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An Empirical Research on the Construction of a Government Website Public Satisfaction Index Model in China

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ABSTRACT

With proliferated applications of the internet and world wide web, people are increasingly interacting with government websites. It is therefore significant to measure satisfaction on government systems from citizen's perspective. While general customer satisfaction index (CSI) models have received much attention from researchers, few studies are conducted to evaluate public satisfaction on government websites. The extent to which traditional CSI models can be extended to investigate public satisfaction on government websites remains unclear. On analysis of CSI, technology acceptance model (TAM), and task-technology fit (TTF) model, this study constructs a government website public satisfaction index (GWPSI) model and provides an empirical study by adapting GWPSI model in the context of G2C e-government. Structural equation modeling (SEM) is applied to data collection and processing with questionnaires collected from users of the government website of Guangdong Province in China. The findings provide several important implications for e-government research and practice.

KEYWORDS

CSI, Government Website Public Satisfaction Index Model, PLS, SEM, TAM

INTRODUCTION

A government website is a virtual platform for providing the public with specific e-government services through integrating and linking various applications and resources (H. T. Li, 2018). It is an indispensable part of e-government development in individual countries across the world. This is because government websites usually function as the focus point for various stakeholders to access e-government services (Wong & Welch, 2004). Through government websites, governments are able to provide citizens with diversified public services (J. Y. Liu et al., 2005). In this context, improving the performance of government websites is becoming critical for the continuous development of e-government under different circumstances.

In the last two decades, researchers have conducted in-depth studies on the performance evaluation of government websites with regard to the evaluation theories, evaluation systems and evaluation methods (Torres et al., 2005; Gouscos et al., 2007; Elling et al., 2012). While most of them focused on the supply side of government websites, knowledge about the evaluation of public satisfaction on government websites still remains limited. As an integrated platform for public service delivery and a channel for the interaction between the government and the public, the government

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website should focus on public demand and provide online products and services with high quality and efficiency, ultimately satisfying different groups of users. Therefore, conducting performance evaluation research from the perspective of public satisfaction is strongly persuasive for guiding the construction and improvement of government websites. How to identify the critical factors affecting public satisfaction on government websites is becoming a prominent focus in the government website evaluation research and practice.

The public satisfaction on government websites is a reflection of the public psychological feeling generated by the disconfirmation between expectancy quality and perceived service quality of government websites (H.T. Li, 2018). It shares the same essence with the customer satisfaction (CS) concept from marketing. This is because the interaction between government websites and the public is essentially a relationship of producers and consumers. According to the Lindahl Equilibrium theory, to ensure the effective supply of public products, each citizen should undertake corresponding costs consciously in accordance with the marginal benefits from public products (Foley, 1970). The public service supplied by government websites is actually the product which governments provide to the public, and the funds for constructing and maintaining government websites are taxes paid by the public who gain benefits from the services. The disconfirmation between the "product" provided by government websites and "cost" paid by public will directly affect the degree of public satisfaction. This is consistent with the idea of traditional CS theories. Due to the connection point between government website public satisfaction and customer satisfaction, exploring how to apply existing CS models and theories to the government website performance evaluation is both reasonable and essential.

The research on government website public satisfaction essentially pertains to the domain of information system user acceptance. Therefore, factors derived from information system theories and models should be taken into consideration as well. Although the development of information technology promotes the increase of websites and the improvement of website functions, well developed website technology platforms and service systems would be useless without public acceptance and utilization. To better understand the information technology acceptance of government website users and figure out its influence on public satisfaction, it is useful to absorb factors related to the public psychology, cognition, and behaviors from Technology Acceptance Model (TAM). In a sense, the public take the government website as a tool to solve specific tasks in their work and study. Due to the objective diversity of public information literacy, utilization behavior and task contexts, same technology supports provided by government websites may bring different experience under different "task" circumstances, which will directly make a difference to public satisfaction. So, the fitness between the information technology provided by government websites and users' real tasks should also be considered when evaluating government website public satisfaction, which leads to the adoption of Task-technology Fit Model (TTF).

According to the analysis above, while government website public satisfaction shares the same essence with corporate customer satisfaction, it is also influenced by various factors from the information system theories, such as public perception of usefulness (Joo & Sohn, 2008), ease of use (Gefen & Straub, 2000), and fitness between actual utilization transaction and technology support of the website (Sun, 2010). Thus, it is necessary to integrate theories and models in the fields of marketing and information system for a more thorough understanding of public satisfaction on government websites. This study aims to meet this call by constructing a Government Website Public Satisfaction Index (GWPSI) model in China with a combination of CS, TAM and TTF models. The research findings contribute to the existing knowledge about evaluating government website performance from the perspective of public satisfaction, and broaden the application fields of existing CS, TAM and TTF theories and models.

The rest of this paper starts with a comprehensive discussion of the related literature and theoretical models, leading to the development of a Government Website Public Satisfaction Index (GWPSI) model. Such a conceptual model is then tested and validated through an empirical study. Finally, the

validation and modification of GWPSI model is illustrated, together with findings and implications drawn from the research.

THEORETICAL BACKGROUND

Government Website Public Satisfaction Evaluation

The research on evaluating the public satisfaction of government websites began in the early 21st century. In general, there are three categories of related studies, including institutional research, project evaluation, and academic research. Institutional research and project evaluation are generally carried out by national governments and large commercial organizations. Since 1998, Institute for Citizen-Centered Service in Canada has carried out eight government-commissioned surveys named "Citizen First", using SEM to analyze the factors affecting public satisfaction on government websites (Institute for Citizen-Centered Service, 2019). In 2001, the United States applied the ACSI model to the performance evaluation of government websites and replaced the traditional indicators (e.g., the number of pages viewed) with the customer satisfaction index (Genie, 2004). In 2005, the Swiss government set up the E-Government Development Index project and constructed the conceptual model of public satisfaction on government websites (Schedler, 2002).

There are several attempts for evaluating public satisfaction on government websites in the literature. Morgeson Iii (2011), for example, develops and validates a conceptual framework derived from the ACSI model, and finds out that both e-government and e-business website satisfaction are determined by website personalization, organization, navigation and reliability. Wirtz and Kurtz (2016) apply binary logistic regression to investigate user satisfaction with government city portals based on citizens' perceptions, and confirm that full online services, downloadable forms, search function integration and perceived ease of use positively influence user satisfaction. Bournaris et al. (2016) implement MUlticriteria Satisfaction Analysis to assess user satisfaction on a government portal. Criteria including navigation, design, accessibility, interaction and content are considered. Sugandini et al. (2018) prove that reputation and experience are two critical factors affecting user satisfaction on government websites by using the structural equation modeling method. R. X. Zhu et al. (2018) construct an evaluation model for government website public satisfaction and confirm that perceived value, perceived quality, reliability, trust and government image have positive effects on government website public satisfaction.

Through analyzing the existing related studies, certain progress in government website public satisfaction evaluation has been found. Firstly, government agencies and large commercial organizations have paid much attention on this issue (Hirschman, 1970). Secondly, concerns of scholars consistent in that the primary task of government website performance evaluation research is to construct the evaluation indicator system, which leads to the development of a series of inherited systems(Jia et al., 2008). Thirdly, existing studies on customer satisfaction evaluation theories and models have laid a solid foundation for the establishment of government website public satisfaction index model (GWPSI). On the one hand, they provide reference models for the construction of GWPSI from the perspectives of satisfaction (Xin, 2008), technology acceptance (Sun, 2010) and task-technology fitness (Dishaw & Strong, 1999). On the other hand, they (Dempster et al., 1977; Efron, 1979) provide scientific methods such as structural equation model (SEM) and partial least squares (PLS) (Chin et al., 2003). Besides, they also provide references for the empirical research steps and implementation methods of GWPSI.

However, further progress is yet to be made. On the selection of variables, one opinion is that the developed customer satisfaction theories and models should be referred, while the other argues that the rational cores of other models need to be adopted as well. The majority of the existing model variables

are derived from corporate customer satisfaction models, resulting in a lack of attention on other variables' impact on public satisfaction, such as technology acceptance and task-technology fit, etc.

Reference Models

The first model referred in this study is Customer Satisfaction Index (CSI) (Fornell et al., 1996; Wu, 2009). Basing on the disconfirmation of goods, CSI explores the antecedent and outcome variables impacting customer satisfaction through empirical studies. It also analyzes the relationships between variables by using SEM. In recent years, with the reform of public administration and transformation of government functions, a few studies have introduced CSI from marketing into the e-government setting (Morgeson Iii, 2011; P. F. Li and C. Wang, 2014; Z. G. Li and T. Xu, 2017; R. X. Zhu et al., 2018). These studies mainly focus on adapting and applying CSI to the evaluation of satisfaction on e-government facilities and services. P. F. Li and C. Wang (2014), for example, construct an evaluation model for local government website public satisfaction based on several classic Customer Satisfaction models, and prove that perceived value, perceived quality and government image have positive effects on public satisfaction. Z. G. Li and T. Xu (2017) combine ACSI, ECSI and CCSI models to evaluate public satisfaction on e-government information service quality, and investigate the relationships among perceived quality, public expectancy, public satisfaction, trust and government image. These previous works show the connection point between users' satisfaction in commercial and governmental settings, and suggest the feasibility of adopting CSI models to develop a conceptual model for evaluating public satisfaction on government websites.

The second model referred is Technology Acceptance Model (TAM), proposed by Davis (1989) through the empirical study of rational behavior theory. It explains the information technology (IT) acceptance behavior of users. In this model, Davis introduced Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). PU refers to the individual perception of the improvement degree of work performance by utilizing certain information systems, while PEOU refers to the individual perception of the degree of ease of use when using certain information systems. According to related empirical research based on the TAM theories, many more researchers have formed a consistent view that PU and PEOU directly affect user satisfaction especially in the network virtual environment (Joo & Sohn, 2008; Gefen & Straub, 2000; N. N. Zhang et al., 2009). This is also true in the e-government context (Lai &Pires, 2010; Danila & Abdullah,2014; H.T. Li & Song, 2015). In the recent research on e-government, the variables from TAM are adopted to evaluate the satisfaction degree. Lai & Pires (2010), for example, construct a government portal satisfaction evaluation model derived from TAM and End User Satisfaction theories. Danila & Abdullah (2014) combine TAM, Theory of Planned Behavior, and Information System Success models to investigate the impact of PU, PEOU, subjective norm, perceived behavior control etc. on user satisfaction of e-government services. The government website is an IT-based system. Understanding the public's IT acceptance towards government websites and its impact on public satisfaction is essential for guiding the construction and development of government websites (Liao et al., 2007). Therefore, the rational core of TAM is absorbed in this study.

The third model referred is Task-Technology Fit model (TTF), which is proposed on the basis of Cognitive Fit Theory (Venkatesh & Davis, 2000; Sun, 2010). TTF is capable of covering the shortage of insufficient attention on individual task in TAM. So, it is also adopted by several studies on e-government performance evaluation. Lu et al. (2011) develop a conceptual model of e-government satisfaction grounded in TAM and TTF, and prove that perceived fit, perceived usefulness and perceived security have a positive effect on satisfaction of e-government products and services. Z. Z. Du (2010) integrate TAM and TTF to evaluate the public's acceptance of e-government. Larosiliere & Carter (2016) confirm that TTF is an important factor influencing e-government maturity through an empirical study. The latest studies of CS, TAM and TTF in the e-government setting and their main focuses are summarized in Table 1.

Table 1. The latest studies of CS, TAM and TTF in the e-government setting and their main focuses

Reference Models	Related studies	Focus
Customer Satisfaction Index (CSI)	Morgeson Iii, 2011 P. F. Li and C. Wang, 2014 Z. G. Li and T. Xu, 2017 R. X. Zhu et al., 2018	the application of CSI to the evaluation of e-government facilities and services, and the critical factors affecting the satisfaction on e-government.
Technology Acceptance Model (TAM)	Lai & Pires, 2010 Danila & Abdullah, 2014 D. G. Zhu & Guo, 2016 Qian et al., 2016	the role and effectiveness of PU and PEOU in the performance evaluation of e-government services.
Task-Technology Fit model (TTF)	Z. Z. Du, 2010 Lu et al., 2011 Larosiliere & Carter, 2016	the impact of task-technology fit on users' acceptance and satisfaction of e-government technology and services.

CONSTRUCTION OF GWPSI STRUCTURE MODEL

Selection of Constructs

Traditional CSI models typically select the following constructs: Disconfirmation, Customer Expectation, Perceived Quality, Customer Satisfaction, Customer Loyalty and Customer Complaint. A sufficient number of studies (Bharati & Chaudhury, 2004; Cardozo,1965; Gefen & Straub, 2000; Gilbert, Churchill, & Surprenant, 1982; Jia et al., 2008) have proven the stable structural system and relationship paths of such paradigm. Accordingly, basing on foundations above, this study focuses on the selection of constructs and establishment of relationship paths in the construction of GWPSI.

The first construct is Expectancy Quality (EQ), namely the public's psychological expectancy to government websites in a certain period of time. It is based on users' previous utilization experience of government websites. Using government websites is a process of seeking solutions for certain issues through exploring the websites. For well-structured issues with clear rules and conditions, users tend to form explicit expectancy, otherwise the expectancy is ambiguous. Due to the limitations of users' information literacy and utilization context (Y. Liu, 2006), bad-structured issues are more common (For bad-structured issues are related to unclear expressions and designs of government websites, and they are hinders for users with different information literacy and tasks). Thus, users' EQ towards government website service is characterized with uncertainty.

Perceived Quality (PQ) refers to the public's actual perception of online products and service quality provided by government websites. Affected by users' information literacy, experience and other factors (C. L. Wang, 2014), public perceived quality tends to deviate from the actual level of service quality. However, in the long term, the public's perception of the overall quality of government websites is capable of objectively reflecting the actual service quality. It is impacted by various factors including content of website information resources, functions of information systems, etc.

Disconfirmation (D) is an important structure variable related to the public satisfaction and it is often directly measured by the difference between Expected Quality and Perceived Quality. Some research such as Oliver (1997) shows that D has a positive effect on CS. Due to the uncertainty of EQ, to explain D by comparing EQ and PQ may cause deviation of the evaluation results. So, selecting the comparison standard to measure D is crucial. In the beginning, some researchers such as Tse and Wilton (Tse & Wilton, 1988) pointed out that the product or service performance can be used to explain D. After that, Parasuraman (Parasuraman et al., 1994) confirmed the views above through empirical studies. Later, some researchers such as Swan (Swan et al., 1980) added the sense of fairness as a key factor to evaluate D. They pointed out that in the process of consumption, the comparison between the investment related to time and money and the gain will directly affect D (Parasuraman et al., 1994; Swan et al., 1980).

Affected by information literacy and external subjective norm, the public's judgment of government websites tends to be subjective. Thus, the comparison standard of expectancy performance is not suitable to independently explain the disconfirmation of government websites. It is possible to approximately measure the process fairness related to time and effort investment, while the fairness of economic investment is hard to calculate, which means process fairness cannot independently reflect disconfirmation either. Westbrook and Oliver (Westbrook & Oliver, 1991) proposed a measurement standard of disconfirmation by comparing customer demand and the state of fulfillment after consumption, which has been universally applied in information user satisfaction studies. In the case of uncertain EQ, it is feasible to apply public demand as a comparison standard of disconfirmation. To sum up, multi-dimensional comparing standards including "expectancy quality", "process fairness", "public demand" can be applied to explain the disconfirmation of government websites.

As two important motivating factors, Perceived usefulness (PU) refers to users' perception related to the role of government websites in improving their work, life and study quality, while perceived ease of use (PEOU) refers to users' perception related the government website operability. In the case that both PU and PEOU are positive, the disconfirmation between EQ and PQ would directly increase, which indirectly results in an increase of public satisfaction and promotes the public's intention of continuous using. Therefore, in the interaction with government websites, PU and PEOU are critical factors from the start of public use to the formation of both public satisfaction and continuance use intention. In addition, introducing these two variables helps to reduce uncertainty caused by EQ.

Subjective norm (SN) in TAM model refers to the individual perception of the impact of normative beliefs on individual behavior. It is introduced in order to explore its relationships with variables like PEOU and continuance use intention. Its impact can be measured through public normative beliefs and motivation of conducting certain behavior. Normative beliefs, internalized in individuals, are the mainstream concepts of influential individuals or organizations. When weights of both public normative beliefs and behavior motivation are high, SN has an obvious impact on continuance use intention.

In the interaction with government websites, public satisfaction is possibly confined to the actual technology literacy of individuals as well as their financial situation, time and efforts. Traditional CSI model is insufficient in explaining factors like self-efficiency, external environment, etc., which are supposed to affect public satisfaction and continuance use behavior. In order to cover this shortage, Perceived Behavioral Control (PBC) of TAM model is introduced. PBC refers to the individual perception of the ease or difficulties in their actions and is affected by internal and external factors. Internal factors include users' knowledge and self-efficacy, while the external factor is users' specific usage environment. In this study, PBC is introduced in order to observe its relationship with PEOU and continuance use intention.

Public satisfaction (PS) refers to users' general satisfaction on government websites and forms during or after the use of government websites. It is a function of emotion and a function based on cumulative satisfaction, as well as a function of fairness, that is, fairness in the process and service experienced by public when using government websites. In the construction of GWPSI, it is significant to further analyze the causality of public satisfaction and to identify critical factors affecting PS.

Since government investment, organization and administration are the main operating modes of government websites in China, most of the online products or services provided are monopoly services (e.g., online census register service, online tax service, etc.) restricted by laws. In this context, public loyalty towards government websites is not obvious. Thus, instead of public loyalty, continuance Behavior Intention (BI) is selected as an outcome variable of PS. It refers to users' psychological intention to choose government websites.

Task-Technology Fit (TTF) is derived from TTF model and it refers to the fitness of technology supported by government websites in solving users' actual problems. In this study, TTF construct is introduced to discuss the actual public utilization of government website service resources according

to the public demand. The utilization efficiency of service resources is calculated in order to indirectly measure TTF's enhancement effect towards PS and BI.

Path Relationship Hypothesis

Represented by Cardozo (Cardozo, 1965), scholars believe that EQ has a positive direct effect on PQ and D, which is supported by Expectancy Disconfirmation Theory. Accordingly, this study regards EQ as a positive direct variable impacting PQ and D. Gilbert et al. (1982) believe that EQ has a direct effect on customer satisfaction. Alloy & Tabachnik (1984) propose that whether direct relationship exists between EQ and customer satisfaction depends on the level of customer's understanding of consumption products or service information. Considering the influence of bad-structure issues mentioned above, the public may be provided with relatively limited information when establishing expectancy, which leads to uncertain EQ. It is thus hypothesized: *H1.* EQ has a positive direct effect on PQ. *H2.* EQ has a positive direct effect on D.

Within CSI model, the positive and direct relationship path between PQ and D is stable and consistent. Thus, this study takes PQ as a direct variable impacting D. Halstead et al. (1994) propose that PQ directly influences PS, while Gilbert et al. (1982) consider it with reservation. Owing to the variety of public demands and abilities, it is yet difficult to form a unified interpretation of public satisfaction when using government websites. Therefore, PQ is not applied as a direct variable impacting PS in this study. Accordingly, hypothesis is proposed: *H3.* PQ has a positive direct effect on D.

The Contrast Theory of Cardozo (Cardozo, 1965) proposed that D directly influences customer satisfaction. By adopting the opinion above, this study regards D as a positive direct variable impacting PS. As a key variable, D determines the perception of usefulness and ease of use towards government websites. Therefore, it is hypothesized: *H4*. D has a positive direct effect on PS. *H5.* D has a positive direct effect on PU. *H6.* D has a positive direct effect on PEOU.

PU and PEOU provide a variable selection reference for customer satisfaction evaluation under virtual network environment. Similar to Davis (Davis, 1989) et al., this study believes that PU or PEOU each has a positive direct effect on PS. In the studies of TAM, these two variables are believed to have a positive direct effect on BI. When the public perceive that their demands are satisfied by government websites, their continuance use intention will increase. On the analysis above, hypotheses are proposed: *H7.* PU has a positive direct effect on PS. *H8.* PEOU has a positive direct effect on PS. *H9.* PU has a positive direct effect on BI. *H10.* PEOU has a positive direct effect on BI.

Ajzen (Ajzen, 1991) et al. proposed that SN is one of the three antecedent variables that impact BI and it can be applied to effectively predict users' intention for continuance use. Those who hold the same perspective include GoodHue & Thompson (1995) and Liao et al. (2007). If a government website is highly regarded and frequently used by influential groups, it can positively impact the formation of continuance use intention. Meanwhile, SN has an impact on PU. When influential groups think highly of government websites and use them frequently, the public will regard this as an external signal reflecting usefulness of the website and tend to increase the perception of usefulness. Hypotheses are raised: *H11.* SN has a positive direct effect on BI. *H12.* SN has a positive direct effect on PU.

In existing studies, Venkatesh and Davis (Venkatesh & Davis, 2000) agreed that PBC is closely related to PEOU. When using government websites, individuals with stronger self-efficacy are more likely to form internal positive and initiative beliefs when facing external pressure. In such circumstances, the public's perception of convenience of external conditions (e.g. technology and resource) is stronger, which generates stronger PEOU. In the Theory of Planned Behavior, Ajzen (Ajzen, 1991) proposed that in addition to be directly affected by attitude and SN, BI is also directly impacted by PBC. It is thereby hypothesized: *H13.* PBC has a positive direct effect on PEOU. *H14.* PBC has a positive direct effect on BI.

Users' perception of usefulness and ease of use towards a certain information system depends on how helpful the system is in the task implementation process (Dishaw & Strong, 1999; Klopping &

McKinney, 2004). Users would not consider it to be useful if services provided by government websites fail to satisfy their demand, no matter how powerful the service functions are. Additionally, complex functions of government websites tend to bring unnecessary troubles to the public. Accordingly, hypotheses are raised: *H15.* TTF has a positive direct effect on PU. *H16.* TTF has a positive direct effect on PEOU.

PS directly affects the public's intention to use government websites. The higher the satisfaction, the greater the public's willingness of continuous use (Cronin & Taylor, 1994). Thus, the last hypothesis is: *H17.* PS has a positive direct effect on BI.

GWPSI Structure Model

According to the basis above, a model of GWPSI is constructed as shown in Figure 1. This model is centered with PS in the causal chain and is characterized with 10 constructs and 17 path relationships.

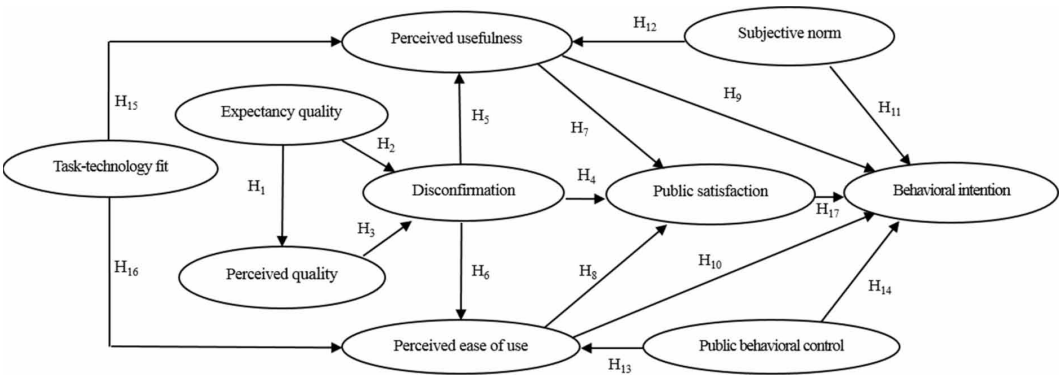
CONSTRUCTION OF GWPSI MEASUREMENT MODEL

Selection of Observed Variables

Currently, in the field of Management Information System and Library and Information Science, a number of studies (L. Li, Gan, & Xie, 2009; H. W. Du et al., 2010; C. Y. Xu, 2007; Ma, 2006) have been conducted on system implementation effect evaluation from users' perspective, which provides references for the construction of GWPSI measurement model. The selection of observed variables in this study applies methods of literature research, user survey, exploratory factor analysis and expert interview. This method system has been maturely applied in the construction of other information system models (Y. Liu, 2006; C. Y. Xu, 2007; Ma, 2006; Eschenfelder et al., 1997; Negash, Ryan, & Igbaria, 2003). Concretely, at first, a combination of qualitative (i.e. literature research) and quantitative (i.e. user survey) method is adopted to extensively collect critical factors affecting the constructs. Secondly, exploratory factor analysis is conducted to cluster similar factors. Finally, the key observed variables are determined by using Delphi method.

Taking PQ for instance, due to the difficulty of measuring PQ directly, this study divides it into two dimensions including perceived information resources quality (IQ) and perceived information system quality (SQ). These two dimensions are adopted by a number of classic empirical studies (Bharati & Chaudhury, 2004; Negash, Ryan, & Igbaria, 2003; L. Li, Gan, & Xie, 2009; C. Y. Xu, 2007) to reflect the perceived quality of information systems. Then, this study extensively collects relative factors impacting IQ and SQ on the basis of literature research and user survey. Finally, it

Figure 1. Government Website Public Satisfaction Index (GWPSI) Structure Model



selects key factors related to IQ and SQ and determines preliminary observed variables by applying exploratory factor analysis and expert interviews, as shown in Table 2.

For other constructs, the analysis and selection of observed variables follow the same steps. The final GWPSI measurement model is presented as Table 3.

According to the results in Table 3, a GWPSI model is developed as shown in Figure 2.

RESEARCH DESIGN AND METHOD

This paper aims to construct a GWPSI model for evaluating the public satisfaction on government websites in China. Due to the nature of this study in which a conceptual model hypothesized through the literature review need to be tested and validated, a quantitative methodology based on the use of the questionnaire and SEM is adopted.

Model Parameter Estimation Methods

Commonly used SEM parameter estimation methods include Linear Structural Relationship (LISREL) and Partial Least Squares (PLS) path modeling. This study compares these two methods in order to select an appropriate one for GWPSI modeling. The comparison is shown in Table 4. According to Table 4, PLS does not have so many strict limitations on sample data and it is still useful with unclear variable distribution or multi-linear correlation of variable. So, it is more effective than LISREL in theory.

In order to figure out the performance of PLS and LISREL, a simulation experiment is carried out. The simulation model showed in Figure 3 is composed of an exogenous construct, an endogenous construct and their corresponding observed variables. The structural model is represented as $\eta = \gamma_1 \xi + \zeta$ where γ_1 is the path coefficient, ζ is the residual. x is the observed variable of the exogenous construct ξ, and y is the observed variable of the endogenous structural construct η. The measurement model can be represented as follows:

$$x_1 = \lambda_1^x \xi + \delta_1$$

$$x_2 = \lambda_2^x \xi + \delta_2$$

$$x_3 = \lambda_3^x \xi + \delta_3$$

$$y_1 = \lambda_1^y \eta + \epsilon_1$$

Table 2. The selection methods of observed variables of government website public perceived quality

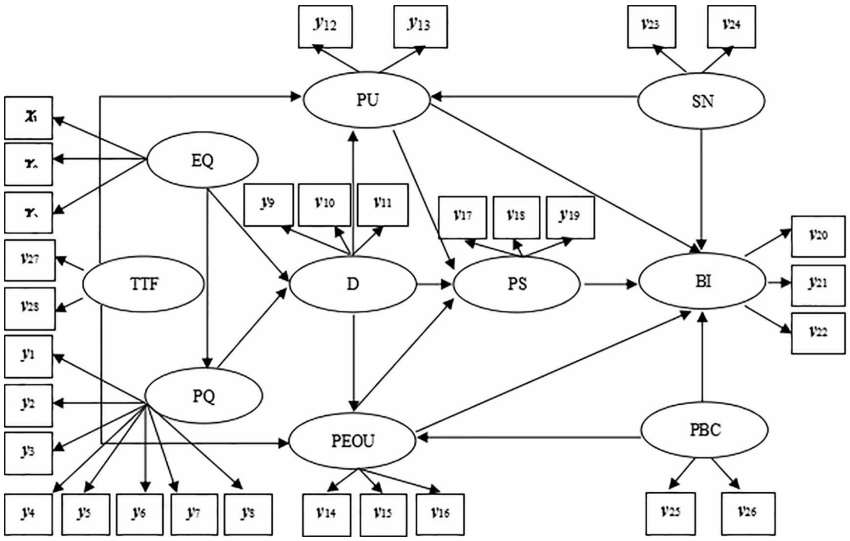
Construct	Observed Variables	Selection Methods
Perceived Quality	Information resources scope	Literature research; User survey; Exploratory factor analysis; Expert interview.
	Information resources adequacy	
	Information resources reliability	
	Information resources timeliness	
	Information system interactivity	
	Information system function	
	Information system fairness	
	Information system accessibility	

Table 3. Government Website Public Satisfaction Index (GWPSI) measurement model

Constructs	Observed Variables		Sources and References
Expectancy Quality (ξ)	Information resources expectancy quality (χ_1) *expectancy about information scopes, adequacy, reliability and so on*		Settings of Expectancy Quality variables in traditional CSI models such as SCSB and ACSI
	Information system expectancy quality (χ_2) expectancy about information system interactivity, functions and so on		
	Overall expectancy quality (χ_3) *general expectancy about service and information*		
Perceived Quality (η_1)	Information Resources Quality	Scope (y_1) *integrity of contents and types*	Results based on expert interview and exploratory factor analysis
		Adequacy (y_2) *adequacy of contents and types*	
		Reliability (y_3) *reality, authority and relevance of information resource*	
		Timeliness (y_4) *update frequency, uploading / downloading speeds*	
	Information System Quality	Interactivity (y_5) *response time, validity and accessibility*	
		Function (y_6) *retrieval, navigation and online services*	
		Fairness (y_7) *equal service for all users*	
		Accessibility (y_8) *easy to learn, easy to use, with friendly interface and personalized services*	
Disconfirmation (η_2)	Disconfirmation towards expectancy quality (y_9)	Towards expectancy information resources quality *disconfirmation between users' expectancy and information resource quality*	Settings of Disconfirmation variables in traditional CSI models; Liao et al., 2007
		Towards expectancy information system quality *disconfirmation between users' expectancy and information system quality*	
	Disconfirmation towards public needs (y_{10})	Breadth of government website services development *disconfirmation between government website information scopes, types and users' needs*	
		Depth of government website services development *disconfirmation between government website functions and users' needs*	
	Fairness Theory (y_{11})	Horizontal fairness *disconfirmation among different users' pays and gains when using government websites*	
		Vertical fairness *disconfirmation among one user's pays and gains when using government websites at different times*	
Perceived Usefulness (η_3)	Enhancement degree of transaction efficiency (y_{12}) *efficiency to solve users' problems*		Settings of Perceived Usefulness and Perceived Ease of Use variables in TAM model; Gefen & Straub, 2000
	Satisfaction degree of individual demand (y_{13}) *the degree to which uses' demands are satisfied*		
Perceived Ease of Use (η_4)	Understandability (y_{14}) *ease of understanding*		
	Operability (y_{15}) *ease of operation*		
	Learnability (y_{16}) *ease of learning*		

Constructs	Observed Variables	Sources and References
Public Satisfaction (η_5)	Overall satisfaction (y_{17}) *general satisfaction on government websites*	Settings of Public Satisfaction variables in traditional CSI models such as ACSI and ECSI.
	Process satisfaction (y_{18}) *satisfaction related to using process*	
	Result Satisfaction (y_{19}) *satisfaction related to responses*	
Behavioral Intention (η_6)	Intention to reuse (y_{20}) *intention to use next time*	X. Zhang & Prybutok, 2005; Liao et al., 2007
	Intention to frequently use (y_{21}) *intention to use frequently in the future*	
	Intention to recommend use (y_{22}) *intention to recommend others to use*	
Subjective Norm (η_7)	Impact of normative beliefs (y_{23}) *impact of mainstream concepts originating from significant people or groups*	Settings of Subjective Norm variables in TPB theory; Yaghoubi, 2010
	Impact of social information (y_{24}) *impact of significant people or groups*	
Public Behavioral Control (η_8)	Self-efficacy (y_{25}) *users' self-control abilities about computer operation, software application and information comprehension*	Settings of Perceived Behavioral Control variables in TPB theory; Bandura, 1982
	Conditions of convenience (y_{26}) *users' perceptions of network resources*	
Task-technology Fit (η_9)	Task complexity (y_{27}) *the complexity of users' actual needs*	Settings of Task-Technology Fit variables in TTF model; GoodHue & Thompson, 1995; Dishaw & Strong, 1999
	Technological impact on perceived performance (y_{28}) *the effects of technology supported by government websites on users' application performance*	

Figure 2. Government Website Public Satisfaction Index (GWPSI) Model



$$y_2 = \lambda_2^y \eta + \epsilon_2$$

$$y_3 = \lambda_3^y \eta + \epsilon_3$$

where λ^x and λ^y are the regression coefficients, δ and ϵ are the residuals.

The experiment was carried out in the following steps: Firstly, randomly generate sample data with sizes of 100, 80, 50, 30 and 20 respectively; Secondly, estimate coefficients of the model by

Table 4. Comparison of applicability between LISREL and PLS path modeling for GWPSI

Features of Sample Data	Selection of Parameter Estimation Method	
	LISREL	PLS
Small scale of sample data		√
Skewed distribution of data		√
Deficiency of data	√	√
Extreme data		√
Unclear variable distribution		√
Multi-linear correlation of variable	√	√

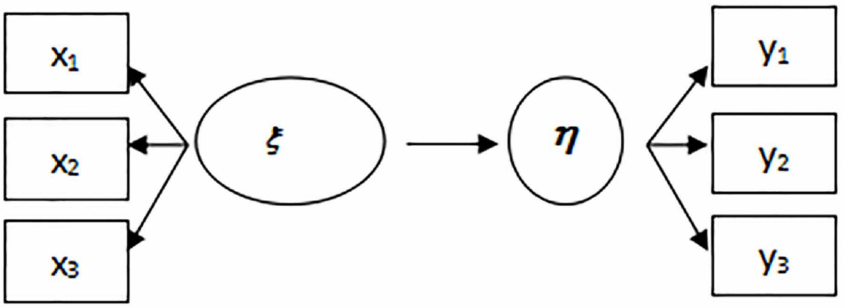
using LISREL and PLS; Then, calculate the standard errors of estimated coefficients by the maximum likelihood and unbiased estimation function; Finally, compare the performance of LISREL and PLS in GWPSI conceptual model by the standard errors. The simulation results are summarized in Table 5.

According to Table 5, the standard errors of LISREL are larger than that of PLS with each sample size, proving that PLS is able to attain weights of constructs while better present relationships between variables of the measurement model, and it can fit the reality better than LISREL. Therefore, this study opts for PLS path modeling for variable estimation of GWPSI model.

Table 5. The simulation results of LISREL and PLS path modeling for GWPSI

Sample Size	LISREL		PLS	
	Standard error of λ^x	Standard error of λ^y	Standard error of λ^x	Standard error of λ^y
20	2.42E-1	1.71E-1	1.49E-1	1.14E-1
30	2.17E-1	9.87E-2	1.24E-1	7.65E-2
50	1.67E-1	1.10E-1	8.15E-2	2.04E-2
80	1.14E-1	4.19E-2	4.85E-2	2.85E-2
100	3.79E-2	4.04E-2	1.85E-2	1.55E-2

Figure 3. GWPSI simulation model



Questionnaire Development

In order to obtain data for the verification of GWPSI model, this study applies Likert scale for developing the questionnaire and sets a scale with 7 items according to the contrast variation (Likert scales (1–7) with items ranging from "strongly disagree" to "strongly agree" were used for all questions). By questionnaire pre-test combining with research backgrounds, certain question items were adjusted accordingly. The Appendix shows a list of items used in the survey.

Sample Selection and Questionnaire Distribution

Guangdong province government website (http://www.gd.gov.cn/) is one of the earliest government websites in China. It was set by Guangdong people's government in 1998 and covers 55 columns related to opening governmental affairs, law enforcement supervision, finance, culture and public service. It is a very representative government website across the country and reflects the whole evolution process of Chinese e-government system. An empirical study on this sample can lead to a more comprehensive and typical understanding of public satisfaction on government websites in China.

This paper takes users of Guangdong province government website as the targeted survey population. A random sampling strategy is used for determining the sample. Questionnaires were distributed through a professional survey website (http://www.sojump.com/) and Wechat, which began on February 20, 2017, ended in May 20, 2017.

Questionnaire Reliability and Validity Analysis

This study applies Cronbach's coefficient α to analyze questionnaire reliability. For the majority of questionnaire items, the values of Cronbach's α are above 0.65. The overall Cronbach's α reaches 0.968, which indicates high internal consistency reliability of the questionnaire.

The questionnaire validity is examined by KMO and Bartlett's test. The KMO coefficient is 0.930 and the statistical significance of Bartlett's test is at the level of 0.001, which indicates high structure validity.

RESULTS

Sample Demographics

There are 133 questionnaires collected and 129 of them are valid. A statistical analysis of the demographics of the respondents is shown in Table 6.

Estimation Results

This paper chooses SmartPLS, a widely used PLS-SEM modelling software, to perform the estimation and evaluation of GWPSI model. The confirmatory factor analysis (CFA) of GWPSI measurement model and structural model are conducted. Figure 4 shows a full GWPSI model estimated by PLS.

CFA of the Measurement Model

The communality, load factor and average variance extracted (AVE) are indicators commonly used to evaluate the validity of the measurement model. Communality examines the extent to which observed variables are predicted by constructs. Normally, a communality value higher than 0.5 is recommended. The load factor is the correlation coefficient between constructs and observed variables in a measurement model. Higher value of the load factor means larger shared variance between constructs and observed variables. A large number of empirical studies have proved that when the load factor is higher than 0.7, the constructs can explain over 50% variance of the corresponding observed variable group. AVE measures the discriminant validity among measurement models. Generally, the value of AVE should be at least 0.5 or higher, and the square root of AVE needs to be higher than the correlation coefficients with other constructs (Hao, 2008).

Table 6. An overview of sample demographics

	Features	Proportion (%)
Gender	Male	46.51
	Female	53.49
Age	Under 25 years	13.95
	26-30 years	34.88
	31-35 years	28.68
	Above35 years	22.48
Education	College graduate and lower than college graduate	13.95
	Undergraduate	79.07
	Master	6.98
	Doctor	0
Occupation	Civil servants (related to public service, public safety and public financial etc.)	7.75
	Enterprise staffs (related to information service, real estate and project management)	65.89
	institution staffs (institutions related to education public health culture and sports)	8.53
	Students (related to sixth-graders and above)	7.75
	Self-employed businessmen	7.75
	others (including unemployed people and retired people)	2.33
Network age	Less than 1 year	1.55
	1-5 year	20.93
	6-10 year	41.86
	More than 10	35.66

Figure 4. Estimation results of GWPSI model

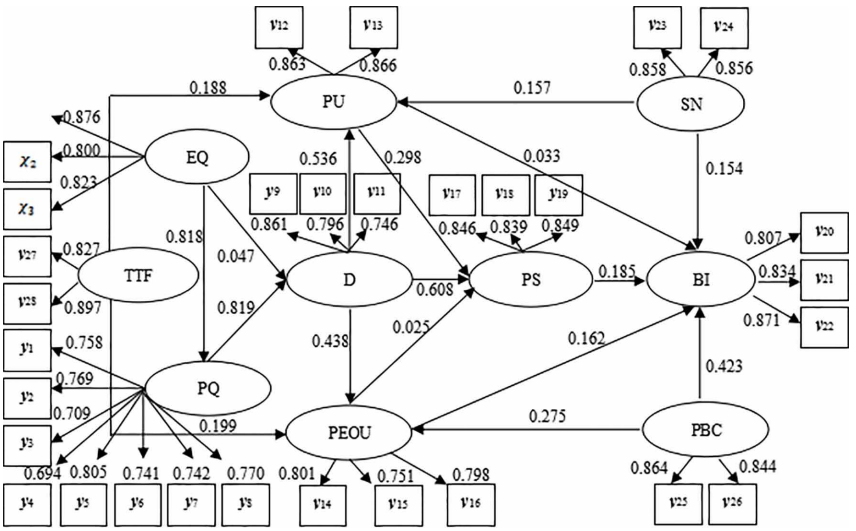


Table 7 and Table 8 summarizes the CFA results of the GWPSI measurement model. The communality values of most observed variables are higher than recommended value (0.5), except the information resources reliability (y_3) and information resources timeliness (y_4). The load factors of all observed variables are within the acceptable range except the information resources timeliness (y_4). All AVE values in Table 7 are above 0.5, and the $\sqrt{}$AVE values of most constructs in Table 8 are higher than the correlation coefficients with other constructs, which indicates that the constructs in the measurement model have appropriate discriminant validity.

Table 7. The communality and load factors of the GWPSI measurement model

Constructs	Observed Variables	Load factor	Communality	AVE
EQ	x_1	0.876	0.692	0. 695
	x_2	0.800	0.638	
	x_3	0.823	0.776	
PQ	y_1	0.758	0.583	0.561
	y_2	0.769	0.597	
	y_3	0.709	0.499	
	y_4	0.694	0.474	
	y_5	0.805	0.651	
	y_6	0.741	0.545	
	y_7	0.742	0.555	
	y_8	0.770	0.589	
D	y_9	0.861	0.719	0.644
	y_{10}	0.796	0.627	
	y_{11}	0.746	0.590	
PU	y_{12}	0.863	0.747	0.747
	y_{13}	0.866	0.747	
PEOU	y_{14}	0.801	0.648	0.614
	y_{15}	0.751	0.628	
	y_{16}	0.798	0.573	
PS	y_{17}	0.846	0.727	0.714
	y_{18}	0.839	0.702	
	y_{19}	0.849	0.714	
BI	y_{20}	0.807	0.651	0.702
	y_{21}	0.834	0.713	
	y_{22}	0.871	0.742	
SN	y_{23}	0.858	0.735	0.735
	y_{24}	0.856	0.735	
PBC	y_{25}	0.864	0.729	0.729
	y_{26}	0.844	0.729	
TTF	y_{27}	0.827	0.744	0.744
	y_{28}	0.897	0.744	

Table 8. The √AVE values and correlation coefficients of the GWPSI measurement model

	SN	TTF	PS	PEOU	PU	PBC	PQ	BI	D	EQ
SN	0.857									
TTF	0.544	0.863								
PS	0.529	0.587	0.845							
PEOU	0.561	0.615	0.690	0.784						
PU	0.537	0.592	0.759	0.703	0.864					
PBC	0.606	0.564	0.664	0.693	0.652	0.854				
PQ	0.595	0.652	0.840	0.795	0.780	0.712	0.749			
BI	0.616	0.569	0.684	0.692	0.645	0.773	0.708	0.838		
D	0.519	0.595	0.845	0.748	0.729	0.698	0.858	0.708	0.803	
EQ	0.460	0.548	0.725	0.667	0.682	0.613	0.818	0.642	0.717	0.834

Notes: The data on the diagonal of the table are√AVE values of all constructs. The off-diagonal data are the correlation coefficients with other constructs.

CFA of the Structural Model

Path coefficient is a critical parameter for measuring the direct effect between constructs. A larger path coefficient indicates stronger direct effect between constructs. This paper uses the Bootstrap method to test each path relationship hypothesis. The results are shown in Table 9.

Generally, when T value is greater than 1.96, the probability (p) will reach 0.05, presenting statistically significance. According to Table 9, the T values of *H1*, *H3*, *H4*, *H5*, *H6*, *H7*, *H13*, *H14*,

Table 9. Path coefficient test results of the GWPSI structural model

Hypothesis	Path	T Value	Test Result
H_1	EQ -> PQ	16.560	Supported
H_2	EQ -> D	0.501	Rejected
H_3	PQ -> D	9.884	Supported
H_4	D -> PS	3.993	Supported
H_5	D -> PU	6.158	Supported
H_6	D -> PEOU	4.757	Supported
H_7	PU -> PS	3.655	Supported
H_8	PEOU -> PS	0.328	Rejected
H_9	PU -> BI	0.359	Rejected
H_{10}	PEOU -> BI	1.724	Rejected
H_{11}	SN -> BI	1.830	Rejected
H_{12}	SN -> PU	1.516	Rejected
H_{13}	PBC -> PEOU	2.784	Supported
H_{14}	PBC -> BI	4.352	Supported
H_{15}	TTF -> PU	2.012	Supported
H_{16}	TTF -> PEOU	2.237	Supported
H_{17}	PS -> BI	1.917	Rejected

H15, *H16* are higher than 1.96, indicating the corresponding path relationships are significant. The direct effects between constructs in *H2*, *H8*, *H9*, *H10*, *H11*, *H12*, *H17* are not significant, which indicates these hypotheses are not supported.

The main indicators for evaluating the structural model are the R^2 and redundancy. R^2 reflects the extent to which the endogenous constructs are explained by the structural model. Based on previous empirical studies (Chin, 1998; Rossiter, 2002; Hao, 2008), this paper takes R^2 >=0.35 as the minimum standard. The redundancy indicates the extent to which the corresponding observed variables of endogenous constructs are explained by the exogenous constructs. Normally, the value of redundancy should be at least 0.25.

Table 10 shows the values of R^2 and redundancy of the endogenous constructs. R^2 of PQ, PEOU, PU, and BI are above 0.5, while R^2 of PS and D are higher than 0.7, which reveals that the GWPSI structural model can well explain all endogenous constructs. The redundancy values of all endogenous constructs are above 0.25, indicating good predictive ability of the whole structural model.

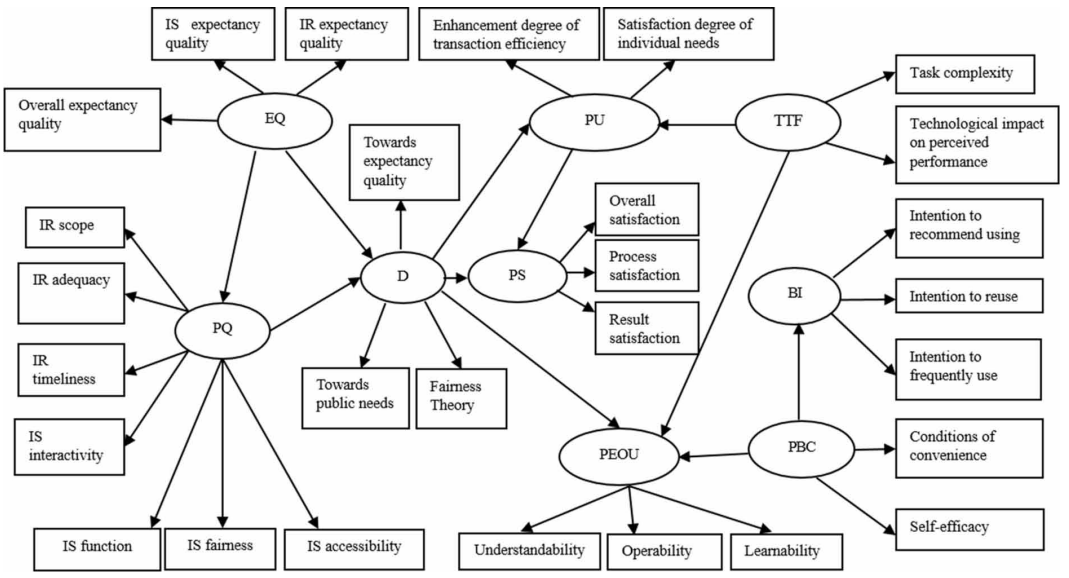
Revision Results

According to the direct and overall effects between the constructs, the GWPSI model is revised. Since the direct and overall effects of PEOU -> PS, SN -> PU, SN -> BI, PU -> BI, PS -> BI, PEOU -> BI are not significant, these paths are deleted. Due to the low path coefficients between SN and other constructs, SN is removed from the revised model. Although the direct effect between EQ and D is relatively weak, their overall effect reaches 0.717, indicating statistically significance. Thus, the path between EQ and D is retained. The revised model is shown in Figure 5.

Table 10. The R^2 and redundancy values of the endogenous constructs

Item	PQ	D	PEOU	PU	PS	BI
R^2	0.669	0.737	0.641	0.586	0.758	0.681
Redundancy	0.346	0.433	0.358	0.411	0.500	0.440

Figure 5. Revised GWPSI model



DISCUSSION

Relationships Between Constructs and Observed Variables

In the revised GWPSI model, the load factors of the information resources expectancy quality, information system expectancy quality and overall expectancy quality are 0.876, 0.800 and 0.823 respectively, indicating that these three observed variables can well explain EQ. Among the observed variables of PQ, the load factor of interactivity is the highest (0.805), suggesting that enhancing the interactivity of government websites can significantly improve the public's perception of website quality. At the same time, the load factor between the reliability and PQ is relatively low. This may result from the difference in people's information literacy, which affects whether the public can accurately judge the credibility of information on government websites. The load factors between D and its observed variables are all greater than the recommended value (0.7). Among them, the load factor of the disconfirmation towards expectancy quality is the largest (0.861), indicating that the public pays more attention to whether their actual experience with government websites can match their expectation. The load factors of PS and its observed variables are all above 0.8, representing that each observed variable is closely related to the construct. The result satisfaction has the strongest effect among the observed variables of PS, suggesting that the public focuses more on the results of using government websites. In the two observed variables of PU, the load factor of the satisfaction degree of individual demands is higher, implicating that comparing with the enhancement of transaction efficiency, the public inclines to perceive usefulness of government websites through satisfaction degree of individual demand. There are also obvious relationships between PEOU and its observed variables. Among them, the understandability has the largest load factor, which shows that the public is more likely to perceive the ease of use of government websites through the understandability. The comparison of the two observed variables of PBC indicates the public believe that the self-efficacy is more likely to promote their use of government websites than the conditions of convenience. For the observed variables of TTF, the technological impact on perceived performance is more contributing than the task complexity to the promotion of government website utilization. There are also strong relationships between the BI and its observed variables, among which the intention to recommend use can better reflect the public's intention to reuse government websites.

Relationships Between Constructs

According to Figure 4, the direct effect between EQ and PQ is 0.818, supporting hypothesis *H1*. Although the direct effect between EQ and D is not significant, the total effect between them reaches 0.717, which can support hypothesis *H2*. In addition, according to the indirect effects between constructs, the indirect effects of EQ on PS, PEOU and PU are 0.559, 0.314 and 0.384 respectively. This indicates that EQ is an important variable affecting public satisfaction and to some extent it also affects the public's perception of the usefulness and ease of use of government websites.

PQ has a direct effect of 0.819 on D, which supports hypothesis *H3*. The indirect effect of PQ on PS, PEOU and PU are 0.638, 0.359 and 0.439 respectively. This shows that PQ indirectly affects the public's satisfaction, and their perception of ease of use and usefulness.

The direct effect of D on PS is 0.608, supporting hypothesis *H4* and the opinion of Cardozo (1965) and Oliver (1997). The direct effect of D on PU, PEOU are 0.438, 0.536 respectively, supportive to the hypothesis of *H5* and *H6.* Meanwhile, D has an indirect effect of 0.232 on BI, implicating that reducing the disconfirmation is conducive to the public's continuous use of government websites.

The direct effect between PS and BI is merely 0.185 without significance. This indicates that there is no positive correlation between public satisfaction on government websites and their intention to reuse, and *H17* is rejected. The path coefficient of PU and PS is 0.298, suggesting that the public's perceived usefulness of government websites can improve their satisfaction. This is consistent with the finding of Davis (1989).

There is no significant relationship between PQ and BI, so hypothesis *H9* is rejected. The direct effect of PEOU on PS and BI are 0.025 and 0.162 respectively, showing no significance. Therefore, these two paths are deleted in the revised GWPSI model. The path coefficients of PBC towards PEOU and BI are 0.275 and 0.423 respectively, supporting the hypothesis of *H13* and *H14*. This result is consistent with Ajzen (1991). In our previous discussion, PBC is reflected more by the self-efficacy. Higher self-efficacy makes the public more skilled in using government websites. This will enhance the public's perception of the ease of use of government websites, especially when supported by convenient external conditions.

The direct effect between TTF and PU is 0.188, indicating that the higher the matching degree between the public's tasks and technology supported by government websites, the higher the public's perception of usefulness. This supports the finding of Klopping & McKinney (2004). The direct effect between TTF and PEOU is 0.199, supporting hypothesis *H16*. This proves that the support for public tasks by government website technologies has a positive impact on PEOU.

Implications

From the theoretical perspective, this study proposes and validates a GWPSI model for evaluating the public satisfaction on government websites by adopting CS, TAM and TTF theories. It explores how the core concepts of such theories can be extended to the evaluation of government websites, which expands the application fields of these theories. Moreover, this study contributes to the existing knowledge about evaluating government website performance from the public satisfaction perspective. Despite that several studies have been conducted on government website performance evaluation from the perspective of the public, they mainly focus on the technology factors of government websites instead of users' psychology, cognition, behaviors and satisfaction. The findings of this study reveal how psychological, cognitive and behavioral factors affect public satisfaction on government websites, leading to a more comprehensive understanding of government website public satisfaction.

From the practical perspective, this study provides a comprehensive framework to investigate the government website public satisfaction in China. Compared to the traditional information system evaluation methods, which regard relationships among variables as static, the GWPSI model in this study can identify critical factors affecting public satisfaction on government websites and show the constantly evolving relationships among variables by long-term empirical studies. So, it provides a more reliable tool for evaluating government website public satisfaction in a generic e-government setting. In order to achieve continuous development of government websites, it is essential to understand the public's expectancy, demands and perception when providing government website services. In this sense, this study can provide implications for the government to analyze the public's cognition and usage, and scientifically guide the construction and development of government websites.

CONCLUSION AND LIMITATIONS

This study proposes and validates a GWPSI model by adopting CS, TAM and TTF theories, leading to the identification of the critical factors for evaluating public satisfaction on government websites in China. The results suggest that Expectancy Quality, Perceived Quality, Disconfirmation and Perceived Usefulness are critical factors that affect Public Satisfaction on government websites directly and indirectly. Such findings provide governments with useful information for developing user-centered government websites and improving public satisfaction on government websites.

This study has several limitations that need to be addressed by future research. First, due to the differences in service quality among government websites caused by the regional, economic and cultural diversity, the GWPSI model cannot be applicable to every government website in reality. In the specific application, multiple factors such as economy and culture should be considered. Second, despite that the GWPSI model constructed in this study has introduced factors of user, technology and task, yet how to extract factors of individual differences and environment and refine them into

stable constructs remains to be studied. Finally, due to the adjustments of national e-government development strategies and information technology revolution, the information resource quality and information system functions of government websites change frequently, asking for the corresponding revision of the GWPSI model. Therefore, the key point of future research is to explore the change tendency and rules of the GWPSI model.

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APPENDIX: SURVEY ITEMS

Expectancy Quality

1. What is your overall expectancy quality towards this government website?

Perceived Quality

1. Can you easily get access to this government website anytime, anywhere?
2. How do you think the speed of opening and linking webpages in this government website?
3. Is this government website providing information that are sufficient and trustable?
4. How often is the information updated in this government website?
5. Does this government website provide services like online consulting, online business transaction and customized individual services, etc.?

Disconfirmation

1. Does the process of using this government website meet your expectancy?
2. Do the information resources services and system functions provided by this government website meet your expectancy?
3. Is the time and efforts you pay equal to the result you gain from this government website?

Perceived Usefulness

1. Is this government website helpful to enhance your transaction efficiency?
2. Does this government website satisfy your individual demand?

Perceived Ease of Use

1. Is the interface of this government website helpful for you to use the website?
2. Is it easy for you to learn to use this government website and to access the services provided?

Public Satisfaction

1. Are you satisfied with the entire process of using this government website?
2. Are you satisfied with the services provided by this government website?
3. What is the degree of your overall satisfaction towards this government website?

Behavioral Intention

1. Would you like to choose this government website next time?
2. Would you like to recommend this government website to others?

Task-Technology Fit

1. Does your knowledge and skills enable you to access the desired services through this government website?
2. When using this government website, does the support of technology and function provided by this website fit the problems you want to solve?

Subjective Norm

1. Do those who are influential to you support you to access desired services through this government website?
2. Do those who are influential to you consider this government website to be a primary choice to interact with government departments?

Perceived Behavioral Control

1. When using this government website for transaction processing, are you clear about the functions provided by this website?
2. Can you proficiently use government websites to deal with your work?

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