A Quality Model of e-Government Services Based on the ISO/IEC 9126 Standard

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Keywords: e-Government services, Quality model, Quality characteristics

Abstract: The paper addresses the quality model of e-Government services (e-GSQ Model) by employing the ISO/IEC 9126 standard. This model is used to verify government services whether or not they meet citizens' needs. There are fifteen characteristics describing government services in terms of services given by government organizations and five other characteristics describing government services in term of citizens' needs. These characteristics are suggested to be minimum requirements for establishing the quality model of e-Government services. The result of tested quality metrics for e-Government services supports the basic characteristics of a quality model of e-Government services.

1.   Introduction

Many government organizations have applied the capability of electronic media to upgrade services from direct contacts with government organizations to services provided through electronic media. This is called electronic Government services (e-Government services). The e-Government services can replace the government's traditional services for better quantity, quality,

and satisfactory results using Information and Communication Technology (ICT)[1]. The services are provided to related stakeholders such as citizens, non-profit organizations, private sectors, and public sector organizations. E-Government services aim at providing services to promote government commerce which helps save time and increases the quantity of services per time unit[2].

There are many problems of accessing e-Government services by related stakeholders[3, 4]. For example: 1) The technological infrastructure that affects the distribution of e-Government services to all related stakeholders through various channels. The lack of trust in the security and stability of internet-based systems is another handicap. 2) The geographic problem of related stakeholders who live in rural areas. They have less chance to successfully access the Internet, and 3) Information mismatch that affects the submission of requests from related stakeholders to government officers who have direct responsibility and true authority to consider the matters.

The primary factors that government organizations should consider in the use of e-Government services are the preparation in both technology and channels and the understanding in the use of technology by related stakeholders. Therefore, the quality model of e-Government services (e-GSQ Model) should be reviewed by government organizations to acquire the necessary drive and motivation in the form of 'push services' or called the supply side, and to increase the trust of related stakeholders to use the services in the form of 'pull services' or called the demand side. Both views are considered mainly from the needs and satisfaction in e-Government services of related stakeholders.

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1 *Millard, J.*, Prisma Strategic Guideline 10: eStrategies for Government (2003), Information Societies Technologies (IST) Programme, April, 1–57.

2 *United Nations*, Compendium of Innovative E-government Practices Vol II (2006), Department of Economic and Social Affairs, August, 354 p.

3 *United Nations*, Global E-government Readiness Report 2005: From e-Government to e-Inclusion (2005), Department of Economic and Social Affairs, Division for Public Administration and Development Management, New York, 270 p.

4 *Australian Government*, Australians' Use of and Satisfaction with e-Government Services (2005), Department of Finance and Administration, June, 1–81.

2. The Requirements of e-Government Services and the ISO/IEC 9126 Standard

2.1 The Requirements of e-Government Services

The transformation from government services to e-Government services makes a new generation in public services. Government organizations need to design digital services for the needs of related stakeholders, making it simple to find and access government information and services electronically[5]. E-Services are Information System and Information Technology that are delivered electronically[6]. Moreover, the different requirements between customers in the typical e-Services and the related stakeholders in the e-Government services concern the aspects of rights and duties. Each related stakeholder has the right to request information and services from government organizations. E-Services strategy aims to provide optimal service to those who should be convinced to become good customers[7]. Therefore, the quality of e-Government services can actually be considered from the needs and satisfaction of related stakeholders who request for the government services. Since e-Government services occur from implementation of e-Government, the needs and satisfaction of related stakeholders in e-Government services are divided based on the framework of e-Government as identified by Lenk and Traunmüller[8]. The framework of e-Government comprises the addressee's perspective, the process perspective, the cooperation perspective, and the knowledge perspective. Therefore, by applying this framework for e-Government services, the details of the requirements of e-Government services are described in table 1[8, 9].

5 *Pinder, A.*, Digital Inclusion Panel Report (2004), The Office of the e-Envoy, 88p.

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7 *Reinhard,* R., Design Principles for e-Government Services (2006), http://www.ifi.unizh.ch/egov/Wien03.pdf (last accessed: January 13, 2007).

8 *Lenk, K. and Traunmüller, R.*, A Framework for electronic Government, in: Proceedings of the 11th International Workshop on Database and Expert Systems Applications, September (2000), 271–277.

9 *Strover, S. and* Straubhaar, *J.*, E-Government Services and Computer and Internet Use in Texas, Telecommunications and Information Policy Institute, University of Texas, June (2000), 1- 81.

Perspectives	Description
The related stakeholders' perspectives	1. The confidentiality of personal information of related stakeholders who request for the use of e-Government Services. 2. Related stakeholders can receive e-Government Services according to their interests, e.g. requesting for information, downloading and/or printing official document forms, and sending off document forms to government organizations through various electronic media. e.g. websites or e-mails. 3. If there is any cost incurred from government services, the government organizations need to increase the confidence of related stakeholders in the ability of the government to pay for those expenses.
The process perspective	4. Related stakeholders spend less time and do not have to wait in a queue in order to contact government organizations to receive the services. 5. Related stakeholders take the easy, uncomplicated, and convenient process to contact government organizations.
The cooperation perspective	6. Related stakeholders have more suitable choices/channels to access the government services. 7. There is a search or help section so that related stakeholders that use e-Government Services can successfully follow the service from the beginning to end of their operation.
The knowledge perspective	8. The related stakeholders understand the process of searching for e-Government Services in details to gain the service needed with satisfaction. 9. The related stakeholders know about the information of e-Government Services, for example, the information of suggestions for those who receive the services, steps of searching for needed information or services through electronic media, and information of services currently available.

Table 1: The Requirements of e-Government Services

The quality of e-Government services is another incentive that will promote the use of e-Government services by related stakeholders, which will lead to sustainable e-Government services that is a basis of full participation of democracy process of related stakeholders. Therefore, to create high-quality and complete e-Government services, features that are necessary for e-Government services are specified in many researches[10, 11, 12, 13]. These features can be categorized into five issues. The first issue is quick and correct access to the services at any place by related stakeholders of all educational levels and quick response from government organizations. The second one is interoperability of e-Government services between related government organizations. The third issue is security and privacy. The arrangement of security level and the protection of user privacy is also a significant point that should be considered to create trust and increase the confidence of related stakeholders to use the service. The fourth issue is reliability and efficiency of e-Government services. The last is unique identity that facilitates related stakeholders to register only one time to receive more than one service.

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10 *McGrath, S., and O'Reilly, C.*, A Service Oriented Approach to e-Government Architecture (2004), http://www.idealliance.org/ papers/dx_xmle04/papers/02–06–04/02–06–04.html (last accessed: January 13, 2007).

11 *Atkinson, R. D.,* Turbo-Charging E-Government, Government Technology's Public CIO: Technology Leadership in the Public Sector (2006) (http://www.public-cio.com/story.php?id=Turbo-Charging %20E-Government99814&story_pg=4 (last accessed: January 13, 2007.

12 *Cabinet Office*, Executive Summary: e-Government Framework for Information Assurance, Central Sponsor for Information Assurance, December (2006), 1–6.

13 *Commission of the European Communities*, Communication from the Commission to the Council and the European Parliament: Interoperability for Pan-European eGovernment Services, Brussels, February (2006), 1–12.

2.2   The ISO/IEC 9126 Standard

The ISO/IEC 9126 standard was developed in 1991 by the International Organization for Standardization (ISO) to provide the framework for evaluating software quality[14, 15]. The ISO/IEC 9126 standard is used as a tool to identify the quality considered in each application. The ISO/IEC 9126 standard describes an internal and external software quality. The internal software quality derives from the product itself. The external software quality derives from the behaviour of the system of which it is a part, either direct or indirect. Both the internal and external software qualities are prescribed in a quantitative scale and measurement method in six characteristics which consist of functionality, portability, maintainability, efficiency, usability, and reliability. The use of quality model defined in this part of the ISO/IEC 9126 standard is to: (1) identify quality assurance criteria; (2) identify acceptance criteria for a completed software product; (3) support for setting quality goals; and (4) support for design review, verification, and validation. There are many applications that use the ISO/IEC 9126 standard to evaluate their quality. These applications are: 1) E-Learning system in applying the ISO/IEC 9126 model to the evaluation of an e-Learning system[16]. 2) The geographic information system on the web in accessibility as a quality requirement: geographic information systems on the web[17]. 3) The text mining system known as Parmenides project in the evolution of an evaluation framework for a text mining system[18]. The main quality characteristics of the ISO/IEC 9126 standard that are evaluated within these applications are the accessibility, user requirements, and priorities. The result from these applications concluded that the ISO/IEC 9126 standard could be a useful model for evaluation of the quality of basic information providing and rational decision making to avoid costly mistakes.

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14 *American National Standards Institute*, Software Engineering – Product Quality – Part 1: Quality Model (2001), International Standard ISO/IEC, pp 1–8.

15 *Essiscope*, ISO 9126: the Standard of Reference (2006), http://www.cse.dcu.ie/essiscope/sm2/9126ref.html (last accessed: September 22, 2006).

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17 *Schimiguel, J. Melo, A. M., C.* Baranauskas *, M. C., and Medeiros, C. B.*, Accessibility as a Quality Requirement: Geographic Information Systems on the Web, ACM 1–59593–224–0, CLIHC'05, Cuernavaca, Mexico, October (2005), 1–12.

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3.   The Quality Model of e-Government Services

The quality model of e-Government services mainly considers the quality of the needs and satisfaction of service providing from government organizations and access to the services by related stakeholders. The consideration of e-Government service quality is based on the principles of the ISO/IEC 9126 standard that is related to functionality, reliability, usability, efficiency, maintainability, and portability. The quality of e-Government services comprises supply and demand sides which consist of nineteen quality characteristics. The supply side includes fifteen quality characteristics which are suitability, accuracy, interoperability, security, maturity, fault tolerance, recoverability, time behaviour, resource behaviour, analyzability, changeability, stability, testability, installability, and compliance. The demand side consists of five quality characteristics which are understandability, learnability, operability, compliance, and privacy. Compliance can be considered both in the supply and demand sides. In supply side, it refers to e-Government services that comply with aimed rules and/or targets which are reduction of service cost, provision of service that meets the requirements at appropriate time. In demand side, compliance means that related stakeholders are able to request for services anywhere from any available service channels that are convenient and appropriate. The privacy characteristic is not identified in the ISO/IEC 9126 standard but is added in this research because user privacy is an important issue in the supply side and it is not a matter of security since it concerns the protection of related stakeholders' personal information when they request for services from government organizations. The security characteristic concerns a system that performs security function in preventing unauthorized access and the anonymity of related stakeholders. The quality model of e-Government services is shown in Figure 1. Descriptions of quality characteristics are shown in Table 2.
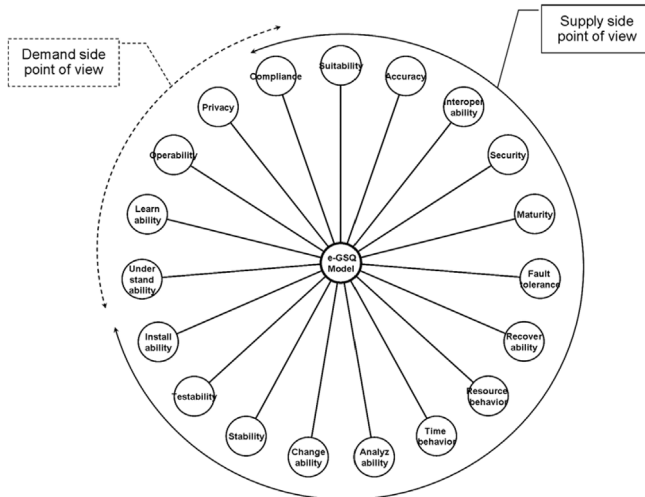
Figure 1: The Quality Model of e-Government Services (e-GSQ Model)

e-Government Services quality characteristics	Description
Supply side	
Suitability	The direction for receipt of e-Government services that is suitable, quick, and time saving.
Accuracy	The accuracy of e-Government services provided to related stakeholders.
Interoperability	The connection of e-Government services with other units within related government organizations.
Security	The prevention of unauthorized access and the anonymity of related stakeholders while accessing the e-Government services.
Maturity	The e-Government services must be performed regularly, and the service provided must be up-to-date.
Fault tolerance	The specification of levels of errors to occur from the operation of e-Government services. This is to prevent errors from service provision.
Recoverability	Government organizations can recover e-Government services immediately when unexpected problems occur.
Time behavior	The time of response or service provision of e-Government services should be set to a period of time that is suitable for each different types of service.
Resource behavior	The source of e-Government services which provides information and details of service provision. The information must be sufficient, reliable, and up-to-date.
Analyzability	The e-Government services must be analyzable. The analysis focuses on possible mistakes so that one can prepare to prevent them or make changes to the service in time.
Changeability	E-Government services provided must be in accordance with the changing needs of related stakeholders and are not in conflict with the set policies or objectives of service providing.
Stability	The e-Government service system must be stable.
Testability	Sending off confirmation message to related stakeholders after accessing to receive service from e-Government services.
Installability	The e-Government service system can be installed in all environments as required by government organization so that the related stakeholders can widely access the service.
Compliance	The e-Government services that are in compliance with regulations and/or set targets. These are reduction of service cost, service provision that meets the needs at appropriate time, the related stakeholders request for services from every place through every service channel that is convenient and suitable.
Demand side	
Understandability	The channels for accessing the e-Government services are processed in an easy, convenient, and uncomplicated way.
Learnability	There are the help sections as the first step for related stakeholders to find out the direct or suitable way in acquiring e-Government services.
Operability	There are many channels provided to related stakeholders for accessing the e-Government services including the walk-in contact.
Privacy	E-Government services must provide protection of related stakeholders' information when they request for service from government organizations.
Compliance	Related stakeholders are able to request for e-Government services from government organizations from any place, any time according to their needs and satisfaction.

Table 2: The Quality Characteristics of e-Government Services

The quality characteristics of e-Government services stated in this research have their own features, some quality characteristics are in conflict with each other. A trade-off between security and privacy is that related stakeholders agree to decrease the degree of personal information protection to receive e-Government services at any time and place; or they agree to

reduce the number of service channels to increase the level of personal information protection.

4. The Quality Metrics for e-Government Services

The quality metrics for e-Government services are performed using comparison of the case studies from successful e-Government services in leading countries mapped with the quality characteristics identified in the quality model of e-Government services. European countries and Australia are two sample groups to be considered. Countries in the two groups were ranked by The United Nations as top ten countries that are ready to use e-Government. The first group derives from the research titled "Top of The Web" which is a survey on user satisfaction and usage of public e-Service in European Union Member States, Norway and Iceland[19]. Another group derives from the research titled "Australians' Use of and Satisfaction with e-Government services". Issues to be considered in terms of satisfaction of related stakeholders with e-Government services in each country group are summarized in Table 3.

e-Government Services Characteristics	1.Suitability	2.Accuracy	3.Interoperability	4.Security	5.Maturity	6.Fault tolerance	7.Recoverability	8.Time behavior	9.Resource behavior	10.Analyzability	11.Changeability	12.Stability	13.Testability	14.Installability	15.Understandability	16.Learnability	17.Operability	18.Privacy	19.Compliance
e-Government Services in EU Countries																			
1) Was it easy to find your way to this website?									X										
2) Did you find what you were looking for?					X														
3) Is it easy to use the service?																X			
4) Are you satisfied with the speed by which the pages appear on the screen?											X								
5) Is the language clear and easy to understand?															X				
6) Save time.	X																		
7) Gain flexibility.													X						
8) Get more and better information.		X																	
9) Receive better help.			X																
10) Get a faster case/reply.								X											
11) Get better control over the process.						X	X												
12) Save money.																			X
Australians' Use of and Satisfaction with e-Government Services																			
1) Being able to undertake a transaction at a time that suits the individual, together with a method that is perceived to take less time, was the key reason given for selecting most channels.															X				
2) Internet users are becoming more cautious. They would prefer a higher level of security that adds time to transactions when dealing with government services via the internet.				X													X		
3) The speed and time-saving benefits of using the internet allow a transaction to be accomplished immediately and at a time that suits the respondent.								X			X								
4) Conducting transactions by email providing a 'hard record' that can then be used as reference if the transaction is not resolved to the respondent's satisfaction, or as evidence of contact.									X										
5) Providing tracking facilities for internet transactions and provide online confirmations for transactions.														X					

Table 3: The Quality Metrics for e-Government Services

19 European Commission, Top of the Web: User Satisfaction and Usage Survey of eGovernment Services, Rambøll Management, Denmark, December (2004), 1–64.

The example of satisfying citizens' needs in the aspect of 'understandability' comes from the e-Government services in the aspect of 'is the language clear and understand'. Another example of the features of e-Government Service system in the aspect of 'time behavior' comes from the e-Government services in the aspect of 'get a faster case/reply'. The result of the quality metrics can support the basic characteristics of quality model for e-Government services that meet related stakeholders' needs and satisfaction.

5. Conclusion

The paper proposes a quality model of e-Government services on the basis of the ISO/IEC 9126 standard. This quality model of e-Government services can be a benchmark for government organizations to efficiently develop e-Government services and to be in accordance with the set objectives and policy. This quality model of e-Government services will lead to easy-to-use, efficient, safe, and stable services that related stakeholders will receive. Further work should consider the checking of the proposed quality model of e-Government services which can be made by implementing the service in the form of e-Government services with specified quality according to the operation models proposed in this paper.