





# Good Practices of User Experience and Design Research for Mobile and Electronic Governmental Services

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**Abstract.** This paper summarizes desk research conducted on User Experience and Design Research for Mobile Governmental Services and presents Good Practices. As mobile services are the next step for governmental services, it is necessary that as this transition occurs that the integration of user needs, and user experience is considered from the start of the development process. This paper summarizes the methods, key findings, challenges that were discovered from UX and Design literature research on mobile and electronic governmental services. As a result, this paper derives Good Practices as a reference point for technical developers and other interested stakeholders to include the necessary user experience and design needs for market success.

**Keywords:** Mobile services · Mobile government · mGovernment · eGovernment · Governmental services · User experience · Design research

## 1 Introduction

It is becoming increasingly important today that the electronic services provided by the government offer policy information and governmental services. However, the design and management of electronic government (eGov) apps is in some cases in great need of improvement, which leads to problems in their use (Cahyono and Susanto 2019). The technologies developed in recent years in the field of mobile and electronic services for governmental services, all faced the problem of having to meet different requirements of digitalization. These requirements are in security, privacy and numerous other requirements but also around user friendliness. Unfortunately, when technologies are developed, the focus is often on one of the requirements and far too rarely on the user experience (Kureerung and Ramingwong 2019b). Only if the services are accepted by the users, they can benefit from the usefulness of the services. This then leads to the ability to tailor the government's services to its target audience, thereby reaching the broader population (Kö et al. 2018).

The motivation of this work was to conduct a literature review of existing User Experience and Design Research that has been done on mobile governmental (mGov)

services and electronic governmental (eGov) services. After reviewing which methods have been used and results that have been the outcome of a general consensus of what is lacking and how it could be improved, this paper presents ten good practices that other key stakeholders could follow to improve their User Experience of their services along their development process. The research and work presented in this paper has contributed and will be ongoing work in the EU funded MGOV4EU. This project focuses on creating pilots that showcases a citizen-centric approach that enables eIDAS and the Single Digital Gateway in mobile cross-border governmental services in Europe.

This paper has three following chapters. Chapter two will highlight key related work on User Experience (UX) and Design Research that has been conducted on mGov and eGov Services. This chapter will have two subsections where the first it will explain which methods, models, and approaches have been used. Second, it will explore the key insights from those studies. The third chapter will present the Good Practices which have been extracted from the related work that has been done. Lastly, this paper finishes with a conclusion and future work section.

## **2 Related Work for UX and Design Research on mGov and eGov Services**

This section expands on desk research conducted as a basis for the good practices. There was a reviewing process of selected key words in relation to User Experience and Design Research on Mobile and Electronic Government Services in Scopus and Google Scholar. After this process was conducted, then the most relevant studies were chosen to be presented. First, this section describes an overview of methods that include interviews, surveys, and case studies on mGov and eGov applications and websites regarding User Experience or Design Research. Second, there is a summary of some key results that were concluded in of how some of the research solved various challenges in User Experience and Design Research. The studies highlighted here aimed at gathering feedback about the usability, design, and user experience from mGov developers, designers, and users which were then used to present UX principles and improvements for the development of mGov services.

### **2.1 User Experience and Design Research Methods Used on mGov and eGov Services**

This section summarizes and highlights the related work of five different approaches that were used on evaluating the mobile government services in the user experience and design research.

First, this approach analyzes existing user experience models and uses them to develop a framework for user experience designs that promote awareness of information distribution via mGov applications (Kureerung and Ramingwong 2019a). Several usability models used in the topics of mobile applications evaluation, mGov, and user interface design were identified and analyzed. The authors examined the recurrency of the usability characteristics of usability models like Nielsen's usability model (Nielsen 1993), the ISO 9241-11 usability norm (Abran et al. 2003), and the Software Usability

Measurement Inventory (SUMI) (Kirakowski 2018) along with MGQM (Hussain and Kutar 2009), PACMAD (Harrison et al. 2013), Extend PACMAD (Saleh et al. 2015), QUIM (Seffah et al. 2006), MUSiC (Macleod et al. 1993). Usability factors for mGovernment applications are then collected and clustered. The usability design framework is put forward to promote the effective use of usability factors in the development process. Based on the most recurrent characteristics such as efficiency and ease of use, the authors then developed a framework for designing mGov applications (Kureerung and Ramingwong 2019a).

The second approach that involved the use of usability model which is the Norman's Interaction model aimed at studying the Interaction Design Patterns in governmental apps with the help of the 76 mobile interaction design patterns developed by Hooper and Berkman in 2011 (da Silva and Freire 2020); (Hooper and Berkman 2011). The 13 categories of interaction design patterns developed by Hooper and Berkman are Composition, Display of Information, Control and Confirmation, Revealing more Information, Lateral Access, Drilldown, Labels and Indicators, Information Controls, Text and Character Input, General Interactive Controls, Input and Selection, Audio and Vibration, Screens & Lights and Sensors. These were then combined by Silva and Freire into the following six categories: User Action, Help & Feedback, Search & Filter, Content Design, Input, and Navigation. The authors then evaluated 27 governmental applications in order to find the implemented design patterns in each one of them (da Silva and Freire 2020; Hooper and Berkman 2011).

The third kind of approaches employed empirical research methods to examine the design of gov applications by conducting surveys, interviews, and case studies with citizens and mGov designers and developers (Chang et al. 2020a, 2020b; Isagah and Wimmer 2018; Lönn et al. 2016). A similar approach has been employed for the examination of the collaboration through citizen sourcing for the improvement of the development of mobile government applications (Lönn et al. 2016). The research follows the six steps of the Design Science Research Process by Peffers: Problem identification and motivation, Definition of objectives of the solution, Design and Development, Demonstration, Evaluation, Communication. For the improvement of mobile government applications, workshops were conducted with municipality officials from multiple municipalities and discussed the potential process that can be implemented or invented that would allow citizens to send complaints directly to the government. Based on the results of the workshops, the authors developed three prototypes: An App, an app integrated with an ePlatform, and a final solution integrated with a case management system. The prototypes were then demonstrated to the municipality officials and evaluated via simulations, informed arguments from the government and citizens, tests, and a survey with 35 (Lönn et al. 2016).

In order to determine the most important factors in mGov applications for the elderly, a fourth approach has been identified in their study, they used a mix of quantitative and qualitative methods, including an mGovernment prototype, to investigate key acceptance factors. Research approach used the IGUAN framework, which is a user-driven method. The approach consisted in deriving some design factors from the TAM such as perceptions and attitudes towards the system (Kö et al. 2018). The factors derived were then used to develop an After Scenario Questionnaire (ASQ) that has been filled out by

elderly citizens after getting a demonstration of a conceptual model of an mGov service. Based on those results, a prototype has been developed and demonstrated and a survey has been conducted to assess if the improvements were effective (Kö et al. 2018).

Another method by Cahyono and Susanto examined the user design of mobile eGovernment websites. This involved using eye-trackers and MindWave to record retinal activity and brain waves while e participants searched for specific information on 9 government websites. Then, a 28 statement interview was conducted with the participants to determine the impact of human-computer interaction aspects and mobile website design on the efficiency of mGov services in Indonesia (Cahyono and Susanto 2019). Overall, this section shows that different methods and approaches can be utilized for the evaluation of the user experience in mGov websites and applications. The variety of the methods used does not only display the difficulty of properly evaluating mGov services, but also proves that different target groups require different research approaches. This section first provided a look on the usage of existing usability models and how mobile application characteristics are relevant for the evaluation of mGov services. Case studies were also a popular evaluation method, as multiple authors employed different techniques in conducting these studies, including ASQs, workshops, and the analysis of the brain activity.

## 2.2 Key Findings from Related Work

These key findings present a set of factors, solutions, and methods that have been identified and developed for the improvement of mGov and eGov design. First, this section provides an overview of design framework for mGov applications, that focuses on satisfying the primary requirements of the user interface. Second, there is an overview of a set of design pattern categories and usability requirements found in empirical research carried out with mGov developers and designers. These findings were found to be the most impactful in the improvement of the usability in mGov applications. Third, UX principles that derived from empirical research from a citizens and mGov users perspectives are presented. These principles can be used for the improvement of the information layout and user interface in governmental apps.

Overview of design framework for the interface of for mGovernmental applications.

Focusing on meeting the primary user interface requirements, this is an overview of some of the design framework results that related work came up with for mGovernmental applications.







The analysis of usability models such as Nielsen's heuristics and the SUMI resulted in the development of a framework for the development of user interface design for mGov applications (Kureerung and Ramingwong 2019a). Their framework consists first in defining the inputs required and the goals that need to be met. The findings are then used to raise questions and start with the design process. In this process, security, privacy, simplicity, learnability, memorability, and satisfaction are the most important factors in use to be improved. Within the factor of use, factor requirements, that are based on specific criteria, need to be fulfilled in order to present an improved user interface for the mGov service (Kureerung and Ramingwong 2019a). This method allows mGov developers to first identify and describe the main functionality of the user interface, which in return provides a way to determine the main requirements of the application.

From there, mGov developers can work on developing mobile applications and websites that are focused on providing the main functionalities in the most usability-satisfying and user-friendly way. These findings also align with other studies, that emphasize the importance of user interface design (Chang et al. 2020a 2020b); (Isagah and Wimmer 2018); (Kureerung and Ramingwong 2019a).

Design pattern categories and usability requirements gained from mGov developers.

This section provides an overview of a set of design pattern categories and usability requirements found in empirical research with mGov developers and designers. These findings proved to be particularly important for improving the usability of mGov applications.

The analysis and categorization of Hooper and Berkman's interaction design patterns resulted in the identification of 6 interaction design categories, that are most impactful in the design of mGov services (da Silva and Freire 2020); (Hooper and Berkman 2011). These categories contain different components that allow mGov application designers to provide a cleaner user interface, an effort free user experience, and an overall more user-friendly product (da Silva and Freire 2020). The 76 interaction design patterns from which these categories were derived can be further studied in (Hooper and Berkman 2011). As for the pattern categories, a brief explanation and some examples of interaction design patterns are presented in the following figure.

 <b>Content Design</b>	The Content Design category describes the way content is presented to users in a mobile application. It includes Patterns like Titles, Icons, Lists, Pop-ups, and grids along with the dynamic arrangement of graphical or textual information.
 <b>User Actions</b>	The User Actions define the set of methods the app provides to the user to interact with the application and execute the wished-for operation. This category contains interaction strategies such as gestures, touch, voice, and sign on.
 <b>Input</b>	The Input patterns category consists of patterns that concern data entry activities. These patterns include Keyboards, Input areas, form selections, voice inputs, and mode switches along with other data entry related patterns.
 <b>Navigation</b>	The Navigation category incorporates all activities related with the navigation, access, and movement of the user between content pages. The patterns included in this pattern category are tabs, revealable menus, scrolling, links, and fixed menus along with many more patterns.
 <b>Help &amp; Feedback</b>	The Help & Feedback patterns category consists of patterns that informs the users about the status of the operations they are conducting. Wait indicators, notifications, and haptic output are some of the patterns that belong to this category.
 <b>Search &amp; filter</b>	The Search & filter patterns category includes search engines and filters that aim at optimizing the search for data and functionalities. These patters are also employed to limit the data volume that the user is exposed to.

**Fig. 1.** The most impactful interaction design pattern categories for the design of mGov applications (da Silva and Freire 2020); (Hooper and Berkman 2011).

The empirical studies carried out with mGov designers and developers that aimed at identifying the requirements of mGovernment services from designers' perspective, showed that most mGov designers and developers prioritized the usability over other requirements of mGov services such as security, privacy, interoperability, integration, compatibility, and scalability (da Silva and Freire 2020) (Isagah and Wimmer 2018,

2017). A detailed overview of the usability requirements expressed by mGov developers and designers, as well as their characteristics is presented in Table 1:

**Table 1.** Usability requirements from the perspective of mGov application developers and designers (Isagah and Wimmer 2017, 2018)

Learnability	Easy to learn, Easy to use, Easy to remember
Recognizability	Meets Service Goals, Convenient to user environment, Easy to understand
Operability	Suitability for the device, Conformity of the device with user expectation
User Error Protection	Error tolerance
User Error Aesthetics	Clear and attractive interface
Accessibility	The use of multichannel, The use of multi-language, The use of common and cheap channel

As displayed in Table 1, the usability requirements of mGov applications are categorized into Learnability, Recognizability, Operability, User Error Protection and Aesthetics, and Accessibility (Isagah and Wimmer 2017, 2018). Each of these requirements vary in importance according to the kind of service and kind of users it attracts. For the elderly, for example, the ease of use is the most important requirements, since most of the elderly lack experience with new technologies (Kö et al. 2018); (Susanto et al. 2017); (Talukder et al. 2020). The main challenge in satisfying these requirements consists in finding or developing principles, methods, or frameworks that could cover these concerns but can also be employed across different mGov applications. Furthermore, most designers and developers rely on the existing agile methods used as a substitute for traditional software development methods. These agile methods differ in practices and tactics and do address service requirements in different ways, which shows that there is a lack of standards in the development of mGov services (Isagah and Wimmer 2018). Most designers were also found to employ design approaches that do not involve the user, nor do they use development frameworks that address all usability requirements (Isagah and Wimmer 2018). Cross-platform frameworks, as an example, address compatibility requirements but do pose some challenges regarding the user interface and performance of an app. In addition, the employed guidelines such as material design guidelines, SMS guidelines, and mobile operating systems guidelines are very different for each kind of device. With the technological development happening in the smartphone industry, it becomes hard for mGov designers and developers to agree on a specific guideline. Therefore, standardized principles, guidelines, and best practices should be developed, that address the requirements of m-government services, regardless of the type of device the service is provided on (Isagah and Wimmer 2018).

UX principles derived from citizens for improvement.

Now, UX principles derived from empirical research from the perspective of citizens and mGov users are presented. These principles can be used to improve information layouts and user interfaces in government apps.

Regarding the usability of mobile government applications, the results from case studies and empirical work with citizens can be matched to the Content Design and Search & Filter categories in Fig. 1. (Chang et al. 2020a, 2020b; Isagah and Wimmer 2018). The layout of information is the first design aspect that has a large potential of having a usability reducing effect on mGov apps. To reduce the efforts that the user must make when using the app's functionalities, repeated entrances should be avoided. A proper display of information and functionalities according to their importance also showed signs of increased usability in our findings (Chang et al. 2020a, 2020b; da Silva and Freire 2020; Isagah and Wimmer 2018, 2017). In addition, mixed or large quantities of displayed information proved to be discouraging for potential mGov users (Kureerung and Ramingwong 2019a, Chang et al. 2020a, 2020b).

The next design aspects that showed some negative effects on the usability were colors and icons. The effect of different colors on the human brain has been largely documented, thus making the choice of color a somewhat important decision in the appearance of the interface (Chang et al. 2020a, 2020b; Kö et al. 2018). The colors used should therefore not be too heavy or occupy too much space, nor should the background color be too close to the colors of the buttons. In some cases, where an administration possesses a logo, the colors used in their mobile website or applications should match the colors of the logo (Chang et al. 2020a, 2020b). The icons used in mobile government applications also proved to affect the user-experience, since icons that are hard to recognize or to understand lowered the usability of the app. Inconsistencies in design styles were also found to be negatively affecting the mGov app (Chang et al. 2020a, 2020b; Isagah and Wimmer 2018). Regarding the aforementioned usability aspects, the following principles have been applied and have been proven to improve mobile government applications from an user-experience point of view (; Isagah and Wimmer 2018):

- Multiple entries for the same functions need to be simplified.
- Redundant entries need to be removed.
- Important services need to be placed at high priority positions in the layout.
- The size of visual elements needs to be adapted to their importance.
- The popular services identified in surveys and user experiments need to be added.
- The information architecture needs to be changed to show the most important information first.
- Government applications should need to have a uniform design across administrations to reduce the cost of training users.

## Challenges

As a reflection of this desk research, there were five main challenges that can be summarized. The first challenge is that different smartphones and interfaces have different requirements for mGov application development (Isagah and Wimmer 2018, 2017). The second challenge is that there are no standardized approaches that meet the usability requirements of mGov services (Chang et al. 2020a, 2020b; Isagah and Wimmer 2018; Lönn et al. 2016). Third, many developers and designers of mGov use approaches to develop working mobile applications. This requirement usually takes precedence over usability (Isagah and Wimmer 2018; Kureerung and Ramingwong 2019a). The fourth

challenge is that demographics, political status, familiarity with technology, trust, and the nature of the service being offered have the most impact on the usability of mGov services (Chang et al. 2020a, 2020b; da Silva and Freire 2020; Isagah and Wimmer 2018; Kö et al. 2018; Kureerung and Ramingwong 2019a; Lönn et al. 2016). The final challenge is that many mGov solutions do not involve citizens in the development process, making it even more difficult to make them user-friendly (Kö et al. 2018; Lönn et al. 2016).

### **3 Good Practices of User Experience and Design Research for mGov and eGov Services**

As a result of the literature review, summarizing the different methods and results from the relevant results, this section summarizes ten good practices for mGov and eGov services to follow in pursuing a higher level of user experience and design for their services. These good practices should be seen as guidelines or a tool kit in the design of new or improving existing mobile government and e-government services.

#### **1. Learnability**

According to (Isagah and Wimmer 2018) learnability is characterized that the user is able to easily learn, use and remember. In the context of both eGovernment and mGovernment applications, learnability means that the user would easily learn how to use the app or service, not have any difficulties using it and finally, easily remember how to use the app or service or how to find certain information within the application. Learnability contributes to the increase of user-friendliness in the short term and user acceptance in the long term. Thus, learnability is also a way to overcome the third challenge, which states that many developers and designers of mGov use approaches to develop working mobile applications. This requirement usually takes precedence over usability. (Isagah and Wimmer 2018; Kureerung and Ramingwong 2019a), where developers would only focus on technical aspects rather than on usability aspects of the solution.

#### **2. Minimalistic and simple design**

The need for a minimalistic and simple design of the service that allows the user to focus on the important functions of the services. Simplicity automatically increases accessibility, which means that no user groups are excluded because they lack certain capabilities. Therefore, this good practice is to provide a barrier-free and user-friendly solution in order to overcome the fourth challenge which is that demographics, political status, familiarity with technology, trust, and the nature of the service being offered have the most impact on the usability of mGov services which highlights the inevitable different characteristics of users (Chang et al. 2020a, 2020b; da Silva and Freire 2020; Isagah and Wimmer 2018; Kö et al. 2018; Kureerung and Ramingwong 2019a; Lönn et al. 2016) that make it difficult to develop a service that fulfills the needs of different user groups.

#### **3. Language**

Language refers to the language in which the eGov or mGov service is offered. The goal of this good practice is to ensure that the language used in the service is one that is understood by a broad user group. This can be fulfilled by offering one common



language or many. However, this good practice goes beyond offering various languages for the service, but to ensure that the language used is presented in a simple and clear way that any average user would understand despite their technical or legal understanding. Similarly, to a simple design, language can help to overcome the differences between user groups.

#### **4. User readable terminology**

The User Readable Terminology good practice implies that all the terminology (labels, buttons, messages, etc.) is understandable for users with little technical understanding. This should also include users that are new to the software and the subject. This good practice does not only enhance usability, but it also guarantees that no user group is excluded. This is particularly important regarding overcoming the forementioned challenge about how demographics, political status, familiarity with technology, trust, and the nature of the service being offered have the most impact on the usability of mGov services.

#### **5. Help & feedback**

This good practice implies offering a “helpdesk” for users that answers any questions that may arise during the user experience. Whenever the user is not able to proceed within the application, he or she must be able to get assistance. This assistance can be provided either by means of direct interaction with a team or a software in the background e.g. through a chatbot, or by means of simple clickable “i” that provides the user with additional information. Feedback in mobile or web-based applications refers to patterns that “inform the users about the status of the operations they are conducting”. Such patterns include for example notifications or haptic output (da Silva and Freire 2020; Hooper and Berkman 2011). However, feedback can also mean that the user provides feedback to the developer. Both help and feedback contribute to an enhanced user-friendliness.

#### **6. Error handling**

Error handling is an important step within the development of any application and has been described in many user design studies. This good practice implies the involvement of end users to ensure that all predictable cases the system hinders the user to make mistakes. But the system should not just block an operation. Instead, it should explain to the user why this operation is not available at the moment. If there is an error, or the user makes a mistake the system should provide clear and understandable cause, also giving the user clear instruction on how to fix it. It shows that there is a strong interdependency between error handling and feedback and therefore, both must be installed.

#### **7. Search & filter**

One of six interaction design patterns defined by Hooper and Berkman is the search & filter design pattern (da Silva and Freire 2020; Hooper and Berkman 2011). As in any other web-based or mobile application, there must be a way for the user to search for certain information, data or functionality through a search engine implemented in the application. Even if all good practices described in this chapter are fulfilled by the developer, some users might prefer to look for data through a search engine instead of using other functionalities that are already there. Another add-on that comes along with that search engine is a filter. Such a filter makes it much faster for the user to find what he or she is looking for.

#### **8. Operability**

Operability or adaptability is a good practice where the User Interface developed must be adaptive, where the content is presented to users in a high quality way despite the size or device. According to (Isagah and Wimmer 2018, 2017) operability stands for (a) suitability for the device, and (b) conformity of the device with user expectation. Independently of the definition, the developer must make sure that the service can be accessed through any device. This good practice addresses another challenge that many developers of mGovernmental services have faced is the huge variety of devices available on the market, through which the user can access a service. This challenge requires that any solution is operable and supported by all mobile devices available on the market.

### **9. Placement of information**

Two good practices for user interaction and design of mGov services have been already studied intensively in case studies and empirical work with citizens by (Kureerung and Ramingwong 2019a), (Chang et al. 2020a, 2020b; da Silva and Freire 2020; Isagah and Wimmer 2018, 2017). One important factor is the right placement of information within the application. It has been shown that a straight-forward layout and arrangement of instructions and functionalities is crucial for the usability of the service. Also, overlaps and replications of text and generally, large quantities of text should be avoided. The user must always be clearly directed to the most important functionalities.

### **10. Use of colors**

This good practice is one that has reflected its importance in case studies and empirical studies with citizens is the right choice of colors (Chang et al. 2020a, 2020b; Kö et al. 2018). Not only the wrong choice of colors can negatively impact the user, but also the inconsistent use of logos or corporate identity of a service provider. Moreover, icons play an important role in the user experience. Well-designed and well-placed icons can be a benefit for the user (Chang et al. 2020a, 2020b; Isagah and Wimmer 2018). All in all, the “look and feel” of the application for the user must be as appealing as possible. The aforementioned studies show, that the involvement of citizens in the user design process can help a lot to design a user-friendly service that attracts many users.

## **4 Conclusion and Future Work**

As a result of exploring related work, there has been a variety of different methods or frameworks that have been used to study the User Experience and Design research of mGovernment and eGovernment services. They have explored and described different design approaches and characteristics that are used for various eGov or mGov services and portals. Many previous research conducted combined multiple usability evaluation models during their process.

After summarizing which methods, models, and approaches were used in the most suitable related work, a summary of their results was also made and their suggestions. This process of establishing an overview set the foundation for creating the ten good practices for developers and other interested stakeholders in establishing User Experience and Design Good Practices in a simple and efficient way. While User Experience and Usability are often thought of at the end of the development process, this is something that should be integrated throughout the entirety of development. With integrating or having good practices in mind of how to make future services with a higher level of user experience, could assist greatly in user adoption of these services.

These good practices also set a foundation for future work for research. These good practices should be set to be tested, evaluated, refined, or expanded in an academic field as well as in a practice. Future work could include a greater amount of User Experience and Design models in its consideration, including ones that have not already been studied with in regard to mGov or eGov services.

Overall, this is a continuous work to assist in improving the integration of User Experience and Design Research into practice of future mGov and eGov services. While this paper has been focused on mGov and eGov services, these good practices are broad enough to apply to many different situations regarding improving services and their User Experience.

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