

## **A Formal Model for Electronic and Mobile Government Service Delivery Success Factors**

Gunadi Gunadi  
School of Management and Information Systems Victoria University  
Victoria, Australia  
and  
Gajayana University  
Malang, Indonesia  
Email: [gunadi.gunadi@live.vu.edu.au](mailto:gunadi.gunadi@live.vu.edu.au)

Geoffrey A Sandy  
School of Management and Information Systems  
Victoria University  
Victoria, Australia  
Email: [Geoff.Sandy@vu.edu.au](mailto:Geoff.Sandy@vu.edu.au)

### **Abstract**

Previous studies investigating the success of electronic and mobile government service delivery (EMGSD) have identified the factors that promote or mitigate against realisation of the benefits of such delivery. Models have lacked formality and have generally ignored the complexity of relationships between factors and factor sets. The studies have generally been concerned with EMGSD in a developed country. This paper reports on research-in-progress to address these areas. A preliminary formal model is presented with indicative examples of modelled relationships, together with a brief description of how the usefulness of the model will be validated for developing countries.

### **Keywords**

e-government, m-government, success factors, systems dynamics

### **BACKGROUND**

The rapid growth of the development and implementation of electronic and mobile government service delivery (EMGSD) has encouraged many researchers to study factors that affect the success and failure of EMGSD. An extensive review of the literature on success factors reveals that there are many factors that have been conceptualized and proposed, or empirically confirmed. Some examples of these identified in previous studies include financial resources (Rose 2004; Sandy and McMillan 2005), ICT infrastructures (Furuholt and Wahid 2008; Harijadi 2004; Ndou 2004), political-will of top leader (Furuholt and Wahid 2008; Grabow et al. 2004; Heeks 2008a; Misuraca 2007; Rosacker and Olson 2008; Rose 2004), external pressures (Heeks 2008a; Reddick 2004), management (Furuholt and Wahid 2008; Heeks 2008a; Ndou 2004), and population size (Leenes 2004; Moon 2002).

A variety of e-government models have been developed. Beynon-Davies (2007), for instance, presented a meta-model that organised inter-related horizontal and vertical dimension. Gupta et al. (2008) employed the Unified Theory and Use of Technology Model to study internal user acceptance of e-government. Evangelidis (2005) introduced a risk assessment model. Rosacker and Olson (2008) modelled critical success factors of e-government projects. Altameem et al. (2006) proposed a model for e-government implementation based on three categories of critical success factors. Gichoya (2005) adapting DeLone and McLean's (1992) earlier work developed a framework of e-government success factors implementation in Kenyan context.

However, these previous studies were unable to address the complexity of EMGSD success factors in the sense that it is not only individual and sets of factors that promote the successful design, development and delivery of government electronic and mobile service but also their relationships. These relationships can be complex. Accordingly, it is the success factors and their relationships that determine the EMGSD success. A similar conclusion was also observed by Titah and Barki (2008) when they reviewed the e-government adoption and acceptance literature. They recommended the conceptual development of the interactions and complex relationships of these factors from the multidimensional and multilevel point of view. In another area of information systems, the interrelationships among critical success factors of ERP implementation had been successfully modelled. Akkermans and Helden (2002) used a causal loop diagram method to help reverse an

initial failure of ERP implementation. This case is further studied by King and Burgess (2006) in a system dynamics context.

The purpose of this paper, which reports on research-in-progress is to:

- present a preliminary model of success factors of EMGSD that captures the complexity of relationships among them,
- demonstrate the appropriateness of the chosen modeling tool to capture that complexity.

Previous studies of EMGSD have usually been undertaken in a developed country. This is to be expected as such societies are more advanced in the application of electronic and mobile technologies to information processing, communication, e-commerce and service delivery. However, governments of many developing countries are currently involved or are planning involvement in EMGSD. Their achievements to date in EMGSD development, implementation and utilization are still at low-level (UN 2008) or less successful because the promised EMGSD benefits have not been fully realized. However, some successful EMGSD applications have been reported, for instance, Bhatnagar (2004 and Furuholt and Wahid (2008). This paper reports on the Indonesian situation and how the formal model will be applied to that country, and, how its practical usefulness will be validated. However, the research has not progressed to this point.

It is expected that this research will contribute to the improvement of insight into EMGSD success factors and their relationships as well as the process to realize the expected benefits of EMGSD. In addition, the resulting model can help EMGSD decision makers in developing countries to develop a fruitful EMGSD.

## **NATURE AND IMPORTANCE OF EMGSD**

EMGSD has been implemented in many forms. In developed countries EMGSD systems have been configured to maximise self-service based on internet technology allowing citizens to obtain government service at their own time and place. This transforms the way government operates internally and interacts externally with its citizens. Bhatnagar (2002) observed that this implementation differs from developing countries in the sense that many implementations take in a combination of manual and automated forms where citizens still have to access government employees who operate ICT-based processes. Compared with those in developed countries the level of sophistication and functionality of the EMGSD is still low due to the lack of many necessary factors (Dada 2006). However, there has been a broad range of functions implemented in developing countries such as agricultural information provision, birth registration and e-procurement (Heeks 2008b; InfoDev 2002). Implementations have extended through a mobile-based channel to provide information services anytime and anywhere in various areas such as agriculture (Ntaliani et al. 2007) and public infrastructure maintenance (Song 2005). These implementations have provided many common benefits such as cost and time saving and more transparent processes for the citizens.

The literature reveals a variety of definitions for e-government and m-government and the relationship between the two. This study adopts the term Electronic and Mobile Government Service Delivery (EMGSD) and so tacitly makes a distinction between “electronic” and “mobile”. This is more for convenience than the distinction is considered significant. The working definition of EMGSD is the government information systems that enable better quality operations, better service delivery and more convenient and efficient access to information which both benefits its customers and enhances their participation. By embracing the notion of information system into the EMGSD definition, then the EMGSD is a system that consists of interdependencies among and between social and technical elements. The definition by itself does not restrict the EMGSD within Internet-based technology, but all type of digital ICTs.

A study of EMGSD success factors will also necessitate the adoption and definition of the concept of success. Review of the EMGSD success literature show that this notion is multifaceted. There have been several EMGSD success definitions used in the previous EMGSD research however, DeLone and McLean's (2003) information system success model seems more appropriate. This model had been empirically adapted in various context (Hu et al. 2005; Sedera and Gable 2004; Wang and Liao 2008). Nonetheless, subjectivity in judging the EMGSD success practically can not be avoided as various stakeholders have their own perspectives.

Referring to DeLone and McLean's (2003) model, the EMGSD success can be defined as the net benefit obtained by the majority of the EMGSD stakeholders. However, to make this definition operational in the developing countries context, it is necessary to consider the current development level of the EMGSD in that environment and, the fact that the government does not need to compete in service provision. With reference to the UN's (2008) model of EMGSD development, many studies have shown that most of the developing countries are still on a lower level where customers access to EMGSD is indirectly performed through government officers operating on-line services. Therefore, EMGSD in developing countries is deemed successful if it successfully achieves at least the first level of UN's model in Internet-based service and implements on-line

services. This represents EMGSD success in system quality, information quality and service quality from the government perspective. At the first level this means a) quality information on government policies, service provision and its procedures, regulations, etc are highly available; b) those information are easily downloadable; and c) the services is sustainable. At the second level this means a) the on-line service is always available; b) the on-line services is sustainable; and c) the government unit that provide service can operate in seamlessly manner; etc. This definition assumes that benefits realized by the majority of the EMGSD stakeholders, such as cost and time saving, are a direct consequence of the EMGSD success according to that definition.

## **TOWARDS A FORMAL MODEL**

A review on previous EMGSD success factors studies shows a variety of approaches with a variety of resulting models. This may create confusion among EMGSD stakeholders who may therefore be unable to take advantage of the findings of these studies to realise success in EMGSD. In order to overcome this problem, it is suggested that the EMGSD success factors system be modelled formally. A system always benefits from being represented as a model (Wetherbe and Vitalari 1994) One that is a purposefully simplified and contains only the essential and relevantly selected characteristics of the system (Myers and Kaposi 2004). The word “formal” in this study means in accordance with explicitly prescribed procedures or organized steps to achieve correctness, controllability, certainty (Sartor 1994). This formality will facilitate organized and precise evaluation of the resulting model. Therefore, a formal model in this study means representation of the systems using explicitly prescribed procedures or organized steps that eliminate or reduce ambiguity, provide rigor reasoning and precision.

The EMGSD success factors system will be formally modelled by utilizing a well-known and readily available information systems process modelling approach (Whitten and Bentley 2007) referred to as causal loop diagram and system dynamic approach (Maani and Cavana 2007). The EMGSD success factors system is firstly considered as a whole within a particular domain. At this stage, it is necessary to define the boundary and identify all the relevant EMGSD success factors (at a “high-level”) that influence the success of EMGSD.

Secondly, the EMGSD success factors are decomposed from the “high-level” factors. Decomposition has been one of the most important tools and successfully practiced to tackle large scale and complex domain of interests (Courtois 1985; Paulson and Wand 1992) such that it facilitates system analysts to better understand a complex system (Wand and Weber, 1990). At this stage, it is not necessary to describe relationships amongst the high-level factors. The decomposition process is done in a top-down manner to a relatively manageable size of subsystems. Good decomposition incorporates minimal coupling, maximal cohesion, minimality, losslessness, and determinism (Burton-Jones and Meso 2008).

Thirdly, for each of the EMGSD success factors subsystem or high-level factors identified in the previous stage, all possible success factors within the subsystem are then explored and identified along with all its possible affected factors. In this case, a “use-case” list technique is used to formalize the step, instead of affinity or hexagons diagram (Maani and Cavana 2007), by introducing success factors in place of use-case in order to reveal a sequence of influences among the success factors. Based on the “use-case” list of success factors, causal loop diagrams (Maani and Cavana 2007) are then developed. The resulting diagrams will reveal the causal relationships amongst the EMGSD success factors, explain what factors influence others, and how change in one or several factors of the EMGSD success factors system propagate to other factors and back to the source factor in reinforcing or balancing loops. In addition, the system thinking acknowledges that cause-factors may take some time to have an effect to other factors.

Finally, the EMGSD success factors model revealed at the previous stage is run through a computer simulation within a system dynamics framework. System dynamics is mostly appropriate to analyse interrelationships within systems to form a causal relationships as a basis of policy models (Sharma et al. -). The simulation model represents the model in terms of stocks, flows, converters and the feedback loops (Maani and Cavana 2007). By simulating the model, visual behaviour over time of the EMGSD success and its success factors system will be revealed, and this will help to manage complex behaviour of the system. Therefore, this simulation provides a mean for shared-learning the system by rehearsing various alternatives and the effect of change towards the future of the EMGSD success factors systems (Morecroft 2007, p. 6), or to identify key leverage factors to intervene the system as if it is in a real context. This shareable conceptualization of the EMGSD success factors system will be able to help the EMGSD stakeholders on how to achieve success.

## **MODEL CONSTRUCTS**

Based on the system dynamics along with the advantages of a formal modelling approach described in the previous section a preliminary formal model for the EMGSD is presented as research-in-progress. The EMGSD success factors are things (objects or activities or conditions) that contribute to or determine the success of the

EMGSD (Gichoya 2005). Druke (2005) acknowledges that the level of importance of some factors may differ from when they are in an interaction. Review of the EMGSD success factors literature indicate the existence of relationship between the factors such as cost relate to staff skill then relate to quality of information (Heeks and Bhatnagar 2001), EMGSD champions relate to long-term sustainability then relate to processes re-engineering (Bhatnagar 2002) then relate to staff resistance (Ndou 2004) then relate to leadership and then relate to EMGSD champion (Bhatnagar 2002). This shows that there is an inherent complexity, and suggests the existence and importance of systemic structure (Senge 2006) within the EMGSD success factors. So, it is quite appropriately that this study defines the EMGSD success factors and their relationships as a system. Figure 1 describes the “top-level” hypothesis that EMGSD success is not only determined by the individual success factors but also the dynamics expressed as relationships between them.

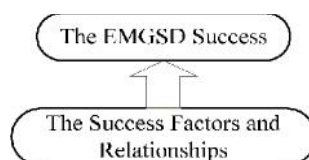


Figure 1. The EMGSD success is influenced by the success factors and their relationships.

A large number of the success factors have been identified and categorized in many previous studies such as (Altameem et al. 2006; Heeks 2008a). A decomposition of the EMGSD success factors into high-level success factors can be described by Figure 2 and Table 1.



Figure 2. High-level success factors decomposition. Table

1. List of high-level success factors and references.

General ICT infrastructure and electricity	(Heeks 2005)
Law, regulation and politics	(Basu 2004; Bhatnagar 2004; Heeks 2008a; Kaaya 2004)
NGOs or Non-Government Organization and Other Similar Organization	(Heeks 2005)
Research and Educational Institution	(Grabow et al. 2004)
Private or Business Sectors	(Grabow et al. 2004)
Population size	(Reddick 2004; Schwester 2009)
Organization, Business Process and Culture	(Gil-Garcia and Pardo 2005; Heeks and Davies 2001)
Informatics Infrastructure	(Beynon-Davies 2007; Heeks and Bhatnagar 2001)
Human Resources	(Heeks and Bhatnagar 2001)
Leadership and Overall Strategy	(Grabow et al. 2004; Ndou 2004)
Project and Process Change Management	(Heeks 2008a)
Finance and Budget Management	(Anonymous 2005; Kahraman et al. 2007)

In order to present how the complexity of the success factors influences the EMGSD success, two high-level success factors are chosen and the modelling tools will be implemented to demonstrate the appropriateness. By implementing causal loop diagram, relationships amongst success factors will be specifically represented in cause and effect factors which eventually form a closed loop. These, therefore, represent presumption interrelationships or causal loops among the identified success factors.

In the following figures 3 and 4, a causal relationship is represented by an arrow with arrowhead pointing to an effect factor. A plus (+) symbol next to the arrow represents a same change direction, while a minus (-) symbol represents a change with opposite direction between the cause and effect factors. The diagrams below have not identified possible time delay that may be taken in order a success factors to influence others. The success factors depicted outside the curved-rectangle indicate that they are from other high-level success factors.

Table 2. Success Factors within the Organization, Business Process and Culture high-level factors.

Success Factors	Description
Organizational diversity (Gil-Garcia and Pardo 2005)	Diversity of the organisational units/levels involved in the EMGSD.
Coordination among organizational unit (Ndou 2004)	Coordination among organizational units/level involved in the EMGSD.
Work culture (Heeks and Bhatnagar 2001)	The norm or long-established practice that is applied in doing jobs daily.
Bureaucratic practice (Heeks and Bhatnagar 2001)	The way and time needed for services are done and decisions making are taken.
Willingness to reduce authority (Kumar and Best 2006)	Willingness of the authorities who perform service or make decision to transfer their power to the EMGSD system.
Departmental ownership of EMGSD (Bhatnagar 2002)	Ownerships among departments or units towards EMGSD applications operated in the department to perform services.

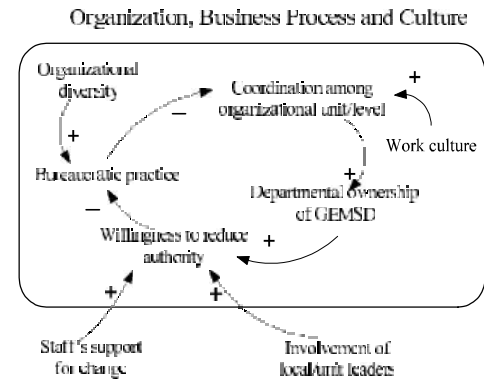


Figure 3. A dynamic feedback structure of the success factors within the Organization, Business Process and Culture high-level factors.

Figure 3 tells that within a high-level success factor, named Organization, Business Process and Culture, an Organizational Diversity and Willingness to Reduce Authority factors influence the Bureaucratic Practice factor which is then it affects Coordination among Organizational Unit/Level factor. This factor further affects the Departmental Ownership of EMGSD that further influences the Willingness to Reduce Authority factor. This sequence of influences along with the direction of changes between a pair of factors elicits the reinforcing dynamic feedback structure within this high-level factor, and informs that an improvement or decline in one factor will be followed in the same direction by other factors within the loop. In addition, other success factors, such as Staff Support for change from Human Resources high-level factor and Involvement of Local/Unit leaders from Leadership and Overall Strategy high-level factor illustrate the causal relationship amongst high-level success factors.

Table 3. Success Factors within the Informatics Infrastructure high-level factors.

Success Factors	Description
ICT staffs' skill and knowledge (Gil-Garcia and Pardo 2005)	Skills and knowledge owned by overall ICT staff within EMGSD unit or by those who manage government's informatics infrastructure.
ICT staffs motivation (Heeks and Bhatnagar 2001)	Motivation of overall ICT staff within EMGSD unit or those who manage government's informatics infrastructure.
Technological complexity (Gil-Garcia and Pardo 2005)	Complexity of overall hardware, software, network needed for the EMGSD applications.
Job performance (Robbins 1994)	Performance of ICT staff in doing their jobs.
ICT staff training (Gil-Garcia and Pardo 2005)	Adequacy of ICT staff training (contents, frequency, level).
Staffs' technical availability (Hussein et al. 2007)	Technical availability of overall ICT staff to do their jobs.
Informatics infrastructure reliability and availability (Beynon-Davies 2007)	Reliability and availability of overall ICT related services to perform EMGSD service.
Reward or incentive for ICT staffs (Robbins 1994)	Various reward accepted by ICT staffs, such as finance or promotion.

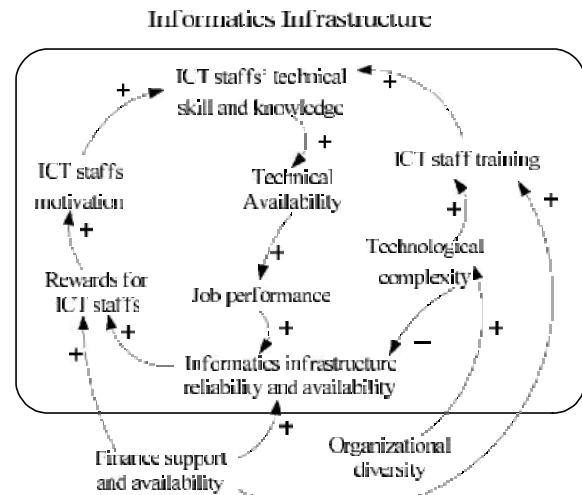


Figure 4. A dynamic feedback structure of the success factors within the Informatics Infrastructure high-level factors.

Similar with Figure 3, Figure 4 also reveal a reinforcing causal loop structure of success factors within Informatics Infrastructure high-level factor. In this case, two other success factors (Finance support and Availability, and Organizational Diversity) those that comes from two different "high-level" success factors influence factors within Informatics Infrastructure high-level factor.

These two figures also reveal the existence of causal relationships between the two as well as with other high-levels success factors. Further investigation may elicit further feedback loop within as well as between the high-level success factors that represents dynamics structure of the success factors system.

These examples are indicative of how formal modelling can facilitate a more organized view towards EMGSD success, to untangle the messy of previously identified success factors, to provide understanding in viewing the complexity of the success factors through causal relationships. The usefulness of the model may be seen from the fact that the model helps identify an impact through the change of a particular factor that, at the beginning, seems unlikely to affect the EMGSD success. Through tracing the causal effect the change can work proactively or act as an inhibitor. On the other hand, if one success factor within a causal loop is broken, then the effect will propagate to other success factors. Hence, this will help the EMGSD decision makers to develop fruitful policies.

It should be noted that the simulation under system dynamics framework has not yet been developed but this will be undertaken in the next stage of this research.

## **VALIDATION OF THE MODEL**

Indonesia has been selected as a representative developing country. The government of Indonesia has begun to develop and implement EMGSD within various agencies and levels. A variety of EMGSD applications with various level of sophistication have been implemented. Several local governments in Indonesia, for example, have successfully developed and implement EMGSD application called PSB on-line that requires manual input by government employees but the output can be accessed by citizens through internet and mobile phones. This application has been acknowledged by citizens as provide cost and time effective transactions and transparent process. Therefore, Indonesia has provided cases that fulfil the EMGSD success definition in developing countries context. In addition, the UN (2008) reveals that its EMGSD development level is similar with many other developing countries, and a number of EMGSD development programs have also been undertaken. Hence, it is believed that Indonesian's EMGSD can represent other developing countries EMGSD conditions quite well. The resulting models are believed generalize-able to the wider context of developing countries.

Many EMGSD stakeholders in Indonesia have addressed and acknowledged the important role of EMGSD success factors. One example of this attention is realized in an e-Government Award activity. This yearly activity has been conducted in several consecutive years to evaluate EMGSD achievement level of various government's offices and levels based on a number of success factors. A similar activity is also regularly conducted by the Department of Communication and Informatics of the Indonesian Government.

An interpretive study like that used by Walsham (2002) will be conducted in order to collect data regarding factors, attributes, measures and the factors relationships from the successful Indonesian EMGSD cases and to corroborate the literature review finding. The data collection is intended to verify the proposed model, that is to ensure that the model has included correctly the success factors and relationships from the real system (Maani and Cavana 2007). The EMGSD cases will be selected according to the successful EMGSD definition and the secondary data of the winner of eGovernment Awards 2008 published by Warta eGov Magazine (MajalahWartaEkonomi 2008). There will be three EMGSD cases representing each of three level of the Indonesian government structure: national, provincial and regional. If there is more than one case available for each level then the selection will rely on the level of the Internet-based services provision.

Data will be collected through interviews and available documentation. Key stakeholders of the selected case will be interviewed using open-ended semi-structured interviews. The proposed model resulted from the model development stage will be used as the interview guidance. The interviewees will consist of the decision maker or top leader of the EMGSD, the EMGSD application champion, the leader of government units that provides ICT-based services or senior staffs who are involved since early development and implementation of the EMGSD. The documents relevant to the case, both internal and external, will be studied to corroborate the interview finding.

As suggested by Yin (2003), the analysis of the interview transcripts will be guided by the proposed model based on a pattern-matching reasoning. Any indication from the interviews in relation to the success factors and their relationships, verbatim or derived, as well as other acquired data will be coded and categorised using appropriate criteria. The existence and the importance of a particular factor along with the relationship will be based on what interviewees say, how they expresses it and on the occurrence of the factors during the interview. Documentation analysis is also guided by the proposed model.

## **CONTRIBUTION TO RESEARCH AND PRACTICE**

It is expected that the research will advance existing theory as it addresses the complexity of relationships between success factors and their sets. It is also expected that the model will be validated as useful for Government in Indonesia and similar developing countries. It is useful in ensuring that the design, development and implementation of EMGSD will lead to full realisation of the benefits claimed for such delivery.

## CONCLUSION AND SUMMARY

This paper reports on some research-in-progress in the important area of electronic and mobile government service delivery. Specifically, it focuses on EMGSD in developing countries. It presents a preliminary formal model of the EMGSD success factors and their relationships. It also demonstrates the usefulness of the chosen modelling tool, one that has widespread acceptance within the information systems community. The paper also reports on how the formal model, when complete, will be validated using the case study country of Indonesia.

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