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A quality function deployment strategy for improving mobile-government service quality in the Gulf cooperation council countries

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Abstract

Purpose – The purpose of this paper is to derive mobile-government (m-government) service-quality factors in the Gulf Cooperation Council (GCC) and develop an integrated strategic plan for improving the quality of m-government services from a customer perspective in the GCC.

Design/methodology/approach – A quantitative approach was used in this case study of m-government services in the GCC. Data were collected using focus groups and questionnaires for three similar m-government applications (one from the United Arab Emirates, one from the Saudi Arabia and one from Oman). The house of quality tool, including technical benchmarking, was applied as part of the quality function deployment (QFD) approach to identify customer requirements, translate them to technical requirements and develop a strategic plan for improving the quality of m-government services.

Findings – The results revealed that "real time" had the highest priority for deployment, while "tangible service," contrary to expectations, had the lowest priority for deployment.

Research limitations/implications – Study findings are limited to the m-government services delivered to citizens. There is scope for further study into m-government services delivered both to businesses and other governments.

Practical implications – The findings imply that the m-government decision makers must involve citizens in all service-development processes to ensure that service delivery meets citizens' expectations.

Originality/value – Most previous studies regarding m-government service-quality dimensions have used information system service-quality dimensions. This study is one of the pioneering studies to have successfully derived m-government service-quality factors using the QFD matrix.

Keywords Service quality, Quality function deployment, House of quality, Business process management, Mobile government

Paper type Research paper

1. Introduction

Recent rapid developments in information and communications technology have led governments to adopt various initiatives to improve the quality of the services they deliver to enhance the relationship between the citizens and governments and to meet the citizens' expectations (Al-Hubaishi *et al.*, 2017). One of these initiatives is mobile-government (m-government). M-government is the ability of governments to deliver services through the mobile devices (Abaza and Saif, 2015; Abdelghaffar and Magdy, 2012; Al-Hubaishi *et al.*, 2017). The Gulf Cooperation Council (GCC) countries (United Arab Emirates (UAE), Kingdom of Saudi Arabia (KSA), Oman, Qatar, Kuwait and Bahrain) are among those countries to have already adopted m-government initiatives, having begun in 2013 to provide services, anytime and anywhere, through mobile devices (Emirates Newswire, 2014). This decision was made to meet the challenges faced by citizens regarding difficulties in using and applying for the governments' public services (Al-Rajehi, 2007). Citizens had previously been forced to deal with several customer-service agencies to complete one service, increasing the time to complete these services and decreasing customer satisfaction

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(*Khaleej Times*, 2015). The main challenge for m-government services, however, is to provide a high quality of services that meet citizens' expectations (Alrabghi, 2013; Saadi *et al.*, 2017).

Competition subsequently developed between GCC governments to provide the highest quality of m-government services (*Khaleej Times*, 2015). The UAE was recently ranked first among GCC countries in providing government services via mobile devices, followed by Bahrain, KSA, Qatar, Kuwait and Oman (Innovation and Tech, 2016). However, despite the successful implementation of m-government services in the GCC, many citizens were still using traditional office-based, face-to-face channels for public services (*Khaleej Times*, 2015). Increasing the usage of m-government services requires m-government decision makers to focus on understanding citizens' expectations to improve the quality of m-government services (Al-Hubaishi *et al.*, 2017; Zheng and Pulli, 2007). Ahmad and Khalid (2017) also stated that citizens' participation is highly recommended for improving m-government service quality and providing competitive services that meet citizens' needs.

One of the best methods to achieve this, often applied in similar research, is quality function deployment (QFD), which can translate customers' requirements and expectations into a technical design to improve the quality of products and services (Cauchick Miguel, 2005; Hussain *et al.*, 2011). Vinayak and Kodali (2013) asserted that QFD is a tool, using a series of matrices, that can help all companies focus on customers' perceptions and ensure that their expectations and requirements are met in the final product or service. Applying QFD leads to an increased awareness of complex customer requirements (Gremyr and Raharjo, 2013). QFD can also reveal both the visible and invisible needs of the customer (Mazur, 1993). Using a QFD approach, this study aims to answer the following questions:

RQ1. Based on citizens' requirements, what are the technical requirements for improving the quality of m-government services in the GCC?

RQ2. How can these requirements help m-government decision makers and software developers formulate a strategic plan to improve the quality of m-government services in the GCC?

This study adds to the body of knowledge regarding m-government service quality in several ways. First, it is the first to establish a technique for applying a QFD approach for improving the quality of m-government services. Second, it explores the citizens' perspective by identifying customer expectations and requirements for m-government services in the GCC. Third, it identifies critical areas of m-government-service provisions by determining the technical requirements for improving customer-service quality in the provision of m-government services. Fourth, it enables citizens to see the comparative analysis of m-government-service provision between GCC countries. Finally, it enables the formulation of strategic plans by m-government decision makers and software developers in the GCC to improve the quality of m-government services.

The rest of the paper is structured as follows. The following section provides a literature review of m-government, both globally and in the GCC, and a brief introduction to QFD. The subsequent section provides the methodology, including an overview of the house of quality (HOQ) and details of, and results from, the case study carried out comparing the UAE and the KSA. The final section discusses the results and draws conclusions, including both the study's theoretical and practical contributions and limitations.

2. Literature review

2.1 M-government

M-government is a technological innovation that extends the reach of electronic government (e-government), which is defined as an innovative technology offered to citizens that allows

a government to provide access to, and improve, services through web portals (Alomari *et al.*, 2014). M-government improves the interaction between a government and its citizens by providing services that improve government processes through smart devices, such as personal digital assistants and smartphones (Al-Hubaishi *et al.*, 2017; Kushchu and Kuscu, 2003; Shareef *et al.*, 2014; Gang, 2005). Oghuma *et al.* (2012) studied the adoption of m-government service initiatives by exploring the factors affecting its implementation using diffusion of innovation theory and grounded theory. The study found that factors such as public awareness, trust, infrastructural constraints, access costs and the lack of an enabling legal framework were all challenges to adopting m-government in developing countries. The study clarified that "m-government has emerged as an appropriate form of governments' initiatives using mobile devices within the purview of government administration to deliver public services to citizens and organizations in a transparent, accountable, efficient and effective manner on mobile devices" (Oghuma *et al.*, 2012, p. 1). The increasing number of mobile-device users has enabled governments to transfer services to mobile platforms (Al-Hubaishi *et al.*, 2017).

The adoption of m-government services has been driven by major technological changes, such as the widespread availability of mobile services (m-services) and improvements to infrastructure (Abdelghaffar and Magdy, 2012; Abu-Shanab and Haider, 2015; Kushchu and Kuscu, 2003; El-Kiki *et al.*, 2005). M-government delivers government services to citizens using mobile devices by providing multichannel service delivery through wireless networks that support mobility, quality and flexibility, and facilitate access to government services anytime and anywhere (Gang, 2005). M-government provides important information when needed (such as traffic and road condition information, terrorist alerts, disaster management, weather forecasting and police investigations) where real-time information is important (Shareef *et al.*, 2014). An important objective of m-government is also to save money, effort and time, i.e. to increase efficiency.

2.2 M-government in the GCC

M-government has been embraced in the GCC to transform government services for citizens with impressive efficiency and effectiveness (Al-Khouri, 2012). All six countries have high per-capita income levels and share common traits as emerging countries (Awan, 2003). As in other parts of the world, governments of the GCC countries also compete to attract internal investment, to design and develop high-quality products and services in the global marketplace and to create an innovative environment that will attract the brightest minds in the world (Al-Khouri, 2012). Thus, the GCC states are moving toward adopting more services-oriented and citizens-centric models for the provision of government services, transforming the way citizens in the GCC countries interact with their governments (Emirates Newswire, 2014). Consequently, the GCC countries have established themselves as among the global leaders in providing the best quality of m-services to their citizens, and the region is now moving toward the next phase of citizen engagement and smart governance (Emirates Newswire, 2014; United Arab Emirates Ministry of Communication and Information Technology, 2014). As shown in Table I, in the in the United Nations' (UN) 2016 e-Smart Services Index, the UAE was ranked eighth globally and first regionally based on the percentage of government services available via e-government and m-government (Innovation and Tech, 2016).

Several mobile initiatives took center stage across the GCC, covering the entire spectrum of government services from police, transport, utilities, municipalities and customs, to health services, education, bill payment history and gathering citizens' feedback (Emirates Newswire, 2014). All the GCC states have established m-government strategies, and there is competition to provide the best government services via mobile devices 24/7, 365 days a year (*Khaleej Times*, 2015).

Country	Rank	Percentage of government services available via e-government and m-government
The UK	1	100
Australia	2	97.826
Singapore	3	97.101
Canada	4	95.652
France, Korea, New Zealand, Finland	5	94.203
The Netherlands, The USA	6	92.754
Austria, Spain	7	91.304
Estonia, UAE	8	89.13
Sweden, Japan	9	87.681
Italy	10	86.957

Source: Innovation and Tech (2016)

Table I. Top countries in e-services and m-services in 2016

The UN's 2016 e-Smart Services Index provided other valuable information on the GCC states. For example, Table II shows the percentage of government services available online in the GCC states, with the UAE being ranked first. The next stage of implementing m-government services in the GCC was to provide citizens with high-quality services by involving them during the design and implementation stages, planned to begin in the UAE in June 2015 (Emirates Newswire, 2014).

The GCC states are proceeding to use more service-oriented and citizen-centric models to meet citizens' requirements and expectations. This has changed the way citizens in the GCC interact with governments (Emirates Newswire, 2014). As previously stated, the GCC countries are among the global leaders in providing the best quality m-services to their citizens, and the region is now moving toward the next stage of citizen engagement and smart governance (Emirates Newswire, 2014; United Arab Emirates Ministry of Communication and Information Technology, 2014). However, despite the successful implementation of m-government services in the GCC, many citizens still use services via traditional channels, such as visiting agencies of customer services (*Khaleej Times*, 2015). This refusal to adopt m-government services points toward a mismatch between the m-government services' goals and citizens' needs (Shareef *et al.*, 2014). To increase the number of m-government service users, m-government decision makers should focus on improving the quality of the m-government services based on citizens' requirements and expectations (Al-Hubaishi *et al.*, 2017; Zheng and Pulli, 2007).

2.3 M-government service quality

In recent years, quality has emerged as a critical issue for government and industry (Zaidi, 2017) and the measurement of m-service quality, especially in mobile commerce

GCC country	Percentage of government services available via e-government or m-government
United Arab Emirates (UAE)	89.13
Kingdom of Bahrain	82.609
Kingdom of Saudi Arabia (KSA)	67.391
Qatar	67.391
Kuwait	65.217
Oman	59.42

Source: Innovation and Tech (2016)

Table II. Ranking of GCC countries for provision of e-services and m-services in 2016

(m-commerce) has received close attention (Zhao *et al.*, 2012). Thus, it is important to focus on the challenge of how to improve m-commerce quality to offer better services (Yeh and Li, 2009). M-service quality examines both the relationship between the customer's expectations for service performance prior to the service encounter and the customer's perception of service received (Zhao *et al.*, 2012). When the service performance does not meet the customer's expectations, then the evaluation of the service quality will be low, and when the service performance meets or exceeds the customer's expectation, then the evaluation of the service quality will be high (Al-Hubaishi *et al.*, 2017). Consequently, the major criterion in any evaluation of service quality is the customer's expectation (Zaidi, 2017). The better the quality of service, which means that the organization meets or exceeds customers' expectations or needs, the greater the customer satisfaction.

In the m-government context, service quality can play a vital role in improving efficiency and increasing citizens' satisfaction (Al-Hubaishi *et al.*, 2017). Shareef *et al.* (2014) defined m-government service quality as the degree to which m-government services facilitate the delivery of effective m-services to help businesses, agencies and citizens perform their governmental transactions. Service quality in m-government plays an important role and is considered as the most effective way to help governments meet citizens' specific, explicit, implicit and dynamic needs (Stiakakis and Petridis, 2014).

Focusing on the quality of governments' mobile applications (apps) and citizens' expectations is a common approach in assessing the improvement of m-government services (Stiakakis and Petridis, 2014). Service quality, combined with citizens' expectation of, or needs for, these services, affects citizens' satisfaction with that service (Al-Hubaishi *et al.*, 2017). Recent research has also explored m-service quality's multidimensionality using information system service-quality dimensions (Stiakakis and Petridis, 2014). Al-Hubaishi *et al.* (2017) explored m-government services from the service-quality perspective by identifying the service-quality dimensions and sub-dimensions of m-government services. The study identified 20 service-quality sub-dimensions within 6 service-quality dimensions: interaction quality; environment quality; information quality; system quality; network quality; and outcome quality. Stiakakis and Petridis (2014) explored m-service quality by adopting m-service quality dimensions from the literature. Their multidimensional or hierarchical framework included the following dimensions with the related sub-dimensions: interaction quality (expertise, problem solving, information, security/privacy and customization/personalization); environment quality (equipment, design and context); and outcome quality (reliability, tangibles and valence). The dimensions were tested using principle component analysis and structural equation modeling. The study found that these dimensions mostly fit the model and positively affected improving m-services design. The results indicated that m-service quality is primarily influenced by security/privacy, customization/personalization and reliability. Furthermore, the study suggested that future studies could compare the perspective of mobile users with the perspective of service providers and designers regarding the determinants of m-service quality and their relative importance.

Motamarri *et al.* (2014) examined factors that distinguish healthcare services, from a patient's perspective, using four dimensions of m-service quality (system, interaction, information and outcome quality), with 20 sub-dimensions. The study found that 11 out of the 20 sub-dimensions were significant to m-health. The study concluded that there is a lack of comparative evaluation regarding healthcare services and how this evaluation could contribute to improving the design of the m-health services. Zhao and Guo (2013) tested a multidimensional, hierarchical model, suggesting that four dimensions (service environment, service interaction, information control and service effect), with 12 sub-dimensions, predicted library m-service quality in three Chinese universities.

The study found that all 4 dimensions and 12 sub-dimensions were significant in assessing a library's m-service quality. The study suggested that future studies regarding the development and improvement of m-service quality need to review and adjust the scale of m-service quality according to users' demands.

Mobile technology has several m-service quality factors that influence the customer that require mapping and interpretation (Stiakakis and Petridis, 2014). However, these factors focus on information, rather than service quality. Providing high quality for m-government services is a critical strategy for meeting customers' demands (Zhao and Guo, 2013; Zheng and Pulli, 2007) because m-service quality regarding wireless and mobile devices is linked to customer satisfaction (Zheng and Pulli, 2007). However, it is difficult to improve m-service quality to satisfy customers because of a lack of understanding concerning the factors that influence m-service quality from a user's perspective (Li and Suomi, 2009; Stiakakis and Petridis, 2014).

2.4 QFD

QFD was developed by Yoji Akao and Shigeru Mizuno during the late 1960s as a quality system to deliver goods and services efficiently, in a way that satisfied customers, by listening to the "voice of the customer" (Özdağoğlu and Salum, 2009; Vinayak and Kodali, 2013; Zare Mehrjerdi, 2010; Zheng and Pulli, 2007). Companies should listen to the voice of the customer throughout the development of products and services (Vinayak and Kodali, 2013). QFD is a method used to translate customer requirements into technical requirements (Vinayak and Kodali, 2013; Zheng and Pulli, 2007) that align customers and products (Ginn and Zairi, 2005), resulting in customer satisfaction and continuous improvements (John *et al.*, 2014). From the m-government perspective, it is also an important tool for identifying customers' requirements and converting them into technical requirements that can be deployed (Zheng and Pulli, 2007). Furthermore, QFD is a method that can be used for continuous service improvement, emphasizing the impact of organizational learning in innovation areas (Govers, 2001).

3. Research methodology

The study uses a quantitative approach by applying QFD, using the HOQ matrix. HOQ is the most utilized QFD tool in the literature and is considered the main matrix for QFD (Pulli *et al.*, 2007). Figure 1 shows the HOQ, presenting the "whats," which are the customer requirements, and "hows," which are the technical requirements for the "whats."

As this study focuses on the QFD matrix, the following section will discuss in detail the HOQ steps followed in this case study both to provide an understanding of the HOQ tool and demonstrate how the objective of the study was achieved:

- Step 1: develop the set of customer needs (whats).
- Step 2: measure customer importance/priority.
- Step 3: identify the technical requirements (hows).
- Step 4: create a correlation matrix of the technical requirements.
- Step 5: create a relationship matrix between customer requirements and technical requirements.
- Step 6: perform competitive benchmarking.
- Step 7: prioritize the technical requirements.
- Step 8: determine which technical requirement to deploy.

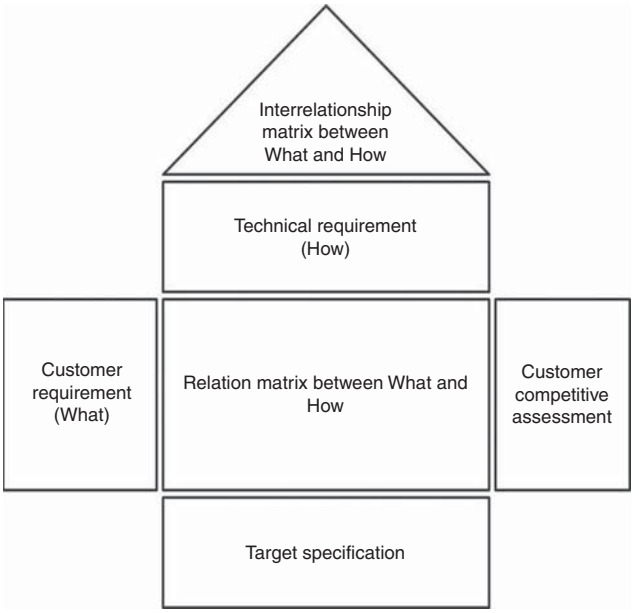


Figure 1.
The house of quality (HOQ)

Source: Akao (1990)

3.1 Case study in GCC

As previously discussed, the GCC is a region that has already implemented most of its government services through mobile devices, and GCC countries are expected to play a vital role in the market in providing services though mobile devices. Competition between GCC governments has also been created regarding implementing mobile apps that increase citizens' satisfaction. In this competition, the UAE ranked first among the GCC countries (see Table II) based on the number of services implemented through mobile apps, followed by Bahrain, KSA, Kuwait, Qatar and Oman. To improve m-government service quality in the GCC countries, the country most successfully implementing m-government should be selected as the case study to evaluate best practice that other GCC countries should adopt. Therefore, the UAE has been chosen as the case-study country.

The UAE Government was an early adopter of m-government services, with its initiative, announced in 2013, to activate all e-government services via mobile apps, establish new m-government services and invite all the UAE's government entities to devise unified mobile strategies for transformation into m-government services (*Gulf News*, 2014). As a result, the UAE is now at the forefront of e-transformation in the Middle East region. The launch of the m-government services, also known as smart government, can be seen as a turning point in how governments work. The transition to the most comprehensive m-government concepts, the development of services available anywhere and the goal of serving citizens efficiently and effectively through smart tools are all in line with the ambitious goals of the UAE 2021 vision (United Arab Emirates Telecommunications Regulatory Authority, 2016).

The UAE's Ministry of Interior (MOI) has led government departments in shifting services to mobile platforms. The MOI recently announced that its app for smartphones supported 16 languages on the IOS, Android, Windows and Blackberry operating platforms, contributing to multilingualism by increasing the proportion of users who speak other

languages and enabling a larger segment of the population with different nationalities, cultures and levels of education to easily browse the app and use its services (United Arab Emirates Ministry of Interior, 2016). The MOI app provides several services to the citizens and residents, including:

(1) traffic and licensing (vehicle registration, traffic fines, license plates, driving tests and traffic services for companies);

(2) civil defense (institutional licensing and engineering plans);

(3) police headquarters (police services); and

(4) naturalization and residency (entry permit services, entry visa services, residency and foreign affairs).

3.2 Applying QFD to m-government services in the GCC

This section details the eight HOQ steps followed.

3.2.1 Step 1: developing the set of customer needs (whats). This step refers to identification of the customer requirements, also called the "voice of the customers," customer needs or customer demands, and are defined as the "whats" in the HOQ matrix (Figure 1). This step should be performed using market research, through personal interviews or focus groups (8–15 people). The requirements identified are usually represented in customer-focused terms, such as "basic needs," i.e. what customers assume the service will do, "articulated needs," i.e. what the customers want the service to do and "excitement needs," i.e. what will, if fulfilled, delight customers. These classifications have been defined by King (1989) as "demanded" or "expected" quality and "exciting" or "attractive" quality. Once these requirements are ascertained, they are then organized in a hierarchical format to aid prioritization, in the form of primary, secondary and specialized requirements. One popular technique that can be used in this process is known as Kawakita Jiro diagram, in which customer requirements are organized in affinity groups (Abdollah Shamshirsaz, 2015).

In this study, a focus group of ten users of the UAE MOI app users was used. These users were selected from the MOI app database, based on years of experience (more than two years) and the number of services used per year (more than 20), who also provided frequent feedback through surveys or suggestion channels to help develop the app and could be contacted by MOI app software developers regularly to test the new versions or services before officially launching them. This group helped in identifying the users' requirements to improve the quality of m-government services. They were gathered together in a workshop as part of a researcher-led focus group and also contacted by phone and e-mail if further information was required. The data were collected through open-ended questions. The users' response were grouped using affinity diagram – a tool that gives structure to the creative process by organizing the ideas in a way that allows the technical developers to discuss, improve, and interact with the participants (Awasthi and Chauhan, 2012) – and used to develop a meaningful questionnaire to capture the users' important requirements. Figure 2 shows the affinity diagram of user input (whats) to improve the quality of the MOI app.

3.2.2 Step 2: measure customer importance/priority. In the questionnaire, the users were asked to rate the importance of the app's services on a standard five-point Likert scale, with 5 being the highest priority. Table III shows the relative importance of each listed user need, which will subsequently be placed in the customer importance column to the right-hand side of the customer requirements in the HOQ.

3.2.3 Step 3: identify the technical requirements (hows). After identifying the customer importance, the next step in the HOQ is to identify the technical requirements. The technical

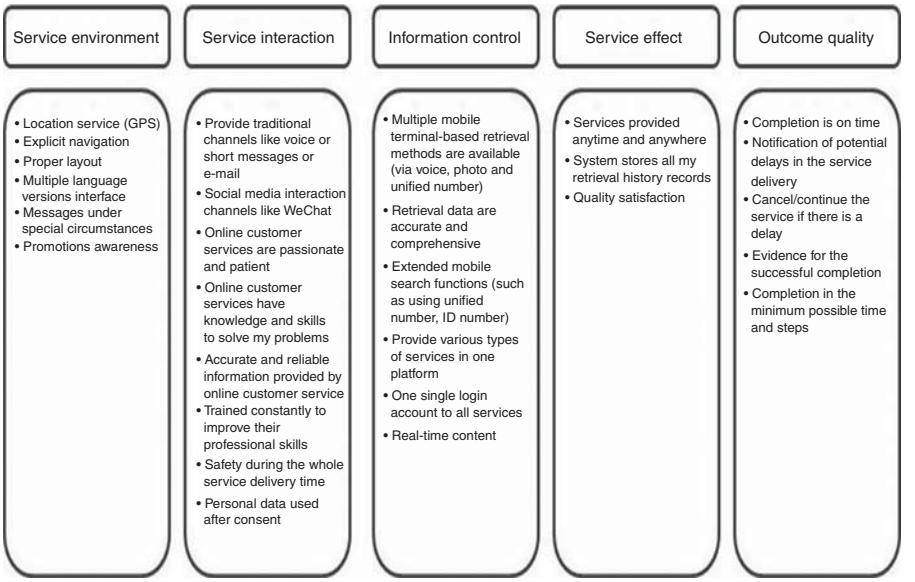


Figure 2.
Affinity diagram of user needs to improve the quality of m-government service

Users' needs (whats)	User importance (1–5; 5 = highest importance)
Location service (GPS)	5
Explicit navigation	5
Proper layout	4
Multiple-language interface	2
Messages in special circumstances	1
Promotions awareness	4
Provide traditional channels like voice or short messages or e-mail	3
Social media interaction channels like WeChat	4
Online customer services are helpful and patient	3
Online customer services have knowledge and skills to solve my problems	4
Trained constantly to improve their professional skills	3
Safety during the service delivery time	5
Personal data used only after consent	5
Multiple mobile terminal-based retrieval methods are available (via voice, photo and unified number)	2
Retrieval data are accurate and comprehensive	4
Extended mobile search functions (such as using unified number, ID number)	3
Provide various types of services in one platform	4
One login account to all services	4
Real-time content	5
Services provided anytime and anywhere	5
System stores all my retrieval history records	3
Quality satisfaction	5
Completion is on time	5
Notification of potential delays in the service delivery	3
Cancel/continue the service if there is a delay	3
Evidence for the successful completion	4
Completion in the minimum possible time and steps	4

Table III.
The MOI app's user needs (whats) and user importance

requirements can be defined as the design specifications needed to meet customer requirements (Han, 2016). These technical requirements are placed on the top of the HOQ and are referred to as the "hows" of the HOQ (Hussain *et al.*, 2011). The "hows" describe how the organization intends to meet each of the customer requirements and improve the service or product. The MOI app's technical requirements were generated by the software developers of MOI app through discussion and consultation with the customer requirements. The identified technical requirements were then developed and sorted using a tree diagram (Figure 3) – a tool that represents all the information on a matrix and groups all the relationships into a tree-and-branch format (Goetsch and Davis, 2014).

3.2.4 Step 4: create a correlation matrix of the technical requirements. The correlation matrix explains the interrelationships between the technical requirements, which will subsequently be placed in the roof of the HOQ (Han, 2016). It maps how each of the technical requirements to one another using the following symbols: ● (strong positive +9); ○ (positive +3); × (negative −3); or ◆ (strong negative −9) (Hussain *et al.*, 2011). Furthermore, it provides an indication of which technical requirement's modification will have a high impact on the overall outcome by affecting other requirements (Han, 2016). However, to identify the interrelationships between the technical requirements, it is important to understand the technical portions of the service improvement. In this study, it was therefore necessary to understand the MOI app and how any improvements could be made. Figure 4 shows the

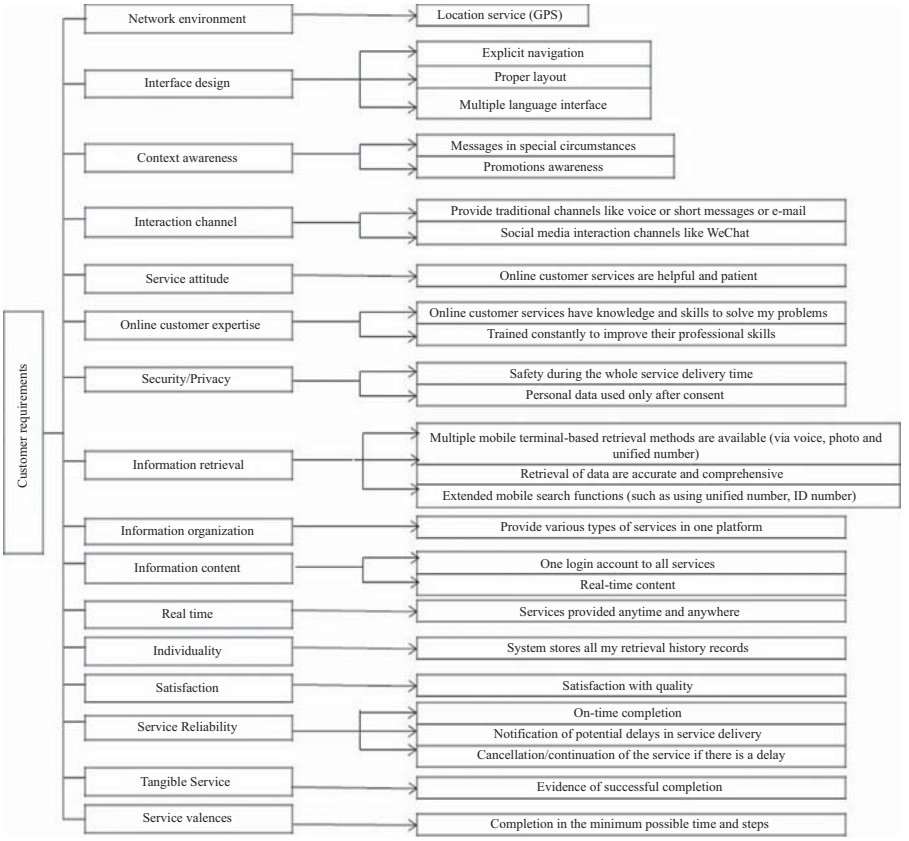


Figure 3.
Tree diagram for identifying technical requirements

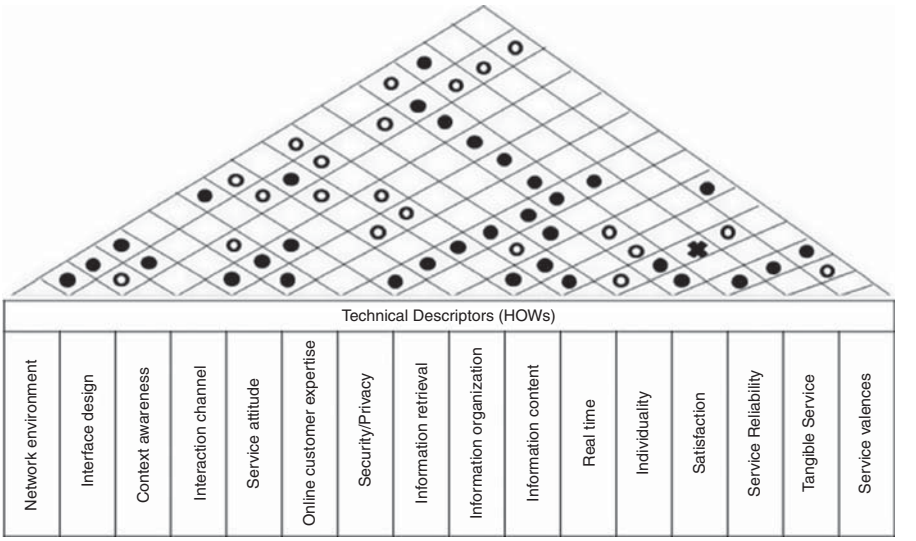


Figure 4.
Correlation matrix of technical requirements

interrelationships among the technical requirements. For example, there is a strong relationship between network environment and security/privacy, which means that the software developers had to consider the safety and privacy of the user's data when improving the network environment by using secure connections to avoid network vulnerability.

3.2.5 Step 5: create a relationship matrix between customer requirements and technical requirements. After identifying the technical requirements and the interrelationships between them, the next step is to examine how the "hows" relate to the "whats." The middle portion of the HOQ shows the relationships between the customer requirements and the technical requirements. The impact on each cell of the matrix shows the relationship between one customer requirement and one technical requirement (Shen *et al.*, 2000). In general, the link between the two requirements is positive, which suggests an improvement on the technical requirements will lead to greater customer satisfaction (Han, 2016). However, differences in the strength of impact are rarely identified (Shen *et al.*, 2000). The differences are usually shown using scales of significance (1–5 or 1–9), with a higher number indicating a stronger relationship (Hussain *et al.*, 2011). This study used the following symbols: ● = 9 (strongest relationship); ○ = 3 (medium relationship); Δ = 1 (weak relationship); and blank cells indicate no relationship. This step helps developers to understand the correlation between the customer requirements and the technical requirements that would not otherwise have been identified (Han, 2016).

3.2.6 Step 6: perform competitive benchmarking. After identifying the correlation matrix of customer requirements and technical requirements, the focus of the service improvements shifted to the customer competitive matrix that is placed in the left-hand side of the HOQ. This matrix shows how each customer requirement has been addressed (Uppalanchi, 2010). The matrix provides market data, facilitating the setting of new strategic goals for the service or product by comparing the service or the product to its key competitors (Uppalanchi, 2010). The study selected the KSA and Oman as competitors of the UAE because they are geographically close and have equally strong economies, salary rates, population density and technological development.

The app chosen for benchmarking the in the KSA was the Absher app: an official m-government service app of the KSA's MOI. The app provides many services for the

citizens and residents such as: accessing personal data; issuing/revoking travel permits; issuing/canceling final exit visas; issuing/canceling exit return visas; renewing driving licenses; renewing traffic permits; issuing/renewing residency permits; accessing the travel log; viewing details of traffic violations; reporting missing documents; timeline (Personal Calendar); office locations (Passport, Status, Absher Self Service); and inquiries regarding the balance of available funds' fingerprint registration, eligibility for the Hajj, identity validity, validity of residency, health insurance, the arrival of new labor, traffic violations, visa status and the return of labor.

The app chosen for benchmarking the in Oman was the Royal Oman Police: an official m-government service app provided by Oman's MOI. The app provides several services, including: accessing traffic-offense information; license renewals for private vehicles; visa-application-status enquiries; calling and locating nearby police stations based on GPS coordinates; and making emergency calls.

After identifying the competitors, the same questionnaire used for the UAE's MOI app was administered to the KSA's and Oman's MOI app users (though online, and not researcher-led as was the case for the UAE's MOI app). The results are shown in Table IV. The data collected from these competitors were used in setting the targets for customer satisfaction. These targets were set by the software developers, using a five-point Likert scale, as follows:

(1) Calculate the improvement factor for each service using the following formula: improvement factor = ((planned customer performance rate – existing customer rate) × 0.2) +1.

Users' needs (whats)	KSA	Oman
Location service (GPS)	3.9	4.0
Explicit navigation	3.8	3.3
Proper layout	4.5	4.7
Multiple-language interface	3.8	4.3
Messages under special circumstances	4.3	4.0
Promotions awareness	3.0	3.0
Provide traditional channels like voice or short messages or e-mail	3.2	3.3
Social media interaction channels like WeChat	3.0	2.3
Online customer services are passionate and patient	3.0	3.3
Online customer services have knowledge and skills to solve my problems	3.5	3.7
Trained constantly to improve their professional skills	3.3	3.3
Safety during the whole service delivery time	4.5	4.7
Personal data used after consent	4.2	4.0
Multiple mobile terminal-based retrieval methods are available (via voice, photo and unified number)	3.5	3.7
Retrieval data are accurate and comprehensive	3.8	4.0
Extended mobile search functions (such as using unified number, ID number)	4.2	4.7
Provide various types of services in one platform	4.3	4.0
One single login account to all services	4.6	4.7
Real-time content	4.1	4.0
Services provided anytime and anywhere	4.6	4.7
System stores all my retrieval history records	4.1	4.3
Quality satisfaction	4.3	4.0
Completion is on time	4.4	4.3
Notification of potential delays in the service delivery	4.0	4.0
Cancelation/continuation the service if there is a delay	4.1	3.7
Evidence of the successful completion	4.3	4.7
Completion in the minimum possible time and steps	4.4	4.5

Table IV. Customer comparative assessment of the KSA's and Oman's MOI apps

(2) Calculate the sales point, which is a strategic market factor that can be measured using a number from 1 to 1.5, with 1 resulting in no change in the overall weight and 1.5 increasing the overall weight (Goetsch and Davis, 2014). The sales point was set to 1 in this study since it is investigating the improvement of a government app, which means that the focus is user satisfaction and not profit.

(3) Calculate the overall weight of customer needs (customer priority × improvement factor × sales point).

(4) Calculate the percentage of total weighting (overall weighting/sum of overall weightings) × 100.

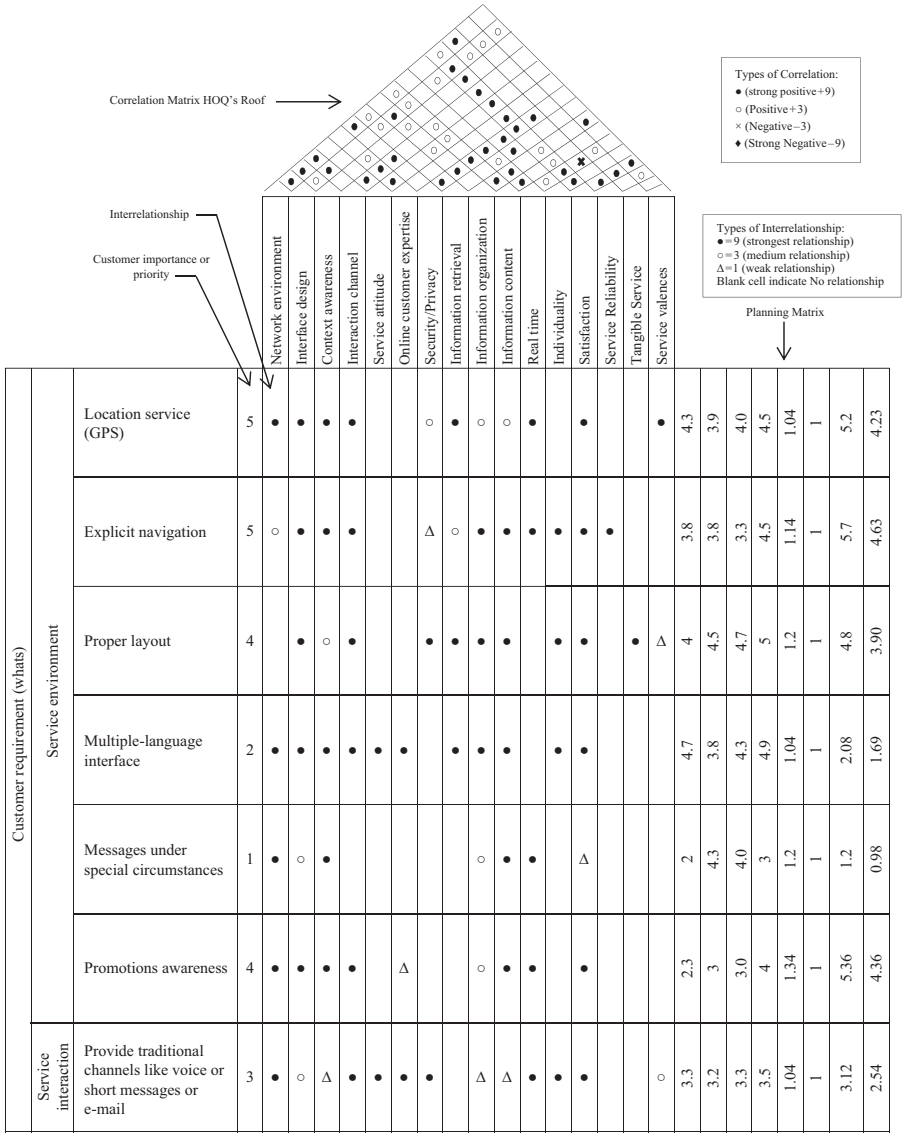
3.2.7 Step 7: prioritize the technical requirements. The technical priority matrix determines the relative importance or priority of each of the technical requirements (hows) in meeting customer requirements (whats). To calculate each technical priority, the software developer multiplies each of the interrelationship ratings (0, 1, 3 or 9) in the interrelationship matrix of technical requirements by the corresponding customer requirement's overall weighting (Goetsch and Davis, 2014). Figure 5 shows the HOQ, including all the data for these calculations. The percentage of total technical priority can then be calculated using the following formula: % total priority = (technical priority ÷ $\sum$ technical priorities) × 100.

3.2.8 Step 8: determine which technical requirements to deploy. The last step, which produces the outcome of HOQ, is called design target matrix (used both for the design and improvement of products and services) and this matrix is placed at the bottom of the HOQ (Han, 2016). This step allows the organization to set its strategic goals by selecting which requirements have the highest priority for deployment to ensure customer satisfaction and assigning them design target values (Goetsch and Davis, 2014). Technical benchmarking is used to compare the organization which plans to produce or improve the product or service with competing products or services; in this case, the KSA's and Oman's MOI apps. A target is set that ensures customer satisfaction based on specific information on where the organization's current product or service stands relative to competing products or services with respect to each of the technical requirements (Goetsch and Davis, 2014). Figure 5 shows the completed HOQ including the target plan matrix.

4. Discussion and conclusions

In this study, a systematic procedure has been applied to explore the factors involved in improving m-government service quality. Citizens' requirements were identified through a focus group of ten users of the UAE's MOI app and the collected data were refined, using an affinity diagram, to correctly categorize the factors and remove any redundancy from the collected data. The study categorized the data into the following five categories: service environment; service interaction; information control; service effect; and outcome quality. After identifying the users' requirements, technical requirements were developed to meet them, which meant translating users' requirements into technical requirements that were easy for the software developers to understand, with the overall aim of improving the quality of m-government services according to citizens' specifications. Citizens' priority for each requirement has been determined using a five-point Likert scale. A correlation matrix of technical requirements and the interrelationships between technical requirements and citizens' requirements was created. Finally, technical benchmarking of the UAE's MOI app against those of the KSA and Oman was completed to develop the strategic plan for future development.

The findings reveal that the factor "real time," i.e. the app must provide up-to-date information even if this information has been updated or entered only a few seconds ago, had the highest priority, with a weight of 10.47 percent. These results differ from those of



Customer requirement (whats)				Network environment	Interface design	Context awareness	Interaction channel	Service attitude	Online customer expertise	Security/Privacy	Information retrieval	Information organization	Information content	Real time	Individuality	Satisfaction	Service Reliability	Tangible Service	Service valences				
	Service environment																						
		Location service (GPS)	5	●	●	●	●			○	●	○	○	●		●			●	4.3	3.9	4.0	4.5
		Explicit navigation	5	○	●	●	●			Δ	○	●	●	●	●	●	●			3.8	3.8	3.3	4.5
		Proper layout	4		●	○	●			●	●	●	●		●	●		●	Δ	4	4.5	4.7	5
		Multiple-language interface	2	●	●	●	●	●	●		●	●	●		●	●				4.7	3.8	4.3	4.9
		Messages under special circumstances	1	●	○	●						○	●	●		Δ				2	4.3	4.0	3
		Promotions awareness	4	●	●	●	●		Δ			○	●	●		●				2.3	3	3.0	4
	Service interaction	Provide traditional channels like voice or short messages or e-mail	3	●	○	Δ	●	●	●	●		Δ	Δ	●	●	●			○	3.3	3.2	3.3	3.5
																				1.04	1.34	1.04	1.2
																				1	1	1	1
																				3.12	5.36	2.08	1.2
																				2.54	4.36	1.69	0.98

Customer requirement (whats)				Real time	Individuality	Satisfaction	Service Reliability	Tangible Service	Service valences				
	Service environment												
		Location service (GPS)	5	●		●			●	4.3	3.9	4.0	4.5
		Explicit navigation	5	●	●	●	●			3.8	3.8	3.3	4.5
		Proper layout	4		●	●		●	Δ	4	4.5	4.7	5
		Multiple-language interface	2		●	●				4.7	3.8	4.3	4.9
		Messages under special circumstances	1			Δ				2	4.3	4.0	3
		Promotions awareness	4			●				2.3	3	3.0	4
	Service interaction	Provide traditional channels like voice or short messages or e-mail	3	●	●	●			○	3.3	3.2	3.3	3.5
										1.04	1.34	1.04	1.2
										1	1	1	1
										3.12	5.36	2.08	1.2
										2.54	4.36	1.69	0.98

continued

Figure 5.
The completed HOQ

		Social media interaction channels like WeChat	4	●	○		●	●	●	●		○	○	●		●		Δ	Δ	1.3	3	2.3	5	1.74	1	6.96	5.66
		Online customer services are passionate and patient	3				●	●	●				○	○		○				4.1	3	3.3	5	1.18	1	3.54	2.88
		Online customer services have knowledge and skills to solve my problems	4			○	●	●	●	○	Δ	○	○	●			○		Δ	3.7	3.5	3.7	5	1.26	1	5.04	4.10
		Trained constantly to improve their professional skills	3				●	●	●		Δ	Δ		●		Δ				3.5	3.3	3.3	5	1.3	1	3.9	3.17
		Safety during the whole service delivery time	5	●			Δ			●				●	●	●	●	○	●	4.3	4.5	4.7	5	1.14	1	5.7	4.63
		Personal data used after consent	5	●			○		○	●	●		●			○				4	4.2	4.0	5	1.2	1	6	4.88
	Information control	Multiple mobile terminal-based retrieval methods are available (via voice, photo and unified number)	2		●					●	●	○	●	●	Δ	Δ			○	3.6	3.5	3.7	4	1.08	1	2.16	1.76
		Retrieval data are accurate and comprehensive	4		○					○	●	○	●	●	●	Δ	○		Δ	3.3	3.8	4.0	4.5	1.24	1	4.96	4.03
		Extended mobile search functions (such as using unified number, ID number)	3		●					●	●	Δ	●	●		Δ	●		○	3.9	4.2	4.7	4.2	1.06	1	3.18	2.58
		Provide various types of services in one platform	4	●	●	○	Δ	Δ	Δ	○	○	●	○	○		○	●		●	4.1	4.3	4.0	5	1.18	1	4.72	3.84
		One single login account to all services	4		●					●		●			●	●	Δ		●	4.3	4.6	4.7	5	1.14	1	4.56	3.71
		Real-time content	5			Δ				Δ	○	○	●	●		Δ				3.8	4.1	4.0	4.7	1.18	1	5.9	4.80

Figure 5. *continued*

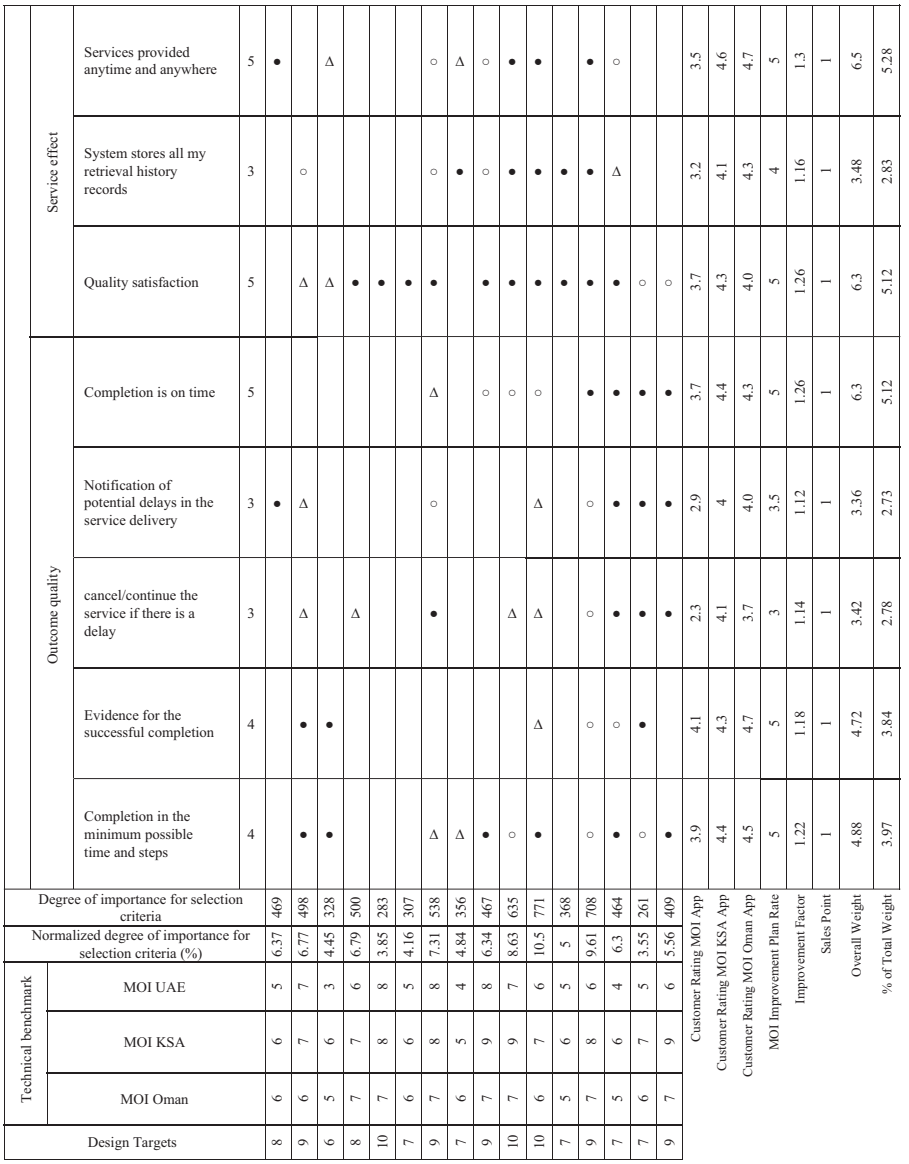


Figure 5.

Chanana *et al.* (2016), who found that up-to-date information was not important, with a relative importance of 6 out of 17 in their study of m-government service quality in India. However, these results are compatible with those of Motamarri *et al.* (2014) who found that up-to-date information was highly significant for m-health service quality, with a load factor of 0.529. The study noted that m-health services deal with the patients' lives and any incorrect or out-of-date information may risk the safety of the patients. Zhao and Guo (2013) found that the average variance extracted for "real time" was 0.731, further demonstrating the importance of real-time information in m-service-quality dimensions.

Thus, m-government decision makers should ensure that the data presented to the users should to be up-to-date to avoid any misunderstanding.

"Satisfaction" was the second most important criterion, with a weight of 9.61 percent. This refers to users being able to provide feedback on their perception of the quality of service provided (it can be presented by smiley face if the user is satisfied, a neutral face if the user is neutral or a sad face if the user not satisfied). The research findings are compatible with those of Lu *et al.* (2009), who found that satisfaction was one of the most important m-services quality dimensions and noted that the more the users are satisfied with an m-service, the higher its usage. Zhao and Guo (2013) also found that satisfaction was an important m-service quality dimension, with an average importance of 0.755. M-government software developers need to understand that direct evaluation of each service allows them to spot the weaknesses in service delivery.

Regarding less important criteria, "tangible services" was the least important criterion, with a weight of 3.55 percent. A tangible service refers to the evidence of the service's completion. There are many ways to notify users of the completion of a service, such as receiving a notification message on the app, receiving an SMS or receiving an e-mail. M-government decision makers must consider all the possible ways of notifying users to provide user satisfaction. This finding differs from those of Stiakakis and Petridis (2014), who found that the average importance of tangible services was high (51 percent). Their results are also inconsistent with Qureshi *et al.* (2015) and Zhao and Guo (2013) who confirmed that tangible services were highly significant for improving m-services.

To improve the m-government service quality in the GCC, all the GCC countries must make use of technical benchmarking to increase competition and to formulate strategic plans, based on clear targets that are directly linked to citizens' requirements and expectations.

4.1 Theoretical contributions

The study adds to the QFD literature and provides a unique insight into m-government service quality by demonstrating that QFD is an effective, specialized approach that can be used to improve the service quality of m-government services. QFD is an engineering approach that can translate the voice of the customer into technical requirements that enable the formulation of strategic plans that ensure m-government service quality when either improving or designing new m-government services. Refining the citizens' requirements using an affinity diagram provided a way to categorize and understand each requirement. Finally, using a tree diagram proved useful in several ways when refining either customer or technical requirements.

4.2 Practical contributions

The methodology provides an effective approach for government decision-making authorities and software developers to determine which factors require more consideration and develop a strategy to yield the highest possible citizen satisfaction and increase usage of these services. In other words, the study offers an understanding of citizens' perceptions of m-government service quality.

Government agencies and software developers that design and deliver m-government services to their citizens should consider the m-services quality factors provided by the citizens to better improve the quality of m-government services. Ensuring m-government service quality is a continuous and innovative process and maintaining the quality of such services is a vital factor in influencing and generating citizen satisfaction. The methodology also allows m-government decision makers to formulate a strategic plan incorporating competitor benchmarking. The study suggests that government agencies should keep improving the quality of their m-government services by incorporating citizens' requirements. Providing complete services, secure and private information, real-time information, good online customer-service attitudes, reliability, easy navigation, valances services, several

interaction channels, tangible services, easy information retrieval and offering context awareness are confirmed in this study to be the most significant factors in improving m-government services from the citizens' point of view.

4.3 Limitations of the study and directions for future research

It is important, however, to understand the limitations of this study. For example, customer importance weight for the technical requirements depends of the user's psychological judgment. Further studies could integrate QFD with other methods such as the analytical hierarchy process to deal with the complex structure of the data and better prioritize the requirements. While this study explores m-government service quality from the citizens' perspective, future research could explore it from a business or government perspective.

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