

# Development of a Maturity Model based on the Input, Process, and Output Aspects of E-government

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## Abstract

Digital transformation is happening around the world with the emerging new technologies to support the transformation. Digital technologies are disrupting not only the private sector, but also the public sector, significantly. Users, or citizens in this case, demand a high-value and real-time process from the government's public administration services. Governments that are digitally matured are more likely to have an efficient, transparent, and integrated system, and yet there are only a small number of digitally maturing governments compared to the less maturing ones. In fact, the "maturity" levels of e-governments around the world differ from one another. Maturity models have been developed by many academic researchers to aid governments in assessing the current maturity level and providing recommendations for the e-governments to improve their services. The Indonesian central government also developed the SPBE maturity model to assess the maturity levels of ministries, institutions, and regional governments in Indonesia. However, the previous models do not assess the digital public service comprehensively from the input, process, and output aspects. This research will develop a comprehensive e-government maturity model based on the input, process, and output dimensions. The model development is done by literature review of previous models and e-government service quality.

## Keywords

Maturity model, e-government, digital transformation

## 1. Introduction

Digital transformation is happening all around the world, with the emerging new technologies to support the transformation. It has been a topic of research in the recent years as an important phenomenon in strategic Information Systems research (Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013). The new emerging technologies that are mainly used in an organization's digital transformation include big data, Internet of Things (IoT), artificial intelligence, and cloud computing (Samuels, 2018). Organizations around the world have implemented those technologies to digitalize their business processes, in responding to the new digital economy that has caused disruptions to their business (Yucel, 2018). By transforming to digital, organizations can increase process efficiency with automation, optimize digital infrastructure to simplify management, improve product and service quality, increase productivity and transparency, optimize digital infrastructure to improve customer experience and engagement, and gain insights from customer's data to improve business decision making (Yucel, 2018). Digital transformation also helps improve operational efficiency (40%), reduce time to market (36%), and meet customer expectations (35%) (Corporate Leaders, 2018).

Digital trends and technologies are also impacting and disrupting the public sector significantly. The disruptions that have shifted private sector organizations to digital have also affected customer's behavior, changing users' expectation on the public sector agencies. Users, or citizens in this case, demand a high-value and real-time process from the government's public administration services (Mergel, Edelmann, & Haug, 2019). Digital transformation is now happening in the public sector, and government officials around the world have noted the opportunity, as a study by Deloitte in 2015 reported that 82% of government agencies surveyed see digital technologies as an opportunity (Eggers & Bellman, 2015). Although, unlike its private sector counterpart, digital transformation in the public sector has yet to be as advanced and swift. Nevertheless, it is still notable that many governments in the world have already progressed towards the digitalization of their services, such as online passport processing, online tax payments, online citizen complaint service, and many others.

Digitalization in the government sector has been widely discussed in the concept of electronic government or often referred to as e-government. Many governments in various countries have implemented this e-government, including Indonesia. The Government of Indonesia in particular has also developed a maturity assessment of the implementation of e-government for government agencies called "Sistem Pemerintah Berbasis Elektronik (SPBE)" or Electronic-Based Government Systems. The maturity models usually consist of several stages of "maturity", where each stage or level has its own dimensions or factors and are used to guide organizations to develop capabilities in order to achieve their strategic objectives (Khanra & Joseph, 2019). The SPBE maturity model itself has been implemented in 2019, assessing more than 437 e-governments in Indonesia (SPBE, 2019). The SPBE maturity model ranks Indonesian e-governments according to five maturity levels: "Excellent", "Very Good", "Good", "Fair", and "Poor".

However, there are some limitations to the previous maturity models and the SPBE maturity model that this research would like to address. While it is true that the SPBE maturity model assesses both the back-end and front-end government activities, the model does not assess the e-government's public service in details. The model can be useful in comparing one e-government to another and to evaluate in which areas the e-government is still lacking, but its general assessment indicators will not be able to guide e-governments in which specific areas of the digital public service that they have to improve upon. As mentioned in Deloitte (2015)'s survey, e-governments must focus on improving user satisfaction, and therefore, a more user-centric e-government maturity model is required.

Another limitation from the previous maturity models is that the models do not classify the maturity dimensions into the value creation process of inputs, processes, and outputs. Value creation exists in an organization's business model, which turns valuable resources and relationships (known as inputs) into products or services (known as outputs) that create value to users and other stakeholders, including society (outcomes) (International Federation of Accountants (IFAC), 2020). Value creation is important to identify to which extent an organization creates value and why. Classifying dimensions into inputs, processes, and outputs, therefore, will help e-governments identify in which areas they are still lacking and identify the relationship between each of the input, process, and output. That way, when things go wrong, e-governments can identify the factors that cause the errors.

This research aims to fill that gap by developing a more comprehensive and user-centric e-government maturity model to assess e-government's digital public services. This model is developed with an objective to help e-governments evaluate their digital maturity level and use it as a base to improve their services to meet user's demand for a fast, reliable, and transparent e-government service. The research will develop measurement indicators based on the literature review about digital transformation, e-government service quality dimensions, and previous e-government maturity models. This research's case study will involve the Department of Population and Civil Registration of Surabaya or "Dinas Kependudukan dan Pencatatan Sipil Kota Surabaya", with the hopes that the maturity model can be used as a policy foundation by the government agency to improve its digital public services.

## 2. E-government Maturity Model

E-governments may have existed in countries all around the world, but their readiness levels differ from one e-government to another. This readiness level is also known as maturity level, which is defined as the level to which an organization is able to adapt to changes in policies regarding the management of information assets (Ladley, 2012), that can be used to identify strengths and improvement points and prioritize actions to reach higher maturity levels (Proença & Borbinha, 2016). In the field of Information Systems, maturity models are often used to assess the maturity level of an organization's IT governance. Several well-known IT governance maturity models are Control Objectives for Information and Related Technology (COBIT) 2019, ITIL, and Capability Maturity Model Integration (CMMI).

Most e-government maturity models contain four to five stages, a few of them have six. The first stage is usually related to the availability of a website or a web portal (Fath-Allah, Cheikhi, Al-Qutaish, & Idri, 2014), where users can find information about the services offered by the government. The second stage is usually related to a shift from one-way communication to two-way communication with the government, the third stage is related to the existence of transactions between the government and the users, and the final stage is usually related to the integration of data and services among government agencies (Fath-Allah, Cheikhi, Al-Qutaish, & Idri, 2014). Several maturity models that are used as references in this research are models developed by Layne & Lee (2001), Moon (2002), Siau & Long (2005), Davison, Wagner, & Ma (2005), Andersen & Henriksen (2006), Gottschalk (2009), Kim & Grant (2010), Valdés, et al. (2011), and COBIT (2019). COBIT (2019) is a more general IT governance maturity model, while the other models are tailored for e-government.

**Layne and Lee's maturity model:** the model consists of four sequential stages, which are catalogue, transaction, vertical integration, and horizontal integration. It follows a progressive trajectory, which means that in order to be in the upper stage, the e-government should pass the lower stages. E-governments are measured by looking at the functionality and matching it to the stage's functionality. The first stage, catalogue, is related to the online presence of the e-government, which is usually indicated by the existence of a website, catalogue presentation, and downloadable forms available online. At this point, there is no transaction or interaction between the government and the users. The second stage, transaction, refers to transactions between the government and the users, usually indicated by online service and forms, database supporting online transactions, and government performing electronic transaction. The third stage, vertical integration, is a stage where local systems are linked to higher level systems. The final stage, horizontal integration, means that systems are integrated across different functions (between government bodies), where users can access more than one services through one portal (Layne & Lee, 2001).

**Moon's maturity model:** this model consists of five stages, adding one stage that is not present in the previous model. The stages are simple information dissemination, two-way communication, service and financial transactions, horizontal and vertical integration, and political participation. The first stage, simple information dissemination, is similar to Layne and Lee's model, which indicates that governments at this stage only has one-way communication to users, by providing information about its services online. The second stage, two-way communication, indicates that at this stage, there is a two-way communication between the government and its users. The third stage, service and financial transactions, means that there are transactions between the government and its users, such as electronic paychecks, paying taxes online, and electronic funds transfers. Horizontal and vertical integration are combined at the same stage, which is the fourth stage. The final stage, political participation, refers to the participation of citizens in the government's decision making, such as online voting, filling comments online, and chatrooms (Moon, 2002).

**Siau and Long's maturity model:** this model adopted Moon (2002)'s model. It has five stages too but with different stage names. The stages are web presence, interaction, transaction, transformation, and e-democracy. The first stage, web presence, refers to posting simple information through websites, without two-way interaction with the users. The second stage, interaction, indicates the existence of two-way communication between the government and its users, although still quite simple, such as search engines, email system, and official forms downloads. The third stage, transaction, features a more complex interaction, with the ability of users to communicate and transact with the government. The fourth stage is transformation, where a transformation of the way governments provides services occur, including vertical and horizontal integration. The final stage, e-democracy, is a long-term goal for e-government development (Siau & Long, 2005).

**Davison, et al.'s maturity model:** this model is distinct from the previous ones. The previous models focus on the appearance and features of e-government but did not assess what occurs in the back end of e-government. Davison, Wagner, & Ma (2005) brought a new perspective into the model, which is government's digital transformation strategies. The model connects government's strategy to the digital strategy, as well as to the availability and

capability of IT infrastructure. The model has five stages, namely rhetorical intention, strategic planning, systems development, integration, and transformation (Davison, Wagner, & Ma, 2005).

**Andersen and Henriksen's maturity model:** this model consists of four stages, which are cultivation, extension, maturity, and revolution. In this model, horizontal and vertical integration take place at the very first stage, cultivation. Internal data integration is the priority, before proceeding to digital interface to users. The second stage, extension, is related to the use of intranet, personalized web interface for user processes, and redirecting users to get more information at other agencies. Governments at the third stage, maturity, abandon the use of intranet, improve accountability and transparent processes, and prioritize self-service by users (Andersen & Henriksen, 2006).

**Gottschalk's interoperability maturity model:** this model highlights a new perspective in e-government maturity study, which is interoperability. Different from the previous models, this model particularly focuses on the interoperability aspect of e-government, which occurs in the back end. There are five stages that comprise the model, which are computer interoperability, process interoperability, knowledge interoperability, value interoperability, and goal interoperability. Gottschalk (2009) stated in the research paper that interoperability is defined as the ability of government agencies to share information and integrate business processes, and that interoperability among government agencies (public organizations) and between public and private organizations is important to make e-government successful. Therefore, the research paper addressed issues about interoperability in e-government (Gottschalk, 2009).

**Kim and Grant's maturity model:** this conceptual framework is based on two models, which are the intellectual capital (IC) management and the capability maturity model integration (CMMI). Kim & Grant (2010) defined the maturity stages in their research, but the maturity level measurement adopted CMMI's measurement system. Specifically, the IC management is used to manage and assess input area, while the CMMI model is used to assess the result area. From the model, the input areas are human capital, structural capital, relational capital, and IT investment. These input areas are the areas that will be assessed each maturity level. CMMI has five maturity levels, namely initial, managed, defined, quantitatively managed, and optimizing. In this model, however, the maturity levels are called web presence, interaction, transaction, integration, and continuous improvement (Kim & Grant, 2010).

**Valdés, et al.'s maturity model:** this model, similar to Kim & Grant (2010)'s model, also based its conceptual framework on CMMI. The measurement system also adopts CMMI's measurement system. There are three main elements structured in the model, which are leverage domains, key domain areas, and critical variables. These elements will help government agencies to consider the necessary aspects to develop an e-government system (Valdés, et al., 2011). The leverage domains contain several key domain areas, which also consist of critical variables. The four leverage domains are "e-government strategy", "IT governance", "process management", and "organization and people". Each leverage domain has a few key domain areas. For example, the "process management" leverage domain has six key domain areas, namely "business process management", "performance management", "services to citizens and businesses", "interoperability", "compliance", and "quality and security assurance". Each key domain area is comprised of several critical variables. For example, the key domain area "business process management" has three critical variables, namely "process modelling", "process simulation", and "process monitoring and accountability". The assessment of the e-government's maturity level is based on the capability level of the key domain areas, which is determined by measuring the capability level of the critical variables. The key domain area's capability level represents its readiness to support the organizational development (Valdés, et al., 2011). While the maturity level is a property of the whole e-government organization, which is a configuration of the capability levels of key domain areas. What differs this model from the previous ones is the flexibility that allows the government to identify which key domain areas are of a higher priority than the others. The maturity levels consist of five levels, namely initial, developing, defined, managed, and optimized.

**COBIT 2019 maturity model:** this model is not specified for e-government or any other public sector agencies, but it provides a view to e-government's IT governance. The COBIT 2019 model is structured into governance and management objectives, which are the objectives that will be assessed the capability level of. Each governance and management objective has process activities, similar to Valdés, et al. (2011)'s structure of key domain areas and critical variables. While the maturity level is associated with focus area. The model defines focus area as a collection of governance and management objectives and their underlying components. The maturity level will be achieved if the required capability levels of the objectives are achieved (ISACA, 2019).

Most of the maturity models reviewed above were developed using the top-down approach. This research will try to develop a model using the bottom-up approach, referring to Valdés, et al. (2011)'s maturity model. The bottom-up approach develops the model from the objectives or the factors in e-government. Each factor will be assessed its maturity level, which later will define the maturity level of the whole organization of the e-government.

### 3. E-government Maturity Model in Indonesia

The Central Government of Indonesia developed a maturity model to assess the maturity of e-governments in Indonesia. The maturity model is called “Sistem Pemerintahan Berbasis Elektronik” or “Electronic Based Government System”. The model is abbreviated as SPBE, and thus it will be referred to SPBE throughout this paper. SPBE is regulated in the Presidential Decree No. 95 of 2018, which is about electronic based government system. The aims of SPBE are to create a transparent and accountable governance and to increase public services’ quality and trust (SPBE, 2019). E-governments in Indonesia have been implemented in various maturity levels, according to the capacity and the capability of each government body. To reach the objectives of Indonesia’s e-government program, an integrated approach to e-governments should be implemented. The SPBE monitoring and evaluation system can help governments identify in what areas they are still lacking and help create integrated e-governments in Indonesia.

The SPBE monitoring and evaluation system is done by assessing the maturity level of each e-government. SPBE’s structure consists of domains, aspects, and indicators, from level 1 (lowest) to level 5 (highest). Similar to Valdés, et al. (2011)’s model, the domains are the areas that will be assessed the maturity level, the aspects are specific areas in a domain that will be assessed, and the indicators are specific information in an aspect that will be assessed. There are three domains that SPBE assesses in an e-government, which are internal policy, governance, and public service. The internal policy domain consists of two aspects, which are “governance internal policy” and “public service internal policy”. The governance domain consists of three aspects, which are “institutional”, “strategy and planning”, and “information and communication technology”. While the public service domain consists of two aspects, which are “electronic based government administration service” and “electronic based public service” (SPBE, 2019).

The SPBE model assesses both the back-end and the front-end aspects of e-government, although it focuses more on the back-end rather than the front-end aspect, given that there are 27 indicators related to back-end activities out of 35 indicators. This leaves only 8 indicators for the front-end activities. The front-end activities here refer to public-related services, which are related to the “public service internal policy” and the “electronic based public service” aspects of the SPBE. The eight indicators are presented in Table 1 below.

Table 1. Indicators for Aspect 2 and Aspect 7 of SPBE

<b>Aspect 2: Public Service Internal Policy</b>	
Indicator 14	Public Complaint Service Internal Policy
Indicator 15	Law Documentation and Information Service Internal Policy
Indicator 16	Whistle Blowing System Internal Policy
Indicator 17	Government Public Service Internal Policy
<b>Aspect 7: Electronic Based Public Service</b>	
Indicator 32	Public Complaint Service
Indicator 33	Law Documentation and Information Service
Indicator 34	Whistle Blowing System
Indicator 35	Government Public Service Internal Policy

Source: (Kementerian Pendayagunaan Aparatur Negara, 2020)

Furthermore, SPBE does not assess the details of each of the 8 indicators. The assessment is still very general. Since user-centricity is important in e-government’s success (Eggers & Bellman, 2015), and that service quality is always the priority of users (Hien, A Study on Evaluation of E-Government Service Quality, 2014), it is important to develop a maturity model that is centered around the users, and of which the indicators measure the e-government’s public service in detail.

### 4. Methodology

In modeling the maturity level of e-government based on the input, process and output aspects, several stages are carried out which include maturity framework determination, maturity dimensions identification, maturity model development, and maturity model validation and verification. Each stage will be described in sub sections below.

#### 4.1 Maturity Framework Determination

This stage starts with a literature review on previous e-government models in order to grasp an understanding about how the models were developed and implemented in the real e-government settings. It also helps in identifying the similarities and differences among the maturity models. From the extensive literature review on the previous

maturity models, it was found that many models have similarities in the maturity dimensions definition, despite the different terms used in the dimensions. Differences were found in how the maturity assessment works, where several maturity models first measure the maturity level of each dimension and then calculate the organization's maturity level, but some others directly measure the organization's maturity level using indicators on each level.

This research will develop and modify the maturity assessment system from the models developed by Valdés, et al. (2011), COBIT (2019), and SPBE (2019). The three models are used as references because they have similar maturity assessment system, where they first measure the maturity level of each dimension and then calculate the organization's maturity level based on it. However, the maturity dimensions will differ from those three because this research will only focus on the digital public services, thus it will include user-centric dimensions.

#### **4.2 Maturity Dimensions Identification**

The maturity dimension identification is done to identify relevant dimensions for the model. The dimensions must be related to the e-government's digital public services. This stage starts with the literature review on the previous e-government maturity models and e-government service quality to determine the success factors. E-government's success factors mean the factors or dimensions that an e-government must have to run a successful e-government. The literature review extends from 2005 to 2015, including research done by Parasuraman, Zeithaml, & Malhotra (2005), Valdés, et al. (2011), Papadomichelaki & Mentzas (2012), Manzin, Žurga, & Mrak (2012), Alanezi, Mahmood, & Basri (2012), and Hien (2015).

An expert judgement on this identification is required to confirm whether these dimensions are relevant to the e-government's success factors. The Head of Dinas Kependudukan dan Pencatatan Sipil Kota Surabaya became the survey respondent and confirmed which dimensions are of significant importance and which ones are not.

#### **4.3 Maturity Model Development**

The next step after confirming the maturity dimensions is the maturity model development. This stage starts with classifying the maturity dimensions into Input, Process, and Output domains. The Input domain includes dimensions related to human resources, IT infrastructure (software, hardware, and network), and budget allocation. The Process domain includes dimensions related to standard operating procedure (SOP), privacy and security assurance, system reliability, and data and services integration among units in the government agency and among different government agencies. The Output domain includes dimensions related to comprehensive system features and information available for users, contact center availability, digital public service accuracy, and the number of public services that have been digitalized. The next step in this stage is to define and describe in detail the indicators for each maturity dimension. Each maturity dimension will be assessed its maturity level; therefore, the indicators should be described in detail. The maturity level range is from 1 to 5, where 1 is the lowest and 5 the highest level. It is important to note that there should be notable differences among the five levels.

#### **4.4 Maturity Model Validation and Verification**

The verification process is required to identify any errors in the model, such as object relationship errors, dimension classification errors, and indicator definition errors. Meanwhile, the validation process is required to confirm whether the model already represents the real condition in the government agency. Both the verification and validation will be done with the help of an expert judgement by the Head of Dinas Kependudukan dan Pencatatan Sipil Kota Surabaya.

### **5. Results**

Based on the two maturity models and COBIT (2019) model, the maturity model developed in this research will also use a similar hierarchical leveling. There are three levels in the model: domains, dimensions, and indicators. There are three domains in the model, as previously mentioned in Subchapter 3.1.3, and which will be the distinct point of this model. The domains are "Input", "Process", and "Output". The "Input" domain will include dimensions related to the capital inputs required to run the e-government system processes, the "Process" domain will include dimensions related to the e-government system processes that turn inputs into outputs, and the "Output" domain will include dimensions related to the outputs or outcomes from the e-government system processes.

To identify which dimensions are significant to the success of an e-government, the first step is to analyze the previous e-government models' dimensions. This is done to identify similarities among the previous e-government models' dimensions. The analysis is not limited to e-government maturity models but also includes an analysis of e-government service quality. The parameter used to determine which dimensions to be used as an input in this

research is the dimensions must be applicable in an e-government's digital public services, as digital public service is the main focus of this research.

From the analysis, the identified dimensions come mostly from the research of Parasuraman, et al. (2005), Valdés, et al. (2011), Papadomichelaki and Mentzas (2012), Manzin, et al. (2012), Alanezi, et al. (2012), and Hien (2015). COBIT (2019) and SPBE (2019)'s dimensions were also considered in the analysis, but the models' relevant dimensions are already represented by the previous research's dimensions so they will not be mentioned twice. Table 2 summarizes the list of dimensions identified at the initial analysis. The identified dimensions are also classified into the domains for an initial classification.

Table 2. List of Identified Dimensions from Literature Analysis

Domain	Dimension	Author(s)
Input	Citizen Support	(Papadomichelaki & Mentzas, 2012)
	Leadership	(Hien, 2015)
	Chief Information Officer (CIO)	
	IT Architecture	(Valdés, et al., 2011)
	Infrastructure and eGov Tools	
	Performance Management	
Process	Procedures	(Manzin, Žurga, & Mrak, 2012)
	Privacy / Security	(Alanezi, Mahmood, & Basri, 2012)
	Quality and Security Assurance	(Valdés, et al., 2011)
	System Availability	(Alanezi, Mahmood, & Basri, 2012)
	Reliability	(Papadomichelaki & Mentzas, 2012)
Output	Information	(Alanezi, Mahmood, & Basri, 2012)
	Efficiency	(Papadomichelaki & Mentzas, 2012)
	Responsiveness	(Alanezi, Mahmood, & Basri, 2012)
	Interactivity	
	Contact	
	Format	
	Personalization	(Parasuraman, Zeithaml, & Malhotra, 2005)
	Fulfillment	
	Credibility	(Alanezi, Mahmood, & Basri, 2012)
	Ease of use	

The identified dimensions in table 2 are still written in the original terms used by the respective authors, with the original description or indicators of each dimension too. A second further analysis is required to align the dimensions and their indicators with the new model's purpose, which is to assess the maturity level of the e-government's digital public services specifically. The second analysis is done by classifying the identified dimensions into broader terms, grouping them by how related one dimension is to the others. It is useful to analyze each dimension's indicators carefully during the classification, as some indicators of a dimension might overlap with another dimension's due to being developed by different researchers. This process is also supported by literature analysis of the previous maturity models on how they classify the dimensions.

After the second analysis of the dimensions, an initial survey is done to confirm whether the dimensions are relevant to e-government's digital public service success factors. The survey is done by expert judgement from the Head of Dinas Kependudukan dan Pencatatan Sipil Kota Surabaya. It is done online using the Google Form platform, with a total of 16 questionnaire items that require the respondent to rate the importance of each dimension to the maturity level of an e-government's digital public service, from a range of 1 (Not Important) to 3 (Very Important). This survey is rather simplified and is used only to determine which dimensions to be considered in the model, not for assigning weights to the dimensions.

In the survey, the Head of Dinas Kependudukan dan Pencatatan Sipil Kota Surabaya confirmed that the identified dimensions are either "Very Important" or "Important". This means that all the identified dimensions are important factors in the success of an e-government's digital public service and can be used as inputs to the model. The survey also required the respondent to suggest what other important factors that were not in the survey, to which the respondent suggested that key performance indicators or performance measurement be included in the model. Performance measurement itself will be included in the maturity level indicators of each dimension, therefore, it will

not be written as a separate dimension. Table 3 summarizes the data from the survey, including the domains, dimensions, and the importance levels of all dimensions. The importance level is stated in score ranges, where 1 means “Not Important”, 2 means “Important”, and 3 means “Very Important”.

Table 3. The Importance Level of the Maturity Dimensions

Domain	Dimension	Importance Level
Input	Vision and Leadership	3
	Human Capital	3
	IT Infrastructure	3
	Budget Allocation	2
Process	Standard Operating Procedure	3
	Privacy / Security Assurance	3
	System Reliability	3
	Data and Services Integration	3
Output	Comprehensive System Features and Information	3
	Availability of Contact Center	3
	Accuracy of the Digital Public Services	3
	Number of Existing Digital Public Services	2

**The Input domain**, which includes the capital required as an input to run the e-government system, represents the e-government’s capability to align IT strategy with the government’s business strategy and senior management that plays a role in the digital transformation, with the support from the human resources, IT infrastructure, and budget allocation for the e-government system development and innovation.

**The Process domain**, which includes the processes required to turn the input capital into value-added services for users (citizens and businesses), represents the e-government’s capability to establish standardized procedures throughout the organization, manage data privacy and security assurance to protect the organization’s and users’ data, ensure the reliability of the e-government system, and integrate data and services throughout the organization and, if possible, with external stakeholders.

**The Output domain**, which includes the value-added services delivered to and felt by users, represents the e-government’s capability to provide a comprehensive or complete system features and information that users can access remotely, provide a contact center available to answer user’s inquiries and complaints, deliver accurate and on-time digital services to users, and digitalize all its digital services that users can access remotely.

This research will use the confirmed dimensions to build the new model. As of this stage, the dimensions only have brief descriptions and therefore cannot be used to assess the maturity level of e-government yet. A detailed description of each dimension’s indicators is required to complete the model. The indicators act as an objective guide for the assessors when assessing the e-government’s maturity level.

Figure 1 illustrates the maturity model’s hierarchical levels in a chart.

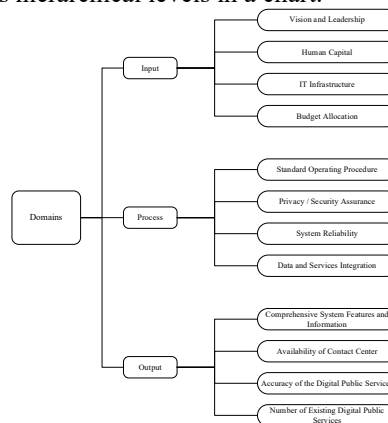


Figure 1. The Hierarchical Levels of the Domains and Dimensions of the Maturity Mode



After the maturity dimensions already defined and classified into the three domains, the next step in the maturity model development is to define the indicators of each dimension. The indicators are the instruments used for measuring and indicating the state or level of the dimensions, and thus will be used to determine the maturity levels of the dimensions. The indicators will contain detailed description of the dimension's state in Level 1, Level 2, Level 3, Level 4, and Level 5 of maturity stages. This information will then act as a guideline for assessing the maturity levels of the dimensions and for suggesting an improvement roadmap for the e-government to reach a higher maturity level.

To ensure the consistency of the definition of each dimension's indicators and the maturity levels, this research will refer to the capability levels definition from Valdés, et al. (2011), which are similar to COBIT (2019)'s capability levels but are tailored for e-government settings. The definition of Valdés, et al. (2011)'s capability levels are adapted in this model, with several adjustments made to fit in the model. The term "capability level" that Valdés, et al. (2011) used to define the maturity level of the key domain areas is changed into "maturity level" in this model, as this model only uses the term "maturity level" to define both the maturity level of the dimensions and the maturity level of the e-government as an organization.

There are five maturity levels, presented in terms such as "Initial" for the lowest maturity level and "Integrated" for the highest maturity level. The definition of each of the dimension maturity level is presented in Table 4.

Table 4. Dimension Maturity Levels and the Description

Dimension Maturity Level	Description
Level 1: <i>Initial</i>	The dimension is addressed reactively and individually on a case-by-case basis; there is evidence that it has been recognized and needs to be addressed but no initiatives are executed yet.
Level 2: <i>Developing</i>	A regular intuitive pattern is followed in addressing the dimension; people follow similar procedures for the same tasks; no formal trainings given yet; no dissemination of procedures yet.
Level 3: <i>Defined</i>	Procedures related to the dimension have been defined, documented, and communicated with internal stakeholders; the procedures are only formalization of existing practices; no formal training and standardization of procedures yet.
Level 4: <i>Managed</i>	Procedures and processes are standardized; there is a periodic quantitative performance monitoring and controlling of the dimension; it is possible to monitor and measure procedure fulfillment and compliance; the standards and rules are applied throughout the organization.
Level 5: <i>Integrated</i>	Procedures and processes related to the dimension have reached the level of best practices; continuous improvements are applied and ensured throughout the organization; the dimension is optimized with ICT and it is integrated with other related dimensions.

Source: Adapted from Valdés, et al. (2011)

From the definition of each of the dimension maturity level, it is clear that there are noticeable distinctions among the maturity levels. Level 1 "Initial" emphasizes that there is evidence that the dimension is recognized but no initiatives have been taken yet. Level 2 "Developing" indicates that there are initial or early initiatives on the dimension but there are no formal procedures yet, which are later introduced in Level 3 "Defined" with the main highlight of the formalization of existing practices. Level 4 "Managed" differs from the previous level with the development of standards and rules on procedures throughout the organization and the existence of quantitative performance measurement. The 'best practice' level, or Level 5 "Integrated" emphasizes on the continuous improvement and best practice of the procedures throughout the organization, as well as the integration with other dimensions.

While the maturity levels definition applies to all dimensions in the model, what vary one dimension from another are the dimension's indicators, which have been previously mentioned before. A further literature review (Al-Matari, Helal, Mazen, & Elhennawy, 2020; Alanezi, Mahmood, & Basri, 2012; Hien, 2015; ISACA, 2019; Manzin, Žurga, & Mrak, 2012; Papadomichelaki & Mentzas, 2012; Parasuraman, Zeithaml, & Malhotra, 2005; Septiani, 2020; Valdés, et al., 2011) was done to determine the indicators that best describe the maturity dimensions. All of the dimensions identified from literature review were already defined with indicators, but since they are cited from various research papers, they need to be adapted to adjust with the purpose of the model in this research. Table 5 contains the list of all dimension indicators in summary, each indicator separated by a semicolon (;).

Table 5. Maturity Dimension Indicators Summary

Domain	Dimension	Indicators
Input	Vision and Leadership	Strategy Alignment; Senior Management Commitment; E-government Drivers
	Human Capital	Resource Commitment to E-government; E-government IT Special Function; E-government Competency Management
	IT Infrastructure	Digital Interaction with User; Technology
	Budget Allocation	E-government Investment Planning; Budget Spending Monitoring
Process	Standard Operating Procedure	Public Service and Administrative Procedures; E-government Transparency; Compliance with Internal and External Requirements
	Privacy / Security Assurance	Information Security Management System; Security Measurement and Monitoring; Privacy Statement
	System Reliability	Response to System Failures/Errors; Visibility into System Errors; Staff's Willingness to Assist User; Reliable and Knowledgeable Resources
	Data and Services Integration	Data Storage System; Data Integration
Output	Comprehensive System Features and Information	E-government Public Information; E-government Service Digital Features
	Availability of Contact Center	Means of Communication with User; Responsiveness
	Accuracy of the Digital Public Services	On-time Service Delivery; Complete and Accurate Service Delivery
	Number of Existing Digital Public Services	Number of Existing Digital Public Services

## 6. Conclusion

The e-government maturity model proposed by this study classifies the assessment dimensions along with their assessment indicators into input, process and output aspects. With this grouping, decision makers will be able to see which aspects of e-government maturity from their organizations are still lacking and need improvement. The decision maker could make policy to prioritize the improvement in input, process, or output aspects. Further research can be conducted to examine how the dimensions of each of these aspects can affect the maturity of e-government implementation and prove whether maturity in the input aspect will affect the process, and ultimately also affect the output.

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