Research on Government Informatization: A Crisp-Set Qualitative and Comparative Analysis (csQCA) Based on 31 Province Government APP in Mainland of China

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Abstract. With social progress and technological development, government informatization is an effective way for the government to provide public services to the public. The government APP is a typical product of government informatization. This study constructs a government APP evaluation system from the availability, usefulness, usability, satisfaction, and security of the quality of government APPs in 31 provinces in mainland China. Using crisp set qualitative comparative analysis (csQCA) finds four configurational that can influence the quality of government APPs. Based on the analysis results, this study suggests that government informatization should focus on user security and satisfaction to build excellent government APPs.

Keywords: Government Informatization · Government APP · csQCA

1 Introduction

With the rapid development of science and technology, the trend of government informatization is becoming more and more obvious. Government informatization is break up the physical boundary of administration by employing information communication technology [15]. Through investment in information and communication technologies infrastructure could attain a high-level E-government [6]. Government APP is a typical product of information and communication technologies. In an information society, the APP is a platform for demanders and providers to interact with each other. Since it is not limited by time and space, it becomes a convenient way to handle affairs through APP.

Mobile Government App (Mobile Government Application) is a mobile application for the government to provide government services to the public [5] and an effective way for local governments offer public services to the public [12]. The APP, as a platform, for people sent their request to government, and get a response. Building an excellent Mobile Government App has become an important initiative to improve government service capacity. And the central government also calls on localities to make full use of

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government APPs to improve efficiency. However, the current construction of mobile government APPs around China has a lot of differences [4]. Zhao, Ren, and Zhou (2020) pointed out that some government APPs have missing functions, do not have business processing functions, and even some government APPs never work [16]. Chen, and Liu (2017) investigated the mobile government APPs in Hebei province and found the following problems: government APPs are difficult to access; some government APPs are not running smoothly, with limited functions and insufficient independence; service category vacancy and duplication are serious, and the number of information is small and slow to update, as well as user-generated content is small and lacks limited management [5]. These studies mainly analyzed and evaluated the problems of government APPs from the perspective of user. The government APPs are to serve user, so it is an important idea to consider how to build an excellent government APP from the perspective of user experience. In this paper, we will adopt the method of qualitative comparative analysis from the perspective of user experience to explore the elements of an excellent government APP.

2 Model Construction and Research Methodology

2.1 Model Construction

2.1.1 User Experience Theory

User experience refers to "the subjective feelings and reactions when they use or expect to use a product, system or service" [9]. Since more and more mobile applications (APPs) have been developed and used by people, the research on user experience with APPs has also become a hot topic. Xue and Zhao (2020) conducted a study on the user experience of mobile music APPs and proposed a corresponding user experience evaluation system [14]. Feng (2021) analyzed the user experience of mobile reading APPs from the perspective of interface design [7]. Zhu, Zha, and Yan (2020) studied mobile reading APPs and found that user experience has a positive impact on user satisfaction and trust [17]. Lu, Zhang, and Nong (2019) conducted a study on the user experience of the State Council APP and found that users' motives for using it mainly include obtaining government information, pursuing the right to know, participating in social public affairs, social responsibility and sense of belonging, and proposed that the development of government new media should build a government communication platform with multi-functionality from the perspective of users [10]. The above studies all start from the user's perspective and explore how to build a good mobile APP with a good user experience. it is evident that user experience can affect the quality of an APP, and an excellent government APP needs to have a good user experience.

The China Mobile Government Services Index released by the Digital and Mobile Governance Laboratory of Fudan University has built an evaluation system of mobile government APPs in five dimensions, including availability, usefulness, usability, satisfaction, and sense of security. This five-dimensional user evaluation system reflects the user experience, and this study adopts this evaluation system as the measurement standard for the user experience of the government APPs. According to the expression of user experience by the Digital and Mobile Governance Laboratory of Fudan University,

the specific meaning of the five dimensions is as follows. Availability means that users can be informed and download the mobile government APP through the official website and application market. The app notification and download to evaluate availability. Usefulness means that the mobile government APP can provide and effectively use four types of services. The app information service, service processing, problem consultation, and complaint suggestion evaluate usefulness. Usability refers to the user's ability to use services smoothly and conveniently on the mobile government APP. Technical, login, content, navigation, the effectiveness of search, inclusiveness of services, and perfection of customer service evaluate usability. Satisfaction refers to the user's overall feeling and satisfaction with the mobile government APP. Specifically, service processing effect, user experience evaluation, user stickiness, and user propagation will evaluate satisfaction. Security can make users feel safe, refers to the main body of the mobile government APP marked with authority, privacy policy compliance, and the ability to deal with various technical security issues. Specifically, authority, compliance with the privacy protection agreement, and strong security protection evaluate security.

2.1.2 Government APP Evaluation System

There are four methods to evaluate informatization quality classification as follows: income view based on input and output, process view based on project construction, a quality view based on organizing the global situation, and application view based on customer demands [13]. These four methods make some sense but lack a focus on user experience. Establishing a government APP centered on user experience can better reflect the humanistic care of the government. From the user's perspective, a government app can work must be downloaded before. So, how to get a government APP can affect the user's experience. People easy to get the government app must consider when constructing a government APP evaluation system. During the use of a government APP, there are three dimensions to evaluate the government from the user experience. First, the government APP must be easy to operate for the user. Secondly, the app should meet various needs. And last but not least, the privacy of personal information must be well protected. In this stage, the evaluation system may focus on the usefulness, usability, and security of the government APP. After using the government app, there is an overall feeling that must consider in constructing the evaluation system. It indicates the overall satisfaction of the user. Therefore, base on the process of users using the government APP to make the evaluation system is practically significant.

According to the user experience theory, this study constructs an evaluation system for government apps. Availability is measured before use; usefulness, usability, and security are measured during use; satisfaction is measured after using the government app. In order to express the evaluation system of the government APP more graphically, we have made a figure to show the evaluation system. Figure 1 shows the government APP evaluation system as follows.

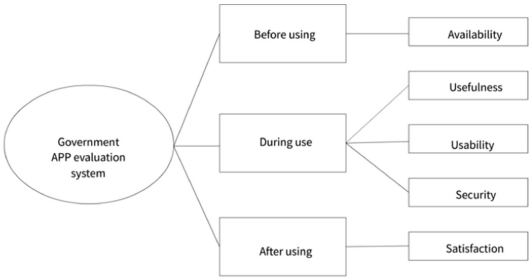

Fig. 1. Government APP evaluation system

2.2 Research Methods and Variable Settings

2.2.1 Crisp-Set Qualitative Comparative Analysis (csQCA)

Crisp-set Qualitative Comparative Analysis (csQCA) is a QCA technique developed by Charles Ragin and Kriss Drass in the late 1980s. The method is case-oriented and integrates the advantages of quantitative analysis by focusing on "concurrent causality" across cases; in short, csQCA explores how different configurational conditions may lead to the same outcome [11]. For example, GDP per capita, urbanization, literacy rate, and industrial labor force influence the democracy of a country. But all four factors don't need to meet. It is possible to achieve democratization with one or a configurational of these factors. The configurational of these factors may vary from country to country. And csQCA can find out such configurational. The user experience of a government APP may have several indicators, and it may be possible that one or configurational can achieve the standard of an excellent government APP. Therefore, this study adopts csQCA to explore the configurational conditions of the excellent government app.

The general steps of clear set qualitative comparative analysis (csQCA): Step 1, construct the dichotomous data table, assign 0 or 1 to the variables in each case to get the dichotomous data table; Step 2, construct the "truth-table", analyze the dichotomous data through QCA software to form the truth table; Step 3, solve the contradictory grouping, if there is Step 4, Boolean minimization, i.e., if only one variable in the configurational of two condition variables is different but the outcome variable is the same, the variables in the two condition configurational are considered unrelated to the outcome variable and can be simplified and removed; Step 5, explanation, return to the case to explain the smallest configurational of condition variables [11].

2.2.2 Variable Settings

Conditional Variables: The conditional variables in this paper use the China "Handheld Good Office" index and the "China Provincial Mobile Government Services Report" released by the Institute of Digital and Mobile Governance of Fudan University, which evaluated the availability, usefulness, usability, satisfaction, and security of 31 provincial government APPs nationwide, with each dimension, is divided into five levels, such as A+, A, B+, B, and C. In this paper, the A+ and A scored 1, and B+, B, and C scored 0.

Outcome Variable: In this paper, based on the excellent level of the 2021 provincial government APP survey evaluation from the 2021 Digital Government Service Capability Evaluation Results released on e-government online, there are 15 province government APPs (municipalities directly under the central government or autonomous regions) such as Beijing, Tianjin, Shanghai, Jiangsu and Zhejiang as excellent. The 15 province government APPs evaluated as excellent scored 1, and the other scored 0. Table 1 shows the outcome variables and conditional variables. Availability, usefulness, usability, satisfaction, and sense of security.

3 Research Results

3.1 Single-Factor Necessity Analysis

First, the explanatory variables are analyzed to see whether a single variable is a necessary or sufficient condition for an excellent government APP. If there is a sufficient explanatory variable, once this variable appears, the provincial government APP is necessarily evaluated as excellent. From Table 1, we can get that none of the five explanatory variables is a sufficient condition. Necessity explanatory variables mean the consistency index with the following formula: consistency $(Yi \leq Xi) = \sum \min(Xi \leq Yi)/\sum(Yi)$. Where Xi refers to the affiliation scores in the explanatory variables and Yi refers to the affiliation scores in the outcome variables. Generally, it is considered necessary for the outcome when the consistency is more than 0.9 [8]. Used csQCA to analyze the univariate necessity. Table 2 shows no single variable among the explanatory variables is a necessary condition. And the explanatory strength of variable X for Y can be further judged by the coverage ratio.

3.2 Multi-factor Configurational Analysis

Since no single factor alone can make a government APP reach the standard of excellence, multi-factor analysis is required. Under the condition that the minimum case threshold is 1 and the fit threshold is 0.8. The explanatory power of the condition variables on the outcome variables is computed in Table 3.

According to the results of the multi-factor analysis, there are four configurational to achieve the goal of building an excellent government APP with an overall consistency of 1 and an overall coverage rate of 0.666667, which indicates the model has good explanatory power. Specifically, the explanatory logic of the four kinds of building an excellent government APP is as follows. Firstly, availability*satisfaction*Security. The row coverage of this configurational is 27%, which can explain 27% of the cases. The unique coverage is 13%, which means 13% of the cases can be explained by this configurational only. Second, ~usefulness*usability*~satisfaction*Security. This configurational has a row coverage of 13%, which explain 13% of the cases. The unique overage is 13%, which means 13% of the cases can be explained by this configurational. Third, ~ usefulness* ~ usability*satisfaction*Security. This configurational has a row coverage of 20%, which explain 20% of the cases. The unique coverage of 13%, which means 13% of the cases can be explained by this configurational. Fourth, availability*usefulness*usability*satisfaction. This configurational has a row coverage of 20%,

Table 1. User experience indexes of government APP, dichotomous data.

Province	Ava	Use	Usa	Sec	Sat	Exc
Guangdong	0	0	0	0	0	0
Jiangsu	1	0	1	0	1	1
Shandong	1	0	0	1	1	1
Zhejiang	1	1	1	1	0	1
Henan	0	0	0	0	0	1
Hebei	0	1	0	0	1	0
Liaoning	0	0	0	0	1	0
Sichuan	0	0	0	1	1	1
Hubei	0	0	1	0	1	1
Hunan	0	0	0	0	0	0
Fujian	0	0	0	0	1	1
Shanghai	1	1	1	1	0	1
Beijing	0	0	0	1	0	1
Anhui	1	1	1	1	1	1
NeiMonggu	0	0	0	1	0	0
Shaanxi	0	0	0	0	0	0
Tianjin	1	0	1	1	1	1
Jiangxi	1	1	0	1	1	1
Guangxi	1	0	0	0	1	0
Heilongjiang	0	0	0	0	0	0
Chongqing	0	0	0	0	0	1
Jilin	0	0	0	0	0	0
Yunnan	0	0	0	1	1	1
Shanxi	0	0	0	0	0	0
Xinjiang	0	0	0	0	0	0
Guizhou	0	0	0	0	0	0
Gansu	0	0	0	0	1	1
Hainan	1	0	0	0	0	0
Ningxia	1	1	0	0	1	0
Qinghai	0	0	0	0	0	0
Tibet	0	0	0	0	0	0

Ava = Availability, Use = Usefullness, Usa = Usability, Sec = Security, Sat = Satisfaction, Exc = Excellence.

Table 2. One-factor sufficiency and necessity analysis.

Conditional	Consistency	Coverage
Availability	0.466667	0.700000
Usefulness	0.266667	0.666667
Usability	0.400000	1.000000
Satisfaction	0.600000	0.900000
Security	0.666667	0.714286

Table 3. Combined results of multiple factors.

Configuration	Row Coverage	Unique Coverage	Consistency
availability*satisfaction*Security	0.266667	0.133333	1
~usefulness*usability*~satisfaction*Security	0.133333	0.133333	1
~usefulness*~usability*satisfaction*Security	0.2	0.133333	1
availability*usefulness*usability*satisfaction	0.2	0.133333	1
Solution Coverage: 0.666667 Solution Consistency: 1			

Note: * is the link symbol between variables, indicating the intersection of "and", ~ means "not", i.e. "must not exist".

which explain 20% of the cases. The unique coverage is 13%, which means 13% of the cases can be explained by this configurational only. The first configurational: availability*satisfaction*Security explains the strongest, indicating that the most important elements for building a good government APP may be availability, satisfaction, and security. Further analysis shows that the two elements of satisfaction and sense of security appear most frequently among the four configurational, indicating that from the perspective of user experience, satisfaction and sense of security of the government APP are more important.

Therefore, there are two ways to meet an excellent government APP from above analysis. One is based on security, which means the personal information can be well protected when using the government app. Security with one of the two factors of usability and satisfaction is enough. The other is based on other factors, which means an excellence government APP must present availability, usefulness, usability, and satisfaction at the same time.

4 Conclusion

Government informatization has gained a lot of attention for many years. The purpose of E-government is to deliver cheap, and effective service to the public [2, 3]. The

government APP is the most significant instrument of government informatization [1], and it is widely used in the field of government services. An excellent government APP is essential to improve the efficiency of administration. Thus, constructing a government with good features is not only contributes to the efficiency of government but also beneficial to the people.

According to the research results, the two most important factors for building an excellent government APP from the user experience perspective are satisfaction and a sense of security. So, it is necessary to pay attention to these two factors in building a government APP. Specifically, to improve the satisfaction of government APPs is to optimize the efficiency of service processing, improve the user experience in the process of doing business, enhance the user's stickiness and improve the user's willingness to spread, etc. The authority of the main body of government APP is better for the sense of security. And the government to make a legal and reasonable privacy policy, improving the skill ability to ensure that it can cope with all kinds of technical security problems. The government to make users feel safe through these three aspects, improving the user experience felling, and improving the overall quality of the government APP.

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