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Full Research Paper

Understanding Users' Response to Open Government Data Portal: an Exploratory Study

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Abstract: Open government data portal (OGDP) makes the government transparent and enables the public to obtain massive data. However, the public know little about OGDP and the value of government data is still waiting for exploration. This paper takes IS success model, TAM and the paradigm of SOR to study the factors affecting users' response to OGDP. It selects system quality, data quality, interactivity, policy environment, perceived usefulness, perceived ease of use and use intention as variables to build research model. After collecting 93 valid respondents, we utilized SmartPLS to conduct statistical analysis for the model. The exploratory study finds that data quality affects system quality, and system quality positively affects perceived usefulness and perceived ease of use. Policy environment affects users' interactivity with OGDP, then influences their perception of the system, ultimately responds as use intention. Finally, this paper confirms that the mediating effect only exists in interactivity and perceived ease of use on the relationship between policy environment and use intention. Then it proposes suggestions for improving data and system quality, enhancing interactivity to encourage the public to use OGDP more frequently, and create value with government data.

Keywords: Open government data portal(OGDP), Perceived usefulness, Perceived ease of use, Use intention

1. INTRODUCTION

Open government data (OGD) is termed as making public sector information freely available in open formats and ways that enable public access and facilitate exploitation^[1], and it constitutes an important resource due to its potential to empower citizens, businesses, and transform how government delivers public services. In the past decades, governments around the world have built data portals, which is of great significance for enabling greater accountability, delivery of higher quality and new services, reduction in operation costs, and stimulation of innovations in both government organizations and businesses^[2]. The US government launched its open data portal data.gov in 2009, and took OGD as national strategy. Afterwards, some other countries such as UK, Denmark and Australia established OGDP as well. In China, the first local government data portal "Shanghai government data service platform" was launched in 2011. From then on, OGD has become necessity for e-government development. However, most of the previous studies concentrate on mechanism of OGD, or the impact on government, but the public still know little about OGD in China, let alone use of OGDP.

Open government data is an important part of the implementation of e-government, there are some studies about continuous use intention of e-government application. Based on TAM and ECM-ISC(Expectation Confirmation Model of IS Continuance), perceived usefulness, perceived ease of use, perceived trust and perceived entertainment affect users' satisfaction and continuous use of e-government^[3]. In addition, others think

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that network externalities, service quality, expectation confirmation and satisfaction significantly affect the citizens' continuous use intention of government portal^[4]. A case study of Harbin showed that perceived ease of use, compatibility and trust of network are the main factors influencing use intention of government portal^[5]. Because e-government and its extended application are kind of novelty, most of the research on the use intention relied on TAM or IS success model.

By far, the research about users' response to OGDG is still scarce. Zhu et al. introduced "flow experience" as users' perception or emotion, attributes of OGDG as stimuli, and response as continuous use intention^[6], but they did not test the reliability and validity of the model. It is ubiquitous that users are with low cognition and utilization of open government data, Gao and Mo integrated TAM and UTAUT to find that perceived trust, performance expectation and convenience have significant impacts on the initial adoption intention of OGDG^[7], but they did not consider of data quality and interactivity, which may influence users' perception.

The goal of this research is to extend previous studies to a better understanding of user's response to open government data portal. We develop a research model that integrates IS success model, technology acceptance model (TAM) and stimulus-organism-response (SOR) paradigm, and then try to find the factors that would influence users' most important response "use intention", and then increase the usage of OGDG, ultimately release the value of government data.

2. RESEARCH BACKGROUND AND HYPOTHESES

In 1992, DeLone and McLean presented Information Systems (IS) Success Model as a framework and model for measuring the complex dependent variable in IS research. The model focuses attention on the information and system quality of specific IT systems. After ten years, they added "service quality" and used "net benefits" to the updated model for measuring IS success. In addition, information quality measures that have been used in e-commerce studies include accuracy, relevance, understandability, completeness, currency, dynamism, personalization, and variety. While data quality is a measure of the condition of data based on factors such as accuracy, completeness, consistency, reliability and whether it's up to date. In big data era, since OGDG is kind of IS, this paper takes data quality as construct instead of information quality to the research model.

Technology acceptance model (TAM) was proposed by Davis^[8], he defined perceived usefulness (PU) as "the degree of which a person believes that using a particular system would enhance his or her job performance", and perceived ease of use (PEOU) as "the degree of which a person believes that using a particular system would be free of effort." Lots of research about e-commerce or e-government use TAM to do empirical study. For example, with regard to the government website of Shanghai, perceived usefulness and perceived ease of use have significant impact on the citizens' use behavior^[9]. Lan took TAM and ISC to study the impact of context-aware services on the continuous use of mobile government^[10]. It seems that perceived usefulness and perceived ease of use are suitable to study use intention of OGDG as well.

According to the Stimulus-Organism-Response (SOR) framework, environmental or situational stimuli(S) affect internal organism (e.g., cognition and emotion)^[11]. Stimuli may manifest in different representations, that affect the internal states (O) of people, then results in their behavioral responses (R). Since SOR is usually applied to investigate the relationship between environmental stimuli and response of users, perceived usefulness and perceived ease of use in TAM are two important factors affecting users' intention or behavior. In the context of open government data, the public are stimulated to visit OGDG in order to access government data for daily use or application development. Scholars confirmed that system quality directly affects user satisfaction and determines users' intention to continuous use^[12]. System quality means the clarity of page layout, ease of data retrieval, diverse function and stability of OGDG, and it will be stimuli to users. While data quality refers to data integrity, reliability, timeliness and clear classification, it also affects users' experience of data access from OGDG.

Interactivity means that users can receive feedback from OGDG in time, make comments about the data,

share data with others, and use the government data for application development. Trentin et al. found that customers would continue to use the website when their opinions are concerned^[13]. Therefore, this paper takes interactivity as kind of stimuli.

OGDP provides public services for citizens. Government should initiate policies or sponsor some activities to encourage citizens to use the portal. Therefore, policy environment also stands for a stimulus variable.

Internal state (O) is the process of cognition and emotion after stimulation. Xu based on TAM to study the factors affecting users' use intention of government applications, and found that perceived ease of use and perceived trust of government applications affect perceived usefulness^[14]. According to TAM and IS success model, Zhu et al. found that perceived usefulness, perceived ease of use and information quality positively affected continuous use intention of government website^[15]. Perceived usefulness means the government data may satisfy the users' demand, and perceived ease of use means the operation of OGDP is simple, users can search and download data in a suitable format freely. Therefore, this paper takes perceived usefulness and perceived ease of use as the "internal state" variables.

Response is use intention or behavior after users experiencing the stimulus and their internal state take some changes. So we takes use intention as the variable of "response" in the context of OGDP.

Scholars have done some research in information technology field. Zheng et al. based on the IS success model to find that information and system quality directly affect perceived individual benefits and user satisfaction, which ultimately determine continuous intention to consume and to provide information^[12]. Since data is kind of information, perceived usefulness and ease of use may stand for perceived benefits as well, this paper proposes the following hypotheses:

H1: System quality of OGDP is positively related to perceived usefulness.

H2: System quality of OGDP is positively related to perceived ease of use.

H3: Data quality of OGDP is positively related to perceived usefulness.

H4: Data quality of OGDP is positively related to perceived ease of use.

As for interactivity and policy environment, Yang proved that interactivity has positive impact on perceived usefulness and perceived ease of use of the virtual community^[16]. Zhang used TAM to study the influence of interactivity on the student's continuous learning intention. The result showed that interactivity positively affects perceived usefulness and perceived fun^[17]. In addition, Wang and Lo argued that the government and the public may influence government agencies throughout OGD adoption and implementation^[18]. Similarly, government may put forward some policies to encourage the public to use OGDP. Then the following hypotheses are proposed.

H5: Interactivity of OGDP is positively related to perceived usefulness.

H6: Interactivity of OGDP is positively related to perceived ease of use.

H7: Policy environment is positively related to perceived usefulness of OGDP.

H8: Policy environment is positively related to perceived ease of use of OGDP.

Based on TAM, the research on use intention of the government application (APP) shows that the public's perceived ease of use and trust of the government APP will affect perceived usefulness, while perceived usefulness and perceived ease of use will positively affect the public's use attitude of government applications^[14]. Eroglu et al. explored how environmental factors influence consumer's attitude with SOR, thus affects shopping outcome of online store^[19]. In the context of OGDP, the following hypotheses are proposed.

H9: Perceived ease of use is positively related to perceived usefulness of OGDP.

H10: Perceived usefulness of OGDP is positively related to use intention.

H11: Perceived ease of use of OGDP is positively related to use intention.

The research model is shown as Figure 1.

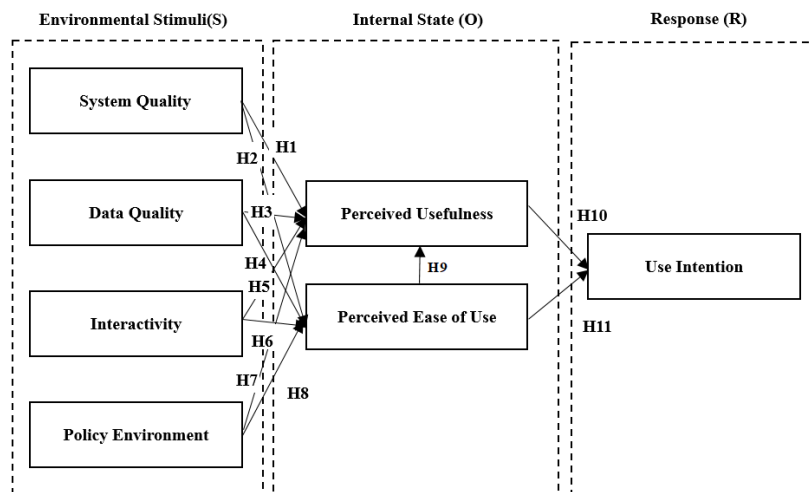


Figure 1. Research model

3. METHODOLOGY

3.1 Scale development

The questionnaire consists of two parts. The first is designed to investigate the demographic features of the respondents. The second part consists of 27 items to measure variables. The items were measured on Likert seven-point scale that ranges from 1 (strongly disagree) to 7 (strongly agree).

Table 1. Constructs and measurement items

Constructs	Item	Measurement	References
System Quality (SQ)	SQ1	Data engine of OGDP offers perfect function and is easy to use.	[6][10][15]
	SQ2	OGDP has clear page layout.	
	SQ3	OGDP is available in multiple formats for downloading data.	
	SQ4	Service provided by OGDP is completed.	
	SQ5	OGDP has smooth system access.	
Data Quality (DQ)	DQ1	OGDP has clear data classification.	[6][15]
	DQ2	OGDP updates data in time.	
	DQ3	The data of OGDP is reliable.	
	DQ4	The data of OGDP is completed.	
Interactivity (IA)	IA1	OGDP provides various forms of interaction.	[6][7]
	IA2	OGDP responds quickly to users' suggestion and comment.	
	IA3	OGDP provides instant data sharing through social media.	
	IA4	It is easy to use OGDP for application development.	
Policy Environment (PE)	PE1	The government ensures the standard and institution of OGDP by policy.	[20]
	PE2	The government encourages the public to participate in the innovative application of OGDP.	
	PE3	Government makes the public pay attention to OGDP.	
Perceived Usefulness (PU)	PU1	OGDP can effectively match my needs.	[6][10]
	PU2	OGDP enables me to learn the latest data released by the government.	
	PU3	OGDP can help me to solve problems and save my time and efforts.	

	PU4	OGDP can help to improve my efficiency.	
Perceived Ease of Use (PEOU)	PEOU1	It is easy to find OGDP.	[14] [21]
	PEOU2	It is easy to learn to use OGDP.	
	PEOU3	It is easy to follow the instructions provided by OGDP.	
	PEOU4	It is easy to find the data that I need by OGDP.	
Use Intention (UI)	UI1	I will try to use OGDP.	[15] [21]
	UI2	I will continue to use OGDP.	
	UI3	I will recommend OGDP to my friends.	

3.2 Descriptive statistical analysis

We distributed 115 questionnaires and received 93 valid responses from January to March 2019. Respondents were asked to visit some OGDP in China (e.g. <http://data.beijing.gov.cn/>, <http://data.sh.gov.cn/>) before they filled in the questionnaire. As shown in Table 2, more than half of the respondents used OGDP for the first time, 30.11% of them used occasionally, and only 16.13% of them used frequently. It is obvious that the public has low awareness of OGDP. Among the respondents, 51.61% were male and 48.39% were female, 55.91% of them were between 18 and 29 years old. As to job occupation, 33.33% were college students, 23.66% were company employees, and 18.28% were government staff. It seems that the respondents are relatively young and the job occupation distributed evenly, the sample is representative for OGDP users.

Table 2. The Demographics of Respondents (N=93)

Profiles	Options	Frequency	Percentage
Gender	Male	48	51.61%
	Female	45	48.39%
Age	18 or Younger	4	4.30%
	18-29	52	55.91%
	30-39	9	9.68%
	40-49	14	15.05%
	50 or Older	14	15.05%
Job Occupation	Professional(teachers/doctors/lawyers)	11	11.83%
	Company employees	22	23.66%
	Government staff	17	18.28%
	College students	31	33.33%
	Others	12	12.90%
Experience of OGDP	First time to Use	50	53.76%
	Frequently Use	15	16.13%
	occasionally Use	28	30.11%

4. DATA ANALYSIS

We employed SmartPLS, a type of partial least squares (PLS) technique for component-based structural equation modeling (SEM) to test the research model. Because PLS is suited for exploratory theory building and just requires the sample size to be at least 10 times the largest number of paths aiming at an endogenous construct^[22]. In our research model, the maximum number of paths that directing at an endogenous variable is 5. Therefore, the sample size of 93 was sufficient for the use of SmartPLS.

4.1 Measurement model

Reliability refers to the consistency or stability of the items, as shown in Table 3. This study employed Cronbach's α and composite reliability (CR) to reflect reliability. Most of Cronbach's α is greater than 0.7 except use intention, but the value 0.698 is very close to 0.7. In addition, CR of each construct is greater than 0.8, the reliability is acceptable. The AVE value of each variable is greater than 0.5, hence convergent validity is established. In addition, the VIFs of all items range from 1.213 to 2.529, far below the suggested threshold value 5. Therefore, there is no multi-collinearity in our study.

Table 3. Construct reliability and convergent validity

Constructs	Items	Loadings	Cronbach's α	CR	AVE	VIF
System Quality	SQ1	0.770	0.778	0.849	0.530	1.699
	SQ2	0.724				1.412
	SQ3	0.713				1.419
	SQ4	0.675				1.385
	SQ5	0.753				1.639
Data Quality	DQ1	0.851	0.820	0.881	0.650	2.019
	DQ2	0.788				1.611
	DQ3	0.737				1.552
	DQ4	0.844				2.147
Interactivity	IA1	0.794	0.773	0.854	0.595	1.600
	IA2	0.737				1.389
	IA3	0.802				1.567
	IA4	0.752				1.489
Policy Environment	PE1	0.883	0.843	0.905	0.761	2.245
	PE2	0.897				2.529
	PE3	0.836				1.715
Perceived Usefulness	PU1	0.799	0.777	0.857	0.600	1.763
	PU2	0.745				1.465
	PU3	0.734				1.355
	PU4	0.818				1.872
Perceived Ease of Use	PEOU 1	0.779	0.831	0.888	0.664	1.587
	PEOU 2	0.855				2.060
	PEOU 3	0.836				1.894
	PEOU 4	0.787				1.776
Use Intention	UI1	0.697	0.698	0.833	0.627	1.213
	UI2	0.824				1.529
	UI3	0.846				1.646

According to the method proposed by Fornell and Larcker^[23], if the Pearson correlation coefficient between each variable is smaller than the square root of the AVE on the diagonal, the discriminant validity is acceptable. As shown in Table 4, the discriminant validity meets the requirement.

Table 4. Results of discriminant validity

Constructs	DQ	IA	PE	PEOU	PU	SQ	UI
DQ	0.806						
IA	0.728	0.771					
PE	0.742	0.718	0.873				
PEOU	0.668	0.777	0.564	0.815			
PU	0.640	0.704	0.612	0.710	0.775		
SQ	0.788	0.736	0.630	0.685	0.709	0.728	
UI	0.660	0.646	0.552	0.692	0.689	0.698	0.792

4.2 Structural model

The relationships in the research model are examined by SmartPLS. After bootstrapping 5000 times, as shown in Table 5, 7 of 11 hypotheses, H2, H3, H4, H5, H7, H8 and H9 are not supported by significant at 0.05 level. It seems that the model needs some modification.

Table 5. Hypotheses testing results of research model

Hypothesis	Relationships	Path coefficient	P value	Results
H1	SQ→PU	0.333	0.013	Supported
H2	SQ→PEOU	0.170	0.192	Not Supported
H3	DQ→PU	-0.061	0.656	Not Supported
H4	DQ→PEOU	0.195	0.189	Not Supported
H5	IA→PU	0.127	0.510	Not Supported
H6	IA→PEOU	0.615	0.000	Supported
H7	PE→PU	0.175	0.176	Not Supported
H8	PE→PEOU	-0.040	0.712	Not Supported
H9	PEOU→PU	0.324	0.051	Not Supported
H10	PU→UI	0.397	0.002	Supported
H11	PEOU→UI	0.411	0.001	Supported

4.3 Model modification

After reviewing literatures again, we find some scholars believe that system quality includes data quality, and others think that data quality affects system quality, so we try to set data quality as an antecedent variable of system quality. Interactivity reflects users' communication with government and feedback of use experience of OGDP. Policy may increase the public's awareness of open government data, and then promote their interaction with government and OGDP. Therefore, policy environment may be an antecedent variable of interactivity. So we delete H3, H4, H7 and H8, afterwards develop two new hypotheses.

H3': Data quality of OGDP is positively related to system quality.

H7': Policy environment is positively related to interactivity of OGDP.

The modified research model is shown as Figure 2.

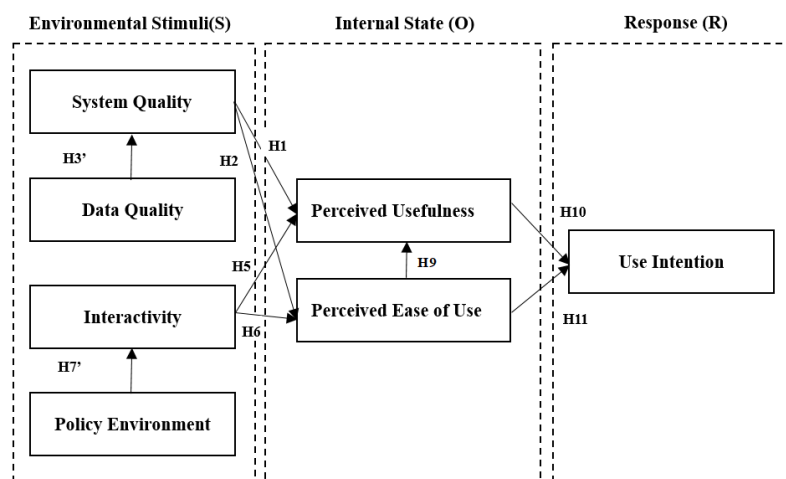


Figure 2. Modified research mode

4.4 Hypotheses testing results of the modified model

The hypotheses testing results of the modified model are shown in Table 6. Only H5 and H9 are not supported by significant at 0.05 level. It seems that the modified model is more suitable than the original one.

Table 6. Hypotheses testing results of the modified model

Hypothesis	Relationships	Path coefficient	P value	Results
H1	SQ → PU	0.339	0.016	Supported
H2	SQ → PEOU	0.247	0.036	Supported
H3'	DQ → SQ	0.788	0.000	Supported
H5	IA → PU	0.210	0.271	Not Supported
H6	IA → PEOU	0.595	0.000	Supported
H7'	PE → IA	0.718	0.000	Supported
H9	PEOU → PU	0.314	0.053	Not Supported
H10	PU → UI	0.397	0.002	Supported
H11	PEOU → UI	0.411	0.001	Supported

4.5 Mediating effect test

In the modified model, there may be some mediating effect between the variables. By comparing the direct effects of data quality and policy environment on use intention (Table 7) and the integrated indirect effects (Table 8) from bootstrapping results of SmartPLS, we find that most of the indirect effects of independent variables on use intention are not significant, indicating only the mediating role of interactivity and perceived ease of use on the relationship between policy environment and use intention exists.

Table 7. Direct effect test of variables on use intention

	Original	Sample(O)	Sample Mean(M)	T value	P value	Test result
DQ → UI		0.211	0.224	2.620	0.009	Significant
PE → UI		0.288	0.284	3.729	0.000	Significant

Table 8. Mediating effect test of variables

	Original Sample(O)	Sample Mean(M)	T value	P value	Test result
DQ→SQ→PU →UI	0.106	0.115	1.528	0.127	Not Significant
DQ→SQ→PEOU →UI	0.080	0.088	1.608	0.108	Not Significant
DQ→SQ→PEOU →PU→UI	0.024	0.022	1.517	0.129	Not Significant
PE→IA→PU →UI	0.060	0.058	0.987	0.324	Not Significant
PE→IA→PEOU →UI	0.175	0.177	2.691	0.007	Significant
PE→IA→PEOU →PU →UI	0.053	0.049	1.644	0.101	Not Significant

5.CONCLUSIONS AND DISCUSSIONS

This study investigated the issue of user's response to open government data portal and revealed that both perceived usefulness and perceived ease of use have positive effects on use intention, which means users are willing to use OGDG when they believe that it is convenient and will bring benefits. System quality has positive impact on perceived usefulness and perceived ease of use, which confirms that OGDG should provide easy and stable access to attract users. So government should increase investment in technology to enhance system reliability and make it convenient to operate. Data quality has significant impact on system quality, and then affects perceived usefulness and perceived ease of use. It seems that ensuring the reliability, timeliness and completeness of data is helpful to improve users' positive perception.

On the other hand, policy environment has positive effect on interactivity, and interactivity influences perceived ease of use, but perceived ease of use does not positively affect perceived usefulness. That is to say, users may prefer to use OGDG if the government offer more channels to interact with them and pay more attention to their feedback.

Finally, we test the mediating effect of the modified research model. Data quality(DQ) and policy environment(PE) have significant direct effect on users' use intention(UI). While there are respectively three path from DQ to UI and from PE to UI, the indirect effect only exists in the path of PE→IA→PEOU →UI, indicating the mediating role of interactivity and perceived ease of use on the relationship between policy environment and use intention.

5.1 Theoretical and Practical Implications

This study has both theoretical and practical implications for understanding users' response to OGDG. From a theoretical perspective, this study enhances current understanding of IS success model and TAM by focusing on OGDG. Considering the situation of open government data, it applies IS success model by taking data quality instead of information quality. More specifically, this study shows data quality of OGDG has significant impact on system quality, and then affects users' perceived usefulness and perceived ease of use. Our findings also explain the mediating role of interactivity and perceived ease of use on the relationship between policy environment and use intention. From a practical perspective, the study results show that both system quality and interactivity are important for improving perceived usefulness and perceived ease of use, and helps OGDG retain users. That means the government should focus on increasing data quality and system quality through continuous system upgrades. Moreover, it is a good strategy for the government to encourage users to visit and interact with the system frequently, and create value with the government data.

5.2 Limitations and Future Directions

This study still has some limitations due to the sampling methods and measurements. First, we distributed the questionnaires online. Respondents were asked to visit some OGDG in China before they filled in the questionnaire. There is no evidence that the sample is representative of the whole population of OGDG users. Future studies should investigate and compare different samples to increase external validity. Second, as

individual survey research, the sample size of 93 is limited. In order to make more sense of our findings, further research may validate the model by using a larger sample of more than 300 respondents. The last but not least, users of different age and job occupation may have different demand of data. In the future, we will discuss how to push accurate data to users by analysis of demographic information and access preferences, ultimately improve users' use intention of OGDP.

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