofold. First, this study could assist researchers who are seeking knowledge and references to develop new maturity models by providing them with useful resources for further investigation and research. Second, the motivation for this review is to highlight the urgent need for formulating a smart government maturity framework, a revolutionary stage characterised by the deployment of a creative mix of modern technologies and innovation in the public sector.

Briefly, we can reach following conclusions based on previous reviews and inspired by our own general insight on the limitations of existing e-government maturity models. First, the maturity model theme still gains researchers and practitioners' attention, and perhaps such interest will not diminish since proposing new models is expected to continue over time. In fact, as long as there are continuous ICT advancement and more pressing demand and needs of e-Government stakeholders (e.g., citizens, businesses, NGOs), as well as heavy and complex challenges face government such as social,

development, environmental, and economic challenges, consequently, new models will be evolved to help governments and policymakers to address and effectively responded to such issues in practice.

Second, the shift from 'stage-based maturity models' to 'dimensional-based maturity models' is clearly observed as mechanisms of impact for proposing a stronger and comprehensive maturity model. The maturity models no longer assuming distinct stages instead, propose interlinked phases that occur simultaneously. A recent attempt working on proposing Enabler-Based Digital Government Maturity Framework instead of stage-based models (Renteria et al., 2019).

Third, a shift is noteworthy from an outdated view of e-government as a mechanism to deliver e-services to a more advanced view of digital or smart government that focuses on developing an environment enabling a better life for people and creating a positive impact on societies. Prior literature indicated that new topics like open government, smart cities, social media, smart government, and analytics have recently been attracting more research (Dutta, 2020; Rakhmawati et al., 2020; Abu-Shanab and Harb, 2019). Clearly, the new wave of e-government maturity models (2012 onward) sees e-government as a path for pursuing digital, resilience, equal, and inclusive societies. However, based on our careful analysis of the existing e-government maturity models, to best of our knowledge no maturity model of smart government that could be used to comprehensively assess the progress of smart government services, has been widely deployed yet. The emergence of modern technologies will change how future government will deliver public services and interact with their citizens (Gil-Garcia et al. 2014). Due to the rapid technological advancements, the existing e-government maturity models reached their possibilities to demonstrate the current maturity levels of e-government (Lemke et al., 2019; Joshi and Islam, 2018). Smart or intelligent public services delivery requires an extension of the current e-government maturity models.

Finally, the maturity model focuses more on government transformation since the successful implementation and development of e-government not only required ICT or delivering services but also need transformation changes in government operations, internal processes, service delivery, laws and regulations, and policies.

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