Building a Measurement Framework for m-Government Services

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ABSTRACT

This study develops and presents a proposed framework for the measurement of mobile government (m-government) services. The measurement framework consists of: (i) identification/categorisation of m-government services; (ii) sophistication stages of these services; and (iii) indicators to evaluate their progress. With respect to the methodological approach followed in the study, twenty e-government services clustered by type of activity and interaction level are ranked for importance in terms of criteria that characterise the mobile setting. Moreover, core indicators used for e-government are examined in terms of their appropriateness to the mobile setting. According to the authors' findings, three m-government service clusters are established, assisting governments to prioritise services to mobile users. A modification in the sophistication model for e-services is recommended for application in m-government. Finally, the proposed indicators are mainly user-focused, in accordance with the personalised nature of services delivered through mobile devices.

Keywords: *Information Communication and Technology (ICT), Mobile Government (M-Government), Mobile Service, Mobile Technology, Public Service*

INTRODUCTION

In recent years, the rapid advances that have been made in wireless/mobile platforms for Information and Communication Technologies (ICTs) have seen the emergence of so-called 'mobile government' ('m-government') services—that is, electronic government (e-government) services delivered to citizens and businesses via wireless/mobile communication channels. Such m-government services offer important benefits to both providers and users. For the provider, overhead costs are reduced in regions where wired infrastructure is lagging behind the reach of mobile telephony networks; moreover, the personalised nature of mobile technologies enables the delivery of customised services to specific users or targeted groups. For users, the enhanced availability of mobile services facilitates the optimal use of time and resources, and reduces the risks of missed deadlines. However, despite these and other benefits, there

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are also important constraints on the utility of m-government services. These include limited screen size, limited computing power, reliance on batteries, and the cost of online access via mobile telephony. As long as home/office users find it easier and cheaper to download and utilise some e-government services (such as large application forms) at their desktop, m-government will remain complementary to e-government (Borucki, Arat, & Kushchu, 2005).

Nevertheless, the proliferation of m-government services continues to extend e-government beyond the desktop, and as it does so it is becoming increasingly apparent that there is a need to develop a coherent measurement framework for such mobile services. Because m-government is essentially complementary to e-government, the models, methods, and frameworks developed for e-government measurement are also relevant to m-government. The proposed measurement framework in this study is therefore based on related e-government work. The proposed framework is comprised of the following elements: (i) a classification of m-government services in terms of their relative importance for mobile users; (ii) a system for determining service sophistication; and (iii) indicators to measure service attributes in the most effective and efficient way. These three dimensions of existing e-government frameworks are therefore adapted for measurement of m-government services.

The remainder of this paper is organised as follows. The next section presents the definition, scope, and typical services of m-government. It also focuses on how m-government services are measured and describes some of the most important frameworks/models for those services. The following section presents the methodology of this study, while the section of research illustrates how the proposed framework for m-government services is tested and verified according to the findings of a survey. The paper concludes with a summary of the framework and suggestions for future research work in this area.

LITERATURE REVIEW

Definition and Scope of m-Government

Wireless and mobile technology advances have created new channels for government service delivery and citizen involvement. This development, by analogy with the term 'electronic government' ('e-government'), has been characterised as 'mobile government' ('m-government'). According to Kushchu and Kuscu (2003), such 'm-government' can be defined as:

...the utilization of all kinds of wireless and mobile technology, services, applications and devices for improving benefits to the parties involved in e-government, including citizens, businesses and all government units.

Although the definition refers to 'all kinds of wireless and mobile technology,' a mobile device differs from a wireless device in that the former—such as a mobile phone or personal digital assistant (PDA)—is portable, whereas the latter (which refers to transmitting information without a physical connection) might not be portable. All mobile devices are wireless, but not all wireless devices are mobile. The term 'mobile' can thus be regarded as a subset of 'wireless' (Roggenkamp, 2004).

Mobile devices, which are the focus of the present study, represent an ideal platform for personalised services. In particular, mobiles are especially suitable for personalised services that utilise user tracking and/or identification—because a mobile device is typically used by only one person and can thus be relied upon (in most instances) to represent that person's identity.

Various interfaces can be delineated within the general domain of m-government (Kumar et al., 2008):

- m-Government-to-citizen (mG2C);
- m-Government-to-business (mG2B);
- m-Government-to-government (mG2G), which refers to interactions between government agencies; and

- m-Government-to-employee (mG2E), which refers to interactions between government and its employees.

The present study is concerned only with the first two of these interfaces (mG2C and mG2B). The attributes of mobility and personalisation, which are characteristic of m-government, provide governments with increased opportunities to provide their citizens (mG2C) and businesses (mG2B) with a greater number of diverse high-quality services. In a sense, m-government can be considered 'value-added e-government' because it possesses the following advantages compared with wired technologies (El Kiki & Lawrence, 2006a; Snellen & Thaens, 2008; Trimi & Sheng, 2008):

- Amelioration of problems associated with Internet connectivity and the so-called 'digital divide'—because mobile technologies are more evenly distributed across society than wired technologies;
- Amelioration of the need to develop wired infrastructure in areas where this is underdeveloped; and
- Improved accessibility to government services (virtually anywhere at any time).

Services of m-Government

The essential value of mobility lies in its capacity to provide services to users on the move. There is thus something of a paradox in mobile services—in that the technological features that apparently constrain mobile services (such as limited screen size) are simultaneously the same features that provide its essential value by enhancing device mobility.

Governments are motivated to tackle these technological challenges and enhance their m-government services in response to pressure from citizens and businesses to take advantage of the benefits offered by mobility (Borucki et al., 2005). However, to ensure user approval and widespread use of such m-government services, the technology and services must match the expectations of citizens and business (Gidlund, 2010). As a consequence, Ishmatova and Obi (2009) have argued that the provision of m-government services must be primarily addressed through the prism of *user-centricity*. In other words, governments should focus on those services that have the highest value for users in the mobile setting.

Such value can be assessed in various ways. For example, El Kiki and Lawrence (2008) focused on usage analysis and satisfaction of mobile users to assess the relative significance of such attributes as usability, timeliness, trust, privacy, and security. Other authors, such as Ishmatova and Obi (2009), have adopted a somewhat different approach by examining the so-called 'feasibility of content' of various services in an attempt to capture the degree of detail and functionality required of service content to satisfy the needs of mobile users. In this latter approach, such factors as geographical region, culture, and language must also be considered in assessing 'feasibility of content' (El Kiki & Lawrence, 2006b).

The present study utilises the notions of 'importance of services in the mobile setting' and 'feasibility of content' in developing a measurement framework for m-government services. Given that m-government can be considered 'value-added e-government' (as noted), it is appropriate to consider the general question of measurement of existing e-government services before proceeding to describe the proposed framework for the emerging phenomenon of m-government services.

Measurement of e-Government Services

According to the European Commission (EC, 2003), e-government can be defined as:

...the use of ICTs in public administrations combined with organizational change and new skills in order to improve public services and democratic processes and strengthen support to public policies.

There has been an expansion in e-government in recent years as governments recognise that such e-services have the capacity to facilitate better government and increased value for consumers (Centeno et al., 2005). They are expected to achieve these outcomes by: (i) delivering high-quality services to citizens and businesses; (ii) enhancing public-sector efficiency; (iii) reducing the administrative burden; (iv) achieving cost savings in public administration; and (v) improving transparency in government decisions and actions.

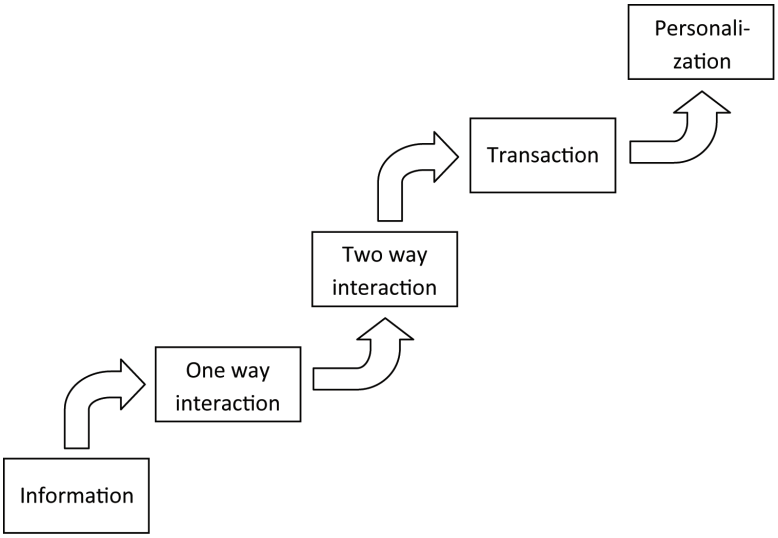
Nevertheless, it has been suggested that discrepancies exist between these theoretical expectations and the practical reality (Åkesson et al., 2008). As a consequence, factors and benchmarks are increasingly being defined to measure e-government performance and success (Almutairi, 2010). For example, the European Commission (EC) has published a comprehensive list of 20 online public services (12 for citizens and 8 for businesses) to be tracked and measured to assess the progress of e-government in EU member states (Capgemini, 2007). This list, which is shown in Table 1, is

Table 1. EU e-government services for assessment

No.	e-Government services for citizens	Scope
1	Income taxes	Income taxes: declaration, notification of assessment
2	Job search	Job search services by labour bureaus
3	Social security benefits	Unemployment benefits Child allowances Medical costs (reimbursement or direct settlement) Student grants
4	Personal documents	Personal documents: passport and driver's license
5	Car registration	Car registration (new, used, imported cars)
6	Building permission	Application for building permission
7	Declaration to the police	Declaration to the police (e.g., in case of theft)
8	Public libraries	Public libraries (availability of catalogues, search tools)
9	Certificates	Certificates (birth and marriage): request and delivery
10	Enrolment in higher education	Enrolment in higher education / university / college
11	Announcement of moving	Announcement of moving (change of address)
12	Health-related services	Health-related services (interactive advice on the availability of services at different hospitals; hospital appointments)
e-Government services for businesses		
13	Social contributions	Social contributions for employees
14	Corporate tax	Corporate tax (declaration, notification)
15	Value Added Tax	VAT (declaration, notification)
16	Company registration	Registration procedure to start a new company
17	Statistical data	Submission of data to statistics bureaus
18	Customs declarations	Procedure for customs declarations
19	Environment-related permits	Procedure to obtain an environment-related permit
20	Public procurement	Procedure for responding to tender for public procurement

Source: Capgemini (2007)

Figure 1. EC model of sophistication stages in e-government services



utilised in the present study's framework for assessing m-government.

The two core indicators proposed by the EC for measuring progress in these e-government services are:

- The degree of *online sophistication* of these services; and
- Whether there is *full online availability* of services.

With regard to the first of these, the degree of *sophistication*, there are numerous e-government models that purport to define distinct stages in the maturity of service provision. Although they differ in detail, these models are essentially similar in defining similar grades of sophistication—beginning with the mere provision of information, then progressing to communication and dialogue, and culminating in active engagement and participation (Kolsaker & Lee-Kelley, 2008). Two of the best-known approaches to e-government measurement are those proposed by the EC (Capgemini, 2007) and the United Nations' Department of Economic and Social Affairs (UNDESA, 2008). Each of these is described in greater detail.

The EC's 5-stage sophistication model is illustrated in Figure 1.

As shown in Figure 1, the five stages of sophistication are as follows:

- **1st stage (*Information*)**: Simple provision of information on how a service is accomplished (required documentation, agencies involved, and so on).
- **2nd stage (*One-way interaction*)**: Provision of official documents (such as application forms) to be downloaded and printed by users.
- **3rd stage (*Two-way interaction*)**: Provision for official forms to be completed online and/or submitted by e-mail; because this involves submission of personal data, mechanisms for user identification and data security are also required.
- **4th stage (*Transaction*)**: Provision of functions for completing financial aspects of a service, thus effectively rendering the non-electronic form of that service redundant.
- **5th stage (*Personalisation*)**: Provision of proactive service delivery in the form of automatic provision of e-services based on user history or earlier registration.

With regard to the second of the core indicators noted, *full online availability*, services at the first three stages of sophistication ('information,' 'one-way interaction,' 'two-way interaction') are said to have no full online availability (score: 0), whereas services at stages 4 or 5 are said have 'full' online availability (score: 1). *Full online availability* (%) can then be calculated as the number of services with a score of 1 divided by the total number of services.

The EC's Directorate-General for Information Society and Media (RSO & IDC, 2008) has proposed a similar indicator using a binary scale (measuring 'available/not available') to measure the availability of each phase of a public e-procurement process. Using this indicator, *online sophistication* of a service is expressed as a percentage as follows:

Online sophistication (%) = (current level / maximum level) x 100

in which:

- *Current level* is the current sophistication level of the service in question (each sophistication stage is given one point); and
- *Maximum level* is the highest attainable level of sophistication for that service (3, 4 or 5 points, depending on stage).

The services of e-government are continuously evaluated to accumulate time series of data and gauge progress over time. In the 2011–2015 benchmarking framework (i2010 High Level Group, 2009), the EC proposed the following indicators:

- Online availability and interactivity of the 20 reference services;
- Proportion of individuals interacting with public authorities online by level of sophistication; and
- Proportion of enterprises interacting with public authorities online by level of sophistication.

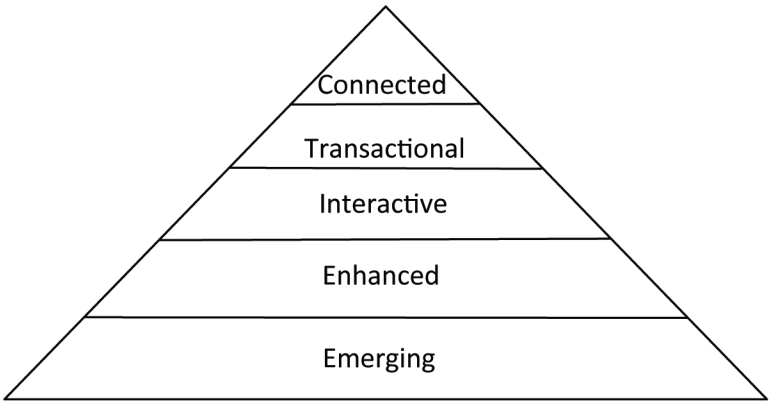
Services are evaluated from the user perspective by means of a *user-centricity* composite indicator (Capgemini, 2007), which is comprised of the following four components: (i) existence or absence of a legally binding e-ID (for example, a digital certificate); (ii) number of data fields requested for transactional services; (iii) multi-channel accessibility; and (iv) portal compliance with international accessibility standards. Similarly, *user experience* (Capgemini et al., 2009) evaluates five aspects: (i) accessibility in conformance with 'web content accessibility guidelines' (WCAG1.0 standards); (ii) usability of e-government services, progress tracking, and existence of a privacy statement; (iii) user satisfaction monitoring (that is, whether users can give feedback or rate the portal); (iv) one-stop-shop approach (that is, what percentage of the 20 reference services is available on the principal portals); and (v) user-focused design (assessing whether portals are organised by theme and/or target group).

The second approach noted, that of the United Nations' Department of Economic and Social Affairs (UNDESA), has adopted a different e-government paradigm, namely *connected* or *networked governance* (UNDESA, 2008). The rationale is that government organisations should move from being system-oriented to chain-oriented with regard to their structure, operations, skills, and management. *Connected governance* relies on interoperability between the information systems of different agencies. UNDESA therefore proposed an indicator known as the *e-government readiness composite indicator*, which is comprised of the following three components: (i) *web measure*; (ii) *telecommunication infrastructure*; and (iii) *human capital*.

Web measure is based on the 5-stage model illustrated in Figure 2. The five stages can be summarised as follows:

- **Emerging:** Government's online presence consists of a webpage/website with mostly static information.
- **Enhanced:** Government publishing more online information on public policy and governance.

Figure 2. Stages of web measure index



- **Interactive:** Portals deliver online services—such as downloadable forms for tax payments and an interactive website commences operation.
- **Transactional:** Two-way interactions between citizens/businesses and government are possible.
- **Connected:** Characterised by: (i) horizontal connections; (ii) vertical connections; (iii) infrastructure connections; (iv) connections between government and citizens; and (v) connections among stakeholders (government, private sector, academic institutions, non-government organisations and civil society).

UNDESA's model superseded the almost identical model proposed by the United Nations Division for Public Economics and Public Administration (UNDPEPA) and the American Society for Public Administration (ASPA) (UNDPEPA & ASPA, 2002), the only difference being the name of the ultimate stage ('seamless' or 'fully integrated presence').

The *telecommunication infrastructure* component of the UNDESA model describes a country's infrastructure capacity in terms of:

- Internet users per 100 persons;
- PCs per 100 persons;
- Main telephone lines per 100 persons;
- Mobile phones per 100 persons; and
- Broadband access per 100 persons.

Finally, *human capital* is made up of the adult literacy rate (two-thirds weight) and the combined primary, secondary, and tertiary gross enrolment ratio (one-third weight).

Most studies have suggested country-level indicators. A UN e-government survey (2008) introduced the *e-participation* index for UN members, which was designed to assess the quality and value of information and services provided by a country to engage its citizens in public policy (UNDESA, 2008). In particular, it assessed the extent to which government portals offer information of interest to citizens, i.e., *e-information*, provide tools for consultation, i.e., *e-consultation*, and collect citizen input for decision making, i.e., *e-decision-making* (Drakopoulou & Xenakis, 2010).

The *Key Elements for Electronic Local Authorities' Networks* (KEeLAN) project focused on local communities and back-office processes of e-government (KEeLAN, 2003). KEeLAN evaluated portal quality with the following criteria (Sakowicz, 2003):

- Request/application (how interactive the portal is);
- Handling (how responsive to external demand it is);

- Help (how user-supportive it is); and
- Modality of appearance (user interface features).

Finally, a somewhat different approach to e-government evaluation is to use the *Balanced Scorecard* (BSC) (Cheng, Cheng, & Yang, 2007). This strategic planning and management tool has been used extensively by businesses, government, and non-profit organisations. With this approach, the strategic goals of a government organisation are translated into a set of targets and measurable indicators related to the key areas of organisational performance: (i) finance; (ii) customers (in this case, e-government users); (iii) internal processes; (iv) learning; and (v) development. The indicators are then tracked to show whether the organisation is on target to achieve its strategic goals.

In summary, this review of the literature on e-government measurement has revealed the following:

- The number of indicators used to evaluate e-government service progress is limited and the available indicators are not universally accepted.
- Most indicators are provider-focused. *User-centricity* and *user experience* are the only user-focused indicators. The present study proposes an m-government service measurement framework that relies on the key characteristic of a mobile device—the fact that it is virtually indistinguishable from its user; as a consequence, the mobile device can represent the user's unique ID for most intents and purposes.
- Many indicators simply note the presence or absence of a given facility or service, which cannot disclose the actual percentage of availability; as a consequence, this is of no assistance in tracking service evolution.

m-Government Frameworks

There has not been, so far, a common research direction concerning the frameworks / models in the area of m-government, since they focus on different aspects of m-government services. The framework, proposed by Carroll (2006) comprises the drivers that 'push' the use of mobile technologies in government. These drivers are: (i) the widespread acceptance of mobile technologies, (ii) the capabilities of mobile technologies, (iii) the needs of government, (iv) the sellers of devices, systems, and applications, (v) business models of m-commerce (coming mainly from the private sector), and (vi) telecommunications companies. This framework aimed to stress the importance of investigating the needs of both those who push for the implementation of m-government and those who use m-government services.

According to Antovski and Gusev (2005), a mobile public-services framework should incorporate the following five principles: (i) interoperability, (ii) security, (iii) openness, (iv) flexibility, and (v) scalability. This framework established the grounds on which an m-government solution should meet the business and citizen's requirements. The five principles are defined in a three-level hierarchy. The top level comprises general principles which reflect the need for coherence across the public sector. The middle level refers to principles that aim to optimize technologically an m-government solution. Finally, the lowest level comprises the principles that are directed towards a specific mobile system.

Sheng and Trimi (2008) proposed a framework based on the theory of Task-Technology Fit (TTF), aiming to better understand m-government. They reviewed current mobile technologies, providing a summary of mobile devices and wireless networks, as well as their characteristics. They also categorised m-government tasks in terms of two criteria: (i) parties involved and (ii) types of transaction performed. Utilising the theory of TTF between mobile technologies and m-government tasks, they summarised the existing m-government applications. Furthermore, the framework provides a foundation for assessing the benefits and challenges of m-government applications. What is deduced from this work is that, if there is a match between the features offered by

mobile technologies and the tasks to be supported, governments can benefit significantly from expanding e-government services into mobile platforms.

El Kiki and Lawrence (2006b) analysed, in their conceptual framework, the user's satisfaction in order to measure the m-government service usage. The framework comprises the following factors (their components are given in parentheses): (i) value for money (pricing and content), (ii) quality of service (awareness of the user, accessibility, service availability, reliability, accuracy, responsiveness, and courtesy and helpfulness of the service provider), (iii) efficient transactions (usability, service timeliness, trust, privacy, and information security), and (iv) strategic data (accountability and transparency). These factors are necessary to ensure mobile user's satisfaction, which is considered the gateway to increase the m-government service usage.

According to the Mobility Response model of Borucki, Arat, and Kushchu (2004), governments implement mobile technologies either as a response to complement the existing e-government initiatives or as a response to take advantage of the benefits of mobility. This model comprises the factors that contribute to the adoption of mobile technologies by government agencies. Borucki et al. (2005) proposed the enhanced response model, which additionally analyses the changes occurred in the structure of a government organisation due to m-government applications.

It becomes evident that the aforementioned frameworks tackle different aspects of m-government (drivers for the use of mobile technologies, m-government principles, m-government service usage, etc.). Our proposed framework consists of three elements: (i) identification / categorisation of m-government services, (ii) sophistication stages of these services, and (iii) indicators to evaluate their progress. It differs from the frameworks presented, since its aim is to assist public organisations in prioritising their services delivered on mobile platforms; this is a distinct aspect for examining m-government services. Moreover, selected indicators are examined in our framework as potential metrics for m-government services. The motivation for that was, on the one, the significance of defining specific metrics for m-government services and, on the other, the lack of a measurement approach, at least, in the frameworks presented in this paper.

METHODOLOGY

Identification/Categorisation of Services

The development of a proposed measurement model for m-government services began with the 20 e-government services listed in Table 1. Given that m-government should be viewed as complementary to e-government (Trimi & Sheng, 2008), these were candidates for delivery to citizens or businesses through mobile devices; however, not all existing e-government services are necessarily suitable for the mobile setting (Gorlenko & Merrick, 2003). The 20 services were therefore clustered according to criteria that characterise the mobile setting, as follows:

- **Short interaction time:** Services requiring considerable concentration, accuracy, or time will probably not be delivered through mobile devices. Empirical studies have shown that users are reluctant to invest time and effort in using mobile devices for complex or lengthy tasks (Carroll, 2006).
- **Time-critical situations:** In time-critical situations, information (such as weather reports or other emergency-related alerts) is typically sent from government agencies; thus constituting what is essentially a 'push service', although user responses might be prompted in some instances (van de Kar, 2004).
- **Spontaneous decisions and needs:** Requests for specific information (such as flight status or emergency health-related information) typically come from users; thus constituting a 'pull service' (van de Kar, 2004).

- **Being away from home/office:** This is a key reason for a citizen to rely on m-government services (Carroll, 2005).
- **Use of quiet moments:** Mobile devices provide opportunities for using quiet moments during the day to access online resources (these moments are referred to as 'dead spots' in the day by Ishmatova & Obi, 2009).

Although these are not the only criteria to consider, they do capture the essence of the mobile setting well enough to enable services to be rated in terms of their importance for delivery through mobile devices. Criteria related to the potential benefits for the provider are excluded because the proposed framework measures service quality in terms of *user experience*.

In accordance with Capgemini (2007), the application of the criteria led to the following clusters being identified among the 20 e-government services.

- **Income generating:** (i) mG2C: income taxes; (ii) mG2B: corporate taxes, social contributions, value-added taxes (VAT), customs;
- **Registration:** (i) mG2C: car, certificates, announcement of moving; (ii) mG2B: company registration, statistical data;
- **Returns:** (i) mG2C: health-related returns, public libraries, declarations to police, job search, social security benefits; (ii) mG2B: public procurement; and
- **Permits and licences:** (i) mG2C: building permits, personal documents, enrolment in higher education; (ii) mG2B: environment-related permits.

In addition to these clusters, which were derived from the 20 e-government services noted, another cluster was added. This consisted of services delivered exclusively through mobile devices that have value only if delivered to the mobile users concerned (such as traffic information, emergencies, alerts for parking violations, etc.).

Sophistication Stages – Indicators

The five-stage sophistication model for e-government services (as described previously) is utilised to benchmark m-government services in the proposed model. In particular, the ultimate stage (*personalisation*) is applicable to mobile devices that incorporate technology for customising services according to users' needs. However, the penultimate stage (*transaction*), which refers to the financial component of a service, is not necessarily the same in m-government and e-government. Whereas it was a prerequisite for reaching the ultimate stage (*personalisation*) in the case of the sophistication of e-government services, this is not necessarily so with m-government services.

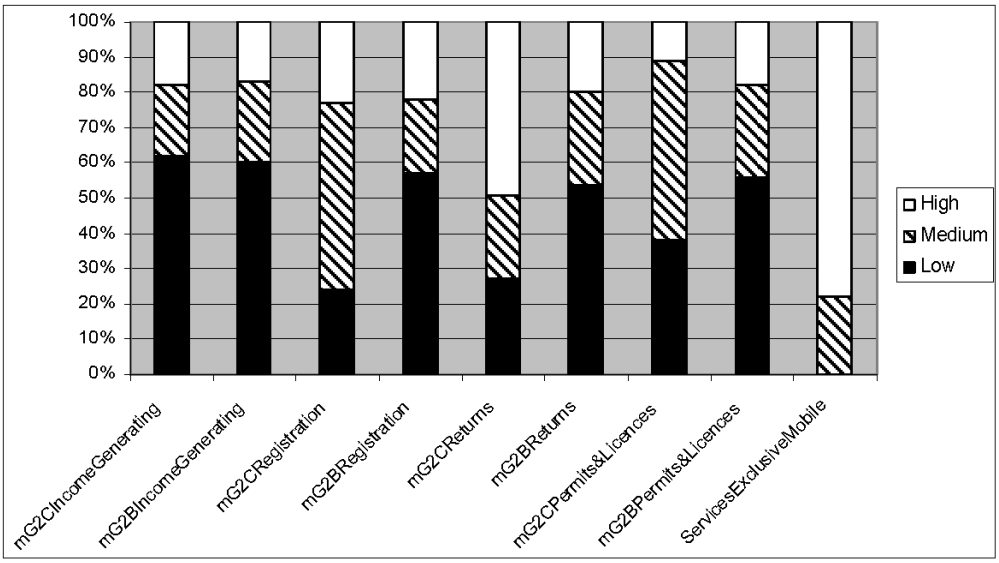
For measuring service aspects, the proposed model adopts the e-government indicators proposed by the EC and UNDESA because they have been validated by respected intergovernmental organisations and multi-stage sophistication models used for e-government.

RESEARCH

The outline of the proposed model was tested by conducting an electronic website-hosted survey of a sample of postgraduate students at an Applied Informatics university department. Postgraduate students have the full rights and obligations of a citizen and thus, were preferred than undergraduate students. All participants were required to be users of mobile phones who had experienced (on at least one occasion) the delivery of an e-government service. A total of 500 e-mails containing a link to the survey website were sent to students of the department in January 2010; of these, 147 individuals (57% males and 43% females) replied to all questions in the survey.

To simplify the rating of the importance of the services, participants were asked to respond on a 3-point scale ('high', 'medium', 'low'), in which 'high importance' indicated 'a service (cluster) that should definitely be delivered through mobile devices because service value

Figure 3. Service importance rating (short interaction time)



is enhanced significantly by mobility'; and 'low importance' indicated 'little or no value is added by delivering this service (cluster) to mobile devices'.

All the ratings, according to each criterion of the mobile setting, are illustrated in Figures 3 through 7. The final results of the survey are shown in Table 2 (the differences in ratings in some particular cases are also included).

Figure 4. Service importance rating (time-critical situations)

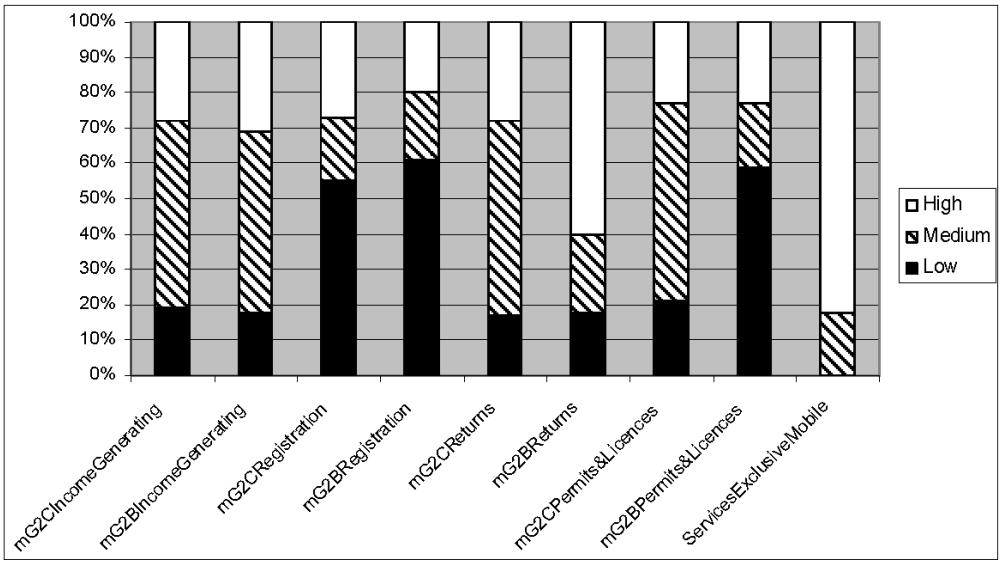
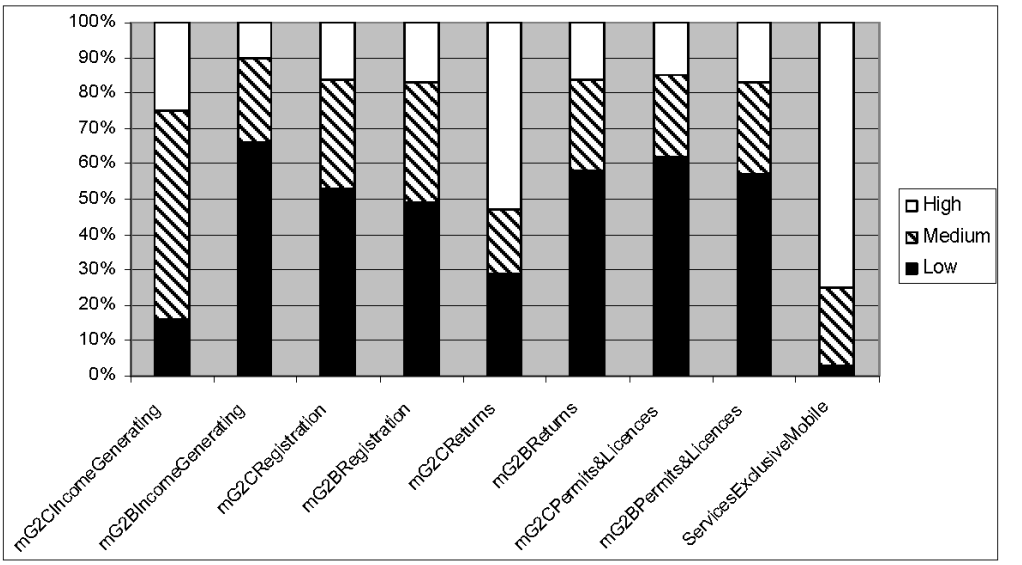


Figure 5. Service importance rating (spontaneous decisions/needs)



By a quasi-quantitative process (adding all 'highs', 'mediums', and 'lows' for each cluster to form a relative ordering), three groupings emerged (Table 3):

- Services to be delivered exclusively through mobile devices (essential services); these include alerts and emergency-related information (the cluster with all 'highs' in Table 2);

Figure 6. Service importance rating (away from home/office)

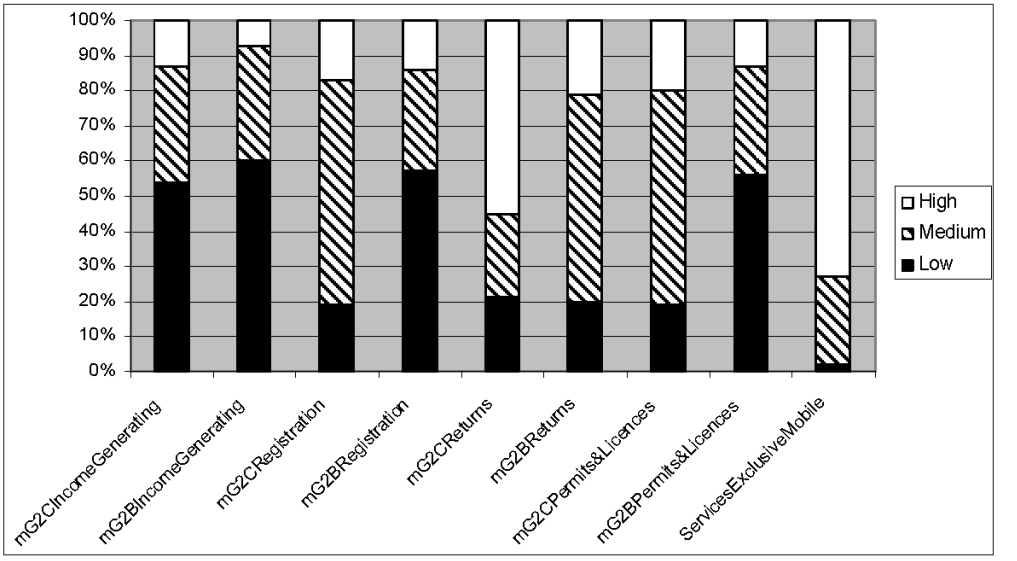
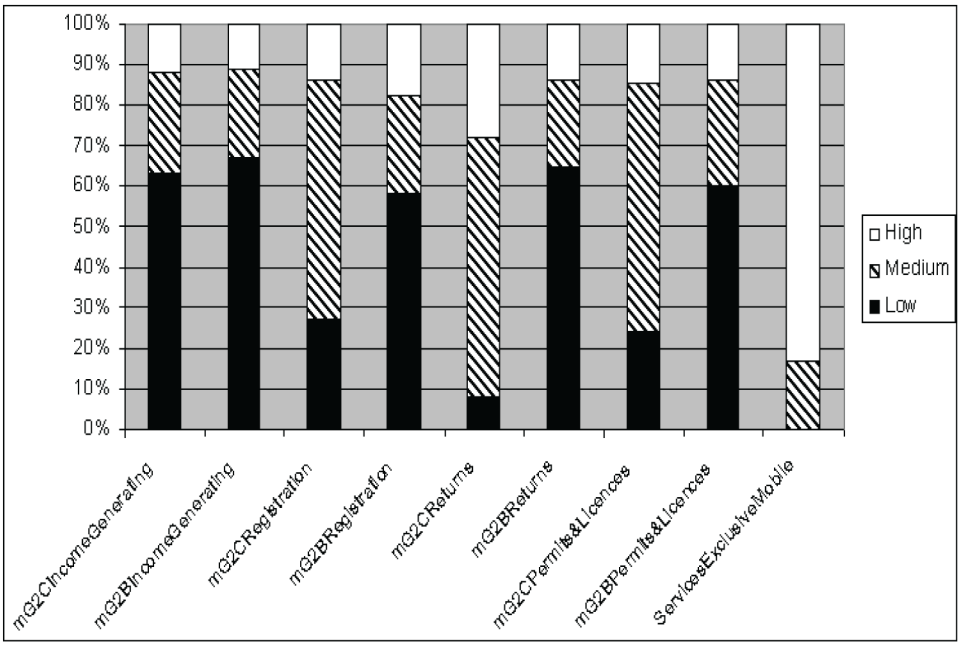


Figure 7. Service importance rating (use of quiet moments)



- Services that should be prioritised for delivery through mobile devices (although also delivered through wired devices); these include mG2C returns, and mG2C permits and licences (the clusters having mostly 'highs' and 'mediums' in Table 2);
- Services that are merely complementary to their corresponding e-government versions, and for which users would need strong incentives to use their mobile devices; these include all the other service clusters (those having mostly 'lows' in Table 2).

The three groupings are illustrated in Table 3.

The EC's 5-stage model for e-services assumes that each stage of sophistication presupposes attainment of the previous stage. In particular, *personalisation* presupposes *transaction*; that is, the model effectively assumes that personalised services have a financial-transaction component. However, as noted, this is not necessarily so in the case of m-government. This is because many m-government services can be personalised without a transaction because a mobile device effectively represents the identity of its user in a way that is not applicable to a wired computer terminal. Indeed, either stage (*transaction* or *personalisation*) could precede the other. For example, a text message might notify a driver of available parking slots before payment via mobile phone is required; conversely, a citizen might subscribe in advance to receive health-related information on demand (Esmahi & Badidi, 2010).

The proposed model therefore modifies the stages of sophistication for e-services (as illustrated in Figure 1) by positing a bifurcation in the pathway leading from *two-way interaction* to the two higher stages. The revised model, which is illustrated in Figure 8, posits *transaction* and *personalisation* as two stages of equal status. The result is a model that is more flexible and suitable for m-government. If a service possesses both a transactional element and a personalised element, it should receive an additional point for each stage at-

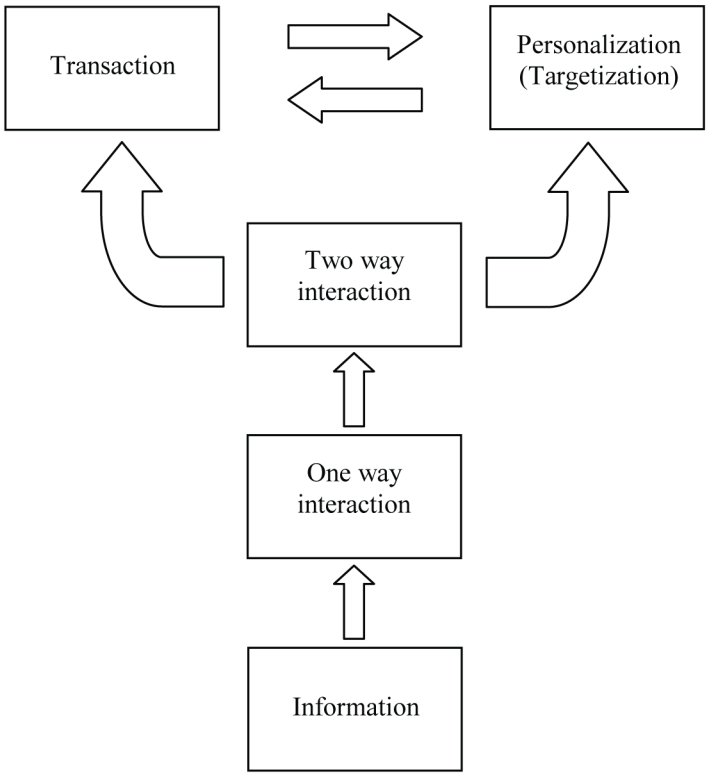
Table 2. Services' importance for m-government

Service clusters by type of activity and interaction level	Short interaction time	Time-critical situations	Spontaneous decisions/needs	Away from home/ office
mG2C Income Generating (income taxes)	Low	Medium (high in case of deadlines)	Medium	Low
mG2B Income Generating (corporate tax, social contributions, VAT, customs declarations)	Low	Medium (high in case of deadlines)	Low	Low (customs declaration: medium)
mG2C Registration (car registration, certificates, announcement of moving)	Medium	Low	Low (certificates: medium)	Medium
mG2B Registration (company registration, statistical data)	Low (company: medium)	Low	Low (company: medium)	Low
mG2C Returns (health-related services, public libraries, declaration to the police, job search, social security benefits)	High	Medium (health, policing: high)	High	High
mG2B Returns (public procurement)	Low	High	Low	Medium
mG2C Permits and Licences (building permission, personal documents, enrolment in higher education)	Medium	Medium	Low (education: medium)	Medium
mG2B Permits and Licences (environment-related permits)	Low	Low	Low	Low
Services delivered exclusively on mobile platforms (essential services) Examples: emergency traffic or health-related information, alerts for parking or other violations	High	High	High	High

Table 3. Grouping services in terms of their importance for mobile users

No.	Definition of Category	Component Service Clusters
1	Services that should be delivered exclusively through mobile devices (essential services)	Services such as traffic- or emergency-related information, alerts for parking or other violations
2	Services that should be prioritized for delivery through mobile devices; also delivered through wired devices	mG2C Returns mG2C Permits and Licences
3	m-Government services that should be only to their e-government service versions	mG2C and mG2B Income Generating mG2C and mG2B Registration mG2B Returns mG2B Permits & Licences

Figure 8. The proposed sophistication stages for m-government services



tained when grading—regardless of whether it reached *transaction* before *personalization*, or vice versa.

Table 4 summarises e-government indicators and comments on their suitability for m-government evaluation. The following criteria were used to assess indicator suitability:

- ***Sophistication stage:*** Whether a given indicator can be applied at every sophistication stage; desirable indicators can be so applied;
- ***Proactive or reactive:*** Whether a given indicator can evaluate m-government initiatives prior to service delivery or only after user reaction to the delivered service; proactive indicators are preferable;
- ***User - or provider-focused:*** Whether an indicator captures user-related data (for example, proportion of individuals interacting with public authorities by level of sophistication) or provider-related performance data (for example, telecommunication infrastructure); user-focused indicators are preferable for service planning and improvement; and
- **Quantitative or qualitative:** Whether an indicator assesses quantitative or qualitative aspects of a service; composite indicators (containing both types) are more useful for planning multi-faceted m-government services.

As shown in Table 4, not all e-government indicators can be considered suitable for m-government measurement. The two i2010 High Level Group indicators were chosen because they can quantify the proportion of citizens and businesses interacting with public authorities at each sophistication level. More importantly,

Table 4. Suitability of indicators for m-government service evaluation

Source	Indicator (as used for e-government services)	Suitability for m-Government services	Suitable?
Capgemini (EC)	Full online availability (full / no full)	A provider-side indicator. Does not reveal the actual percentage of availability. Main strengths: simplicity and ease of use. It could only measure the progress of m-government services at a preliminary level.	No
	Online sophistication	The current stage by the highest possible sophistication stage of an m-government service; hence, our proposed m-government sophistication model requires that this indicator be adjusted accordingly.	If adjusted
	User-centricity, consisting of: (i) services with legally binding e-ID; (ii) number of data fields requested for transactional services; (iii) multi-channel access to service; (iv) compliance with accessibility standards.	A good user-side indicator. Includes four quantitative or qualitative components easily adaptable to the mobile setting. The *user-centricity* approach fits the personalization potential of mobile devices.	Yes
Capgemini, Rand Europe, IDC, Sogeti and DTI (EC)	User experience, consisting of: (i) accessibility; (ii) usability; (iii) user satisfaction monitoring; (iv) one-stop-shop approach; (v) user-focused portal design.	Overlaps with *user-centricity*, has significant user-side emphasis. Measuring *user satisfaction monitoring* could contribute to better personalized services through mobile devices.	Yes
i2010 High Level Group (EC)	Online availability and interactivity	See comments for *full online availability* above.	No
	% of individuals interacting with public authorities by level of sophistication	An appropriate user-side, quantitative indicator for m-government services; it is important that measurements by level of sophistication are possible.	Yes
	% of enterprises interacting with public authorities by level of sophistication	Similarly; business-focused.	Yes
UNDESA (United Nations)	e-government readiness, comprising: (i) Web measure; (ii) telecommunication infrastructure; (iii) human capital.	A composite index, appropriate for the e-government setting. Only its *Web measure* component could be adapted to the mobile setting.	Yes (partial)
	e-participation, comprising: (i) e-information; (ii) e-consultation; (iii) e-decision-making.	Appropriate for m-democracy, m-consultation, and m-decision-making. Outside the scope of this framework.	No
KEeLAN (EC)	A set of best practices and roadmaps	Appropriate as a guide for benchmarking the levels of local and regional e-government.	No
Cheng *et al.*	Balanced Scorecard	More appropriate for m-administration, its modules suit the back office processes of government agencies.	No

user-centricity was selected as the key indicator that best fits m-government for the following reasons:

- It takes the user's perspective whereas most indicators are provider-focused;
- One of its components ('services with legally binding e-ID') covers the security aspect of m-government services;
- Another component ('number of data fields requested for transactional services') takes into consideration the desirability of requiring mobile users to enter as little data as possible on their mobile devices;
- A third component ('multi-channel access to service') takes account of the fact that services can be delivered to a mobile device in various ways (text, multimedia messages, webpages, etc.); and
- A fourth component ('site's compliance with international standards of accessibility') covers access to websites through a mobile device.

In short, *user-centricity* is a user-focused, proactive indicator with quantitative and qualitative components that address essential challenges posed by mobility. *User experience* is also suitable as a user-side indicator. Its 'accessibility' and 'usability' components overlap with *user-centricity*. 'User satisfaction monitoring' would help improve m-government service quality to match what real users expect. 'One-stop-shop' is also appropriate as m-government aims to reduce interaction time with users. Finally, finding information would be faster if information is organised from the user's perspective ('user-focused portal design').

CONCLUSION

This study has proposed a measurement framework for m-government-to-citizen (mG2C) and m-government-to-business (mG2B) services. The first objective was to rate the importance of 20 e-government services used to benchmark the progress of EU member states in e-government. This rating revealed three groupings of potential m-government services: (i) services to be delivered exclusively through mobile devices; (ii) services important for mobile users; and (iii) services that are merely complementary to corresponding e-government services. This rating can be used to assist governments in prioritising (and perhaps redesigning) services of greater importance to mobile users. These services should be distinct from their corresponding e-government versions; indeed, they might have to be redesigned to exploit the capabilities of mobile technology to the fullest extent.

The study has also shown that a 5-stage sophistication model for e-government can also be utilised to evaluate the progress of m-government services. However, to add flexibility for the mobile setting, the model was modified by not assuming that service personalisation is invariably predicated on possessing a transactional element. The modified model posits that services can be transactional or personalised, or both. The modification will have an impact on the construction of some indicators for measuring the progress of m-government services.

Finally, the study has also examined the suitability of selected e-government indicators as potential metrics for m-government services. The proposed indicators are: (i) based on the multi-stage sophistication model; (ii) mainly user-focused (to align the model with the high personalisation potential of m-government service delivery); and (iii) consist of both quantitative and qualitative elements.

With regard to future research in this area, m-government should be evaluated in concert with studies of m-democracy and m-administration. The value and complementarity of these domains demand the development of an all-encompassing measurement framework. In addition, it would be instructive to validate the proposed framework's application in practice by identifying specific provider- and user-side technologies and information systems, choosing the services of interest, and applying the proposed indicators to them. This case study

would require in-depth knowledge of relevant technologies and service implementations.

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