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Usability of E-government Portals in China

Case Study: www.hubei.gov.cn

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ABSTRACT

E-government is the use of Information and Communication Technology (ICT) to enhance the access to and the delivery of government services to benefit citizens, business partners and employees. As an important part of e-government, an e-government portal is a web-based window providing government information and services to citizens.

The quality of the e-government portal directly affects whether the public can effectively use the website. Although e-government portals have been developed rapidly over the past decade in China, their usage is very low. In addition to the habits of citizens and other factors, usability is an essential factor. Currently, the usability issues have become increasingly prominent. However, the domestic studies on the usability of e-government portals in China are still at their primary stage.

The purpose of this thesis was to evaluate the usability of e-government portals in China. This study applies a qualitative research method. Based on the literature review, the researcher chose the heuristic evaluation method to evaluate the usability of an e-government portal. The e-government portal of the Hubei province was selected as the research object to collect data. After the evaluation, the usability issues are listed and some remmondations for the future construction of e-government portals are proposed.

Keywords: E-government Portal, G2C, Usability, Heuristic Evaluation

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1 INTRODUCTION

1.1 Background

In recent years, information and communication technology (ICT) has radically transformed the way individuals, organizations, and governments operate work. In today's information societies, the Internet has become an essential channel that is used for the dissemination of information and services. There are many benefits to transform traditional government into e-government, such as cost-effective delivery of services, integration of services, reduction in administrative costs, a single integrated view of citizens across all government services and faster adaptation to meet residents' needs (Karunasena & Deng, 2012). Taking advantage of the electronic processes, an e-government portal is able to provide citizens and businesses with more convenient access to government information and services, to improve the quality of services, to update democratic mechanisms and to provide more opportunities for public participation (Heeks & Bailur, 2007).

As the Internet and web technologies have advanced from the pure information-sharing phase to interactive, transactional, and intelligent or integration phases, many Chinese province authorities see opportunities in offering web-based government services for improving government transparency, efficiency, and democracy by using the new generation information technologies. The original intention of the Chinese e-government project is to integrate internal and external resources to improve the efficiency of government work and to provide convenient services to citizens. The e-government portal (or website) was officially launched within the "Government Online Project" in1999. With the continuous development of e-government, Chinese governments have made impressive improvements in terms of infrastructure, office automation, and especially in government websites (Du & Wang, 2007). Since government portals have been popularized through governments at national, regional and local levels in China, e-government portals have provided governments the opportunities to improve their administrative processes and procedures, to connect to their citizens effectively as well as to build and bond interactions with its societies, businesses and institutions.

However, there are still some critical issues existing in the construction of e-government. According to the survey of China Youth Daily (2010), some problems have been revealed:

- "The information on the websites is updated slowly" (72.7%)
- "Difficult to use online government services" (71.9%)
- "The content on the website is not complete; sometimes it is not able to query the needed information" (68.8%)
- "No replies from Online Feedback" (62.6%)
- "Lack of official e-mail address, online communication and other interactive services" (49.4%)
- "The website design is unreasonable and difficult to find information" (40.5%).

The survey also found out that the respondents' satisfaction with e-government portals decreased as the level of government reduced. The respondents were most satisfied with national ministries' e-government portals (66.5%). The satisfaction with provinces' e-government portals is reduced to 18.4%. The satisfaction with municipalities' e-government portals came in the third place (12.1%). Only 2.8% of respondents expressed satisfaction with counties' e-government portals. (China Youth Daily, 2010.) From the survey, it is not difficult to find out that the main purpose of citizens using e-government portals is to query and get access to information.

1.2 Purpose of research

As the public awareness increases, the frequency of citizens using e-government portals increases. In consequence, the citizens' demand for the quality of e-government portals becomes higher. In order to meet the public demands and adapt e-government to the development of Chinese economy and society, the quality of e-government construction should be continually improved. The purpose of this study is to evaluate the usability of Chinese e-government portals, by taking the e-government portal of the Hubei province as a case study, and to introduce usability issues to the administrators and to provide corresponding

suggestions for continuous improvement of e-government portals. Because every province in China already has its own portal, the findings of this study could help the provincial-government administrators to compare their portals with the counterparts' portals and to identify opportunities for improvement to better serve their citizens. Therefore, measuring the success of the e-government portals can help government agencies enhance and fully exploit the potential of these portals as innovative tools.

1.3 Overview of thesis

This thesis consists of seven chapters. The first chapter provides a contextual background and the purpose of the study. Following the introduction, Chapter Two defines the research problem and describes the research methods applied to this study, as well as the research process.

Chapter Three first defines usability and web usability and then summarizes previous studies on e-government portals. Finally, this chapter discusses a variety of usability evaluation methods.

Chapter Four provides a description of the case e-government portal, the e-government portal of the Hubei province. Based on the understanding of the case portal, the selected usability evaluation method is described. Then, the thesis describes the detected usability issues according to each principle.

After the study to the case e-government portal, Chapter Five analyzes the usability evaluation results and gives comments on each usability issue. Chapter Six concludes the research findings and proposes some suggestions for the future construction of Chinese e-government portals.

Finally, the last chapter, Chapter Seven, discusses the limitations, reliability and validity issues of the research and provides some recommendations for the future studies in this field.

2 RESEARCH DESIGN AND METHOD

2.1 Research Problem

This study evaluates the usability of e-government portals in China and aims to introduce usability issues to government administrators and to give suggestions on how to improve the quality of e-government portals. The data is based on the evaluation of the e-government portal of the Hubei province. The portal can be used as an example in identifying usability issues. Based on the objectives, the author attempts to answer the following research questions: *What kinds of usability issues exist in Chinese e-government portals?*

2.2 Employing Design Science in Research

Design Science is an information communication technology (ICT) research methodology, which supplies researchers or reviewers with specific guidelines for evaluation and iteration within research projects. Design science research is always applied to assess or evaluate the development and performance of an (designed) artifact with the purpose of improving the functional performance of the artifact. (Hevner et al., 2004.)

In this study, the aim is to evaluate the usability of Chinese e-government portals and detect usability issues. Thus, the researcher employs design science, as the evaluation object is a case e-government portal. The selected model of design science is the one presented by Hevner et al. (2004) as below (Figure 1):

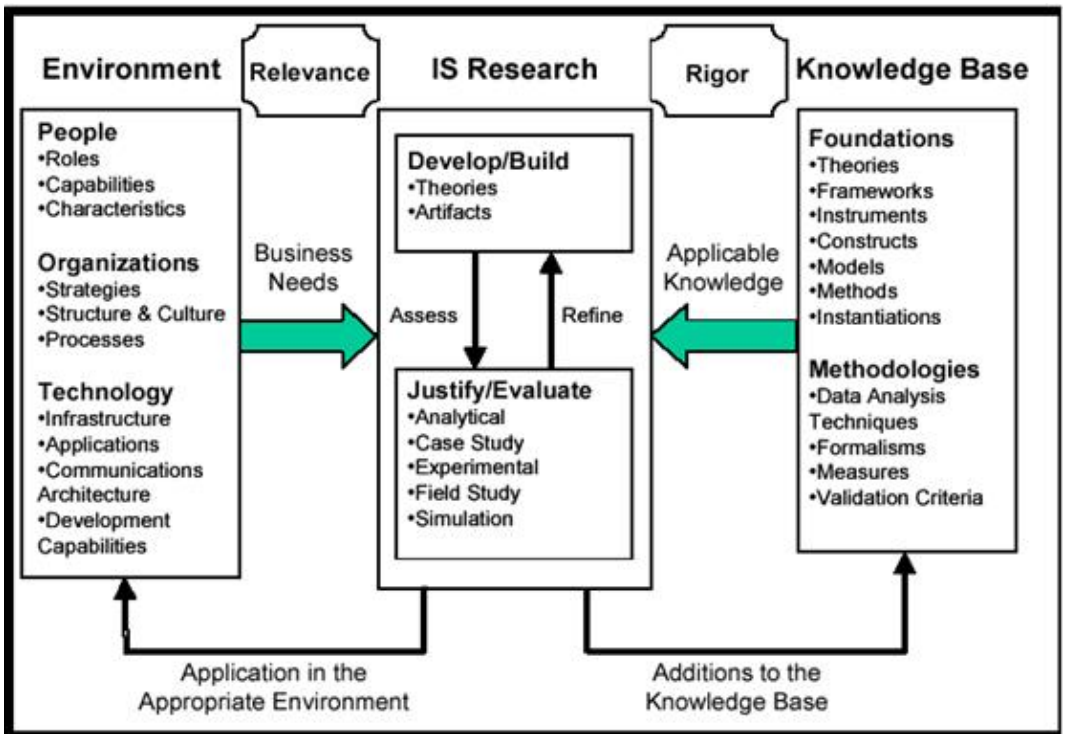


Figure 1: Design Science Research Model (Hevner et al., 2004)

In this case, the "People" in the research environment are the Chinese citizens who are using the e-government portal. The "Organizations" are the government departments which are responsible for the construction of the Chinese e-government. The "Business Need" of e-government portals is to provide online government information and services for Chinese citizens. In addition to the environment part, the study needs to apply the knowledge base which is divided into "Foundations" and "Methodologies". More specifically, the theory within "Foundations" is theoretical information about usability, usability evaluation methods and e-government portals. The "Methodologies" refer to the research methods applied in this study, including the research approach, the data collection method, and the data analysis method.

There are seven guidelines for design science, including "Design as an Artifact", "Problem Revelence", "Design Evaluation", "Research Contributions", "Research Rigor", "Design as a Search", and "Communication of Research". When discussing the design science guidelines, Hevner et al. (2004) indicate that

> IT artifacts can be evaluated in terms of functionality, completeness, consistency, accuracy, performance, reliability, usability, fit with the organization, and other relevant quality

attributes.

Since the aim of this study is to evaluate the usability of e-government portals, the researcher follows the Design Evaluation Guideline. The design evaluation methods are listed in Table 1.

1. Observational	Case Study: Study artifact in depth in business environment
	Field Study: Monitor use of artifact in multiple projects
2. Analytical	Static Analysis: Examine structure of artifact for static qualities (e.g., complexity)
	Architecture Analysis: Study fit of artifact into technical IS architecture
	Optimization: Demonstrate inherent optimal properties of artifact or provide optimality bounds on artifact behavior
	Dynamic Analysis: Study artifact in use for dynamic qualities (e.g., performance)
3. Experimental	Controlled Experiment: Study artifact in controlled environment for qualities (e.g., usability)
	Simulation ñ Execute artifact with artificial data
4. Testing	Functional (Black Box) Testing: Execute artifact interfaces to discover failures and identify defects
	Structural (White Box) Testing: Perform coverage testing of some metric (e.g., execution paths) in the artifact implementation
5. Descriptive	Informed Argument: Use information from the knowledge base (e.g., relevant research) to build a convincing argument for the artifacts utility
	Scenarios: Construct detailed scenarios around the artifact to demonstrate its utility

Table 1: Design Evaluation Methods (Hevner et al., 2004)

During the evaluation, the researcher uses both the testing and the descriptive method. That is, the researcher executes tasks on the interface of the case e-government portal to discover usability issues. Then, the researcher describes the usability issues and corresponding heuristics. Finally, the researcher presents an argument concerning the usability of Chinese e-government portals.

2.3 Research Method

There are two basic methods of reasoning: the inductive and the deductive approach. The main difference between these two approaches is that the deductive approach is aimed at testing theory, whereas the inductive approach is concerned with the generation of new theory emerging from the data.

Figure 2: Inductive Research

Figure 3: Deductive Research

In this study, the researcher has chosen to apply the deductive approach. The thesis starts with a literature review to introduce and define usability, different kinds of usability evaluation methods and to discuss some previous studies on the usability evaluations of e-government portals. This provides basis for theory. By combining the comparison of a variety of usability evaluation methods with the characteristics of Chinese e-government portals, the researcher chooses the heuristic evaluation method and uses Jakob Nielsen's 10 heuristic principles to evaluate the usability of the case e-government portal. The researcher presents a brief description of the case and then identifies the usability issues against each principle. At the end, the researcher introduces a list of usability problems and also gives some suggestions for the future construction of e-government portals.

This study applies a qualitative research approach. Contrary to the quantitative method, the qualitative approach generates verbal information rather than numerical values (Polgar & Thomas, 1995). Instead of using statistical analysis, the qualitative approach uses content or holistic analysis to explain and comprehend research findings.

In Creswell's view (2013), case study research is a type of design in qualitative research which can be an object of study. He defines case study research as:

> a qualitative approach in which the investigator explores a real-life, contemporary bounded system (a case) or multiple

> bounded systems (cases) over time, through detailed, in-depth data collection involving multiple sources of information (e.g., observations, interviews audiovisual material, and documents and reports), and reports a case description and case themes.

The unit of analysis can be an event, a program, an activity or more than one individual. A technical definition of case studies, emphasizing the logic of design, is proposed by Yin (2014) as shown below:

> A case study is an empirical inquiry that
>
> - investigates a contemporary phenomenon (the "case") in depth and within its real-world context, especially when
> - the boundaries between phenomenon and context may not be clearly evident.

In addition, case studies have a distinctive place in evaluation research (U.S. Government Accountability Office, 1990). There are at least four different applications of case studies. One of the applications is to illustrate certain topics within an evaluation, again in a descriptive mode (U.S. Government Accountability Office, 1990). Thus, for the evaluative purpose, the case study approach was adopted in this research. The e-government portal of the Hubei province (www.hubei.gov.cn) was selected as the case. By evaluating the portal, the usability of Chinese e-government portals can be understood better, and the findings may help to improve the quality of e-government portals.

2.4 Research Framework

A conceptual framework can clearly represent the underlying concepts of research and propose relationships between concepts. In addition, a conceptual framework can provide a context for interpreting the study findings and explain observations to answer the research question. Miles and Huberman (1994) defined a conceptual framework as a visual or written product, one that

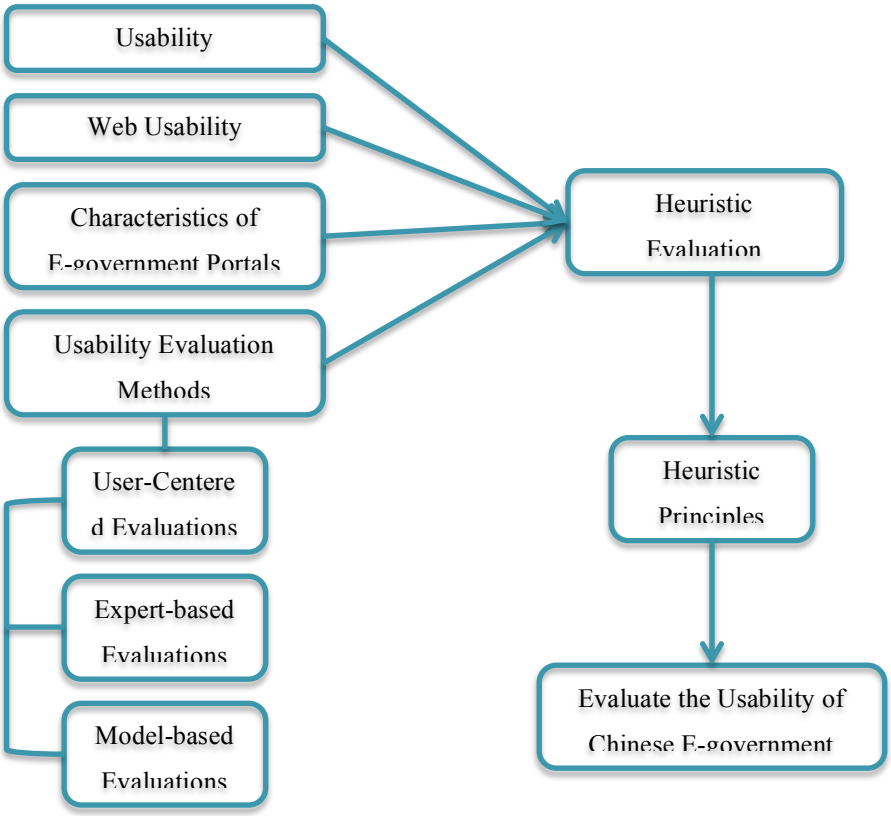
> explains, either graphically or in narrative form, the main things to be studied—the key factors, concepts, or variables—and the presumed relationships among them.

According to the Figure 4 below, some concepts are explained based on the literature review and the case study. Since the aim of this study is to evaluate the usability of the Hubei province e-government portal, the first two concepts provide a basic idea of what usability and web usability mean.

Then, the characteristics of e-government portals are proposed from literature review and the case study. These characteristics help to understand the features and functions of Chinese e-government portals better, in order to choose an appropriate usability evaluation method.

The fourth concept focuses on the three most often used usability evaluation methods, which are user-centered evaluations, expert-based evaluations and model-based evaluations. Based on the first two concepts, the fifth concept - heuristic evaluation is selected as the evaluation method for the usability of Chinese e-government portals.

The sixth concept forms the heuristics principles that are used to evaluate the usability of the case e-government portal. Finally, the seventh concept proposed the usability evaluation result and some suggestions for improvement. Based on these concepts, the research framework can answer the research question - what kinds of usability issues exist in Chinese e-government portals?



2.5 Data Collection

In qualitative research, all forms of data can be categorized into four basic types of information: observations, interviews, and audiovisual materials (Creswell, 2013).

In accordance with the aim of this study which is to evaluate the usability of the case e-government portal, the researcher undertakes qualitative (textual) data collection and analysis. As the researcher applies heuristic evaluations method to inspect usability issues, the collected data is field notes which record the description of usability issues and corresponding heuristics. The data is collected by performing tasks on the interface of the Hubei province e-government portal.

2.6 Data Analysis

To analyze qualitative data, Creswell (2013) illustrates the process of data analysis in a spiral image as below:

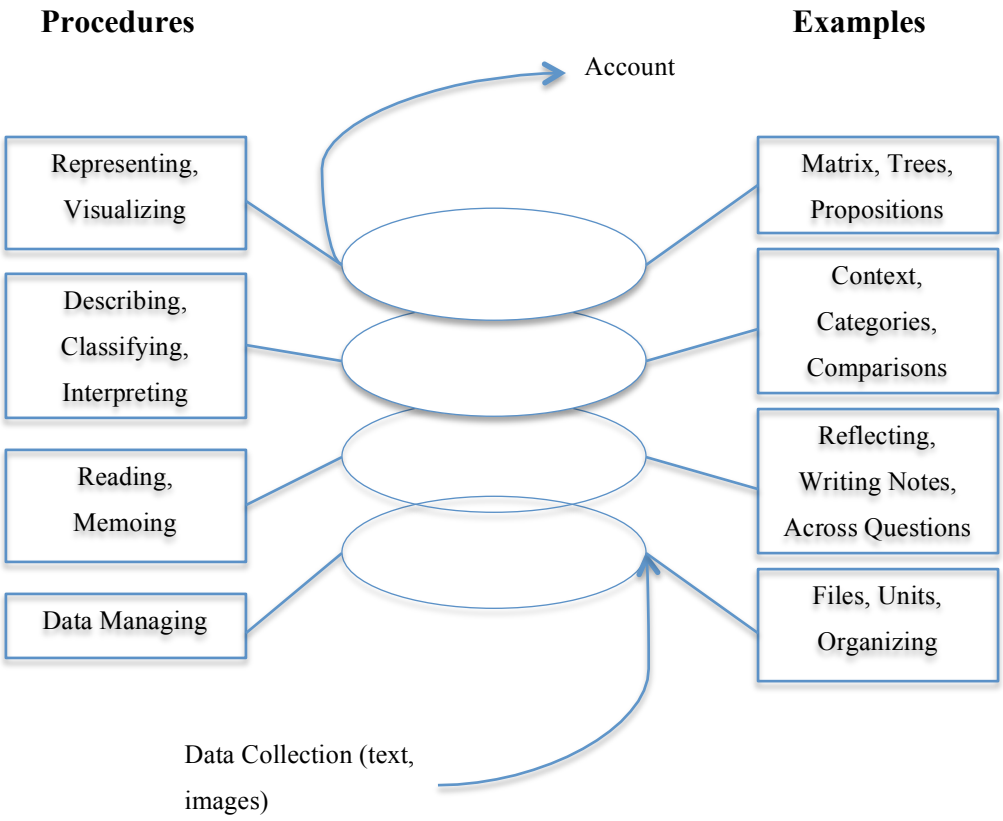


Figure 5: The Data Analysis Spiral (Creswell, 2013)

As shown in Figure 5, the data enters as the form of text or images and exits as an account or a narrative. In between, because every step in the process is interactive or conducted simultaneously, the researcher generally circles around and around (Creswell, 2013). In the spiral, the third step, the most important procedure in qualitative data analysis, consists of describing, classifying, and interpreting the data. The examples of this procedure are contexts, categories and comparisons.

In this study, the researcher follows the data analysis spiral shown in the above figure. The researcher chooses heuristic evaluation methods and applies Jakob Nielsen's 10 usability heuristics as evaluation principles. The researcher classifies the field notes in accordance with heuristic principles. Then, the researcher analyzes the usability evaluation results and gives comments on each usability issue.

3 LITERATURE REVIEW

3.1 Usability

The concept of usability builds on the older idea of “user friendliness” (Bevan et al., 1991), which first appeared in the field of Human-Computer Interaction (HCI). Usability defines whether a given product is easy to use and fulfills users' needs and expectations. The concept of usability has been in use for some time now, and it is regarded as a core element in making products competitive. As time has progressed, the concept of usability has been extended to many other fields. It has been applied to the IT products/systems that are complicated to use, including computer software, websites, consumer electronics, equipment, etc. Meanwhile, it has been applied to other products/systems that exchange information with humans, such as forms, user manuals, timetables, road signs, daily use, and even architecture and organizational structure design. From past to present, many different definitions have been proposed to explain what usability is. Here are two representative explanations of usability.

ISO 9241-11 (1998) standards defines usability as follows:

> the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.

In this definition, effectiveness means that the user is able to carry out the intended task. Efficiency refers to the amount of effort that is needed to accomplish a task. Satisfaction can be defined as how acceptable the product/system is to the users or how comfortable they feel with the operation of the product/system. (Faulkner, 2000.) The context of use refers to characteristics of users, tasks, and environments. An important point to know about the ISO definition of usability is that it pays attention to who is using the product, the goal that users are trying to achieve and the environment in which the product is being used. Therefore, usability can be understood as a property of the interaction among the product, the user, and the task that the user want to accomplish. (Jordan, 1998.) However, this definition is relatively broad. The ISO standard

does not emphasize learnability here. However, it can be argued that an efficient system would not require a long time for learning.

Nielsen (2012) has defined the five quality components of usability as follows:

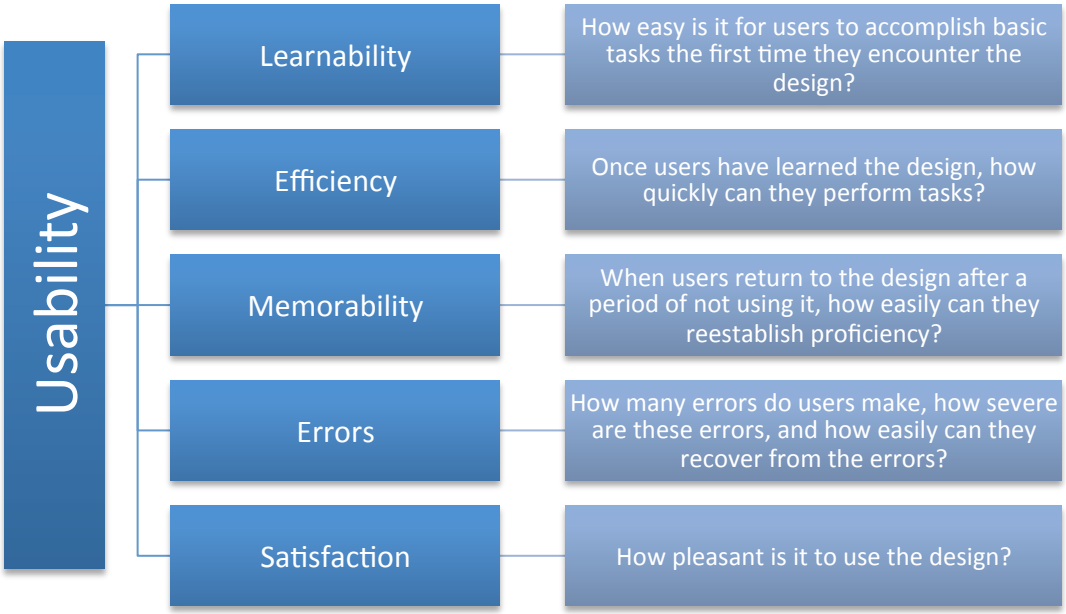


Figure 6: Usability's Five Quality Components (Nielsen, 2012)

According to Nielsen (2012), a product that performs at a high level in every quality component will have high usability. It can be considered that usability is a quality standard from the perspective of users to measure whether a product is effective, easy to learn, efficient and makes few errors and satisfies users.

3.2 Web usability

With the increasing importance of usability, the concept of usability has gradually extended to many other areas. Nowadays the World Wide Web provides access to the vast amount of information available on the Internet. Web applications have affected several domains, providing information and services for a variety of users with different backgrounds and characteristics. Because the main task of the Web is to help users to find desired information and services easily, the contents should be organized in a way that brings users access and navigation. In addition, the contents should be placed with a well-structured layout. In short, the acceptability of websites by users relies on web usability. (Matera, Rizzo & Carughi, 2013.)

Web usability refers to the ease of use of a website or a web application for end-users without any specific training. The users should be able to intuitively connect the operation they need to perform on the website with other interaction processes that they have done in common life. For example, a user presses a button on a web page to cause an activity. The goals of web usability are:

- To present information to users in an understandable and concise way;
- To provide right choices to users in an obvious way;
- To remove any ambiguity about the consequences of an action;
- To place the most important items in appropriate areas on a web page or a web application. (Nielsen, 2012.)

Pedley (2007) defined web usability as a measure of the ease of accomplishing an intended task such as finding a given piece of information or buying a certain product. Web usability affects all users regardless of the user's age, gender or personal abilities. According to Nielsen's definition of usability (2012), the principles can be applied to websites or web applications as well. Thus, web usability can be sub-divided into these five core components:

- *Web Learnability* can be interpreted as the ease for visitors to understand the contents and services available from the navigation on a website, and to look for specific information using the available links or search engines.
- *Web efficiency* means that visitors can quickly reach the contents that they are looking for through available links or search engines.
- *Memorability* implies that, when visitors return to the website after a period of non-use, they are still able to get oriented within the hypertext, for example by means of navigation bars pointing to landmark pages.
- *Few errors* mean that in case visitors have unintentionally clicked a link or gone to another web page, they should be able to return to their previous location.
- *Users' satisfaction* refers to the idea that it is pleasant for visitors to perform intended tasks on websites. For example, how visitors feel about using the navigational commands or the placement of information.

Recently, as an important factor of the quality of websites, usability has received great attention and been regarded as a fundamental property for the success of a website. There is an increasing number of studies that have been contributed into web usability, such as web design usability guideline, usability testing, usability evaluations, computer-aided usability engineering, user-centered design (UCD) methods, etc. (Lin, 2011.)

3.3 E-government and the Development of E-government in China

The development of e-government dates back to 1990s. Since the application of the Internet and other information technology (IT) have helped to provide governmental information and services electronically, e-government related fields of study and projects have been implemented step by step. Currently, it has been realized to provide public-centered services through the development of digital media technology.

Xu and Yang (2009) have defined e-government as the use of information technology such as computers, networking, and communications to optimize the government organizational structure and work processes, to form a simple and efficient mode of operation without constraints from time, space and separate departments, and to provide high-quality, standardized, and transparent management and services to the public.

There are four types of e-government services, as shown in Figure 7:

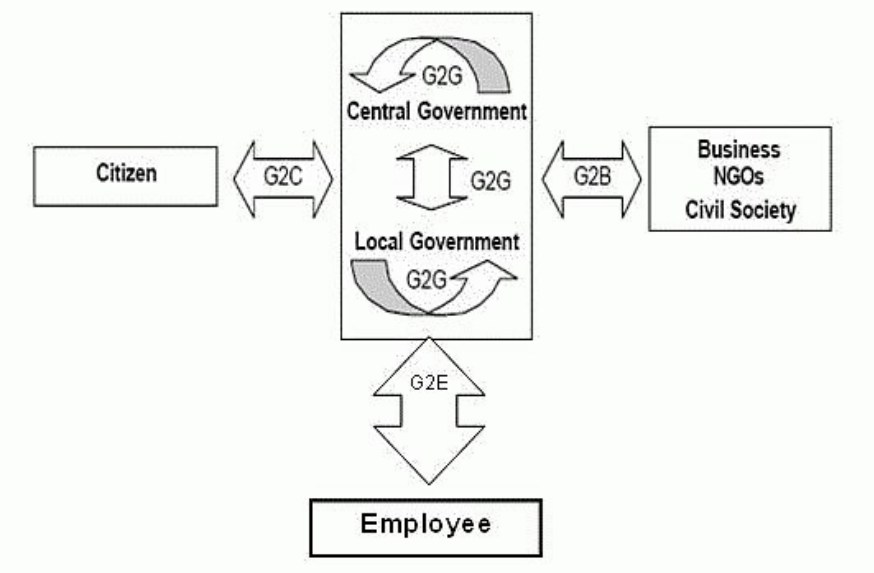


Figure 7: Delivery models and activities of e-government (Pulinat 2011)

- G2C (Government-to-Citizen): G2C includes all the interactions between a government and its citizens, providing basic citizen services, such as license renewals and ordering of birth or marriage certificates, as well as citizen assistance for such basic services as education, health care, hospital information, libraries, etc.
- G2B (Government-to-Business): G2B includes interactions between governments and businesses. The government provides business communities with access to current business information, application forms, licenses renewal, business registration and permits, and payment of taxes. These services offered through G2B transactions can assist in business development, specifically the development of small and medium enterprises. In return, businesses can sell products and services to the government, which can help the government save costs and improve efficiency.
- G2G (Government-to-Government): G2G includes activities among different levels of governments and among different government units.
- G2E (Government -to-Employees): G2E includes activities and services between government units and their employees. G2E services cover only government employees in order to assist employees' daily affairs and provide employees with access to notifications, personnel information, knowledge sharing, collaboration, etc. (Alshehri & Drew, 2010.)

In this study, the researcher focuses on the Hubei province e-government portal, which is a form of G2C, providing services to citizens online. In China, the development of e- government has gone through a decade of history. The "Government Online Project" was launched in 1999, emphasizing 'administrative reform' in order to provide better services to its citizens. According to a report by In-Focus (2006), there have been more than 90 governmental portals, and over 10,000 regional and municipal websites established by the Chinese central government.

The earlier studies outlined by Wang (2008) conclude that the e-government in China has three achievements. First, the information infrastructure has been preliminarily completed and the investment in hardware and software has been gradually increased. Second, the top-level planning and website construction have improved the level of government website construction. Third, the citizens' awareness, utilization and satisfaction of e-government services have been increased. Although the governmental informatization in China has progressed, the overall level is still low.

3.4 E-government Portal

3.4.1 What is an e-government portal

All over the world e-government portals have been an increasingly important factor in public administration reform programs. An e-government portal can be interpreted as a multi-functional information system which provides a one-stop online delivery of government information and services. The portals do not only provide a one-stop online access to government services, but also improve the development of electronic services. The main objective of e-government portals is to improve administrative efficiency and effectiveness, and to give the citizens convenience to reach information and procure services online quickly and efficiently. (Ciafardini, 2007.)

According to Liu (2007), based on the construction of information technology in different government departments, an e-government portal is a web-based

information system to provide interdepartmental and integrated businesses. By using e-government portals, citizens, companies and government employees can access the businesses and organizational information from all relevant government departments and receive personalized services.

3.4.2 Functions of an e-government portal

E-government portals have become an important component of e-government development. Thus, a clear positioning of the functions of e-government portals is the premise for building a good e-government portal.

Scavo & Shi (1999) studied the local e-government portals in the United States and proposed that a successful e-government portal should provide four main functions and services: bulletin, spread of the region or institutions, delivery of services and public participation. In this case, the e-government portal can realize the purpose of serving the public.

Jon & Diana (2001) conducted an study on the content of 50 state government portals in the United States, respectively from the perspective of openness, personalization, usability and transparency. They proposed that on the one hand, e-government portals should have functions for searching, classifying and showing information, and on the other hand, an e-government portal is an integrated application system that provides the possibility to publish information, to connect with other websites, and to communicate with the public.

With reference to the development of Chinese e-government, Yin (2006) studied the construction issues of city portals and generalized the functions of e-government portals in five classifications: information publication, online services, online communications, online supervision and portals' navigation.

Danieli (2008) indicated that an e-government website should fulfill one or more of the following functions:

- As a publishing tool, an e-government portal provides the users an access to information over the internet anytime and anywhere.

- As a communication tool, an e-government portal provides the users a way to share and exchange information in remote locations. For example, the e-government portal provides online consulting service and the citizens can contact the officials or give feedback online.
- As a marketing tool, an e-government portal may be used for building or enhancing the profile and image of public institutions, or promoting commercial services. For example, governments can use the portal to increase the public trust of a new regulatory authority; also an e-government portal can publicize the information of the construction of a new state library or any other public services to invite investment.
- As a transactional tool, an e-government portal allows the users and the public agency to exchange all the necessary transaction information (e.g. requesting licenses, registering complaints, and some more complex transactions, like paying taxes, or managing tenders and contracts);
- As a work tool, an e-government portal allows a public agency to exchange information with its employees and/or other stakeholders in the organization, in order to facilitate professional activity in general. For example, the website that has access restrictions can provide police authorities with access to vehicle registration databases managed by transport authorities.

As this chapter indicates, different researchers have different understandings about the functions of e-government portals. However, based on the purpose of e-government portals to achieve the information sharing and integrated delivery of government services to the public, the researcher in this study has categorized the three most important functions: information publication, online services and public participation.

3.4.3 Characteristics of e-government portals

An e-government portal, as a web-based window to provide public administration and services to the citizens, is different from other portals. E-government portals have their own unique characteristics. Zhang et al. (2008) proposes that e-government portals have differences in essence with general websites, starting

from the point of website style. Through the comparison of general websites and government portals in details, they summarize the characteristics of e-government portals in six areas:

1) The service object should be distinguished; the portal is able to serve disadvantaged groups.
2) Interactive - the interoperability among various departments.
3) The content should be authoritative information, and be updated quickly; the website is capable of handling online government services.
4) The website structure and information should be organized according to the citizens' needs and built with service-centered navigation.
5) There are multiple language versions; there are guidelines for use and search functions; because of a large volume of visitors, the quality of the links within the site should be high.
6) No advertising.

3.4.4 Previous studies on performance of e-government portals

Because of the increasing importance of the development of e-government, the evaluation of e-government portals has received more and more attention from organizations and researchers. Currently, many international and domestic research institutes have tried to build an evaluation system for e-government portals, especially evaluating the performance of e-government portals.

However, there is no internationally accepted evaluation system. In this section, the researcher summarizes some influential evaluation systems. There are some representative evaluation methods from Accenture consulting company, the United Nations department of public economic and public administration, and Gartner consulting company.

Since 2000, Accenture Company has evaluated the level of e-government in many countries and published the annual reports. In 2002, Accenture investigated the government services of 24 national e-governments and classified the government services into nine areas: health and human services, justice and public safety, state revenues, education, transportation and vehicles, control and participation,

procurement, and postal services. The website evaluations, Accenture has introduced two indicator systems to evaluate the actual service capabilities of e-government portals: service maturity and delivery maturity. The service maturity indicator evaluates an e-government portals ability to publish information, the portal's interactivity, and its administrative processing. The delivery maturity indicator system evaluates an e-government portal's maturity of delivering online services, including judgment, interactivity, site features, pertinence, network interconnection, etc. Accenture has summarized the maturity of e-government into four types: innovative leaders, visionary challengers, emerging performers, platform builders. (Accenture, 2003.)

The UN Online Network in Public Administration (UNPAN) measures the overall development level of e-government based on the current status of a government website construction, information infrastructure construction and the quality of human resources. And UNPAN (2005) has proposed that the construction of e-government portals should follow five stages: emerging presence, enhanced presence, transactional presence, seamless or fully integrated presence.

Gartner has focused on evaluating the effectiveness of a particular e-government project from service level for citizens, operational benefits, and political rewards. Of these, the service level is the most important factor to evaluate governments' ability to provide online services, including maturity, success, usefulness and other indicators. Gartner group (2000) has developed a four-stage maturity model of e-government. The stages are web presence, interaction, transaction, and transformation.

Chinese city e-government development research group (2003) took e-government online service ability (OSA) and e-government online application ability (OAA) as the core indicators to evaluate the e-government realization (EGR) of government portals of 336 cities. The research group analyzed the statistics based on regions and defined the current status of Chinese cities' e-government application and development trend.

Since 2005, Chinese Software Testing Center (CSTC) has been entrusted by the information office of the state council to evaluate the performance of Chinese

government websites. In its latest performance evaluation report, CSTC (2014) started from the users' viewpoint and focused on the quality of content. CSTC has designed an evaluation indicator system based on five main functions of e-government portals: information publication, online services, interaction and communication, the guidance of public opinion, functions and administration. CSTC combined the websites' daily monitoring data and the survey data of users' awareness and satisfaction to evaluate the performance of e-government portals comprehensively.

3.5 Usability Evaluation

Usability issues and the need to solve these issues led to the birth of usability engineering. Usability engineering is a product development methodology which aims at enhancing a product's usability. This methodology benefited a great deal from the human-oriented research methods of psychology, ergonomics, industrial design, human science, sociology, and other fields, by paying attention to human factors involved in the use of technology and emphasizing human-centered design and development. Since the 1990s, this development method has been generally applied to the industrial sector in developed countries. (Nielsen 1993.)

In the field of human-computer interaction, usability engineering provides some structured approaches to improve the usability of the user interface design during the product development process. Usability evaluation is one stage of this process. There have been an increasing number of studies on the evaluative methods which focus on analyzing the web usability problems. Sweenery et al. (2003) divide usability evaluation methods into user-based evaluations and expert-based evaluations. Kantner & Rosenbaum (2003) note that researchers are supposed to use expert-based evaluations first to collect basic usability issues and then explore more usability issues that are difficult to find through user-centered evaluations. Scholtz (2011) proposes that the basic methods used to evaluate usability can be divided into three categories in accordance with the used sources during the evaluation. These sources can be users, usability experts, or models.

3.5.1 User-centered evaluation

User-centered evaluation emphasizes an understanding of end-users, their primary goals, and tasks. Scholtz (2011) proposes that user-centered evaluations can be accomplished by identifying representative users and representative tasks, then developing a procedure for finding out the problems that users have when they try to use a particular software product to accomplish their intended tasks. There are two types of user-centered evaluation approach: formative evaluation and summative evaluation.

Faulkner (2000) notes that formative evaluation is used to help the design process, which follows the design-evaluate-redesign cycle. This type of evaluative method involves working closely with users at the very early stage of design and gathering feedback about the ways in which users interact with the system. Hewitt (1986) described that summative evaluation is used to assess the impact, usability and effectiveness of a product. Summative evaluation aims to evaluate the overall performance of the user and the product. This type of method is more useful when the design is completed.

As above, the advantage of user-centered evaluation is the user involvement. The collected data helps to understand the users' feedback on how they feel about the system, what problems they are experiencing and what changes are needed. On the other hand, the disadvantage is that this method is expensive and time-consuming.

3.5.2 Expert-based evaluation

Expert-based evaluation is a widely used method because it is inexpensive and takes less time. Early on, some researchers questioned the accuracy of expert-based evaluation since the tasks were performed with simple commands. In order to enhance the accuracy of expert-based evaluation, Hinds (1995) introduced two methods: one is to provide experts with a list of evaluation criteria; the other is to recall experts' own experience as users. Heuristic evaluation belongs to the first type of method, while scenario-based evaluation belongs to the second type of method. The scenario-based evaluation helps experts evaluate the

websites from the target users' viewpoint by constructing specific scenarios. Thus, experts can use the websites personally and find more in-depth usability problems.

Nielsen & Mack (1994) noted the usability inspection of user interfaces could be divided into four aspects:

- Automatic inspection method refers to adding some sub-programs in the system, from which the process, residence time, occurred errors and other information can be recorded automatically when the user is using the system. Then the usability inspection results of the system can be obtained from analyzing the records.
- Empirical inspection method is to carry out a rigorous experiment with actual users in the experimental sites and then analyze the usability from the experimental results, like thinking aloud method.
- Formal inspection method utilizes some rigorously designed models to represent the interface and then analyzes usability based on the models.
- Informal inspection method means that on the basis of evaluators' own experience and evaluation techniques and knowledge, evaluators inspect the design of interface according to some principles and find problems contrary to the usability principles, like heuristic evaluation and cognitive walkthrough.

Expert-based evaluation includes heuristic evaluation, guideline reviews, pluralistic walkthroughs, consistency inspections, standards inspections, cognitive walkthroughs, formal usability inspections, and feature inspections. Here are two typical usability evaluation methods described in detail:

1) Heuristic evaluation: As the most widely used inspection method, heuristic evaluation refers to testing the performance of the interface against a set of predefined usability principles. Jakob Nielsen's ten heuristics (Nielsen, 1994) is the most well-known set of heuristics, as shown in Table 2.

Heuristic	Description
1. Visibility of system status	The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.

2. Match between system and the real world	The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.
3. User control and freedom	Users often choose system functions by mistake and will need a clearly marked “emergency exit” to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.
4. Consistency and standards	Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.
5. Error prevention	Even better than good error messages is a careful design which prevents a problem from occurring in the first place.
6. Recognition rather than recall	Make objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.
7. Flexibility and efficiency of use	Accelerators -- unseen by the novice user -- may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.
8. Aesthetic and minimalist design	Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.
9. Help users recognize, diagnose, and recover from errors	Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.
10. Help and documentation	Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.

Table 2: Jakob Nielsen’s 10 Usability Heuristics (Nielsen, 1994)

The core of heuristic evaluation is that each evaluator reviews the interface individually and proposes potential problems. In addition, Nielsen (1995) indicated that heuristic evaluation is known to find about 75% of usability problems if it is performed by about five evaluators. From the curve below (Figure 8), it is evident that the more evaluators are involved in the evaluation

process, the more problems it is possible to find. However, considering time and expense, reasonable results can be obtained by having only five evaluators, but not less than three.

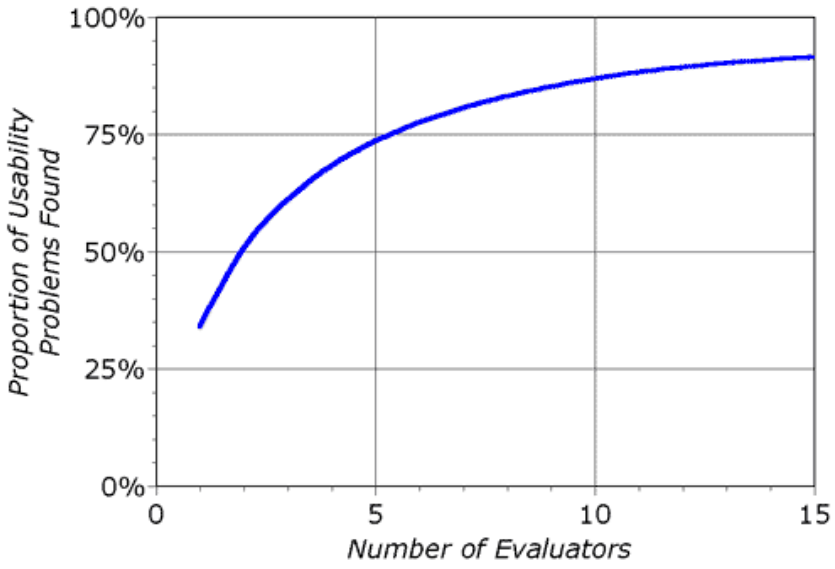


Figure 8: The proportion of usability problems found by heuristic evaluation using various numbers of evaluators (Nielsen, 1995)

2) Cognitive walkthrough: A cognitive walkthrough requires a detailed description of the user interface, a description of the users, a description of the task to be carried out, a sequence of actions needed to complete the task. Starting with a task analysis, the experts should know the actions that the user needs to take to complete an intended task and also the system response. When the system designer and developer carry out the actions to complete the task, they need to answer a series of questions at each step as follows (Faulkner 2000): whether the goal is clear at this stage; whether the appropriate action is obvious; whether the appropriate action leads to the goal; what problems exist in performing the action. During this interpretation process, the user or evaluator can change the initial goal when the actions are impossible to reach it. Each negative answer is added to the list of inspected problems. Scholtz (2011) points out that the critical information to collect during the walkthrough is what the user should know prior to performing the task and what the user should learn while performing the task. Faulkner (2000) indicates that carrying out a cognitive walkthrough requires a close understanding of potential user

behavior. Matera et al. (2013) recommend using cognitive walkthrough in the advanced phases of the Web application development, for evaluating the interaction functionalities that already work.

3.5.3 Model-based evaluations

Model-based evaluation is using a model which demonstrates how a user doing the task to predict the execution steps or the learning time. These predictions can help to evaluate the usability of user interface design. In addition, the content of the model itself shows the interaction between the user's task and the system design. A representative model is the GOMS model which consists of Goals, Operators, Methods and Selection rules (Figure 9). The GOMS model is first developed by Card et al. (1983).

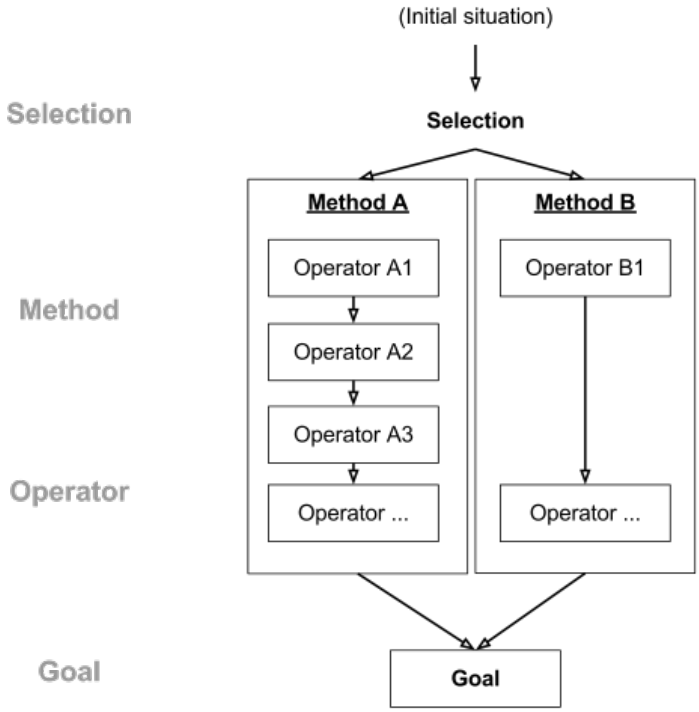


Figure 9: GOMS model (Card et al., 1983)

A Goal is defined as the end state of the successful task. An Operator refers to an action performed to reach a goal. A Method is a series of operators that complete a goal. A Selection is a decision made by a user to choose a method. Scholtz (2011) recommends that the GOMS model could be used only for evaluating the

efficiency of the procedural aspects of usability but not for detecting potential errors due to screen design or terminology.

3.5.4 Previous studies on usability of e-government portals

International studies on usability have presented many results. Here the researcher introduces the previous studies which started from users' perspective to evaluate the usability of e-commerce websites, e-government portals and educational websites and other types of websites.

Nielsen (2000) concluded the common usability design problems and pointed out that the principle of website design should be simple and user-centered. Northwest Alliance for Computational Science & Engineering (NACSE) developed a general usability guidance in aspects of website design, web style design and navigations. Schneider (2004) emphasized the client-centered website design method and provided a set of more specific usability principles for e-commerce websites. For example, the navigation of the website should be designed according to the consumers' ways of thinking and habits of using links, but not according to the company's organizational structure; the contents of a website should avoid using the special terms that the users may not understand; the website should provide consumers the possibility to find the needed information quickly.

Usability in the field of e-governance has also been studied. James & Huang (2001) noted that the time spent on government portals has an important influence on the quality and effectiveness of the portals. They chose 18 indicators based on Nielsen's research on usability to evaluate the usability of 33 portals of different government departments in Taiwan, and found out that most of the portals have usability problems.

Welch et al. (2005) pointed out that the usability of e-government portals has affects on the degree of public satisfaction and trust in government. They took information publication, online services and online interaction, three main functions of portals, as their starting point. The results indicated that most of the users have higher satisfaction for information publication, but most of them have lower satisfaction with online services and online interaction.

Menno & Leo (2006) conducted scenarios-based evaluations on 15 e-government portals. On the one hand, they introduced a representative usability evaluation method. On the other hand, the evaluation result showed that those e-government portals had many usability problems, such as unclear navigation, invalid links, titles that are difficult to understand, etc.

In China, there have been some studies on the usability of e-government portals. Lin (2011) evaluated the usability of Beijing's e-government portal by using a heuristic evaluation method and found out the following usability problems: complex structure, unclear navigation, inconsistent style, the delay of updating information, and the unobvious classification of contents and titles. Wei (2009) conducted a study on the usability of e-government portals and its influence on the degree of public trust in the portals. Wei used a scenario-based evaluation method to insure the usability differences between the actual users and then figured out the relationship between usability, user satisfaction, and website reputation. The results indicated that the quality of content, ease of use, website navigation, online services and emotional factors could help to find usability problems of e-government portals and be applied to the construction and performance evaluation of e-government portals. Moreover, the results showed the importance of differences between users, because users of different genders and educational backgrounds had different perceptions of usability. In addition, usability of e-government portals has a positive impact on user satisfaction and website reputation.

To sum up the above study results, user-centered design is the most significant factor in web usability design. The purpose is that website development should consider user needs. Users should be involved in the testing process, and they should be encouraged to give feedback. If e-government portals are developed in this way, the portals can be easier to use and enhance user satisfaction and effectiveness. Finally, it is important to inspect usability problems to ensure the quality of portals.

4 CASE STUDY

4.1 Case Description

www.hubei.gov.cn is the e-government portal of the Hubei province (Figure 10). It is a form of the Government-to-Citizen (G2C) service which aims at providing a one-stop online delivery of government information and services for citizens. The office of the People's Government of the Hubei province is responsible for managing the portal and updating the latest information.

On the home page of the portal, there are the major news within the province, the latest government affairs, and the fast access to services. The navigation has been divided into "Home", "Government Leader", "Overview of Hubei", "Government Affairs", "Online Services", "Public Interaction", "Investment in Hubei", "Sceneries in Hubei", and "Price Services".

The online services include license renewals and ordering of birth or marriage certificates, as well as citizen assistance for such basic services as education, health care, social security, accommodation, transportation, corporate registration, etc. These services are directly linked to the online service center of the department which is responsible for the specific service.

The users who mainly use the e-government portal are the normal citizens of the Hubei province. They access the portal to obtain the latest news about government information or policy changes. In addition, the business communities that are not familiar with the business procedures also use the e-government portal to look for useful information and relevant services. The users can then navigate to the official websites of other departments that are responsible for the specific procedures.

Figure 10: E-government portal of the people's government of Hubei Province

According to the 13th Chinese Government Websites' Performance Evaluation (CSTC, 2014), the e-government portal of the Hubei province is ranked eighth in the provincial governments. The quality of the case e-government portal plays an important role to lead other provinces' e-government construction. However, the overall usage of the portal is still low. Many citizens reflect that the website is not easy to use and it is difficult to find needed information.

4.2 Heuristics as the Usability Evaluation Tool

Heuristic evaluation is an often-used usability inspection method on account of its relative quickness and cheapness compared to other methods. Moreover, Jakob Nielsen's ten usability heuristics are useful when evaluating the user interface design. As the goal of the evaluation here is to identify the usability issues of the case e-government portal, the researcher conducted a heuristic evaluation, using Nielsen's ten heuristics.

Heuristic usability evaluation is conducted as follows. The researcher acts as an evaluator and reviews the heuristics to reach a better interpration:

1. Visibility of system status: The user should be able to keep track of the current situation and know where he/she is and where he/she can go next.
2. Match between system and the real world: Each element of the interface should be consistent with user expectations and intuitive behavior. For example, the words and icons should be in line with users' actual habits, and closely-related content should be grouped together.
3. User control and freedom: The user should feel free to carry out tasks, cancel an operation, and go forward or back at every stage. For example, the "Home" button appears on every page so that users feel in control of the system and can go back to the home page at every stage of the process.
4. Consistency and standards: The interface should ensure the consistency among the elements. For example, the design elements (font family, font size, font color, alignment) should be consistent and the operations for the same object should be consistent.
5. Error prevention: The interface should help users to avoid making mistakes and leave out the elements that may cause misunderstanding or errors. For example, the function button that may lead to serious consequences should have a certain distance with the common function buttons.
6. Recognition rather than recall: The user should be able to use the interface to perform the same task without recalling the operations by which he/she completed the task last time. For example, the interface might be too complex so that the user has to remember the operations or whether the navigation may have too many layers.
7. Flexibility and efficiency of use: The interface navigation should be simple and convenient to use. In addition, the system should provide different entry points for different user groups (such as different languages, culture, disabled people, etc.).
8. Aesthetic and minimalist design: The content on the screen should not be too crowded, because extraneous information on a webpage is a distraction and a slow-down.

9. Help users recognize, diagnose, and recover from errors: An error should be presented in a friendly manner, and its description should provide further operational recommendations to resolve the error
10. Help and documentation: The important support information and FAQs should be placed at the appropriate location.

After this, the researcher reviews the interface by performing some tasks. Finally, the researcher gets a list of usability problems, and evaluates each of these in light of the ten usability heuristics.

4.3 Heuristic Evaluation of the Case E-government Portal

4.3.1 Visibility of system status

Issue 1: Although there is the current location on the page, some pages do not have clear tab names. Because most of the links on the website are opened in new tabs, the user has to operate across multiple pages. The title of the page tab does not describe the content of the page, as is shown in Figure 11 below. This issue exists on the pages that are classified under the menu of "Overview of Hubei" and "Investment in Hubei".

Figure 11: Page tabs without clear titles

4.3.2 Match between system and the real world

Issue 1: The weather forecast on the top of the home page is forecasting the weather for Beijing City, but not for the cities in the Hubei province (See Figure 12).

Figure 12: Weather forecast of Beijing City

Issue 2: The email icon does not link to the email address of the government official (See Figure 13).

Figure 13: The icon of email does not link to the government officials' email

Issue 3: The search function is using Baidu Search Engine to search the relevant content within the portal. The search results are sorted by relevance. The result filter is classified by "All", "Overview of Hubei", "Online Services", "Responses to the concerns", "Government Leaders", "Tourism", "Investment" (See Figure 14). However, this kind of filter is unnecessary. According to the users' real-life habits, it is preferred that the search results can be sorted by both relevance and the latest release data.

Figure 14: Baidu Search Engine applied to the portal

Issue 4: On the "Investment Projects" page, the title of the left-side navigation bar is "Investment Guide". However, the navigation links refer to different industries. The projects are classified according to industry. Therefore, the words "Investment Guide" do not match the user's understanding of the industry categories. (See Figure 15)

Figure 15: Left-side navigation bar of "Investment Projects" page

4.3.3 User control and freedom

Issue 1: On the "Hubei Province Government Information Publication Service System" page, the "Information Publication Guidebook Links", "Information Publication Category Links", "Information Publication Application Links", and "Information Publication Annual Report Links" do not have the "Back to Home" function. (See Figure 16 & Figure 17)

Figure 16: With "Back to Home" Lin

Figure 17: Without "Back to Home" Link

4.3.4 Consistency and standards

Issue 1: The header of "Online Services", "Public Interaction", "Investment in Hubei", and "Sceneries in Hubei" pages is different from the header of "Home", "Government Leaders", "Overview of Hubei", and "Government Affairs" pages. (See Figure 18 & Figure 19)

Figure 18: Header of "Home", "Government Leaders", "Overview of Hubei", and "Government Affairs" pages

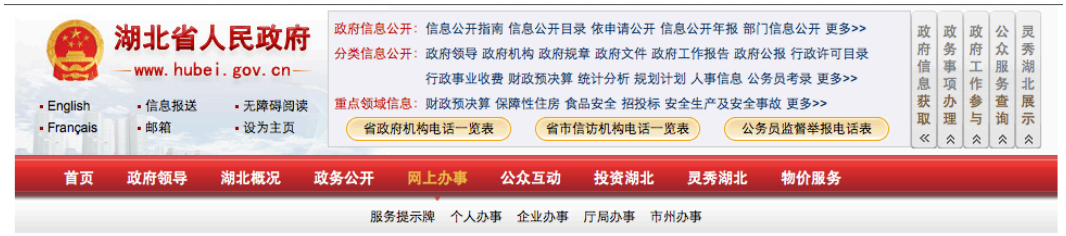


Figure 19: Header of "Online Services", "Public Interaction", "Investment in Hubei", and "Sceneries in Hubei" pages

Issue 2: "Investment in Hubei" and "Sceneries in Hubei" belong to first-class navigations, but the style of their titles in corresponding blocks is different from that of other first-class navigations on the home page (See Figure 20).

Figure 20: Different styles of the first-class titles in blocks

Issue 3: On the "Hubei Province Government Information Publication Service System" page, the "Information Publication Guide Links", "Information Publication Category Links", "Information Publication Application Links", and "Information Publication Annual Report Links" do not have the "Back to Home" link (See Figure 16 & Figure 17).

Issue 4: The name of the title on the home page is different from the name of the current navigation path, as shown in Figure 21 and Figure 22:

Figure 21: "Topics of Government Affairs" & "The current location: Topic Publicity"

Figure 22: "Focused Services" & "The current location: Micro Services"

Issue 5: The first-class navigation of "Topics of Government Affairs" pages is different from that of the home page. The "Public Interaction" is changed to "Interaction". The "Price Services" is changed to "Government Affairs Baike". (See Figure 23 & Figure 24)

Figure 23: Navigation of main pages

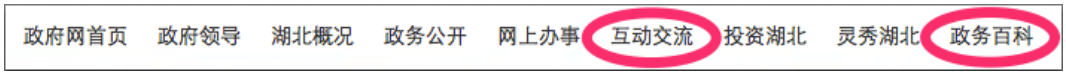


Figure 24: Navigation of a government affair topic page

Issue 6: On the "Online Interview" and the "Government Affairs" page, there is no dividing line between the language selection bar and the image (See Figure 25, Figure 26 & Figure 27).

Issue 7: On the "Online Interview" page, the font-family and the font-size of the language selection bar and the search engine are different from that on the other main pages. In addition, the width of the search button is narrower than that on the other main pages. (See Figure 25 & Figure 27)

Figure 25: Header of "Online Interview" page

Figure 26: Header of "Government Affairs" page

Figure 27: Header of other main pages

Issue 8: The menus of the first-class navigation on the "Investment Environment" and the "Projects" pages cannot be displayed in the unified layout (See Figure 28 & Figure 29).

Figure 28: The menu on the "Investment Environment" and the "Projects" pages

Figure 29: Unified layout of menus

Issue 9: Some pages do not have clear page titles. The tabs should be named by a unified rule to let the user realizing the content of the page. This issue exists on the pages that are classified under the menu of "Overview of Hubei" and "Investment in Hubei" (See Figure 11).

Issue 10: On the home page, the "Public Interaction" menu contains four options. However, on the "Public Interaction" page, the menu contains five options. (See Figure 30 & Figure 31)

Figure 30: The "Public Interaction" menu on the home page

Figure 31: The "Public Interaction" menu on the "Public Interaction" page

4.3.5 Error prevention

Issue 1: On the page of "Government Affairs", the titles in the "Information of Key Areas" block are floating and overlapped. This can easily direct the user to click the unhoped titles by mistake. (See Figure 32)

Figure 32: "Information of Key Areas" block on the "Government Affairs" page

4.3.6 Recognition rather than recall

Issue 1: The interface is too complex and the navigation path only provides the current location but not the whole path, so that the user has to recall the operations by which he/she completed the task last time.

Issue 2: The information provided on the home page is not sufficient, so the users have to find relevant information from another part of the website. For example, on the main pages, there is no navigation linked to the "Government Affairs Baike" page (See Figure 33 & Figure 34). This requires users to recall the operations to reach the navigation "Government Affairs Baike" by opening a topic of government affairs on the home page or going to the search page.

Figure 33: Navigation of "Government Affairs Baike" page

Figure 34: Navigation of other main pages

Issue 3: There are pages with the same page title and the same navigations. Those pages have the most common functions in different layout, so that the user may be confused of those duplicate pages. For example, there is a navigation from the "Online Services" to the "Business Start-up" page. The "Business Start-up" page contains business registration, examination and approval, and taxation services. All the services are linked to the online service centers of the relevant departments. There is another "Business Start-up" page which is navigated from the "Investor Services". This page includes not only the business start-up process, but also the bulletin and the links for downloading support documents (See Figure 35 & Figure 36). Therefore, the user has to recall the operations by which he/she achieved the same task earlier.

Figure 35: The "Business Start-up" page from the "Online Services" navigation

Figure 36: The "Business Start-up" page from the "Investment in Hubei" navigation

4.3.7 Flexibility and efficiency of use

Issue 1: All the menu options, the second-class navigations and the links are opened in new tabs. This might reduce the efficiency of use for users when opening too many pages. It is recommended to display content when it overflows its block level container.

Issue 2: On the "Government Affairs Baike" page, the first-class navigation includes all the navigations to other main pages. However, on the main pages, there is no navigation linked to the "Government Affairs Baike" page. This requires users a lot of time to reach the navigation "Government Affairs Baike" by opening a topic of government affairs on the home page or going to the search page. (See Figure 33 & Figure 34)

Issue 3: "Services for Individuals", "Corporate Services", "Departments' Portals", or "Cities' Portals" pages are the same. When clicking the option - "Services for Individuals", "Corporate Services", "Departments' Portals", or "Cities' Portals" under the "Online Services", the page does not link to the corresponding blocks. It is not efficient for users to find needed services.

Issue 4: The online services are not classified clearly to services aimed at individuals and services aimed at corporations. Therefore, the options - "Services for Individuals" and "Corporate Services" are meaningless. The services have been divided into education, social security, employment, health, accommodation, transportation and so on (See Figure 37).

Figure 37: Public Service Classification

Issue 5: There are pages with the same page title and the same navigations. Those pages have the most common functions in different layout, so the user may spend

a lot of time on looking for the intended information and being confused because of the duplicate pages. For example, there is a navigation from the “Online Services” to the “Business Start-up” page. This “Business Start-up” page contains business registration, examination and approval, and taxation services. All the services are linked to the online service centers of the relevant departments. There is another “Business Start-up” page which is navigated from the “Investor Services”. This page includes not only the business start-up process, but also the bulletin and the links for downloading support documents. Therefore, there are too many different ways to do the same task. (See Figure 35 & Figure 36)

Issue 6: Although there is the current location on the page, some pages do not have clear tab names. Because most of the links on the website are opened in new tabs, the user has to operate across multiple pages. The title of the page tab should be clear for users knowing the content of the page, so that the user can quickly choose the page he/she wants to browse. This issue exists on the pages that are classified under the menu of “Overview of Hubei” and “Investment in Hubei” (See Figure 11).

4.3.8 Aesthetic and minimalist design

Issue 1: The contents on the home page are too crowded. The user has to scroll a lot to browse the whole page.

Issue 2: Some pages do not have clear tab names for describing the content of the pages. This issue exists on the pages that are classified under the menu of “Overview of Hubei” and “Investment in Hubei” (See Figure 11).

4.3.9 Help users recognize, diagnose, and recover from errors

The researcher did not find any usability issue related to this heuristic.

4.3.10 Help and documentation

Issue 1: The site map, as a help tool, does not provide users with a clear structure of the navigation on one page. The site map was not classified rigorously by the

navigation. It only contains part of quick links related to government information, government affairs, online services and public participation (See Figure 38). Thus, the site map does not allow users to find needed information easily.

Figure 38: Site Map

5 DATA ANALYSIS

The objective of this study was to find usability issues that exists in Chinese e-government portals. The researcher takes the e-government portal of the Hubei province as the case and conducts a heuristic evaluation in light of Nielsen's Ten Heuristics. During the evaluation, the researcher takes notes of the usability issues and analyzes the corresponding heuristics. Then, the researcher integrates all the data in the table, and gives the comments for each issue, as shown in Table 3 below.

No.	Usability Issue	Heuristics	Comments
1	The pages that are classified under the menu of "Overview of Hubei" and "Investment in Hubei" do not have clear tab names.	H1, H7, H8	The name of the page tab should simply and exactly describe the content of the page.
2	The weather forecast on the top of the home page is forecasting the weather for Beijing City.	H2	The weather forecast on the top of the home page should forecast the weather of the cities in Hubei Province.
3	The email icon does not link to the email address of the government official.	H2	The icon of email should provide the email address or link to the email system.
4	The search results are sorted by relevance and the result filter is classified by "All", "Overview of Hubei", "Online Services", "Responses to the concerns", "Government Leaders", "Tourism", and "Investment"	H2	The classification of results is useless and meaningless. The search results are better to be sorted by both relevance and the latest release data.
5	On the "Investment Projects" page, the title of the left-side navigation bar is "Investment Guide", which does not match the user's understanding of industry.	H2	The title of left-side navigation is better to be changed to "Category of Industry"
6	On the "Hubei Province Government Information Publication Service System" page, "Information Publication Guidebook Links", "Information Publication Category Links", "Information Publication Application Links", and "Information Publication Annual Report Links" pages do not have the "Back to Home"	H3, H4	Add the "Back to Home" link to "Information Publication Guidebook Links", "Information Publication Category Links", "Information Publication Application Links", and "Information Publication Annual Report Links" pages.

	link.		
7	The header of “Online Services”, “Public Interaction”, “Investment in Hubei”, and “Sceneries in Hubei” pages is different from the header of “Home”, “Government Leaders”, “Overview of Hubei”, and “Government Affairs” pages.	H4	The style of the header of “Online Services”, “Public Interaction”, “Investment in Hubei”, and “Sceneries in Hubei” pages should be unified with that of other main pages.
8	“Investment in Hubei” and “Sceneries in Hubei” belong to first-class navigations, but the style of their titles in corresponding blocks is different from that of other first-class navigations on the home page.	H4	The style of the titles of “Investment in Hubei” and “Sceneries in Hubei” blocks on the home page should be unified with that of other first-class titles.
9	The name of the title on the home page is different from the name of the current navigation path. For example, “Topics of Government Affairs” and “Topic Publicity”.	H4	The current location should be the same as the title on the home page.
10	The first-class navigation of “Topics of Government Affairs” pages is different from that of the home page.	H4	The navigation of “Topics of Government Affairs” pages should be keep consistent with that of the home page.
11	The header of the “Online Interview” and the “Government Affairs” page is different from that of other main pages (e.g. dividing line, font-family, font-size, width of search button).	H4	The header of the “Online Interview” and the “Government Affairs” page should be keep consistent with that of the home page.
12	The menus of the first-class navigation on the “Investment Environment” and the “Projects” pages cannot be displayed in the unified layout.	H4	The layout of the menus on the “Investment Environment” and the “Projects” pages should be unified as that on the home page.
13	On the home page, the “Public Interaction” menu contains four options. However, on the “Public Interaction” page, the menu contains five options.	H4	The menu of “Public Interaction” on the home page and the “Public Interaction” page should be unified.
14	On the page of “Government Affairs”, the titles in the “Information of Key Areas” block are floating and overlapped. This can easily direct the user to click the titles by mistake.	H5	List the titles of key information areas in the block.

15	The interface is too complex and the navigation path only provides the current location but not the whole path.	H6, H7	The interface should be simplified and the navigation path should provide the whole path.
16	On the main pages, there is no navigation to the “Government Affairs Baike” page. It can only be reached by other ways.	H6	Add “Government Affairs Baike” to the navigation of all pages.
17	There are duplicate pages reached by two ways. For example, the “Business Start-up” page from the “Online Services” navigation and the “Business Start-up” page from the “Investment in Hubei” navigation.	H6, H7	One of the duplicate pages should be deleted and the content should be integrated in one page.
18	All the menu options, the second-class navigations, and the links are opened in new tabs.	H7	It is recommended to display content overflowing the body of the page.
19	When clicking the option - “Services for Individuals”, “Corporate Services”, “Departments’ Portals”, or “Cities’ Portals” under the “Online Services” menu, the page stays on the common page.	H7	The options are better to be linked to the corresponding blocks on the common page, so that it can improve the efficiency of use.
20	The options - “Services for Individuals” and “Corporate Services” are meaningless. Because the services has been divided into education, social security, employment, health, accommodation, transportation, and etc.	H7	The services should be rigorously by individual services and corporate services. This can improve the efficiency of use for individuals and corporates.
21	The contents on the home page are too crowded. The user has to scroll a lot to browse the whole page.	H8	Some blocks should be left out if the content can be easily reached by the navigation.
22	The site map, as a help tool, does not provide users with a clear structure of the navigation on one page.	H10	The site map should be classified rigorously by the navigation and linked to the wished site pages.

Table 3: Usability Issues

Based on the above, the most serious usability issue is the lack of consistency and standard. This problem appears mostly in the website layout, style, the first-class navigation. In addition, many pages are constructed as sub sites. However, the website style of the sub sites has been getting off the style of the main site a lot.

Another serious usability problem is that. In this case, it is hard for the user to find the needed information or service efficiently. Moreover, the navigation path needs to be paid attention to. On most of the pages, the navigation path only shows the current navigation where the page belongs to. The user has to remember how he/she reached the current page. Thus, the navigation function and the navigation path should be improved.

After the analysis, it can be concluded that the overall usability of the Hubei province e-government portal is on or just above the medium level which leaves much space to improve. Based on the detected usability issues, the researcher provides some suggestions for the future construction of the e-government portal:

First, the structure of an e-government portal should be clear and the classification of content should be reasonable. To solve the accumulation of content on one page, some blocks can be left out if the content can be easily reached by navigation.

Second, the website layout and style should be consistent on both main sites and sub sites.

Third, with the purpose of providing information and services, the e-government portal should have strong navigation and search function. A good navigation can help users find the needed information efficiently and not to get lost during the operation. For the navigation function, the pages without navigations should be improved rapidly, and the navigation path should be completed so that the user can easily go back or forward. For the search function, the results should be sorted according to their relevance and the latest release date.

Forth, the title of the page should briefly and exactly describe its content so that the user can easily know the content of the page when he/she is browsing other pages.

6 CONCLUSION

Form the literature review in this study, the researcher get an understanding of different usability evaluation methods and the current situation of the domestic and international studies on e-government portals. With the increasing demand for reaching the online government information and services efficiently, usability has been an important factor to evaluate the quality of e-government portals.

As the aim of the study was to inspect usability issues that exists in Chinese e-government portals, the researcher conducted a heuristic evaluation to evaluate the e-government portal of Hubei Province according to Nielsen's Ten Heuristics. Although the e-government portal of Hubei Province has been in the leading place among Chinese's e-government portals, the case study still revealed many usability issues.

From the data analysis, the detected usability issues were listed according to the corresponding heuristics. The usability issues were related to unclear website structures, inconsistent style and layout, unified navigation, and the unspecified page titles. Finally, the researcher proposed some suggestions which can serve as a reference for the future construction of e-government portals in China.

Due to the relative quickness and cheapness compared to other usability inspection methods, the heuristic evaluation is a recommended usability inspection method without the involvement of users. For heuristic evaluations, Jakob Nielsen's ten heuristics are widely-used to evaluate the user interface design comprehensively. Thus, in the future, the usability evaluation of Chinese e-government portals can apply the Jakob Nielsen's ten heuristics.

7 DISCUSSION

7.1 Limitation

There are two limitations in this study. One limitation is that the researcher conducted the heuristic evaluation alone. Therefore, it is not realistic to expect all the existing usability issues in the portal were detected. According to the proportion of usability problems found by heuristic evaluation using various numbers of evaluators (Figure 8), one evaluator can only find about 35% of all usability problems.

Another limitation is that the current version of the Hubei province e-government portal may be updated soon, so the detected usability issues might not exist in its future versions. All the usability issues described in this study were confirmed last on 22.04.2015.

However, despite these limitations, the research findings can still provide a good reference for future evaluation of e-government portals in China and point out the most severe usability problems, and propose some suggestions for solving those problems.

7.2 Reliability and Validity

According to Shuttleworth (2008), reliability refers to the repeatability of research findings. Based on the literature review, the previous studies have attached more and more attention to the usability of Chinese e-government portals. Lin (2011) evaluated the usability of Beijing's e-government portal by using heuristic evaluation method and found out some usability problems which are complex structure, unclear navigation, inconsistent style, delay of updating information, unobvious classification of contents and titles. Menno & Leo (2006) conducted scenarios-based evaluations on 15 e-government portals. The evaluation result showed that those e-government portals have many usability problems, such as unclear navigations, invalid links, titles that are difficult to understand, and etc. Although the applied usability evaluation methods are different, the results are

similar. In this study, the researcher finds out the common usability issues in the aspects of website structure, layout, style, navigations, and page titles. Thus, the final research findings are reliable.

Validity refers to the degree to which the tool or the method applied to the research measures what were intended to be measured (Shuttleworth, 2008). In this study, the researcher chooses the heuristic evaluation method and applies Jakob Nielsen's ten heuristics. Then, the researcher rigorously follows each heuristic to inspect usability issues and gives comments to each issue. The heuristic evaluation method helps the researcher review the interface of the case e-government portal comprehensively. In addition, the case study result reveals the similar usability problems compared to other studies. Therefore, this study is valid.

7.3 Further Study

For further study, the researcher can integrate Jakob Nielsen's ten usability heuristics or other well-known principles to the evaluation metrics to build a better evaluation system for the annual evaluation of Chinese e-government portals.

Furthermore, with the increasing amount of information on websites, the future evaluation of e-government could be developed to the direction of automatic evaluation systems. The usability evaluation tools can be developed mainly in the form of software, which can help reduce the human workload and shorten the evaluation cycle.

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