AN ANALYTIC CHARACTERIZATION OF WEBGIS UTILIZATION IN RECREATION AND TOURISM INFORMATION SEARCH

KAOWEN (GRACE) CHANG

Bachelor of Science
National Chung-Hsing University
Taiwan
1997

Master of Science
National Chung-Hsing University
Taiwan
2001

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Dissertation Approved:

Dr. Lowell Caneday

Dissertation Adviser

Dr. Deb Jordan

Dr. Donna Lindenmeier

Dr. Jonathan Comer

Dr. A. Gordon Emslie

Dean of the Graduate College

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CHAPTER I

INTRODUCTION

1.0 Overview

Coupled with the power of the Internet, Web-based spatial data service has promised a new generation of information channel and expanded the ways in which spatial information can be utilized. The integration with the Web has changed the Geographic Information System (GIS) from an isolated, stand-alone, and proprietary system to a Web-based service that encourages data exchange among members of the public (Anderson & Moreno-Sanchez, 2003). Moreover, geo-information online has become much more accessible and user-friendly than it was before. The improvement of the delivery of information has extended the profile of GIS users from what once was limited to well-trained experts to what now includes the entire public, and has changed the application from the foci of research and management to the matters of everyday life.

At the beginning of the 21st century, Web-based GIS services have become vital means to convey information and knowledge to the public (Yang *et al*., 2005), especially in the field of recreation and tourism (Luo, Feng, & Cai, 2005; Spink, Wolfram, Jansen, & Saracevic, 2001). Technological developments in this service have made a number of novel practices feasible, enabling it to become a new category of recreation and tourism information channel. The public and recreation/tourism sectors have recognized the advantages of Web-based geo-information such as direct access, interactivity, up-to-date information, and advanced cartography components. WebGIS, the context- and location-aware service, has been predicted to become widely used and common in today's market.

The advantages of using the Internet for recreation and tourism information searching are apparent. The openness of the Internet has provided the opportunity for virtually the entire public and recreation providers to utilize this effective channel for both communication and the distribution of services. From users' perspectives, spatial information searching is an effective strategy to reduce uncertainty and risk, as well as to enhance the quality of a prospective experience (Jang, 2004). The study of recreation/tourism information search has shifted from traditional information channels to emerging electronic channels. A gradual but remarkable change in the focus of research on information search has taken place.

According to Jansen, Ciamacca, and Spink (2008), in terms of recreation/travel information searching on the Web, geographic information accounted for nearly half of all search queries, while general travel information accounted for approximately ten percent. Such a phenomenon indicated that the use of WebGIS recreation and tourism information has become increasingly important in recent years.

With the increasing usage of WebGIS, the need to understand user behaviors has become more critical. People who plan to participate in recreation and travel experiences often need spatial information. The enriched geo-information that contains diverse forms of spatial information and features of multi-mediated non-spatial information not only has provided people with location information, but also has actively stimulated recreation/travel curiosities and ideas.

While Web-based geo-information has been an important field of study, research discussing the issues has mainly focused on professional uses, planning, or technical development. Given that the context and use of geo-information have changed considerably since the studies in the mid 1990s in terms of the range of users, tasks performed, and perceptions (Haklay & Zafiri, 2008), the changes have been neglected in more contemporary research, with few exceptions. As a result, there is a need to address research to explain how today's consumers interact with web-based spatial information services (Elzakker, & Wealands, 2007; Richmond & Keller, 2003). For instance, research is needed to understand the users of public geo-information sites on a daily basis, and practices such as the use of *Google Maps* or any form of digital geographical information on the Web.

Regarding recreation/tourism information searching, although much work has been done in the use of general tourism information, little discussion has been generated on Web-based geo-information. Moreover, the integration of recreation, tourism, and Web-based GIS has not been investigated thoroughly, though geospatial information-related queries online cover a substantial portion of searches about recreation and travel information.

Due to the lack of research, we know very little about the population (ComScore Networks, 2005; Download.com, 2008; Kraak & Brown, 2000; Peterson 2001) who seeks recreation/tourism information through WebGIS. In addition, we have little understanding to the ways people conduct their searches, and about their perceptions are toward Web-based geo-information services. This lack of understanding has resulted in a deficiency of information for recreation/tourism agencies that design the web-based geo-information for the users in order to ensure that the service is effective, efficient, and enjoyable (Haklay & Zafiri, 2008).

Web-based GIS services offer new opportunities for creating solutions that match people's needs and wants. By establishing a better understanding of the users' characteristics and how they interact with Web-based geo-information, we will be able to design better user-centered services and learn how to best customize these applications for users.

1.1 Problem Statement

The recent surge of research on WebGIS has given us new opportunities and challenges. WebGIS as an information channel provides both the professional recreation sectors and participants with various benefits including the direct access to spatial data with unlimited access, independent time and space, advanced cartographic components (e.g., multimedia), and the ability to tailor information through interactivity (Dickmann, 2005). As a consequence, audiences worldwide have taken the opportunity to benefit from these advantages of WebGIS.

Recently, Web-based spatial information services have been receiving considerable attention, not only from the academic community, but also from recreation/tourism agencies in the field. The development of Web-based geo-information services in recreation agencies is, however, still at early stages considering the information quality, functionality, and the number of sites available. Many recreation agencies that try to incorporate spatial information into their services have proposed a series of questions, for example, the questions about how their potential visitors would be affected by Web-based spatial information provision; what the effective approaches are to facilitate and promote their recreation services through WebGIS; what the profiles of their WebGIS users are; and how users' characteristics affect their attitudes toward WebGIS and their behaviors in the use of WebGIS.

These questions are fundamental and important to understand the impact of WebGIS use among the general public. Although it is apparent that the content of WebGIS in recreation and tourism information is a primary study focus, the research is still at the preliminary stage in helping providers understand the fundamental questions—not to mention a paucity of literature on this subject. Consequently, little is known about how people utilize WebGIS to prepare and are intrigued by interacting with recreation and tourism information available on the WebGIS services. The fact that relatively little research has been accomplished in the area might lead to the application of inappropriate models of GIS; for instance, the models that might not encompass the special needs of non-expert audiences whom the WebGIS truly is designed to serve, or the models that might be too general to assist the mission of effective communications between the recreation agencies and the users.

Studies have been focused more on models of traditional GIS use by experts and general tourism information searches that include multiple information channels, such as magazines, brochures, travel agents, and other general information channels. However, literature on issues of recreation/tourism and WebGIS use has emerged in a more scattered way. In addition, to date, no clear path has become apparent to suggest how models of traditional GIS for experts, information systems, and general travel information searches can be transformed into recreation-oriented WebGIS services.

In the light of these concerns, this study is designed to employ theories across disciplines to describe WebGIS utilization with four objectives: (a) to define dimensions of WebGIS utilization for the purposes of recreation/tourism information search; (b) to develop survey instruments for the dimensions defined; (c) to describe WebGIS utilization by the dimensions; and (d) to provide the information about the relationships between the factors that influence WebGIS utilization.

1.2 Statement of Purpose

By employing theoretical bases from the fields of information system and information search, the purpose of this research is to examine user behavior in the context of WebGIS use specific for recreation/tourism. The aim is to delineate the recreation and tourism information seekers' participation in WebGIS services and to explore the factors that significantly affect WebGIS use. An understanding of user participation in WebGIS is critical in successful service implementations.

The purpose of this study is two-fold. First, the primary purpose is to develop a comprehensive model upon which to construct the dimensions to study WebGIS use in the context of recreation and tourism information searching. The second purpose is to apply the developed model to explore the users' perceptions as well as the factors impacting the practices of recreation/tourism information searching through WebGIS.

To meet the first purpose, this project included a series of tasks to determine the study dimensions and their corresponding constructs, and designed an evaluation instrument that converts abstract concepts to measurable and understandable survey measurements. The tasks included an extensive literature review over interdisciplinary research fields, a Delphi study for the evaluation of domain validity, a pilot study for usability testing, as well as validity and reliability testing.

The second purpose is to explore WebGIS utilization using the model established in the first phase. The investigator explored the users' perceptions and practices in these four aspects: attitude-behavior, personal characteristics, artifact features, and recreation/tourism attributes. Moreover, the overall utilization and the relationships between the four aspects were examined. Also, the factors that influence the utilization were analyzed.

1.3 Research Significance

Both researchers and practitioners have suggested that understanding users is essential to identify impacts of Web-based geo-information on recreation and tourism, as well as to guide more effective products and services (Holbrook, 2007; Vargo & Lusch, 2006). As the Internet has become more and more accessible, how consumers exploit recreation and tourism information has shifted dramatically over the years. These current developments in information communication have affected the field in a wide spectrum. The ability of WebGIS as an information platform that integrates multiple formats of information, in addition to its highly interactive features, has been acknowledged as a great tool, especially for recreation/tourism information searching.

In order to know the opportunities and challenges this shift brings, to understand the dynamics of the use of this unique information channel is essential. For sectors in the market to successfully implement WebGIS, it requires thorough comprehension for the audiences and their behaviors. Hence, the purpose of this study is to contribute to the knowledge about the users' attitude and behavior toward WebGIS and what factors affect their use behaviors. These factors may include the different recreational situations people encounter, the motives that they have when reaching WebGIS, and their actual interactions with this information channel.

The design and findings of this research intend to contribute to product and service development through market communications between providers and users. Better knowledge of utilization and user characteristics will improve the professionalism of recreation management and the quality of leisure/recreation services. The results of this study may assist decision makers in organizing priorities and allocating resources. In addition, this study may help managers to better understand consumers' personal characteristics, perceptions, behavior, and their actual interaction with WebGIS functionalities.

Knowledge of user motives and perceptions toward WebGIS may contribute to strategic planning for product and service development. Moreover, the knowledge of consumers' personal and recreational characteristics may facilitate effective communications with target audiences.

1.4 Research Questions

Based on the problem statement and purpose of the research, the research questions are as follows:

1. How can WebGIS utilization be defined and measured in recreation and tourism studies?

2. How are WebGIS services utilized as recreation/tourism information channels by users in different recreation/tourism attributes, personal characteristics, attitude-behavioral aspects, and artifact interactions?

1.5 Research Objectives

The two main research questions are designed to yield answers that will meet six primary objectives. The objectives of this study are:

(1) To identify the dimensions that influence WebGIS utilization in the recreation/tourism context.

(2) To develop an instrument that measures the underlying dimensions of WebGIS utilization in (a) personal characteristics, (b) attitude-behavioral characteristics, (c) recreation/tourism situations, and (d) artifact aspects.

(3) To explore how the usage of WebGIS varies in the dimensions: (a) personal characteristics, (b) attitude-behavioral characteristics, (c) recreation/tourism situations, and (d) artifact aspects.

(4) To explore how personal characteristics are related to the WebGIS utilization dimensions.

(5) To explore how attitude-behavior variables are related to use and functionality interactions.

(6) To explore how recreation situations are related to functionality interactions, and to attitude-behavior constructs identified significantly within last objective as determinants to WebGIS use and interaction.

This study aims to connect theories and explore empirical findings to investigate the behavioral aspects of the use of Web-based geo-information for tourism and recreation. Since there has been a lack of instruments to answer the research questions, the researcher carries out the task of instrument development.

Initially, to identify the components that are essential to address the research questions, the researcher refers to a multidimensional model. This model includes the components of information system utilization in which recreation/tourism attributes, personal characteristics, behavioral features, and artifact aspects have been identified as the crucial constructs (Amoroso, 1991; Bevan & Macleod, 1994; Davies & Medyckyj-Scott, 1994, 1996; Dillon, 2002; Mawhinney & Lederer, 1990; Nyerges, 1993; Trice & Treacy, 1991) with which to answer WebGIS utilization inquiries. In addition, this model unites with the theoretical foundations of information system uses, such as Activity Theory, Theory of Reasoned Action (TRA), Technology Acceptance Model (TAM), and Task Technology Fit (TTF), to approach the research questions. In order to specify the connections between the three components— directional theories, WebGIS, and recreation/tourism perspective in one context, other research techniques also play great roles to support this study, such as Delphi techniques and validation processes were employed to tailor the instrument to answer the first research question.

Objectives three through six were to address the second research question, which aims to investigate the relationships between the dimensions and the constructs considering WebGIS from recreation/tourism perspectives. As previous studies have paid very little attention to this inquiry and to the factors addressed in the study, the research of this study mainly concerns with how the factors of the underlying constructs identified in objective 1 and objective 2 affect WebGIS utilization.

1.6 Research Design

This study consists of two sequential phases, and includes the exploratory principles on which both phases are founded. In addition to the exploratory basis, in phase two, an explanatory approach is adopted to assess the underlying dimensions of WebGIS utilization.

The first phase includes a series of instrument development processes, which include preliminary instrument generation, Delphi studies, pilot study, and tests for instrument validity, reliability, and usability. The main objective for phase one is to determine the constructs that explain WebGIS utilization within the recreation/tourism context and to obtain operational measurements for the constructs. The final instrument is organized in the form of a survey for quantitative analyses in phase two.

The second phase of this study involves a structured self-administered electronic survey. This phase is quantitative in nature and designed to assess the relationships among the underlying dimensions identified in phase one.

1.7 Limitations and Delimitation

The limitations of this study must be considered when implementing the findings of this research.

The first limitation is associated with non-response biases. The responses completed are limited to those who had a willingness to answer the survey. The groups of response and non-response may have different characteristics in WebGIS use. These non-response bios indicate the limitations to assess non-response group's WebGIS use.

Second, to reduce the obstacles to answer the survey for potential respondents, the researcher allows unrestricted access to the survey. The possibility that the respondents responded to the survey more than one time is another limitation associated with this study.

Third, samples for this study were drawn from two pools: college students and recreation professionals. Although the characteristics of the two pools benefit the study in the deeper considerations to the domain of recreation as well as the familiarity with Internet use, the ideal sampling is to draw the samples equitably with demographic makeup. Hence, the technique of purposive sampling used in this study may have an effect on generalization of study results.

1.8 Definition of Terms

The terms used in this study are defined and clarified as follows:

Geospatial information. The information represents a body of knowledge that focuses on various aspects of geographic, spatial, and spatial-temporal context, such as geodetic, imagery, topographic, and cultural data accurately referenced to a precise location on the earth's surface (Department of Defense, 2005).

Geographic Information System (GIS). A computer system that is capable of capturing, storing, analyzing, and displaying geographically referenced information (U.S. Geological Survey, 2008).

Technology Acceptance Model (TAM). An extensively tested and broadly accepted model for information systems based on its strong theoretical foundation and good explanatory power (Venkatesh, Morris, Davis, & Davis, 2003; Venkatesh, Speier, & Morris, 2002). This model states that the user's intention and attitude determined by perceived usefulness and ease of use toward the information system and the users' intention and attitude are the determinants to the uses of the information system (Davis, Bagozzi, & Warshaw, 1989; Davis, 1989, 1992, 1993; Venkatesh *et al.*, 2002, 2003).

Task Technology Fit Model (TTF). TTF is an established model explaining the acceptance and utilization of information systems. TTF expresses the impact of information technology to support a task when the competencies of the technology match the demand of the task that the user attempts to perform (Goodhue & Thompson, 1995).

WebGIS. *WebGIS* is a special type of GIS tool that uses the WWW as a major means to access and transmit distributed data and analysis tools, conduct spatial analysis, and create multimedia and service GIS presentations. The terminology 'WebGIS' is interchangeable with the terminologies 'Web-based GIS' and 'Web-based geo-information services' in this study. WebGIS is often available to the public. It provides dynamic maps as well as operational tools (Peng & Tsou, 2003). Common examples include, but are not limited to Google Maps, Yahoo! Maps, MSN Virtual Earth, GlobeXplorer, and Geospatial One Stop.

CHAPTER II

REVIEW OF LITERATURE

2.0 Introduction

The purpose of this chapter is to review fundamental theories and existing literature that reflect on the purposes that this study addresses. This chapter provides a historical background, an overview of the current context in which this study is situated by referring to contemporary debates, and a discussion of underpinning theories and concepts. It also introduces relevant definitions to clarify how terminologies are being used and examines related research in the field to provide supporting evidence to the issues that this study addresses. The researcher drew from theories in related fields such as information systems, consumer behavior, and psychology, with a focus on the utilization of WebGIS in recreation and tourism.

Once a sophisticated analytical tool only for scientists, GIS has been introduced into the matters of everyday life for those outside of the scientific world through the improvement of technology. In the past two decades, GIS has become a well-adopted tool in various fields, including business, resource management, education, and other fields.

Assessing the status of recreation and tourism information searches today, geographic information accounted for almost half of total travel and recreation queries online, while general travel information accounted for less than one tenth (Jansen, Ciamacca, & Spink, 2008). However, the task of recreation agencies providing information through WebGIS is still at its early stage regarding information quality, functionality, and the number of kinds available. Similarly, the empirical applications of the proposed theories have been scarce. The lack of information about WebGIS users who search for recreation information has become a fundamental issue for WebGIS managers and decision makers in recreation/tourism sectors. The information regarding such use is one of the most important elements for the implementation of innovative and user-friendly services.

2.1 Recreation and Travel Online Information Search

"Online information search" usually refers to information search activity through the Internet, which has become a vital information channel for tourism information acquisition and delivery (Mills & Law, 2005). Moreover, travelers have become more independent and sophisticated in adopting a variety of tools to plan trips (Buhalis, 1998).

In the field of recreation and tourism, information search is an essential means for participants to reduce uncertainty and perceived risk in travel (McCleary & Whitney, 1994; Urbany, Dickson, & Wilkie, 1989) and to increase the quality of their trips (Fodness & Murry, 1997). Online information searching allows recreation participants to reduce the five dimensions of risks shared across cultures (Dawar, Parker, & Price, 1996). These dimensions of risk are monetary, physical (illness or injury), functional (does not meet needs), social (unfashionable), and psychological (damaging to self-esteem) (Hofstede, 2001; Jang, 2004).

With easier access to the Internet, online recreation and travel information has changed the ecology of communications as to how people receive information and what information people receive for their recreation and travel (Rayman-Bacchus & Molina, 2001). According to the survey of using Web for travel plans in 1997, eighty-seven percent of Web users sought travel information online (Richmond & Keller, 2003). The topic of online information has become an important research topic, especially in a travel/tourism/recreation context (Jang, 2004).

Web-based GIS is influential in how we discover and learn about the world around us. This is especially true for people who are interested in or seeking recreation/tourism experiences and information, but have limited spatial information about the places they visit. WebGIS provides a relatively effective and efficient channel in their acquisition of the spatial knowledge that is vital throughout the entire recreation experience, from the stages of discovery, through planning, being on site, and recollecting (Clawson & Knetsch, 1966; Jensen & Guthrie, 2006). Moreover, for marketing purposes, WebGIS has the potential to visually communicate information regarding places, increasing interest and curiosity, attracting visitors, and retaining attention of destinations (Richmond & Keller, 2003). Further, with the interactive options of WebGIS, the user is not only an information receiver, but also an opinion producer and information provider (Gursoy & McCleary, 2004; Jang, 2004).

2.11 Approaches of recreation*/travel information search*

The studies of online information searches usually integrate the psychological, economic, and processing approaches to explain information seeking behavior (Gursoy & McCleary, 2004). The psychological approach is focused on beliefs and attitudes. This approach values the influences of personal and motivational factors on information search strategies (Urbany, 1986). The economic approach, in general, evaluates the effects of costs and benefits on information seekers' choices among information sources (Avery, 2005; Stigler, 1961). This approach takes into account both internal and external costs. "Internal costs" refers to the efforts that information seekers need to devote to search information internally inside their memory while "external costs" refers to the costs spent to obtain information outside their memory from any available sources, such as time or monetary expense. Those external costs are the determinants that influence the extent and depth of external search activities engaged (Marmorstein, Grewal, & Fishe, 1992). The core of the processing approach is based on the notion of cognitive process, such as information load and memory (Coupey, Irwin, & Payne, 1998).

Since the majority of the recreation/tourism information searches are external, the costs are more likely related to time and financial expenses. However, as more and more people use the Internet and online resources for their information needs, Gursoy and McCleary (2004) suggested the need to re-evaluate the changing equilibrium among the costs of external information.

2.12 Factors influencing recreation/travel information search

Although the findings were inconsistent, numerous studies have found that three groups of factors often have significant influences on tourism information search behavior (Berkman & Gilson, 1986; Bettman & Sujan, 1987; Fodness & Murry, 1997; Grønflaten, 2008; Snepenger, Megen, Snelling, & Worrall, 1990). These factors can be assembled into three categories: personal characteristics such as age, sex, education, nationality, occupation, and income (Beldona, 2005; Fesenmaier & Vogt, 1992; Hyde, 2006; Kim, Lehto, & Morrison, 2007; Lo, Cheung, & Law, 2002; Luo, *et al.*, 2004; Weber & Roehl, 1999); recreation/tourism situational characteristics, such as trip phase (Berkman & Gilson, 1986; Burton-Jones & Hubona, 2005; Chen, 2000a, 2000b; Fodness & Murry, 1998; Grønflaten, 2008; Gursoy, 2003; Gursoy & Chen, 2000; Lo, *et al.*, 2002; Luo, *et al.*, 2004; Rompf, DiPietro, & Ricci, 2005; Snepenger, *et al.*, 1990); and product characteristics such as trip purpose, novelty, length of stay, and distance from home (Chen & Gursoy, 2000; Gursoy, 2003; Kerstetter & Cho, 2004; Lo, *et al.*, 2002; Luo, *et al.*, 2004; Vogt, Stewart, & Fesenmaier, 1998).

In comparison to the field of general tourism information searching in which effective factors have been extensively investigated, studies were scarce on examining the factors that influence geo-spatial recreation information. This study considered two categories—personal and recreation/tourism situations as influential factors to WebGIS use. However, the category of product characteristics in previous studies was different from the 'artifact characteristics' category in this study. Although they may all express something material, the content of factors considered in the 'product category' in previous studies meant the travel packages that interested customers. In this study, 'product characteristics' included the factors that were considered more like recreation/tourism situation categories, such as trip purpose and trip mode.

Although the use of geographic information for recreation/travel purposes is extensive (Kraak, 2001; van Elzakker, 2000), there is inadequate attention addressing the topic either in spatial information or search behaviors using WebGIS. More research efforts have focused on general recreational travelers' information search (Chen, 2000;

Chen & Gursoy, 2000; D'Ambra & Wilson, 2004; Fodness & Murry, 1997; Fodness & Murry, 1998; Fodness & Murry, 1999; Gitelson & Crompton, 1983; Snepenger, *et al.*, 1990; Vogt, *et al.*, 1998) than on the recent information channel of WebGIS.

2.2 The Role of Utilization in Information System

Understanding how people use a certain product or service is a critical issue to many professions. However, the concept of "utilization" is related to a wide spectrum of meanings in the research fields in which people and information systems are the main focus. Different professions and practices interpret the concept of "utilization" with different meanings. Those meanings articulate the concept of utilization to more specific levels to explain and to describe the concept of utilization, such as usability, interaction, or experience. In addition, the perceptions from philosophic, social, and behavioral disciplines have influenced the studies of information systems to value non-technology components to explore the form, function, and contents of information services (Forlizzi & Battarbee, 2004).

2.21 Technology-centered view vs. user-centered view

GIS study has become an important field of research during recent years. As GIS became increasingly accessible, studies started to explore different aspects of it, including rationale for use, motivation for diffusion in various disciplines, and the strategies to effectively utilize it for both communication and commercial purposes. Those studies took either a technology-centered or user-centered view. The technology-centered view describes utilization by probing the technical features of WebGIS, such as interface, content design, and usability studies. The GIS studies with technology-centered view support the focus on examining the specific interactions among the technology features of GIS. Meanwhile, the user-centered view values investigations of GIS through users' perspective, examining user attitudes and beliefs. This view believes that user factors, as well as social-demographic factors, greatly influence GIS utilization. From a user's standpoint, the product provider's intentions and objectives are less important than their own perceptions and experiences (Vargo & Lusch, 2004). Users' experiences and perceptions are essential to determine the utilization of a product, as well as the value of products or services (Gummesson, 1998; Holbrook, 2007). With this approach, the integration with situational factors and personal characteristics becomes essential once users are involved in interactive processes with the services (Grönroos, 2000; Holbrook, 2007; Richins, 1994; Vargo & Lusch, 2004).

2.22 Interaction aspect of utilization

The concept of utilization is closely related to the aspect of interaction. Interaction refers to the relationship between a subject and an object, such as a product or a service (Holbrook, 2007). "Interaction" can be described as the attachments between goals and expected outcomes, or physical contacts with the functional operations of a product (Woodruff & Flint, 2006). In other words, utilization is better understood with the concepts of motives and goals, as well as the notion of tasks performed by users as they interact with functional features provided by a product.

The concept of interactions can be classified based on mental efforts involved in the interaction processes as to fluent, cognitive, and expressive interactions (Forlizzi &

Battarbee, 2004). “Fluent interaction” involves the least mental effort in the interaction process than other two categories. Due to the familiarity with the product, the operation is almost automatic, such as making coffee in the morning using coffeemakers. “Cognitive interaction” may associate with possible confusions and errors during the interactive process but those confusions and errors may result in learning new knowledge. “Expressive interaction” may be represented in the actions of personalizing, modifying, or creating a new relationship with products. This type of interaction requires the most effort. Similar to this concept of mental effort, Davies and Medyckyj-Scott (1996) conducted tape recording to compare “enabling actions” of GIS activity that requires less mental effort, such as preparing the environment for work. This study found that mental efforts were good indications to determine levels of interaction. Therefore, this study adopted the concept of mental effort as one index indentifying the levels of interaction between users and WebGIS services.

2.23 Usability aspect of utilization

Usability refers to the extent to which a product can be used by users to achieve specified goals with effectiveness, efficiency, and satisfaction (ISO 9241-11, 1998). Berry (2005) adopted the usability approach and proposed a framework of an iceberg analogy model to probe the utilization of information technologies. The study examined the usability aspects contributing to user experiences. In addition, the study included the models of— “look”, “feel”, and the “user model”, in which the ”look” referred to the visual cues that gave hints to users to assist users’ operations, and the ”feel” aspect included arrangements of the functional cues of the interface; for example, the menu organization and interface navigation. The study found that the ”look” and ”feel” together facilitated users’ operations with the system, but assisted little in connecting users’ tasks of use and the system’s ability to offer. Different from the “look” and “feel” models, the “user model” contained the factors related to what the users want to achieve, that is, their task goals. According to Berry (2005), the ”feel” and “look” together account for approximately forty percent of user experiences and the “user model” factors account for approximately sixty percent of user experiences. The “user model” provides a comprehensive framework from a practitioners’ view to emphasize the importance of enabling users to accomplish their tasks. In addition, with Berry’s model, the foundation of design is to understand who the users are in terms of their motivations, skills, and the tasks they perform (Burton-Jones & Hubona, 2005), which are the factors serve the principles to assess and validate designs.

WebGIS is the Web application that features more highly interactive ability than the typical traditional website interface that intends to convey a message to users. Traditional Web interfaces have put more foci on visual effects than on interactions and concepts of the “user model”. Davies and Medyckyj-Scott (1994) proposed a GIS system evaluation framework. The framework suggested that system characteristics (e.g., GIS type and hardware platform), user characteristics, and environmental characteristics (e.g., organization type and information handled) are vital in assessing GIS usability. The authors stated that this comprehensive view catches more precise factors of information system usability than the models that focus on solely interface design. This GIS study emphasized the instrument for detecting information system needed to integrate the hardware, the user, and also the environment. Thus, with WebGIS, providers may have to consider these factors, which not only are the interface design elements, but also users' psychological properties and the environments they are given.

Usability measures have been developed into diverse directions to fit the purposes of the instrument designed; for example, ease of learning, error rate, efficacy of use, flexibility, ease of remembrance, as well as some new factors proposed; such as accessibility and safety. Under each category, there are many measures developed based on various directions or specific characteristics of the product. However, only a few of the measurements developed have a theoretical basis and have been tested. To assist the selection of such diverse measures, Bevan (2008) suggested principles that provide guidelines to measure selections, for example, which stakeholders' goal is the main concern? Nevertheless, the guidelines are still vague and lack of a theoretical basis. Ketola and Roto (2008) suggested that when using these measures, the researcher or practitioner needs not only to be cautious about the context in which those measures represent for the objectives of the study, but also to give attention to the validity, reliability, and usability of the instrument.

2.24 The framework of utilization

The framework of information system evaluation is necessary to involve utilization in context. Dillon (2002) stated that evaluators need to consider utilization in three aspects—process, outcome, and affect. In this POA (process, outcome, affect) model, process refers to the actions and responses involved in users' interactions with a device. Outcome covers the range of factors that evaluate the results obtained from the interactions with the device. Affect includes the attitudinal and emotional elements of experiences. In other words, the POA model suggests the evaluation model to incorporate "action" (i.e., what users do), "result" (i.e., what users attain), and "emotion" (i.e., how users feel). Although these three elements are important and intertwined in any interaction with an artifact, this model has not received enough attention in research than it deserved. The POA model suggests that to describe utilization, investigations must reflect multiple factors that determine the experience beyond simple task measures of efficiency, effectiveness, and satisfaction.

Other studies were in support of Dillon's suggestions. Nedovic-Budic and Godschalk (1996) suggested a framework that also recommended holistic views for potential measurements of utilization. The framework included the following dimensions: (1) information quality, such as information effectiveness and usefulness; (2) supporting functionality. This factor specifies tasks to sub-tasks and investigates these subtasks with more precisions; (3) users, such as users' characteristics, levels of use, and the motives of use (DeLone & McLean, 2001); (4) user satisfaction, such as users' reactions and perceptions to the outcomes generated; (5) usefulness, which is the performances related to effectiveness in productivity, such as faster and more informative; (6) ease of use, which refers to the control and clarity perceived; (7) user attitude, which is users' perceptions toward the technology (DeLone & McLean, 2001). This framework emphasizes the importance of using multidimensional factors to determine system utilization (Campbell & Masser, 1995; Huxhold & Levinsohn, 1995; Nedovic-Budic & Godschalk, 1996).

Cuellar, McLean, and Johnson (2006) further proposed preliminary considerations for use measurements. The study re-conceptualized use as the level of incorporation of an information system in the processes of achieving their goals. In this study, the authors proposed components of appropriate utilization measurements, including users, tasks, equipments, and environments as the factors. Another three groups of scholars also proposed multidimensional models as frameworks to determine the variables of utilization study. The authors suggested that investigators need to identify (1) the characteristics of information systems, (2) design and implementation variables, (3) individual differences, and (4) task characteristics (Bevan & Macleod, 1994; MacEachren *et al.*, 2005; Mawhinney & Lederer, 1990).

This current study focuses on user-centered view as the attempt to investigate how the factors of users, environments, situations, as well as technical aspects are related to recreation/tourism information search using WebGIS. According to the discussions of the concept of utilization, utilization evaluation can be exploratory and meaningful when goes beyond the technology focused dimensions. In addition, the selection of utilization dimensions should reflect the nature of WebGIS use as an interaction between user and artifact, and based on a multidimensional model with factors interpreting the characteristics of the system, individual differences, performing tasks as well as users' psychological properties.

2.3 The Concept of Geographic Information System

A WebGIS is a GIS that integrates, disseminates, and communicates geographic information on the Internet (Peng & Tsou, 2003). Therefore, the next subsection takes a closer look at WebGIS as an explicit category within GIS.

GIS/WebGIS is a special entity within the realm of information systems. Although WebGIS/GIS shares some comparable features with other information systems, it is separated by its unique system architectures, data structures, and data presentations. These uniqueness are reflected in its applications and its audiences. The field of GIS has developed into different directions. To tie the literature review close to the topic of this study, this section discusses and provides insights focused around the study themes. Hence, this section provides WebGIS related concepts, terminologies, and definitions, as well as geo-spatial information sources, geo-spatial data classifications, and WebGIS user profiles.

2.31 Definitions and views of GIS

Many definitions of GIS have been suggested over the years. Among them, the most widely accepted definition asserts, "GIS is a computer system capable of capturing, storing, analyzing, and displaying geographically referenced information" (USGS, 2008). The purpose of using information systems is to manage knowledge, by making it easy to organize, store, access, synthesize, and apply knowledge to the solution of problems (Longley, 2003).

Different from this definition that focuses on the functionality of GIS, the leading manufacturer of GIS development, Environmental Systems Research Institute (ESRI) defines GIS as an integration of hardware, software, and data to manage, analyze, and display all forms of geographically referenced information. ESRI also states that the user is the key to the system. Users manipulate the hardware, which engages the software, to work on the data. Together, they handle information processing, such as data entry or data transformation, data selection and query, as well as data display. In addition, GIS is not "canned maps" (ESRI, 2008). The system, instead, integrates geographic data, attributes, and processes by the rules set by the users.

To better describe the spectrum of different levels of uses, ESRI (2008) describes the three views of GIS—the database view, the map view, and the model view. The database view emphasizes the importance of data in GIS in terms of offering the flexibility to query geo-information. The map view illustrates that GIS is a set of intelligent maps that show spatial relationships between features and support queries and analysis. The model view highlights GIS's ability to integrate different formats of data and makes pieces of tasks into one automatic function.

Some scholars argue that database function is central to GIS. GIS is a special-purpose digital database in which a common spatial coordinate system is the primary means of reference (Foote & Lynch, 1995). The database links information with features on maps and, most importantly, to recognize relationships between them. With the observed relationships, professionals and researchers are able to identify issues and further evaluate resolutions to problems such as environmental impact (Alam & Goulias, 1999).

GIS is distinct from database applications by its primary means of linking all information to a spatial reference, which GIS uses to access data. Although other database applications may contain location information, such as address, the location information is not the primary means of linkage as is geo-reference in GIS. In addition, GIS is a comprehensive system. Following the principles of spatial references, the system can integrate specified functions handling digitized maps, satellite imagery, and statistical models (Foote & Lynch, 1995).

In general, GIS provides an opportunity for users to view, comprehend, question, interpret, and visualize data in many forms of maps, globes, charts, and reports that reveal relationships and trends. GIS helps people answer questions and solve problems by looking at the data queried in a way that can be quickly understood and easily shared.

Although the advantages of GIS have been recognized, the system is far from perfect. In Pickles' publication (1995), the author addressed the unease toward GIS application to its social implications. The concerns include the issue of uncertainty, privacy invasion, the trends of the spatial knowledge controlled by the marketplace, the emphasis on technology rather than human needs, the possibility to have GIS become a tool for surveillance in society, and the issue of logical positivism.

2.32 Web-based GIS/Geo-spatial information system on the Internet

WebGIS is a special type of GIS tool that uses WWW as a major means to access, distribute, and analyze data, and to incorporate with other Web applications such as multimedia. WebGIS is often available to the public at no charge. It provides dynamic maps as well as operational tools.

The recent development of GIS and the Internet has been tightly interwoven (Longley, 2005; Peng & Tsou, 2003). The Internet has influenced GIS in three major directions—data access, spatial information dissemination, and GIS processing (Peng & Tsou, 2003). Using map distribution as an example, the number of maps requested through the Internet was estimated at over 200 million on a daily basis (Peterson, 2001). The Internet has been a popular vehicle for delivering GIS applications for several reasons (Heywood, Cornelius, & Carver, 2006; Kraak & Brown, 2000; Longley, 2003; Tang & Selwood, 2003):

- The Internet offers a cost-effective way of linking users, such as customers and suppliers;
- The multimedia and friendly interface expand the range of potential users;
- The better strength of search engines facilitates the dissemination of GIS online;
- The increasing portability of devices with the availability of wireless network has encouraged geo-information delivery on the move;
- The exploratory nature of Web-based GIS has intrigued the users.

Users of Web-based GIS can search, retrieve, query, and manipulate spatial information by simply a click of the mouse on a World Wide Web browser without installing particular GIS software. Web-based geo-spatial use is an application that has encouraged people to go online; meanwhile, GIS has benefited from the popularity of the Web. The GIS data and process functionality on the Internet provides opportunities for the general public to discover the advantages of WebGIS, which was inaccessible before.

Moreover, the capability of WebGIS solved the issue of increasing data volume and variety. The single and centralized architecture of traditional GIS was constrained by the complexity of data volume and variety. By contrast, the dynamic and distributed service has been able to facilitate and energize the GIS process and avoid encountering gigantic data sets. Most of the GIS software was designed for very specific tasks. For example, some have outstanding address matching as their principal function; others have the ability to analyze and calculate spatial indices (Peng & Tsou, 2003).

About ninety percent of users use less than ten percent of the software features in traditional GIS (Peng & Tsou, 2003). However, those users must pay for all applications. With a true WebGIS service, its flexible architecture supports users to combine modules based on their needs, without being constrained to a single GIS package. Additionally, the capability to deliver GIS data with multimedia, such as images, emails, and videos, has made WebGIS a part of everyday life for many people.

In comparison to Web-based GIS, stand-alone GIS has all GIS functions and data in one computer; however, there is no data exchange between one and others (Heywood *et al.*, 2006). As a platform for information exchange, Web-based GIS technology connects knowledge and information from various sources with regard to business, education, and the environment (Anderson & Moreno-Sanchez, 2003).

With years of progress, Web-based GIS software has been developed to fulfill various demands. Its interfaces have advanced from being skill challenging to user-friendly and highly interactive (Peng & Tsou, 2003). The new medium has radically changed the way in which spatial information is distributed (Peterson, 2001). The Internet provides an easy access to spatial data from different providers, including various GIS data clearinghouses, and digital libraries administered by both public and private sectors. For example, the U.S. Geospatial Data Clearing House Activities under the Federal Geographic Data Committee (FGDC) (http://www.fgdc.gov) has built archives for universal access. The Recreation Finder (http://maps.kansasgis.org/recfinder/public/index.cfm) offers recreation information by location, activity, and environment types. Although some WebGIS applications are popular, such as Google Maps, Yahoo! Maps, MSN Virtual Earth, GlobeXplorer, Geospatial One Stop, and National Geographic MapMachine, the WebGIS services of this study were not limited to only those applications.

There are different terms address GIS online, such as Internet GIS (Peng, 1999), distributed GIS, Web-based geo-spatial information system, Web-based GIS, or WebGIS (Grunwald, Reddy, Mathiyalagan, & Bloom, 2003). Among those terminologies, the terms Web-based GIS, WebGIS, and Web-based geo-spatial information service were used interchangeably in this study. They describe the GIS functions offered by a server and consumed by users connected to the Internet.

WebGIS services offer an alternative to stand-alone GIS and allow the users to send a request to a remote server. For example, ParkInfo (http://www.parkinfo.org) offers systematic spatial data online to deliver the information of public parks, and Google Maps (http://maps.google.com) provides routing services that are used by millions of people every day. With the service, users are able to analyze routes by indicating an address on the WebGIS, and the WebGIS service delivers the results remotely to the users in the form of maps and text directions with no need to buy software and data to conduct the analysis.

Internet GIS refers to the use of the Internet to exchange, process, and demonstrate results, whereas WebGIS or Web-based GIS is defined particularly by the use of the WWW (Peng & Tsou, 2003). The similarity between the Internet GIS and WebGIS is that both use the client/server computing principle, but Internet GIS can mean any network technology, not only the WWW. Although the Web is the most important component on the Internet and the focus of much Internet development, the Internet contains network applications other than the Web application. Therefore, the term "Internet GIS" is broader and more diversified than "WebGIS."

WebGIS performs GIS tasks applying the client/server architecture to the Web. Technically, the service is basically arranged with two sides. One is the server side, and the other is the client side. The communication between the two sides, client and server, is developed on a protocol which is often TCP/IP. A client usually is a Web browser identified by a unique IP address. While the sever offers GIS software, the user requests a set of data from a server over the Web. The client computer accepts the query and prepares them for the server. After the client sends the query to the server, the server receives the request from the client and processes the request. During the process, the server translates the client's request to a machine code to function the GIS software within the Web server. Then, the server processes the information requests and re-configures the results to the client's browser application or with a plug-in or Java applet for better demonstration (Peng, 1997; Plewe, 1997).

As a giant distributing system, the WWW enables GIS data and tools to reside in various computers. In addition, since all data and process modules can accept, function, and deliver the queries through servers, users can access spatial data and process spatial query anywhere across the Internet. Also, the dynamic nature enables WebGIS connecting to real-time information, such as traffic and emergency monitoring. WebGIS is advantageous when the requests have to rely on up-to-date data that would be too difficult for users to maintain (Longley, 2003).

2.33 The sources of spatial data on the Internet

There are mainly four types of places and means to find spatial data on the Web—search engines, subjective directories, subjective guides, and specialized databases (Kraak & Brown, 2000). Among these sources, search engines, subjective directories and their hybrid search tools have been the most common for finding spatial data. Subjective directories arrange information by categories using index methods; for example, a “map” subcategory exists under the directory.

Using search engines to find spatial information is popular; however, it has its limitations. One issue is that search engines can only find limited amounts (about thirty-five to forty-two percent) of information available (Lawrence & Giles, 1999). Another issue is that the users may have difficulty finding the right keywords to propose their search questions, or so called “vocabulary differences” (Chen, Houston, Sewell, & Schatz, 1998). Subjective guides are usually compiled by experts in a certain domain, such as Oddens Bookmarks. The audience of subjective guides may be the users who constantly search for specific geo-information.

Another type of source contains spatial data that allows manipulation and analysis and it is data-driven. *American Fact Finder*, hosted by the United States Census Bureau, is an example of this type. Working with a specialized database, users can search, browse, retrieve, visualize, print, and save spatial data. Spatial data, however, are not always free and accessible. Many commercial operations require users to pay for data, and some Web sources allow limited access due to privacy and/or copyright issues.

2.34 Web-based GIS users

Retrieving information of WebGIS users was difficult due to the limited publications available. This study reviewed the information of numbers of users and numbers of maps online to catch the pattern of the use and users of WebGIS.

Based on ComScore Networks's recent estimations, in May 2005, MapQuest.com served 43.7 million U.S. visitors, Yahoo Maps served 20.2 million users, and Google Maps served 4.68 million visitors. In addition, Google Earth claimed 3.40 million activations of its latest version (Download.com, 2008). In the UK, MapQuest claimed that it had over 40 million unique visitors monthly in 2007, and Multimap (2007), another leading geo-service in the UK, served over 10 million unique visitors each month. Kraak and Brown (2000) indicated approximately 2.5 million maps a day, or 1,750 maps a minute, are requested on average by online users. Also, Peterson (2001) estimated 40 million Web maps are used per day world-wide. In 2000, MapQuest was ranked 38th of the most visited websites with 5.5 million individual users and more than 20 million maps downloaded per day (Peterson, 2001). Graphics Visualization and Usability Center (1999) found only 10.4 percent of the 3,291 respondents of a WWW user survey said that they never look for a web map. The data presented above indicated that Web-based spatial data has a massive audience and keeps being disseminated to people's everyday life.

As a result of the popularity of the Internet, much more growth of Web-based Geo-spatial service is expected. Therefore, it is becoming more pressing to know more about who is using what kind of WebGIS services. Kraak and Brown (2000) indicated that little is known as to how people use the WWW to retrieve geographic information.

Under the situation that user profiles have been more and more diversified, knowing users' characteristics, their tasks, and preferences is crucial to provide effective WebGIS (Jokela, Iivari, Matero, & Karukka, 2006; van Elzakker, 2000; Williams & Lafrenière, 2005). In addition, factors, such as preferences, experiences, abilities, and tasks influence how users react to different representations of similar geospatial data (Fairbairn, Andrienko, Andrienko, Buziek, & Dykes, 2001). Therefore, to better deliver WbGIS services, it is essential to identify different needs and preferences of user groups (Nielsen, 1992).

Studies of the use and the users of WebGIS have been relatively recent. Van Elzakker (2000) identified in the mid-'90s users of WebGIS as relatively young, well educated with interests in science, technology, and possession of a personal computer. However, Wellman and Haythornthwaite (2002) argued that the profile has changed rapidly. Peterson (1997) also stated as to the change of Internet users. He indicated that for people who planned to connect to the Internet in their households, half of them had high school educations or less. In 1999, about half of the users were females and twenty percent of users were over fifty years old (van Elzakker, 2000). The Internet has been embraced by people with various educational and economic backgrounds. In fact, most users in the United States had access to the Internet at home instead of, or in addition to, the work place. This diversified user profile resulted in different requirements and indicated the needs of flexibility to tailor geo-information systems for specified user groups.

2.35 Web-based GIS interaction

After years of progress, WebGIS services now feature high interactivity and strong end-user participation. These features distinguish it from other web applications (Skarlatidou & Haklay, 2006; Wilson, Lipford, Carroll, Karr, & Najjar, 2008). The understandings of users' interactions with WebGIS better strengthen the ability to customize the service for specific user groups. However, very little is known about how people interact with these services. Some researchers stated that former GIS studies have typically centered on higher order goals and mental processes (Wilson *et al.*, 2008), such as cognitive loading of static map representations. Other aspects of the utilization that contribute directly to WebGIS management have been overlooked, such as operational features of WebGIS and users' goals and perceptions toward WebGIS.

Classification of spatial representation

One of the objectives of this study was to explore the operational features through interactions between users and WebGIS. However, since there has been little information about the classification of operational features that can be referenced for study WebGIS interactions; this study alternatively referred to the classification models from the field of cartography.

One classification of Web maps categorized the maps into static or dynamic maps (Kraak & Brown, 2000; Schimiguel, Baranauskas, & Medeiros, 2004). Static maps are often scanned from cartography products. When clicked, the objects on the map can lead to other information sources on the Web. The information sources can be other Web pages, maps, or images. In contrast, the users of dynamic maps employ more web functions to define their own needs. The dynamic process allows users to choose the data, and overlay the themes from a geo-database. In recent years, 3D display, animation, and other multimedia are commonly part of WebGIS service. However, since Web GIS services have been developed and become more complex, this static-dynamic classification is only an overview to map services, but not a useful classification to WebGIS management.

Richmond and Keller (2003) evolved the static-dynamic categorization to a classification with other characteristics, including scales and artistic attributes. However, with this classification, the boundaries between types are relatively vague and need many explanations. Another classification of Internet maps is the ”map use cube” (Fig. 2.1) (MacEachren, 1994; MacEachren & Kraak, 1997). This classification considers more users' perspectives than the former categorizations. The cube defines map uses by three dimensions—audience (public-private), interaction (high-low), and data relations (known-unknown). A certain location in the space pointed by the three axes illustrates the map use. For example, the combination of unknown data relation, high interaction, and private audience indicates the exploring characteristic of the geo-service use. Other characteristics such as analysis, synthesis, and presentation occupy a respectively unique place in the cube. This model is similar to Richmond and Keller's (2003) study, which needs indirect judgments by a third party other than users themselves. This issue causes inconsistent understandings by different individuals, and thus creates difficulties to draw study conclusions from findings.

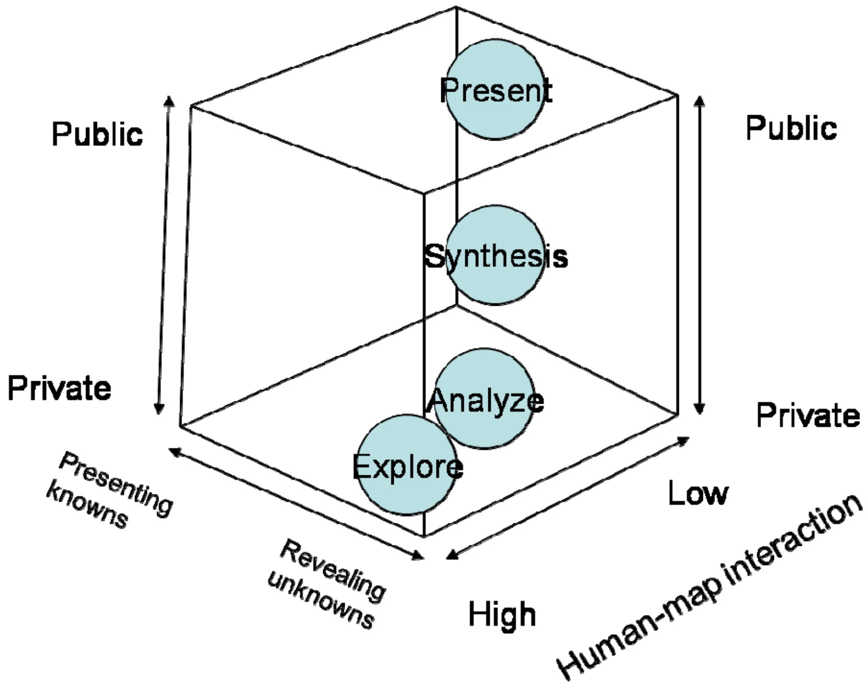

Figure 2.1. The map use cube (MacEachren, 1997)

With a different approach, Davies and Medyckyj-Scott (1996) used observation and qualitative approach to identify interactions between GIS and its users. The authors categorized the interactions by involving the following components: (1) the users' goals to explore, analyze, or synthesize; (2) the operational tasks with WebGIS, such as, select, identify, locate, search, recognize, trace, compare, correlate, position, measure, adjust, and/or highlight; (3) the user experience as a novice or expert; and (4) actions the user is likely to use with his or her GIS interface, such as zoom, pan, scale, or layering. Other groups of authors proposed similar categories to detect interaction levels using a series of preset tasks and functionalities generated based on WebGIS operations (Koua, MacEachren, & Kraak, 2006; Wilson *et al.*, 2008).

Skarlatidou and Haklay (2006) conducted a study comparing users' reactions to different types of tasks with seven WebGIS products. The authors found different tasks result in different time spent with products with similar success rates. Although various functionalities were offered, the users consume only part of those functionalities and remain the rest unused. In addition, the results indicated that users preferred to retrieve the information they needed in a predefined scale of viewing that provided them the geo-information without much effort.

Based on the suggestions from previous studies and the context of this study, a functionality category can be used as an index of interaction between users and WebGIS. This can be coupled with the index of dynamic intensity, as Kraak and Brown (2000) suggested, which measures interaction by taking into account the numbers and types of functionality used in sessions. From this combination, direct statements from the users may generate recommendations for WebGIS implications without distortion.

2.4 Theoretical Basis of WebGIS Utilization

The section reviews and discusses the theoretical foundations of this study. The theories reviewed provide guidance and direct the study framework.

2.41 Activity Theory

Explorations of how humans interact with computers have been conceptualized with many approaches in the recent state of research. The recognition of the complexity of human information processing has intrigued researchers to request further directions from other fields. Activity Theory has its philosophical roots in psychology and sociology. This theory is initiated by Russian psychologists Vygotsky and his colleagues

Leont'ev and Luria. Together they have concluded that the nature of human praxes is a product of consciousness, that is, as later researcher, Kaptelinin, Kuutti, and Bannon (1995) addressed, "Human mind comes to exist, develop, and can only be understood within the context of meaningful, goal-oriented, and socially determined interactions between human beings and their material environment" (p190). Activity Theory provides an extensive theoretical framework that assists the understanding of the structure, development, and context of human activity. Since the 1990s, Activity Theory has been implicated to unfold human-computer interactions by scholars and practitioners of international communities (Kaptelinin, Nardi, & Macaulay, 1999). Activity Theory has been an approach to understand human activity by studying the relationships between individual human beings and their social beings, through probing the initiations, formations, and processes of their activities in the circumstances of their everyday life (Kaptelinin & Nardi, 2006).

The notion of activity is the most fundamental concept in Activity Theory (Kaptelinin & Nardi, 2006). The term "activity" in Activity Theory is understood as a purposeful interaction between the subject and the world. "Activity" is a process where a transformation happens between the object and subject (Leont'ev, 1978). Analyses of activity provide the opportunity to understand both subjects and objects. By contrast, traditional analyses often assume that it is necessary to understand the subjects and objects separately and then conclude an implication about their interaction. Activity Theory has challenged this assumption (Kaptelinin & Nardi, 2006).

Activity Theory claims that subjects and objects truly exist in only enacted activities (Kaptelinin & Nardi, 2006; Leont'ev, 1978). Second, activity is considered the key to development of both objects and subjects. For instance, the developmental changes in the subjects, resulting from activities, may reason a feedback to influence the development of the objects. Therefore, activity has been proposed as the basic unit of studying human practice that provides the channel to understand objects and subjects in the basis of an activity (Engeström, 1987). In other words, human beings interact with their environment not directly, but rather mediated through the use of tools and signs (Vygotsky, 1978). As Nardi (1996) stated, Activity Theory claims that "the consciousness is not a set of discrete disembodied cognitive acts, and certainly it is not the brain; rather, consciousness is located in everyday practice: you are what you do" (p. 7). That is, activity or "what people do" is reflected in the fact that people interact with their world through actions. The rationale of the proposition of activity was to incorporate a mechanism to capture social, psychological, and tool aspects of activities. Leont'ev (1978) further formulated the notion of Activity Theory that incorporates subjects, objects, and community components with mediators of human activity. An activity facilitates behavioral aims toward the satisfaction of recognized objectives.

Subject, in the framework, describes either an individual or social nature of an activity, as reflected through collaborations to satisfy the goals of actions. The tool component of the framework refers to both physical and conceptual tools, which humans use to handle or achieve objectives. Human activity always involves artifacts. In Activity Theory, an artifact is defined as something that can be used in the transformation process between subject and object; for example, technical tool, sign, language, or method (Kuutti, 1995). Artifacts attend as mediators of thoughts and behaviors. Experiences are shaped by the tools and signing systems we utilize. The experiences users have with

WebGIS depend on not only cognition, but also the features of artifacts, such as functions and features of the WebGIS.

Artifact component, in Activity Theory, portrays the mediation aspect of human activity through physical and conceptual tools. Computer artifacts, as other artifacts, mediate human activity within practices (Bertelsen & Godsk, 2004). The formation of desires and expectations is through activities that reflect knowledge and experience about the world (Kaptelinin *et al.*, 1999). The perceptions formed and decisions made reflect the world around users that formed by various time and space specifications, coupled with the purposive nature of an activity, to shape a unique experience with the artifact.

To further elaborate the ideas of Activity Theory, Wertsch (1981) and Kaptelinin *et al.* (1999) outlined the principles that constitute the conceptual system of Activity Theory in the context of human-computer interaction as: objective orientedness, hierarchical structure of activity, mediation, internalization/externalization, and development. Those principles are described as follows:

Objective-orientedness. Kaptelinin *et al.* (1999) indicated objective orientedness is the most important principle of Activity Theory. This principle states that every activity is directed toward an object existing in the world. The notion of object in Activity Theory is not limited to physical and biological entities. Socially and culturally determined entities are also in the realm of the objective properties.

Hierarchical structure. The interaction between human beings and the world consists of three hierarchical levels: activity, action, and operation, and their relationships to motive, goal, and condition (Bertelsen & Godsk, 2004). From the top level (Fig. 2.2), the set of ”activity” and ”motive” explains the question “why,” that is, the purposes of the activity, while the second tier of ”actions” and ”goals” queries more specific with the question like “what” to identify the actual tasks. Finally, the bottom tier of elements ”operations” and ”conditions” constitutes the actual practices to answer the question like “how” to perform the activity. Therefore, the operations performed are the concrete reflections to the activity of interaction with the environment. Although activity is categorized into three levels, the analysis must reflect the internal connections because the activity is considered a process featured by continuous transformations (Leont’ev, 1978). Every level of the interaction is always oriented toward a material or idea that satisfies needs.

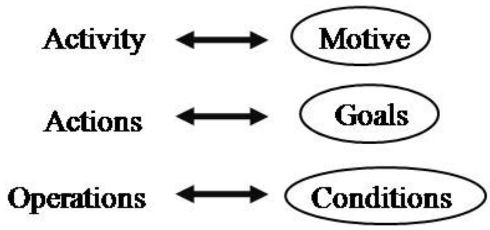

Figure 2.1. The hierarchical structure of activity (Kaptelinin & Nardi, 2006, p. 64).

Internalization/externalization. These are processes relating the human mind to its social culture environment. Activity Theory distinguishes internal and external activities. The traditional notion of cognition process in psychology matches the internal activity. External activity is observable activity that is often expressed in physical actions; for example, operating a personal digital assistant (PDA). Because of the shared transformations between the subject and the world, Activity Theory maintains that the internal activity cannot be realized if analyzed separately from external activity (Kaptelinin & Nardi, 2006). Internalization is the transformation of external activity into internal activity, while externalization transforms internal activity into external activity. This theory emphasizes that the mental process is not only represented in cognition, but also in the activity performed with the use of artifacts. Internalization helps stimulate the actual interactions between users and artifacts through cognitive functions.

Mediation. "Mediation", in Activity Theory, refers to how the relationship between the subject and the artifact is formed and implies that artifacts outline the ways people interact with the actuality (Kaptelinin, *et al.*, 1999). The interactions between users and artifacts often generate feedback from experiences to improve tools to help users fulfill their goals. With the assistances of the transformations of internalization and externalization, feedback from experiences enables the knowledge exchanges between subjects and artifacts. Those experiences enhance the functionality of tools and make tools more useful and usable. Therefore, changes of tools in the outside world often shape the internal process of activities.

Development. Activity Theory claims that it is essential to recognize how the use of tools evolves over time rather than viewing the interaction as static. Although other psychological theories consider development as an important element, Activity Theory sees all activity as the consequences of evolution.

These principles offer a useful starting point for interpreting Activity Theory to investigate human activity in a rich context of the mediation among subjects, objects or motives, artifacts, and social cultures. As Kaptelinin and Nardi (2006) stated, these principles should be considered as an integrated system due to their inter-related roles in an activity.

It should be noted that Activity Theory is a conceptual theory rather than a predictive model (Mwanza, 2001). Activity Theory provides a promising framework to describe human activity with artifacts. In recent years, Activity Theory has drawn attention from different fields of study. However, the studies that involve users' practices with artifacts have been much neglected; there have been only few contributions applying the ideas to practice. Therefore, the core of this study is to investigate the utilization of WebGIS in the context of recreation and tourism information search, with the richness of Activity Theory framework. In addition, this study attempts to apply ideas of Activity Theory to specific problems by extracting its contexture factors, which prospectively affect the use of a computer technology, in real life settings.

Kaptelinin (1999) noted that Activity Theory is not the only attempt to investigate human-computer interactions. The theory can be more successful when used mutually with other models than be employed alone. This study blends Activity Theory with cognitive paradigms, in which the uses of technology system closely relate with users' attitude and satisfaction. The next several sections introduce such theoretical frameworks in line with Activity Theory as the study guidance.

2.42 The Theories of Reasoned Action (TRA)

In an attempt to better understand the utilization of Web-based GIS, this current study incorporates, along with Activity Theory, the models focusing on the attitude and the behavior in information system use. In cognitive process, users' awareness and choice among products and services depended on perceptions and attitudes (Venkatesh, Morris, Davis, & Davis, 2003). A family of studies has given insights to this cognitive consideration. With the focus on technology related innovations, especially information systems, these studies established well defined and tested cognitive constructs for measuring uses of information systems. Although this entire group of models is founded on the relationship between attitude and behavior, each model has different constructs due to their specific study focuses.

The first cognitive model employed to assist Activity Theory is the Theory of Reasoned Actions (TRA). It is rooted in the assumption that people make reasonable decisions based upon the information they hold about themselves and their environments (Ajzen & Fishbein, 1980; Venkatesh, *et al.*, 2003). Derived from social psychology, TRA is a general theory that explains the relationship between attitude and behavior. Ajzen (1991) defined attitude as “an individual’s disposition to respond favorably or unfavorably to an object, person, institution or event” (p. 241). In Triandis’ (1980) study, the author established a two-tier attitude model. This model includes beliefs, affections, and intentions as factors in the first tier, and attitude as a single factor in the second tier. In the model, the construct “attitude” is a latent variable. It cannot be observed directly and must be inferred from measurable verbal and nonverbal responses.

According to TRA, behavior is determined by behavior intentions, which are determined by attitude and subjective norms (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). The extended version of TRA involves the factors of attitude and subjective norms from TRA and with one additional factor— behavior control, which is the level of perceived difficulty to perform a task, such as requiring effort and resources.

Technology Acceptance Model (TAM) and Task Technology Fit (TTF) model are two models established to study human-computer interactions in the field of Management of Information Systems (MIS). The two models are developed on TRA

(Fishbein & Ajzen, 1975) and the Theory of Planned Behavior (TPB), which is the advanced TRA model (Ajzen, 1985, 1991). TRA and TPB granted the foundations for TAM and TTF to develop constructs, involving attitude, behavior, and intention, to measure the level of technology acceptance (Davis, 1989; 1992, 1993; Venkatesh, *et al.*, 2003; Venkatesh, *et al.*, 2002). Those constructs have been employed to investigate users' perceptions toward information systems and to predict behavioral intentions on the relations between belief and attitude. TAM and TTF models are strong theoretical basis to detect the factors that influence technology utilization (Dishaw & Strong, 1999).

2.43 Technology Acceptance Model (TAM)

TAM is an extensively tested and broadly accepted model for evaluations of information system due to its solid theoretical foundation and good explanatory power (Venkatesh, *et al.*, 2002, 2003). Originally developed by Davis, TAM and its derivatives have been one of the most comprehensive attempts to articulate the psychological aspects associated with technology use (Igbaria, Schiffman, & Wieckowski, 1994). Founded on the Theory of Reasoned Action (TRA), which explains the connection between attitude and behavior (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975), TAM developed the psychological determinants and links in technology use contexts. TAM has provided a robust and valuable model to evaluate information systems (Mathieson, Peacock, & Chin, 2001; Talor & Todd, 1995).

TAM asserts that users' attitudes toward an information system are summarized from a cognitive appraisal when interacting with features of an information system. Consecutively, this attitude precedes use intentions and actual uses of the technology.

TAM explains that user's intention and attitude are determined by the constructs of perceived usefulness and ease of use toward an information system (Davis, 1989; Davis, 1992, 1993; Venkatesh, *et al.*, 2002; 2003). In the TAM model, perceived usefulness refers to "the degree to which an individual believes that using a particular system would enhance his or her job performance" (Davis, 1993, p. 477); perceived ease of use refers to "the degree to which an individual believes that using a particular system would be free of physical and mental effort" (Davis, 1993, p. 477). With these two determinants of TAM, this model attempts to explain why people accept or reject a information system (Venkatesh *et al.*, 2003). The TAM model proposes that the higher the degree of usefulness and ease of use are perceived, the better chance users choose to utilize the system. In the context of Web-based applications, studies found that construct "playfulness" was significantly associated with technology adoption in addition to "perceived usefulness" and "ease of use" (Chung & Tan, 2004). Based on the Flow Theory, Moon and Kim (2001) extended the TAM model in the context of the World Wide Web. The extended TAM model includes an intrinsic motivation factor, "perceived playfulness", defined as "the extent to which the individual perceives that his or her attention is focused on the interaction with the WWW; is curious during the interaction; and finds the interaction intrinsically enjoyable or interesting" Hsu and Lu (2004). These authors indicated that playfulness is an important factor to motivate users to utilize a technology system, especially within the Internet context.

Although many empirical studies have found that the TAM model generated consistent results, many scholars argued the need to incorporate other theories to improve its applicability and strength (Hu, Chau, Sheng, & Tam, 1999; Legris, Ingham, & Collerette, 2003).

2.44 Task Technology Fit (TTF) model

Proposed by Goodhue and Thompson (1995), constructs of the TTF express the effect of an information technology on supporting a task. The most efficient and effective performances occur, when the competencies of the technology match the demand of the task, which users attempt to perform. The match between features of a product and the goals of its users is called "correspondence", "fitting", or "matching" in organizational theories (Dishaw & Strong, 1999). The concept of "matching" in task performance has been well supported (Palvia & Chervany, 1995); for example, the fit between data provision and user tasks (Dishaw & Strong, 1998; Strong, 1997; Strong, Lee, & Wang, 1997); "cognitive fit", suggests that, in the case of problem solving, the assistances of a information system should match the mental processes required to solve the targeted problem (Shaft & Vessey, 2006; Vessey & Galletta, 1991).

The model posits that the higher level of "fit" between task and provision leads directly to a better performance (Goodhue, 1998). The "correspondence" between a task and a set of system functionality leads to users' positive reactions toward an information system (Goodhue & Thompson, 1995). Generally, the "fit" between task and information system detects whether the tool is appropriate to a particular task. Different from TAM, which emphasizes the impact of attitude, TTF conceives that users use the information system if they can gain advantage for their tasks. If the information system does not offer benefit to their tasks, it would not be utilized. This current study takes into account the key element—“task characteristics” in the TTF model, to disclose the effect of tasks on the utilization of Web-based GIS.

TAM and TTF have been applied in diverse contexts within the realm of information system. The two models have been employed jointly or individually. Researchers have undertaken numerous modifications to the models of TAM and TTF to match the purposes of various studies. For example, researchers have used the extended models of TAM and TTF to investigate the factors in the context of the World Wide Web (WWW). The two models share their attempts at and roots for detecting uses of information systems. In comparison to TAM, which explains technology utilization by attitude, TTF assumes that users utilize an information system because it provides benefits. TTF also assumes that uses occur regardless of attitudes toward the technology (Goodhue, 1998 ("MSN maps & directions," 2008)). Each model has had significant statistical power to explain IT utilization. In addition, both models are effective to users’ choices of IT utilization. The combination of the two models explains IT utilization better than either an attitude or fit model could provide separately (Dishaw & Strong, 1999). Hence, this current study deliberates the factors supported by both attitude and benefit perspectives to detect WebGIS users’ psychological and behavioral incentives.

2.5 Summary

In today’s dynamic environment, understanding how people acquire knowledge is important. The fact that more than half of recreation/tourism information searches on the Internet were in the form of geo-spatial information through some kind of WebGIS (Jansen *et al*., 2008); it is crucial to understand the use of WebGIS for obtaining recreation information. When provided with choices of whether and how to search recreation/tourism information using WebGIS, users express their choices upon the integration of their attitudes, beliefs, preferences, goals, expectations to WebGIS, as well as the recreation situations combined with time and space.

In this chapter, the researcher has reviewed a number of theoretical stands and utilization dimensions from personal, situational, attitudinal, and artifact perspectives that illuminate the utilization of WebGIS. This study adopts theories and views across different disciplines to describe WebGIS utilization. It seems obvious that there is numerous factors worth to concern, and no single view can explain every dimension involved. The existing literature has contributed some insights to various aspects of this research; however, it seems apparent that more studies are needed to gain understandings, especially those closely tied to the context of WebGIS utilization.

CHAPTER III

METHODOLOGY

3.0 Introduction

This study is designed to explore the utilization of Web-based geographic information system for the purpose of recreation and tourism information search. The research analyzes the information of personal, attitudinal, situational, and artifact dimensions to detect utilization patterns of WebGIS use for recreation/tourism.

This chapter describes the methods and procedures implemented. This section is arranged into five sections: (1) Instrument development; (2) Survey description; (3) Sampling; (4) Data collection; and (5) Data analysis.

The approaches of this chapter reflect on the attempts to answer the research questions of this study:

1. How can WebGIS utilization be measured and defined in recreation and tourism studies?
2. How are WebGIS services utilized as recreation/tourism information channels by users in different recreation/tourism attributes, personal characteristics, attitude-behavioral aspects, and artifact interactions?

3.1 Institutional Review Board Approval

For protecting the rights of human subjects, the researcher gained approvals from the Institutional Review Board (IRB) at Oklahoma State University (OSU) before conducting the processes that involve human subjects, including the Delphi study, the pilot study, and the data collection. IRB approval was granted on December 9th, 2008 and March 30th, 2009 for modification as shown in Appendix E.

3.2 Instrument Development

To illustrate the behavior of persons who utilize Web-based GIS for recreation and tourism, appropriate measures are pivotal. Although recreation and tourism are strong motivators for users to access geo-information services, there have been only a few studies investigating the area. Some studies have developed measures for detecting general Web-based GIS satisfaction, such as the Google Map Happiness Survey 2008. However, the focus has been on the general satisfaction and the choice among competitors rather than the service itself. The majority of usability studies of WebGIS have focused mainly on the interface components, which are not in the scope of this study. Since appropriate instruments have heretofore been unavailable for this study, the researcher needed to develop instruments that validly address the research questions.

The following paragraphs describe the development of the Recreation and WebGIS Use Survey. This instrument was developed based on a multidimensional view of WebGIS uses for recreation and tourism to meet a now recognized need to understand this new, but influential, phenomenon in recreation. The establishment of this instrument is also a necessary element for adding body of knowledge to the current theoretical and empirical literature.

This current study attempts to systematically investigate the pattern and characteristics of the four dimensions of WebGIS utilization: personal, attitude-behavioral, situational, and artifact aspects. The four key elements were stated in previous studies as discussed in the literature review (Amoroso, 1991; Bevan & Macleod, 1994; Davies & Medyckyj-Scott, 1994, 1996; Dillon, 2002; Mawhinney & Lederer, 1990; Nyerges, 1993; Trice & Treacy, 1991). Thus, this instrument is intended to be a broad-based survey tool with the function of distinguishable and empirical scopes.

This user-based instrument for probing the public utilization of Web-based GIS was developed and validated based on instrument design and construct guidelines from former studies (Colton & Covert, 2007; DeVellis, 2003; Dillon, 2002). The development of the instrument was completed in four stages: (1) preliminary developments; (2) Delphi studies; (3) questionnaire improvements and the pilot study; (4) reliability, validity testing, and questionnaire improvements.

3.21 Item generation and item reduction

At this stage, the aim was to collect comprehensive measures of relevant items with well-established theoretical foundations. An extensive literature review was conducted to inspect documents dealing with the related topics including the fields of recreation, tourism, human-computer interaction, management information system, marketing, geography in recreation and tourism, psychology of information search behavior, the Internet use, GIS, and technology acceptance. Those studies and observations provided the information of issues concerned, values, possible measures and the framework for instrument development.

The preliminary questionnaire items and issues collected and considered were categorized into the domains including user characteristics, Web-based GIS utilization, and recreation/tourism. Preliminary items were collected from previous research and organized into the item pools. Later, considering the study context that the instrument was founded on, this study selected the measurement items by the fitness to the study context. Within the domains of users, GIS, and recreation/tourism, different item pools were formed in order to collect the initial items for each sub-category, such as TAM, TTF, WebGIS functionality, tasks, user profile, and recreation characteristics. The survey items of Web-based GIS elements were referred to taxonomy and classification of WebGIS systems and spatial information representations. Web-based GIS task and acceptance items were either employed directly from the acceptance models of TAM and TTF or modified to fit the framework of this current study. The recreation/tourism items were considered based on the previous studies focused on recreation/tourism information search. These items were formulated to the preliminary questionnaire. While the literature appropriate to this study used different terminologies, shared components existed. The key components identified by information system utilization literature including individual differences, tasks, and information system characteristics.

The preliminary instrument adopted the framework consisting of the four dimensions of personal, attitudinal, situational, and artifact aspects. Under each dimension, there were constructs established to measure more specific information from different aspects.

First, the user dimension in the preliminary instrument addresses the users' individual characteristics that have impacts on use behavior. This dimension includes two constructs: demographics and former experiences. Demographics are not only foundations to user profiles, but also important segmentation bases investigated in various fields and in numerous studies to identify factors based on social roles. Users' former experience is another important factor that influences the use of information services (Castañeda, Muñoz-Leiva, & Luque, 2007; Chung & Tan, 2004; Sun & Zhang, 2006; Webster & Martocchio, 1992) with both hardware and software required to perform the work with the information system (IS). For example, novice and expert users usually have significantly different expectations and performance outcomes when working with IS.

To consider individuals' perceptions, technology acceptance measures adopted from TAM and TTF models provide well-established measurements tested in numerous studies. The preliminary instrument employs the measurements from the TAM and TTF models to understand individuals' attitude, perceived usefulness, perceived ease of use, and perceived playfulness toward use. Those attitude-behavioral measurements were originally situated in working environments with more strict performance requirements and social-psychological influences. However, in this study, since the Web use behavior is voluntary and personal, the instruments adopted from these two models were selected and modified with the consideration of the different settings to address the focus of this current context.

The second dimension intends to understand the utilization of WebGIS from a task perspective that interprets the motivations/purposes users hold and the recreational characteristics of the task when using the WebGIS. The motivations and goals drive the use of IS to different directions (Rose & Levinson, 2004); for example, for informational purposes, namely, to learn something and to gain knowledge (e.g., find a new place to go); and for resource purposes, that is, to obtain a resource available (e.g., download a road map). These directions would require unlike costs and generate dissimilar benefits to users through information searching processes.

For the Internet use, the users with goal-directed behavior are often based on functional aspects (i.e., extrinsic motivation), whereas the users with experiential behavior focus more on hedonic aspect (i.e., intrinsic motivation) (Hoffman & Novak, 1996). Consequently, the reasons for people to reach a certain service greatly affect users' attitudes, expectations, and behaviors toward services (Castañeda *et al.*, 2007; Gefen & Straub, 2000).

As for motivation, various studies have shown that recreation characteristics affect information search behavior. Examples for these elements are at what stage of the recreation/trip the users would attempt to approach WebGIS (Arimond, Achenreiner, & Elfessi, 2003), and with what trip/recreation purposes, the users would perceive different levels of usefulness of WebGIS (Fesenmaier, 1994; Vogt & Fesenmaier, 1998).

Finally, under the artifact dimension, the geo-information data type and functionalities utilized are employed to probe operational interactions between users and actual interfaces. The tool use process can be viewed as a set of tasks and operations to reach the goals that drive users to approach WebGIS services (Andrienko & Andrienko, 2005; Fotheringham, Brunsdon, & Charlton, 2000; Koua *et al.*, 2006).

Since the design of effective WebGIS service depends on identifying the way users interact with it (Koua *et al.*, 2006), WebGIS has focused on data allocation of raster and vector data in a client-server web platform (Goodchild, 1992), and function provisions to different WebGIS systems (Yang, Wong, Yang, Kafatos, & Li, 2005). In related studies, several authors have suggested taxonomies for GIS conceptual goals, including identify, locate, distinguish, categorize, cluster, distribute, rank, compare, associate, and correlate (Ogao & Kraak, 2002; Wehrend & Lewis, 1990; Zhou & Feiner, 1998). To accomplish the conceptual goals, the users have to execute some operations during the process.

According to the functionality summarized in Tait's study (2005), the functionalities of geographic Web service commonly published are map rendering, feature streaming, data projection, geographic- and attribute- based queries, network analyses, 3D terrain visualization, and data extraction. More advanced, in addition to searching and mapping, some services provide applications for publishing and administrating spatial data. Although WebGIS services are supplied by venders with different interfaces such as ESRI, Google Maps, Yahoo Maps, MSN Maps & Directions, MapQuest, they share not only cognitive concepts but also a fair amount of functions; for instance, the functions of viewing, selecting, scaling, querying, buffering, measuring distance, information displaying, personal mapping, publishing, and communication such as e-mailing, and exporting, that the functions users can operate for achieving their goals (ESRI, 2008; Google Maps, 2008; Koua *et al.*, 2006; MSN, 2008; Yahoo Maps, 2008).

Considered within the context of this study, the concepts and knowledge exploration process described above are employed as the preliminary foundations to initiate the second development step. This second step is the Delphi study for further development of the instrument. As a result, a total of 84 questionnaire items were prepared for the first round Delphi study after completing the process of preliminary item generation and reduction. It should be noted that this stage is the first step of the instrument development and later modifications are expected.

3.22 Delphi studies

In this phase, the researcher employs the principles of Delphi technique to form an advisory committee for the second step of instrument development. The Delphi technique refers to the method of forming a group of experts on a topic to consider an issue and provide their views. The experts express their views through a series of responses to either structured or open-ended questions raised by the investigator. The intention is to achieve consensus through a series of Delphi rounds on multi-dimensional perspectives around the topic. The Delphi process has been adopted in a variety of settings, especially in science. The achievement of the consensus among Delphi panelists demonstrates significant concurrent validity of the study (Williams & Webb, 1994).

However, this method is criticized for its lack of standards for panelist selection, such as the definition of expert and consensus level needed to be achieved. Nevertheless, the Delphi technique is useful, especially to explore a phenomenon in the absence of empirical data (Hugh, 1994). It is recognized for its ability to eliminate potential bias, retain group dynamics, and reduce group conflicts or domination by one member (Duffield, 1988). Therefore, despite its limitations, Delphi method can be considered a valuable technique to develop measures for studies.

The aim of this Delphi panel is to yield the guidelines to the survey development regarding questionnaire items reduction, revision, and refinement. The experts are experienced and knowledgeable in the related areas from the academic community and the professional field. The members of the Delphi panel would be asked to suggest further improvements and modifications to the preliminary questionnaire. The Delphi panel technique was conducted by asking panel committees to respond to the question items proposed and to the open-ended questions, with specific thoughts, concerns, and suggestions in addition to the importance rankings.

In the first step, all panel candidates were contacted and invited to participate the study. Once the members consented to participate as Delphi panelists, an email was sent with the content of the early draft of the survey including several sections: first section, an official invitation with tasks descriptions as a Delphi member in this study; the second section, an objective introduction of the study with study background, Delphi survey instructions, and description of terminologies shown in the survey; the third section, the lists of 84 preliminary items with ranking scales. The panel committee would review questionnaire items under each construct to rank the importance of the measuring constructs. Meanwhile, the panel committee members were encouraged to provide their thoughts, suggestions, and concerns. The suggestions and opinions from panels were later gathered and considered for modification, reduction, and refinement of the questionnaire items. Following this process frame, two cycles of Delphi reviews were conducted to form the later draft of the survey.

The Delphi panel consisted of four experts from four fields that are closely related to the current study. Each panelist was selected to represent a unique field. The panelists were from the fields of leisure, recreation, and geography in academic community; recreation and tourism management at the state level; and a private GIS consulting firm. The representatives from those fields are Dr. Lowell Caneday, Professor of Leisure Studies, Oklahoma State University; Dr. Jonathan Comer, Professor of Geography, Oklahoma State University; Doug Hawthorne, Assistant Director of Conservation and Planning, Oklahoma Tourism and Recreation Department; and Bob Springer, Vice President at Strategic Consulting International.

The investigator started the Delphi sessions on January 20th for the first round and on February 26th for the second round by sending the electronic versions of preliminary instruments through emails. The members were requested to complete the survey either in paper or electronic version as they preferred.

The first round of the Delphi survey

The first round of the Delphi survey contained 84 items and was expected to capture relevant aspects of WebGIS utilization. The process duration of the first round from delivery to return was five to thirty days. All Delphi one surveys were returned. The first Delphi round required the advisory committees to (1) rank the items based on the importance to the construct measured, and (2) provide thoughts, suggestions, and concerns regarding item content, sequence, and wording. Item selection criteria were based on the total ranking scores and the considerations mentioned in the comments made. Consensus was reached (three of four members) to delete eight items related to situational recreation characteristics because of those items' minor effects on the study. These were the constructs of trip duration and trip group composition. In addition, the contents of the fourteen remaining items were suggested to be revised due to their fitness to the corresponding constructs or the distinction between the items. These were the items that required modification in the second Delphi round. In addition, members commented on several of the items with minor change in wording or had suggestions in the scale choice. The rest of the 62 items were successful in reaching the consensus level of all members and were selected based on the ranking scores and suggestions made for forming the second round Delphi survey.

The second round of the Delphi survey

The second round of the Delphi survey contains 62 items. In the second Delphi round survey, panelists were provided with the results from the first round as well as response instructions, tasks, and survey background. At this stage of the survey development, the panelists were requested to (1) evaluate whether the item well measured the construct, (2) evaluate whether the item was well understood, (3) provide thoughts, suggestions, and/or concerns to individual items, and (4) provide thoughts, suggestions, and/or concerns to the instrument as a whole. Fifty-six items gained the full consensus to measure their corresponding constructs. Three items were suggested for deletion or modification in order to strengthen the measuring power of the constructs. In addition, six items received suggestions to revise the wording for better readability.

The two rounds of Delphi study yielded a self-administered questionnaire for measuring WebGIS utilization constructs based on the consensus of advisory members with diverse expertise related to the study topic.

3.23 Questionnaire improvement and pilot study

The aims of the pilot study were to (1) assess reliability, validity, and usability of the survey, and (2) identify possible issues of understanding and wording prior to the mass distribution of the survey. A pilot study of the instrument was administered to voluntary student respondents from one class in the Leisure Studies program at the Oklahoma State University on 31st March, 2009. The survey was distributed to eleven students. The document delivered included the invitation and survey items determined in the previous instrument developments. In addition to the responses to questionnaire items, the pilot study contained a discussion session. Open-ended questions also provided opportunities to reflect the respondents' questions and opinions towards the questionnaire draft regarding the clarity, length, and the comprehensibility of survey items. To reduce the group pressure in the discussions, the students could also place comments on the anonymous survey as an alternative method.

The participants in the pilot study responded in group consensus (n=11) to the elements regarding the usability of the survey in its clearness, length, and the information of survey context. As a result, several wording and editorial suggestions were made. The pilot group suggested minor changes to the pre-final survey and on average spent seventeen minutes to complete the survey. Both the Delphi panel and pilot study filtered the possible issues of the content, face, and concurrent validity of the instrument. The findings of the pilot study provided an actual perspective from a group who, like the potential respondents, were first-time readers of the survey.

3.24 Reliability and validity testing

Measurement reliability

The study assesses the measurement reliability by estimating the internal consistency. Internal consistency is an index that investigates the instrument reliability by estimating to what extent the items measuring the same construct yield similar results. This study adopted Cronbach's alpha (Cronbach, 1951) which is the statistic widely used to assess internal consistency of reliability. Cronbach's alpha measures the fitness of a set of items that evaluate a single latent construct. The range of Cronbach's alpha coefficient can be from 0.0 to 1.0, thus reflecting the relationship between the factors within the model. The Cronbach's alpha reliability coefficient of .70 or higher is considered the standard of acceptable items to the construct (Agarwal & Karahanna, 2000; Nunnally & Bernstein, 1994).

In operation, this estimation used a single instrument administered to a group of people on one occasion. The data generated in the pilot study was used to assess the internal consistency reliability with Cronbach's alpha index. The results showed that all alpha coefficients of each factor exceed 0.76, thereby affirming the reliability of the scale. The alpha coefficient indicated the reliable consistency toward the dimension of technology adoption dimensions which measure attitudinal aspects, including perceived ease of use, perceived playfulness, attitude, usefulness, and use intention. The recreation situational dimensions including recreation phases and modes were reliable based on the alpha value of 0.9. The results of use motive and experience indicated the measures' consistency (α=0.84). Moreover, both information preference (α=0.83) and functionality offered (α=0.81) showed as reliable in the test.

Table 3.1

The results of instrument reliability testing using Cronbach's Alpha

Factor	Number of items	Cronbach's alpha
Technology adoption	12	0.84
Experience	2	0.76
Recreation characteristics	12	0.90
Motive	6	0.84
Information preference	8	0.83
Functionality	15	0.81

Measurement validity

The study incorporated two types of validity tests including face validity and content validity.

Face validity is concerned with whether the measures are relevant and reasonable to gain the information the study attempts to obtain (Fink, 1995). In the procedure, the face validity was managed by studying the relevant literature and two rounds of four members of Delphi panel reviews. In addition, the feedback and reflections from the pilot study on the questionnaire contributed to the validity and usability as well.

The study assessed content validity by consensus method and the widely used measure of Content Validity Ratio (CVR), developed by Lawshe in 1975. The method determines the content validity by gauging agreements among expert raters about how essential an item is to reflect the specific intended domain (Carmines & Zeller, 1991). The CVR formula is based on the number of panelists who indicate the item is essential to the study domain. The content validity test involves the panelists to evaluate each item of the questionnaire regarding the appropriation and the overall comprehension to the research domain in the two-rounds of Delphi reviews. The CVR value of the study with four panelists was 0.99, which indicated that in this study all experts in Delphi study have to reach consensus. In the first round of Delphi panel, the consensus of the Delphi study was managed by both the importance ranking and the comments to whether the construct was essential to the study topic. The survey items and constructs were revised or deleted from the preliminary survey. In the second round of the Delphi panel, the investigator raised the question to the single item's appropriateness in measuring the correspondent construct. The items with issues of content validity were deleted in the process of expert reviewing as the panel reached the consensus of the CVR standard.

3.3 Study Survey

This study aimed to portray WebGIS utilization in four dimensions, based on the results of the series processes of instrument development, from the item generation, item reduction, context inspection, Delphi study, pilot study, and validity and reliability testing. The researcher used a structured questionnaire to have all participant response to an identical form of the questionnaire. The instrument was composed of mainly closed-end questions to assist the tabulation and interpretation of data. The final survey (see Appendix D) reflected the utilization components into four sections: the attitude-behavioral attributes, the recreation/trip characteristics, the artifacts aspect, and personal factors.

The goal of the first dimension was to detect levels of user adoption based on the instrument items developed by the TAM model and its extended model, which was tested in the context of Internet technology. In the final survey, the adoption dimension consists of six constructs and has 14 items in total. The six constructs measured are "attitude toward use", "perceived ease of use", "perceived usefulness", "perceived playfulness", "actual use", and "use intention". Each construct of the adoption dimension contains two to four question items. Respondents were asked to rate how much they agree with the statements under the constructs of "attitude", "perceived ease of use", "perceived usefulness", "perceived playfulness" and "use intention" in a five level Likert scale ranging from 1-strongly disagree to 5-strongly agree, and to rate how frequently they actually use the WebGIS services in the extent from 1-never to 5-always.

The first construct, "attitude toward adoption", depicts a prospective adopter's positive or negative orientation toward adopting a new technology. "Attitude toward adoption" detects the users' overall perceptions including the evaluation of their level of likeness and favor according to their experiences using WebGIS. "Perceived ease of use" was operationally defined as "the degree to which the prospective adopter expects the new technology adopted to be free of effort regarding its transfer and utilization" (Davis, 1989, p. 320). "Perceived ease of use" is measured based on the items from previous TAM measures. Respondents were asked to indicate the extent of their agreement about the levels of ease and understandable nature of the WebGIS. The third construct, "perceived usefulness" refers to "the degree to which a person believes that using a particular system would enhance his/her task performance" (Davis, 1989, p. 320). Davis (1989) described that a service that rated high in "perceived usefulness" as the one for which the users consider the service positively effective to the tasks they intend to perform. The construct of "perceived playfulness" has been considered as a new factor that reflects users' intrinsic motivation in the Internet context because the hedonistic characteristics of online systems have been evident as effective to information technology adoption behavior (Hsu & Lu, 2004; Kim, Lehto, & Morrison, 2007; Martocchio & Webster, 1992; Pavlou, 2003). The items of “perceived playfulness” depict the extent of playfulness and fun users perceived. The construct of “intention to adoption” refers to the extent to which the user shows willingness to reuse the service. The intention construct measures the degree of willingness to use the system in the future and to recommend it to others. The “actual use” items have two purposes in this study. One is to measure the actual use and the other is to filter the users by their WebGIS experiences, since the respondents need to respond to the questionnaire items based on their actual experiences with WebGIS.

The second dimension is designed to relate uses of WebGIS to recreation/trip factors. This section has five constructs for discovering the recreation dimensions of WebGIS utilization including usages in different recreation/trip preparation stages, experience phases, recreation/trip modes, service seeking motives, and service seeking tasks. Respondents were asked to rate the frequencies in which they use WebGIS under each recreation related situation, using Likert scale, ranging from 1- never, to 5-always.

The first construct, recreation/trip preparation stages, have been identified as distinguishing information needs in terms of information channel and information contents (Berkman & Gilson, 1986; Bettman & Sujan, 1987; Fodness & Murry, 1997; Grønflaten, 2008; Snepenger, *et al.*, 1990). The questionnaire items explore the usages from one of curiosity, to getting ideas about possible alternatives, to comparing recreation/trip alternatives, and finally, to collecting the focused information for the recreation/trip selected.

People in different recreation experience phases hold distinguishable motivational and emotional conditions. Those dissimilarities lead them to use information and of WebGIS service differently (Chen, 2000a, 2000b; Fodness & Murry, 1998; Grønflaten, 2008; Gursoy, 2003; Gursoy & Chen, 2000; Lo, *et al.*, 2002; Luo, *et al.*, 2004; Rompf, *et al.*, 2005; Snepenger, *et al.*, 1990). This construct tries to capture the possible patterns in each phase from anticipation, on site, to recollection phase. The respondents were asked to respond to the usage before, during, and after their trips. Also, the construct of trip mode, whether it is close-to-home recreation, business, or leisure oriented, affects the decisions on the information channels, services needed, and depths of the information search (Kerstetter & Cho, 2004; Lo, *et al*., 2002; Luo, *et al*., 2004).

The construct of "service-seeking tasks" is designed to understand whether the drivers behind the information seeking decision affect the WebGIS utilization. According to the economic theory of information search studies, people often expect returns in satisfaction as to effectiveness and efficiency when they approach information technology and devote their efforts in learning the operations (Avery, 2005; Stigler, 1961). "Service-seeking tasks" is to also detect the factors that connect information seeking behaviors for recreation/travel to actual functionalities widely provided by WebGIS services. The respondents were asked to identify the extent of usage under each category of tasks. The task categories include identification of locations, establishment of a route, customization of maps, viewing terrain, sharing experience with others, or functioning as a third party for providing information to others.

The third dimension of the survey is devoted to personal variables. In the section, several constructs are collected to address the possible user characteristics associated with WebGIS utilization including resource accessibility and demographic information, such as sex, occupation, age, education and income level.

The aim of the final dimension is to understand the artifact/tool aspects of WebGIS utilization. Since WebGIS providers often have a focused population of clients and have limited resources to handle and establish WebGIS, this dimension tries to identify the priority in terms of information contents. This dimension addresses the artifact/tool aspects in two dimensions. One targets information contents and the other functionality interactions. The information content dimension includes the “geo-information regions” characterized by the geographical and social features. Based on the typology of recreation/travel activity, such as outdoor recreation and city sightseeing, coupled with features of physical environments that support certain types of activity, the construct states three types of information regions—local communities, major cities, and natural areas.

The other construct under the information content dimension is the usefulness of “geo-information types”. The WebGIS services provide different formats of information. Although all formats of spatial data can be covered within WebGIS services, it is necessary to balance the cost to provide those formats and benefits in return. This construct aims to probe the index of usefulness using a Likert scale, from 1-totally useless, to 5-very useful, to five different formats broadly provided by WebGIS services, including road maps, aerial photographs, three-dimensional simulations, photos or videos, and text and links.

The functionality dimension are organized into six constructs with eighteen items categorized, based on the investigation to the functionalities of recent WebGIS services and the typology suggested from former studies (Koua *et al*., 2006; Kraak & Brown, 2000; Richins, 1994; Schimiguel *et al*., 2004; Skarlatidou & Haklay, 2006; Wilson *et al*., 2008) as discussed in Chapter 2. The respondents were asked to rate their usage using a five-level Likert scale, from “never use the function” to “always use the function”. The constructs categorized are “viewing,” “information alliance,” “multimedia,” “operational assistance,” and “geo-information processing”.

The “Viewing” construct includes basic viewing, such as zoom, scale, and pan, and advanced viewing, such as tilt and rotate. The “information alliance” construct consists of the service and knowledge directions, in which the service direction indicates the usage of links of listed business partners to locate the services while the knowledge direction indicates the usage of the links or texts attached for more information.

The “Multimedia” construct has three measurements including the passive “viewing”, active “publishing”, and to what extent users use the function to “share” information with others. “Operation assistance” is the accessories which are not the main services, but designed to support the uses including print, copy, and instructional assistance.

The “geo-information processing” construct comprises several categories based on manipulations and functionalities often designed within WebGIS services, including “geo-information extraction” (e.g., show and hide layers), “map customization” (e.g., manually mark on geo-information), “geo-information measuring” (e.g., distance and time measuring), “geo-information gathering” (e.g., retrieve coordinate information), and “geo-information manipulation” (e.g., import geo-data or more advanced manipulation).

The constructs and items as mentioned above were organized into a form of electronic self-administered survey hosted on the OSU Web Server.

3.4 Sampling

In this study, the researcher used multiple e-mail lists to reach the sample population. Two considerations were involved to choose the sample population. First, since the study is focused on recreation-related uses, the first part of the sample is drawn from the e-mail lists of recreation associated organizations. Second, considering the components of Web applications, college students, who are more likely to constantly use the Web applications, represent a good fit for this topic and are thus included.

The providers of e-mail lists of the first part of the sample are the two most recognized recreation/tourism organizations in Oklahoma—Oklahoma Tourism and Recreation Department (OTRD) and Oklahoma Recreation and Park Society (ORPS). OTRD is the state agency that responsible for providing tourism and recreation opportunities. It is organized into four divisions: Administration, Oklahoma Today Magazine, Parks, Resorts & Golf, and Travel & Tourism. The email holders of the OTRD e-mail lists used in this study are staff members of city or local recreation agencies in Oklahoma who have applied recreation/tourism grants to the Parks, Resorts, and Golf division; ORPS is a non-profit professional organization for any agency or persons involved in providing recreation and parks services. E-mail holders of ORPS are members of ORPS. The size of the sample population is 346 in total including 191 from ORPS e-mail lists and 155 from OTRD. The second part of the samples is 1000 randomly selected OSU students, generated by the assistance of the Oklahoma State University Office of Institutional Research and Information Management with IRB approval.

3.5 Data Collection

This current study adopted a self-administered electronic mail survey method without incentives offered to reach the goal of data collection. As Veal (1997) indicated, surveying is probably the most popular research method because of its plasticity and ease of use. Another important advantage of surveying is the lower personnel and implementation costs related to survey delivery and collection (Saris & Gallhofer, 2007). Particularly related to the study context which focuses on the Internet-based information system, electronic survey is a suitable method to reach the population who has access to the Internet. Although additional incentive offering to the respondents in return for their participation may increase the response rate, it was decided not to trade off a higher response rate with the increased risk of receiving biased responses. In addition, utilizing an incentive would require loss of anonymity for the respondents.

The questionnaire comprises four essential parts, including an invitation, an introduction, question items, and a closing. The general design of the questionnaire follows the principles and techniques of the Internet survey method, which contains guidelines for more effective and productive results (Dillman, 2007; Sue & Ritter, 2007). To better protect the confidentiality and manage the data, the questionnaire items were hosted by the OSU Web server instead of commercial servers, so that the data were accessible only to the investigator. Responses submitted over the OSU Web server were stored directly in a database without identifiers. The study established a Web-based survey cover page to advise subjects about the protections in the consent process.

Once the potential respondents received the invitation and consented to participate in the survey, she or he used the link in the invitation, which directed her or him to the survey hosting website, where she or he could start to respond to the questionnaire items. After the respondent completed the survey, the data were automatically recorded into the coding scheme of the study in the format that can be transferred into statistical programs for analyses.

The process of data collection started with, first, sending out the invitation e-mail on the beginning of April 11th, 2009 with information of the study nature, value of participating in the survey, confidentiality and voluntary information, questionnaire instructions along with a hyperlink to direct people who were willing to respond to the questionnaire. Then, a follow-up e-mail was sent out to all potential respondents six days after the invitation e-mail was sent, thanking them for their cooperation as well as reminding the potential respondents who had not yet responded. Eight days later, another e-mail was sent to all potential respondents along with a reminder emphasizing the importance of their responses for success of the survey. The data collection process concluded after sending the total of three e-mails, and the process of data collection was approximately 22 days.

During the period of data collection, requests and comments were received via e-mails regarding the matters of the study or survey delivering. Most comments made were either the participants' notification of having already completed the survey and the request of no more e-mails, or the potential participants' expression of a willingness to participate combined with their admissions that they had no experiences with WebGIS. All the requests and comments sent by the respondents were fulfilled, answered, and explained by the investigator once the message was received.

3.6 Data Analysis

The Statistical Package for Social Science (SPSS) version 16.0 was used in the data analysis process. First, the data were transferred from the data file hosted by the OSU server into Microsoft Excel, cleaned up by the investigator, and processed into the variables defined in the SPSS data sheet. Before conducting the analysis, the assumptions of the statistical techniques were examined and ensured.

The quantitative analysis was deductive in nature and involved comparison among variables. The analysis required the use of statistical formula to represent relationships among variables. First, the descriptive statistics were used for presenting general information. To examine the objectives of the study, the researcher conducted the analysis of variance (ANOVA), Welch ANOVA, post-hoc analyses of ANOVA and Welch ANOVA, and multiple regressions to examine the relationships between the personal factors, adoption, recreation characteristics, information, and functionality variables. The next chapter presents the results, research objectives, and their relationships to the corresponding testing procedures.

CHAPTER IV

FINDINGS

4.0 Introduction

This chapter presents the results of this study which aimed to explore how people utilize WebGIS for recreation/tourism information in the dimensions of (1) personal, (2) attitude-behavioral, (3) situational, and (4) artifact aspects. These four dimensions consist of corresponding constructs to constitute the study dimensions into operational levels. The following table (see Table 4.1) demonstrates the dimensions and corresponding constructs that were employed in the process of data analyses to respond to the research questions.

Table 4.1

The descriptions of utilization dimensions and operational constructs

Dimension	Description	Operational constructs
Personal	• User characteristics	• Access • Sex • Occupation • Age • Education • Income

Table 4.1 (*Continued*)

Dimension	Description	Operational constructs
Personal	• User characteristics	• Access • Sex • Occupation • Age • Education • Income
Attitude-behavioral	• The level of adoption	• Attitude • Ease of use • Usefulness • Playfulness • Use intention
Situational	• Recreation/trip situations	• Intent formation stages • Recreation experience phases • Trip modes • Service seeking tasks
Artifact	• Geo-information features • Tool functionality	• Geo-information regions • Geo-information types • Functionality interactions

The structure of this chapter follows the general organization as shown below:

Objective one: To explore how the usage of WebGIS varies by differing dimensions:

(a) by recreation/trip situations

(b) by geo-information characteristics

(c) by functionalities

Objective two: To explore how personal variables are related to the WebGIS utilization dimensions of:

(a) adoption constructs

(b) usage by recreation/trip constructs

(b) geo-information characteristics

(d) functionality interactions

Objective three: To explore how adoption variables related to:

(a) use indices

(b) functionality interactions

Objective four: To explore how recreation situations are related to:

(a) functionality interactions

(b) perceived usefulness

(b) perceived playfulness

First, the analyses started with an investigation of the samples to provide the initiation information for later analyses.

4.1 Analysis of the Sample

The sample size in this study was 1,346 in total consisting of 346 provided by the leading recreation and tourism sectors in the state of Oklahoma [OTRD (n=155) and ORPS (n=191)], and a sample of 1,000 students were randomly selected and provided by the Office of Institutional Review Board Data Management at Oklahoma State University. After first notification delivery, 81 of the emails were unusable with the reasons of absentee, refusal, delayed notification, or undeliverable. The valid total sample size was 1,265.

The data collection process period was 22 days from April 11^{th}, 2009 to May 2^{nd}, 2009. The numbers of returned survey was 170. By the valid sample size 1,265, the overall return rate was 13.44%. In addition, after data screening, there were 15 surveys evaluated as invalid since the responses indicated the respondents were lacking experiences with WebGIS.

In sum, the numbers of valid completed surveys were 155. Figure 4.1 showed the relative and cumulative amount of survey completed versus the number of days since the notifications were sent (Figure 4.1). The trends indicated that the electronic notifications sent were effective to advance the responses. The positive reactions to the electronic notifications sent were instantaneous, however, the effects faded shortly.

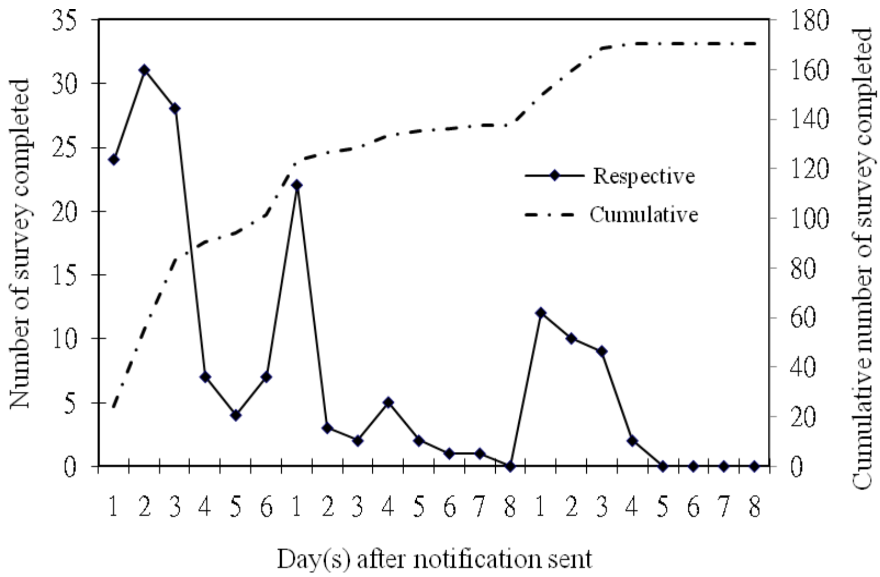

Figure. 4.1. Number of survey completed.

Table 4.2 presented the summary of personal characteristics of the sample used in this study. Although the sampling focused on two groups by occupation because of their potential understandings of the Internet and recreation/trip topics, there appeared reasonably good spread between the variable categories. As there was no response to "slow Internet access" and "less than 18" year old, these two categories were not in the categories for analyses. The variable "sex" has almost even distribution between male and female in the sample. Although the distribution of education level tended to be higher than the average, the spread among the categories was acceptable. Age and income levels had more diverse distribution in the categories than others, but each category kept fairly legitimate size to conduct later analyses. The age and income variables can be a reflection of the samples' occupations since the sample size of professionals was six tenth of the student samples. These two occupation groups cover a wide range of demographics, although they have distinct niches in terms of the age and income variables.

The focus of this study was to identify variables that are related to utilization of WebGIS and to discover the relationships between these variables. In an analytic sense, the goal was to explore the WebGIS usage at different levels of underlying independent variables. Hence, the categories were merged with other categories in the survey if they had been too small to be analyzed reliably in any statistical techniques. The variable of age "over 65" (n=1) was merged with "55-65" to become "over 55", "attend high school" (n=1) and "technical school" (n=1) in education variable were merged with "graduated high school" to become "high school", and the category of occupation as "other" (n=3) was excluded in some of the analyses. The study used those lately merged categories of personal variables through the analyses constantly.

Table 4.2

Sample personal characteristics

Personal Variables	Response	n	Valid Percent (%)
Access speed	Slow	0	0 %
	Medium	19	12.3%
	Fast	98	63.2%
	Very Fast	36	23.2%
Sex	Male	77	50.7%
	Female	75	49.3%
Occupation	Professional	56	36.1%
	Student	95	61.3%
	Other	3	2.6%
Age	Less than 18	0	0%
	18-25	70	45.2%
	26-35	32	20.6%
	36-45	16	10.3%
	46-55	24	15.5%
	Over 55	13	8.3%
Education	High School	14	8.9%
	Attended College	45	29.0%
	Bachelor's Degree	48	31.0%
	Master's Degree and up	48	31.0%
Income	Less than $20,000	75	48.7%
	$20,000-$39,000	18	11.7%
	$40,000-$59,000	20	13.0%
	$60,000-79,000	19	12.3%
	Above $80,000	22	14.3%

Total n=152-155, Missing n: Access speed=2, Sex=3, occupation=1, Income=1

4.2 The Usage of WebGIS in Recreation Trip Situations

This section intended to address the first objective of the study which was to explore how the WebGIS usages were different in recreation situations. The analyses adopted a one-way between subjects analyses of variance to compare the mean accuracy of the usage scores for four recreation situations. The situations include (1) four trip intent formation stages. This independent variable had four levels as "curious stage", "idea discovery stage", "alternatives comparison stage", and "focus information gathering stage”; (2) four recreation/trip mode as “community based recreation”, “business”, “leisure trip”, and “outdoor recreation”; (3) three recreation experience phases. This variable attempted to determine the differences of WebGIS usages when at “prior”, “on-site”, and “recollection” phases; (4) seven service seeking tasks as “location knowledge”, “route knowledge”, “geo-information customization”, “services finding”, “terrain knowledge”, “information sharing”, and “fun seeking”.

Before conducting ANOVA analysis, the statistical assumptions of ANOVA were inspected. The assumption of independence, in which the scores are not related, was ensured by the respondents answering the survey individually having no influences upon each other. The survey was sent through personal email contact. The chance to have the respondents discussing the survey content and thus affecting each other’s responses was small. Second, the normality assumption refers to the distribution of the scores of the dependent variable as bell shaped or the sample size in each group greater than 12. This assumption was confirmed by inspecting the Q-Q plots and histogram with normal distribution curves. The data distributions were a fairly good fit with the normal distribution. Of the several assumptions concerning the distribution of scores, homogeneity of variances is the most important factor that influences ANOVA results. This assumption gives information on how difference in variances is related to the factors of the design. Homogeneity of variances of each group score distribution was tested since this assumption is unique group by group, while the score distribution shared the assumptions of independence and normality and those were valid across all groups.

The study used Levene Statistics to examine the homogeneity of variances. Once the group(s) failed to reject the null hypothesis of equal variances, then the researcher conducted an ANOVA analysis to test the usage differences to each condition. However, if the score distribution resulted in rejection of the null hypothesis of equal variances, a Welch's Statistics, also known as Welch ANOVA, was conducted to test the ANOVA hypothesis replacing the ANOVA to determine the mean differences between groups with unequal variances. Also, when the mean differences were evidently supported by ANOVA or Welch ANOVA, the corresponding post-hoc tests were applied. These were Tukey Honest Significant Difference (HSD) to ANOVA and Games-Howell to Welch Statistics to analyze the source(s) of differences.

Comparing the options of intent formation stages, recreation experience phases, trip modes, and service seeking tasks, ANOVA and Welch ANOVA showed significant differences within the constructs of recreation experience phases [$Fw(2, 304.63)= 147.725$, $p<0.05$], recreation trip modes [$Fw(3, 335.54)= 17.622$, $p<0.05$], and service seeking tasks [$Fw(6, 476.02)= 85.91$, $p<0.05$] (see Table 4.3); however, there was no difference between intent formation stages [$F(3, 606)= 2.11$, $p>0.05$]. This result suggested that WebGIS was used evenly in different recreation/trip planning stages.

The following sections present the follow up tests for recreation situation constructs found to be significantly different between the options. This analysis used the Tukey HSD for equally distributed data sets and Games-Howell for unequally distributed data sets to locate the differences.

Table 4.3

The results of ANOVA of recreation/trip situations

Variables	Statistic(a) (Welch)	*df1*	*df2*	*p*
Recreation experience phases	147.725	2	304.634	<.001
Recreation/trip modes	17.622	3	335.543	<.001
Service seeking tasks	85.905	6	476.017	<.001

4.21 The effect of recreation experience phases

Follow-up tests were conducted to evaluate pair-wise differences using the Games-Howell test among the means of usage prior to the trip, on-site, or at the recollection phase after return from the trip. The results of these tests, as well as the mean differences and estimated standard deviation for each of the groups, are reported in Table 4.4. The results of Games-Howell tests at α= 0.05 indicated that the mean scores of the prior stage (*M*= 3.92, *SD*=0.90), on-site stage (*M*= 2.96, *SD*= 1.13), and recollection stage (*M*= 2.00, *SD*= 1.05) were significantly different from each other (see Table 4.4). As indicated by the group means, the prior stage had the more frequent usage of WebGIS than on-site stage and the recollection had the lowest usage frequency.

Table 4.4

Recreation experiences phases Post-Hoc analyses

(I) Phase	(J) Phase	Mean Difference (I-J)		Std. Error	*p*
Prior	On-site	.96079	(*)	.11695	<.001
	Recollection	1.91563	(*)	.11168	<.001
On-site	Recollection	.95484	(*)	.12463	<.001

4.22 The effect of recreation/trip modes

When comparing usage with trip modes of local recreation, business trip, leisure trip, and outdoor recreation, the Games-Howell tests were performed to evaluate the differences among the means. The result indicated that the differences of usage scores were significantly different at $\alpha = 0.05$ level between leisure trips ($M = 3.78$, $SD = 1.00$) and the other three groups. However, the groups of local recreation ($M=3.00$, $SD=1.20$), business ($M=3.04$, $SD=1.31$), and outdoor ($M=3.14$, $SD=1.20$) did not significantly differ from each other (see Table 4.5). Based on the mean scores, the results suggested that people used WebGIS more frequently for their leisure trips than for local, business, and outdoor recreation trips.

Table 4.5

Recreation/trip modes Post-Hoc analyses

(I) Trip mode	(J) Trip mode	Mean Difference (I-J)		Std. Error	*p*
Local	Business	-.03922		.14436	.993
	Leisure	-.77778	(*)	.12704	<.001
	Outdoor	-.13725		.13771	.751
Business	Leisure	-.73856	(*)	.13346	<.001
	Outdoor	-.09804		.14365	.904
Leisure	Outdoor	.64052	(*)	.12623	<.001

4.23 The effect of service seeking tasks

In terms of the usage differences between “service seeking task” options included location knowledge, route knowledge, geo-information customization, services finding, terrain knowledge, information sharing, and fun seeking. The results indicated that the respondents used more frequently, in turn, when they need to locate places (*M*=

3.96, *SD*= 1.01) and know the travel routes (*M*= 4.12, *SD*= 0.89) than they did the tasks of customizing trip information (*M*=3.21, *SD*=1.29), finding related services (*M*=2.99, *SD*=1.17), knowing the terrain (*M*=2.81, *SD*=1.16), and enjoying the interaction with the Internet service just for fun (*M*=2.88, *SD*=1.28).

Among the tasks people had in their minds before they reached WebGIS, the purpose of sharing (*M*=1.88, *SD*=1.07) had the least usage scores than did the other purposes (see Table 4.6). The results indicated that retrieving the location information and knowing how to move from place to another were the most popular purposes for using WebGIS following by the purposes of customizing their own maps, knowing the terrain, using WebGIS as an intermediate party to find services, or just enjoying WebGIS for fun. However, although many WebGIS services offer the function of encouraging users in sharing the information or/and experiences with others, that was the least common purpose for people to reach WebGIS services.

Table 4.6

Service seeking tasks Post-Hoc analyses

(I) Service seeking tasks	(J) Service seeking tasks	Mean Difference (I-J)		Std. Error	*p*
Location knowledge	Route knowledge	-.16858		.10807	.708
	Geo-information customization	.75484	(*)	.13124	<.001
	Services finding	.96778	(*)	.12408	<.001
	Terrain knowledge	1.15083	(*)	.12360	<.001
	Information sharing	2.07168	(*)	.11814	<.001
	Fun seeking	1.08387	(*)	.13081	<.001
Route knowledge	Geo-information customization	.92342	(*)	.12590	<.001
	Services finding	1.13636	(*)	.11842	<.001
	Terrain knowledge	1.31941	(*)	.11791	<.001
	Information sharing	2.24026	(*)	.11218	<.001
	Fun seeking	1.25245	(*)	.12545	<.001

Table 4.6 (*Continued*)

(I) Service seeking tasks	(J) Service seeking tasks	Mean Difference (I-J)		Std. Error	*p*
Geo-information customization	Services finding	.21295		.13989	.731
	Terrain knowledge	.39599		.13946	.071
	Information sharing	1.31684	(*)	.13465	<.001
	Fun seeking	.32903		.14589	.269
Services finding	Terrain knowledge	.18305		.13274	.813
	Information sharing	1.10390	(*)	.12768	<.001
	Fun seeking	.11609		.13948	.981
Terrain knowledge	Information sharing	.92085	(*)	.12721	<.001
	Fun seeking	-.06696		.13905	.999
Information sharing	Fun seeking	-.98781	(*)	.13423	<.001

4.3 The Usage of WebGIS by Geo-information Characteristics

The aim of this section was to evaluate the use of geo-information widely provided through WebGIS. The two characteristics assessed were the geo-information regions or areas and the types of format for geo-information. The analyses intended to explore (1) How the usages vary between geo-information regions focused; (2) How perceived usefulness differs regarding the formats of geo-information provided. This section adopted a one-way between subjects ANOVA to analyze the two geo-information characteristics. The examining processes before ANOVA were similar to those mentioned in the procedure in previous sections.

According to the Levene tests of homogeneity of variances, Welch ANOVA was employed to determine the mean differences for the usage of geo-information regions [Levene Statistic (2, 452) = 4.013, $p<0.05$] and the types of geo-information provided [Levene Statistic (4, 765)= 4.013, $p<0.05$].

First, the WebGIS usage among people in this sample seeking geo-information regions on local, city, and natural areas were compared using Welch ANOVA. The result indicated that there were significant differences between the usage by geo-information regions [$Fw(2, 299.75)= 30.173$, $p<0.05$]. The result of analysis of geo-information types also indicated that significant differences exist between searches for information with road maps, aerial photographs, three-dimensional images, photo/videos, and texts and links (see Table 4.7).

Table 4.7

The results of ANOVA of geo-information characteristics

Variables	Statistic(a) (Welch)	*df1*	*df2*	*p*
Geo-information region	30.173	2	299.751	<.001
Geo-information types	70.940	4	378.456	<.001

4.31 The effect of geo-information regions

The geo-information regions were the areas on which the users did their focused searching. The geo-information regions assessed include the local areas, those areas not far from the users' residence and fit for casual recreation; city areas that are the more populated areas providing different experiences and requiring different preparation to visit; and natural areas being the areas possibly more remote and needing different attention in terms of the search to the users and provision to the providers.

Games-Howell tests were conducted to evaluate the sources of the differences in responses toward the usage of regional geo-information provisions. The post hoc analyses showed that the city information (M=3.64, SD=1.01) was sought more frequently than the information regarding local areas (M=2.70, SD=1.17) and natural areas (M=2.99, *SD*=1.17) (see Table 4.8). The usage of local information and natural areas shared similar usage levels.

Table 4.8

Geo-information region Post-Hoc analyses

(I) Geo-region	(J) Geo-region	Mean Difference (I-J)		Std. Error	*p*
Local area	City area	-.93617	(*)	.12548	<.001
	Natural area	-.28486		.13435	.087
City area	Natural area	.65132	(*)	.12577	<.001

* $p<0.05$

4.32 The effect of geo-information types

The geo-information types involve the formats of geo-information contents including road maps which have the interactive ability to conduct various transportation search; aerial photographs for landscape and real world objects viewed from the sky; three-dimensional images which present fine scale realistic environments, so that the users can view venues from any angle; photographs and videos which provide living sense to the places; texts/links that the descriptions or any other information presented mainly in text form. Each of the information types provides usefulness to some extent; however, to provide those information types requires different management techniques and cost.

As related to the source differences of information types, results of the Games-Howell tests showed the significant mean differences were between road maps (*M*=4.31, *SD*= 1.14) and aerial photographs (*M*=3.47, *SD*=1.14), and between aerial photographs and other types of information including three dimensional images (*M*=2.76, *SD*=1.21), photos/videos (*M*=3.00, *SD*=1.13), and texts (*M*=3.10, *SD*=1.08) (see Table 4.9). There were no differences found in relation to three dimensional images, photos/videos, and texts. Among the information types, road maps are most frequently used, followed by aerial photographs. The types of three dimensional images, photos/videos, and texts shared similar as to the usages.

Table 4.9

Geo-information type Post-Hoc analyses

(I) InfoType	(J) InfoType	Mean Difference (I-J)		Std. Error	*p*
Road map	Aerial photograph	.83423	(*)	.10954	<.001
	3D image	1.54702	(*)	.11538	<.001
	Photo/video	1.31169	(*)	.10933	<.001
	Text/link	1.20779	(*)	.10589	<.001
Aerial photograph	3D image	.71280	(*)	.13400	<.001
	Photo/video	.47746	(*)	.12883	.002
	Text/link	.37357	(*)	.12592	.027
3D image	Photo/video	-.23534		.13383	.400
	Text/link	-.33923		.13103	.075
Photo/video	Text/link	-.10390		.12574	.922

* The mean difference is significant at the .05 level.

4.4 The Usage of WebGIS Functionality

The goal of this section was to examine the usage of WebGIS functionalities commonly provided by WebGIS services. There was a total of 17 items of functionality divided into six categories of targeting, view, information alliance, multimedia, operation assistance, and geo-information component. Also, based on the mental and physical effort required to perform the function, the functionalities were divided into basic, medium, and advanced levels. Welch ANOVA and Games-Howell tests were conducted to assess the usage differences between the function items since the distributions of the function categories [Levene (5, 910)= 5.12, $p<0.05$] and complexity levels [Levene (2, 448)= 5.81, $p<0.05$] showed unequal variances.

4.41 Functionality categories

The six function categories included targeting, viewing, information alliance, multi-media, operation assistance, and geo-information processing. The result of ANOVA indicated that there were differences between the function categories, $Fw(5, 424.05)= 44.92$, $p<0.05$ (see Table 4.10). The post hoc results showed, except for the pair of "operation assistance" (*M*=0.98, *SD*= 0.87) and "information alliance" (*M*=2.76, *SD*= 0.99) and the pair of "geo-information" (*M*=2.43, *SD*= 0.75) and "multi-media" (*M*=2.42, *SD*= 0.85), those were no significant differences. Other pairs of function categories were all significantly different in terms of their interaction scores (see Table 4.11).

Regarding functionality categories, "targeting" has the highest usage following by "viewing", "operation assistance", "information alliance", "geo-information", and "multimedia". Therefore, the functions did have distinct usages from each other. The "targeting" functions, such as search locations using keywords, and the function of viewing, such as zoom in/out, scale, pan tilt, were necessary to satisfy the popular uses. Information alliances, for example, providing business lists and links to more information, share the similar level of needs in the middle. The more sophisticated functions, such as multi-media and various geo-information processing, somehow may be perceived by the respondents to be more complicated to perform. As a consequence, these sophisticated functions had few uses.

Table 4.10

The results of ANOVA: functionality category

Variable	Welch Statistic(a)	*df1*	*df2*	*p*
Function category	44.917	5	424.046	<.001

Table 4.11

Functionality category Post-Hoc analyses

(I) Function category	(J) Function category	Mean Difference (I-J)		Std. Error	*p*
Targeting	View	.38011	(*)	.11538	.014
	Information alliance	.93678	(*)	.11780	<.001
	Multimedia	1.28189	(*)	.11089	<.001
	Operation assistance	.72403	(*)	.11169	<.001
	Geo-information	1.27390	(*)	.10626	<.001
View	Information alliance	.55668	(*)	.10981	<.001
	Multimedia	.90178	(*)	.10236	<.001
	Operation assistance	.34392	(*)	.10323	.012
	Geo-information	.89379	(*)	.09733	<.001
Information alliance	Multimedia	.34511	(*)	.10508	.014
	Operation assistance	-.21276		.10593	.340
	Geo-information	.33712	(*)	.10019	.011
Multimedia	Operation assistance	-.55786	(*)	.09818	<.001
	Geo-information	-.00799		.09196	1.000
Operation assistance	Geo-information	.54987	(*)	.09293	<.001

* The mean difference is significant at the .05 level.

4.42 Functionality levels

Although functionality categories covered the aspect based on the motives to interact with the functionalities offered by WebGIS, often, the users' choice of uses were founded on the balance between benefits and costs, such as time and mental effort. Functionality levels were divided into basic, medium, and advanced levels based on the complexity required performing the functions.

The goal of the analyses was to examine the interactions based on functionality levels. The result showed there were differences between the functionality levels in terms of usages, *Fw*(2, 295.12)= 118.38, $p<0.05$ (see Table 4.12). The post hoc analyses indicated that the interaction of three levels of functionality were significantly different from each other. Not surprisingly, the basic functionality (*M*= 3.22, *SD*= 0.65), such as key word searching, zoom, pan, view pictures/videos, use instructions, measure travel times, were mostly used as compared to medium level functions (*M*= 2.46, *SD*= 0.79), such as tilt/rotate, share information with other, or show/hide layers over the viewing areas. The more challenging functions (*M*=1.97, *SD*= 0.79), such as customize, create, or publish geo-information were less used (see Table 4.13).

Table 4.12

The Result of ANOVA: Functionality level

Variable	Statistic(a) Welch	*df1*	*df2*	*p*
Functionality level	118.384	2	295.121	<.001

Table 4.13

Functionality Level Post hoc analyses

(I) Functionality Level	(J) Functionality Level	Mean Difference (I-J)		Std. Error	*p*
Basic	Medium	.75822	(*)	.08423	<.001
	Advanced	1.24746	(*)	.08286	<.001
Medium	Basic	-.75822	(*)	.08423	<.001
	Advanced	.48924	(*)	.09156	<.001
Advanced	Basic	-1.24746	(*)	.08286	<.001
	Medium	-.48924	(*)	.09156	<.001

* The mean difference is significant at the .05 level.

4.5 The Personal Variables to the Utilization of WebGIS

This section aimed to explore the second objective of the study. This second objective was to explore how personal variables differentially affect the WebGIS utilization in the four utilization dimensions. This section consists of four sub-sections by utilization dimensions of adoption, recreation, information, and functionality aspects. The personal variables assessed were access speed, sex, occupation, age, education, and income level.

The four sub-sections are:

(1) The effect of personal variables to adoption constructs;

(2) The effect of personal variables to usages by recreation/trip situations;

(3) The effect of personal variables to the use of geo information; and

(4) The effect of personal variables to the functionality interactions.

The analyses employed a one-way between subjects ANOVA to compare the means grouped by each personal variable. The ANOVA assumptions were validated using the procedure addressed in previous sections. Depending upon the conditions of the data distribution of each group, either the pair of ANOVA/Tukey HSD analyses or Welch/Games-Howell analyses was used to perform the evaluation.

4.51 The effect of personal variables to adoption constructs

This section aimed to determine the effects of personal characteristics on WebGIS adoption. The personal characteristics examined were (1) access speed, consisting of four levels—slow, medium, fast, and very fast; (2) sex—male and female; (3) occupation—comprised of three levels as professional, student, or other; (4) age groups—divided into seven levels of “less than 18”, “18-25”, “26-35”, “36-45”, “46-55”, and “over 55”; (5) education - made up of four levels identified as “high school”, “attend college”, “bachelor’s degree”, and “master’s degree and up”; (6) income - five levels categorized as “less than $20,000”, “$20,000-$39,999”, “$40,000-$59,999”, “$60,000-$79,999”, and “above $80,000”. The adoption variable consisted of seven constructs including the (1) the actual use for recreation; (2) use intention, (3) attitude, (4) perceived ease of use, (5) perceived usefulness, (6) perceived playfulness, and (7) total adoption scores: the combination of ease of use, usefulness, attitude, and playfulness. The effect of each personal variable to the respective construct was examined. The specific sub-research questions that reflected the purpose of this section of analysis are shown in the following sections.

Access speed

This analysis attempted to assess the effect of access speeds on WebGIS adoption. Before comparing the group means, the tests of homogeneity variances were conducted to evaluate the scores’ distribution. The results indicated that all the group score distributions shared similar variances. Therefore, ANOVA and Tukey tests were conducted to analyze whether the differences existed and where the differences between groups were. The results of ANOVA showed the access speed groups had significantly different means of perceived playfulness [$F(2, 150) = 5.81$, $p<0.05$], but no significant difference was found between the means of access speeds on other adoption variables including actual recreation use [$F(2, 150) = 0.33$, $p>0.05$], intention [$F(2, 148) = 0.68$, $p>0.05$], attitude [$F(2, 150) = 1.48$, $p>0.05$], usefulness [$F(2, 150) = 0.88$, $p>0.05$], ease of use [$F(2, 150) = 1.38$, $p>0.05$], and total adoption [$F(2, 150) = 2.71$, $p>0.05$]. Among the personal characteristics, the access speed had significant effect on the perceived playfulness toward WebGIS (see Table 4.14).

The follow up Tukey test was conducted to identify the source of these differences. Since the group with slow access category had no respondents, the pair-wise comparisons were between medium, fast, and very fast Internet access speeds. The result showed a significant difference between the medium (*M*= 5.42, *SD*= 1.54), fast (*M*= 6.34, *SD*= 2.20) and very fast access speeds (*M*=7.31, *SD*= 1.74) and between fast and very fast (see Table 4.15). No differences were found between the means of the responses identified as medium and fast. The people with very fast Internet access, among all adoption variables, perceived the more playful experiences than did people with fast and medium speed of Internet accesses.

Table 4.14

Results of ANOVA summary table: Access speeds on adoption constructs

Adoption Variables	Groups	*SS*	*Df*	*MS*	*F*	*p*
Playfulness	Between	47.724	2	23.862	5.809	.004
	Within	616.158	150	4.108		
	Total	663.882	152			

Table 4.15

Post-Hoc Tukey analyses: Access speeds on adoption constructs

Dependent Variable	(I) Access	(J) Access	Mean Difference (I-J)		Std. Error	*p*
Playfulness	Medium	Fast	-.916		.508	.201
		Very Fast	-1.885	(*)	.575	.006
	Fast	Very Fast	-.969		.395	.052

* The mean difference is significant at the .05 level.

Sex

Based on the results of tests of homogeneity, the two sex groups passed the assumption of equal variances. Therefore, ANOVA were performed to reveal the effects of sex on the adoption variables. The results showed that sex had no significant effects on any adoption variables including actual recreation use [$F(1, 150)= 0.14$, $p>0.05$], intention [$F(1, 148)= 0.556$, $p>0.05$], attitude [$F(1, 150)= 1.06$, $p>0.05$], usefulness [$F(1, 150)= 2.148$, $p>0.05$], ease of use [$F(1, 150)= 2.79$, $p>0.05$], playfulness [$F(1, 150)= 2.68$, $p>0.05$], and total adoption [$F(1, 150)= 3.39$, $p>0.05$]. Sex had no influence on the technology adoption.

Occupation

The results of ANOVA revealed that the occupation groups are significantly different toward the perceived ease of use [$F(1, 149)= 5.05$, $p<0.05$] (see Table 4.16). However, no significant differences were found in other adoption constructs. The ANOVA test indicated that the students (M=7.92, SD=1.40) responded with higher scores in perceived ease of use construct than did the professionals (M=7.36, SD=1.59). College students constantly have opportunities and training using various interfaces on the Internet and they embrace the technology as part of their everyday lives. Students appear to have better adoption of WebGIS.

Table 4.16

Results of ANOVA summary table: Occupation on adoption constructs

Variable	Groups	*SS*	*df*	*MS*	*F*	*p*
Ease of Use	Between	10.995	1	10.995	5.054	.026
	Within	324.183	149	2.176		
	Total	335.179	150			

Age

The results of homogeneity tests suggested that all groups of distributions have similar variances for the corresponding adoption variables. Consequently, ANOVA were conducted to determine the effect of age to adoption variables. The results showed that the age factor affected adoption on use intention [$F(4, 148) = 3.31$, $p<0.05$], total adoption [$F(4, 150) = 3.82$, $p<0.05$], ease of use [$F(4, 150) = 4.77$, $p<0.05$], usefulness [$F(4, 150) = 2.68$, $p<0.05$], and playfulness [$F(4, 150) = 2.49$, $p<0.05$] but no significant difference was found on actual use for recreation [$F(4, 150) = 2.28$, $p>0.05$] and attitude [$F(4, 150) = 1.22$, $p>0.05$] (see Table 4.17). Age affected the three most fundamental constructs of adoption. These fundamental constructs are usefulness, ease of use, and playfulness. Those three attitude-behavioral constructs usually led to the actual use and intention towards use. The results showed that although the age groups had significant differences in adoption, interestingly, the differences of adoption did not seem to reflect on the actual use and use intention. This may indicate that the overall adoption level was high enough for every age group to actually access and use WebGIS. In addition, compared to other personal variables, adoption was more sensitive to the factor of age than other factors.

Table 4.17

Results of ANOVA summary tables: Age on adoption constructs

Variable	Groups	*SS*	*df*	*MS*	*F*	*p*
Use Intention	Between	33.283	4	8.321	3.305	.013
	Within	372.599	148	2.518		
	Total	405.882	152			
Adoption	Between	638.903	4	159.726	3.821	.005
	Within	6270.865	150	41.806		
	Total	6909.768	154			

Table 4.17 (*Continued*)

Variable	Groups	*SS*	*df*	*MS*	*F*	*p*
Ease of Use	Between	38.047	4	9.512	4.771	<.001
	Within	299.024	150	1.993		
	Total	337.071	154			
Usefulness	Between	113.035	4	28.259	2.680	.034
	Within	1581.804	150	10.545		
	Total	1694.839	154			
Playfulness	Between	41.417	4	10.354	2.485	.046
	Within	625.061	150	4.167		
	Total	666.477	154			

To determine the age effect on use intention variable, the post hoc Tukey tests were conducted to reveal the source of differences using pair-wise comparisons. The results suggested that the age group of 26-35 on the average (*M*= 4.19, *SD*= 0.97) showed higher intentions to use WebGIS than those in the group of 46-55(*M*= 3.5, *SD*= 0.93). No significant differences were found between the groups of 36-45 (*M*= 3.94, *SD*= 0.93), 18-25 (*M*= 3.80, *SD*= 0.94), and over 55 (*M*= 3.54, *SD*= 0.88) (see Table 4.18).

The Tukey tests were also conducted for the other adoption variables and showed significant differences by age groups. Regarding the total adoption, the differences were found between the pairs of age groups at 18-25 (*M*=37.7, *SD*= 6.65)/ 46-55 (*M*=33.21, *SD*= 6.30), 26-35 (*M*= 38.25, *SD*= 5.54)/ 46-55, and 36-45 (*M*=39.69, *SD*= 4.33)/ 46-55 (see Table 4.18). The average adoption by age group 46-55 was lower than those in other groups.

As related to the significant age effect on ease of use, the results of Tukey tests suggested that the age groups of 18-25 (*M*= 7.9, *SD*= 1.49), 26-35 (*M*= 8.03, *SD*= 1.18), and 36-45 (*M*= 8.31, *SD*= 1.25) had higher ease of use on the average as compared to those in the group of 46-55 (*M*= 6.88, *SD*= 1.19). Also, the age group of 46-55 had higher ease of use scores than the group of those over 55 (*M*= 6.85, *SD*= 1.99). No significant differences were found between the groups of 18-25, 26-35, and over 55 (see Table 4.18). Among the age groups, the group of 36-45 showed the highest means in ease of use variable and the age group 46-55 showed the lowest on the average.

More sensitive follow up tests, Least Significant Difference (LSD), were conducted instead of Tukey tests since Tukey tests were not sensitive enough to distinguish the differences between age groups. The LSD follow up tests indicated that the age 45-55 (*M*= 13.5, *SD*= 2.98) were significantly different from the age of 18-25 (*M*=15.24, *SD*=3.44), 26-35 (*M*=15.69, *SD*= 2.85), 36-45(*M*= 16.13, *SD*= 2.66) but had no difference with the age group of those over 55 (*M*= 13.77, *SD*= 4.13) (see Table 4.18). The age group of 46-55 had lower scores of perceived usefulness than other age groups.

The post hoc comparisons identified the different means between age groups on perceived playfulness. The results showed the differences existed between the age groups of 18-25 (*M*= 6.81, *SD*= 2.20) and 46-55 (*M*= 5.42, *SD*= 2.29) (see Table 4.18). However, there is no significant difference in other comparisons between the age groups. The result seemed to indicate the age group of 46-55 enjoyed less the interaction with WebGIS than did the group of 18-25.

Except for use intentions in which the age of 26-35 had the highest score among other age groups, other reactions to age had similar patterns. The age group of 36-35 had the highest scores among other age groups, even the younger ones. Following were the age groups 18-26 and 26-35. The age group of 46-55 appeared to have lower scores on every construct even when compared with those over age 55.

Table 4.18

Use indices Post-Hoc analyses: Age

Dependent Variable	(I) Age	(J) Age	Mean Difference (I-J)		Std. Error	*p*
Use Intention	18-25	26-35	-.770		.342	.168
		36-45	-.473		.440	.818
		46-55	.627		.381	.471
		Over 55	.484		.479	.851
	26-35	36-45	.296		.488	.974
		46-55	1.397	(*)	.437	.014
		Over 55	1.253		.524	.124
	36-45	46-55	1.101		.517	.213
		Over 55	.957		.592	.490
	46-55	Over 55	-.144		.551	.999
Total adoption	18-25	26-35	-.550		1.380	.995
		36-45	-1.987		1.792	.801
		46-55	4.492	(*)	1.529	.031
		Over 55	3.392		1.953	.414
	26-35	36-45	-1.438		1.980	.950
		46-55	5.042	(*)	1.746	.036
		Over 55	3.942		2.127	.347
	36-45	46-55	6.479	(*)	2.087	.019
		Over 55	5.380		2.414	.175
	46-55	Over 55	-1.099		2.227	.988
Ease of Use	18-25	26-35	-.131		.301	.992
		36-45	-.412		.391	.829
		46-55	1.025	(*)	.334	.021
		Over 55	1.054		.426	.103
	26-35	36-45	-.281		.432	.966
		46-55	1.156	(*)	.381	.024
		Over 55	1.185		.464	.085
	36-45	46-55	1.438	(*)	.456	.016
		Over 55	1.466	(*)	.527	.047
	46-55	Over 55	.029		.486	1.000

Table 4.18 (*Continued*)

Dependent Variable	(I) Age	(J) Age	Mean Difference (I-J)		Std. Error	*p*
Usefulness	18-25	26-35	-.445		.693	.522
		36-45	-.882		.900	.329
		46-55	1.743	(*)	.768	.025
		Over 55	1.474		.981	.135
	26-35	36-45	-.438		.994	.661
		46-55	2.188	(*)	.877	.014
		Over 55	1.918		1.068	.074
	36-45	46-55	2.625	(*)	1.048	.013
		Over 55	2.356		1.213	.054
	46-55	Over 55	-.269		1.118	.810
Playfulness	18-25	26-35	.346		.436	.932
		36-45	-.061		.566	1.000
		46-55	1.398	(*)	.483	.035
		Over 55	.891		.617	.599
	26-35	36-45	-.406		.625	.966
		46-55	1.052		.551	.317
		Over 55	.546		.671	.926
	36-45	46-55	1.458		.659	.180
		Over 55	.952		.762	.723
	46-55	Over 55	-.506		.703	.952

Education

The analyses aimed to determine whether there are differences between the education groups on WebGIS adoption. In the analyses, only one respondent checked having a high school education as the highest level of degree, one checked the category of vocational school, and eight respondents had the education at the doctoral level. Considering the valid sample size for conducting statistical analyses, the two high school related categories with those who had graduated “high school” were merged as high school and doctoral degree respondents were merged with master’s degree respondents.

The results of equal variance tests showed that all the education groups shared similar variances across education groups. Therefore, this section of the study permitted an ANOVA to be conducted to determine the effect of education on adoption. The ANOVA results indicated the education levels did not affect adoption differently in the actual use [$F(3, 151)= 2.01$, $p>0.05$], intention [$F(3, 149)= 2.09$, $p>0.05$], usefulness [$F(3, 150)= 1.11$, $p>0.05$], attitude [$F(3, 151)= 0.77$, $p>0.05$], ease of use [$F(3, 151)= 1.45$, $p>0.05$], and playfulness [$F(3, 151)= 0.70$, $p>0.05$]. In contrast to the age variable that has sufficient and significant effect on adoption, the education variable had no affect on all adoption constructs.

Income

To determine the effect of income on adoption, since the income groups allowed the researcher to fail to reject the null hypothesis of Levene's homogeneity of variance test, all groups shared equal variance in this series of test. Therefore, a one-way between subjects ANOVA was conducted to analyze how the income levels affect the adoption indexed in actual use, use intention, attitude, usefulness, ease of use, and playfulness. The results showed there were no significant effects of income on adoption at the $p<0.005$ level for the five income levels.

4.52 The effect of personal variables on usages by recreation/trip situations

The aim of this section was to examine the effects of personal variables on the WebGIS usage by recreation/trip situations. The personal variables assessed were access speed, sex, occupation, age, education, and income. The trip situations using WebGIS assessed were (1) intent formation stages—from curious, ideation, alternative comparison, to specific target; (2) experience phases were divided by the time of departure— prior, on-site, and recollection; (3) recreation trip mode—local, business, leisure, and outdoor trip; (4) service seeking tasks—location knowledge, route knowledge, customization, terrain knowledge, and sharing. One-way ANOVA and matching follow up analyses were conducted to evaluate the effects of each personal variable to each recreation situation. The analyses are reported in each sections based on the personal characteristics. The specific sub-research questions are shown below.

Access speed

First, the homogeneity of variance assumption was tested in order to conduct the analyses appropriate to the unique analytic conditions. ANOVA were used to analyze whether the groups share equal variances and Welch ANOVA was conducted to test the conditions of unequal variances. Based on both types of the ANOVA summary tables, the only significant difference shown indicated the access speeds affected the "explore just for fun" category of service seeking tasks, $F(2, 150)= 5.70$, $p<0.05$ (see Table 4.19).

The Tukey tests revealed that the very fast speed ($M= 2.32$, $SD= 0.95$) was significantly different from the fast ($M= 2.77$, $SD= 1.27$) and medium speeds ($M= 3.42$, $SD= 1.32$) (see Table 4.20). However, there was no significant difference between fast and medium access speed in the "explore for fun" situation. Among the situations, the access speed mainly had an effect on the service seeking tasks related to fun seeking, but not on trip mode, intent formation, or phases. Within the "explore for fun" category, the speed of the Internet access influenced the willingness to reach WebGIS for hedonistic purposes.

Table 4.19

Results of ANOVA summary tables: Access speed on recreation situations

Construct	Variable	Groups	*SS*	*df*	*MS*	*F*	*p*
Service seeking tasks	Explore for fun	Between	17.660	2	8.830	5.698	.004
		Within	232.457	150	1.550		
		Total	250.118	152			

Table 4.20

Access speed on recreation situations Post-Hoc analyses

Dependent Variable	(I) Access	(J) Access	Mean Difference (I-J)		Std. Error	*p*
Explore for fun	Medium	Fast	-.450		.312	.323
		Very Fast	-1.101	(*)	.353	.006
	Fast	Very Fast	-.651	(*)	.243	.022

* The mean difference is significant at the .05 level.

Sex

ANOVA and Welch ANOVA were conducted to examine the sex effects on recreation/trip situations. The ANOVA summary table for these data indicated that there were group differences on the recollection phase [$F(1, 150) = 9.90$, $p<0.05$] of recreation experience phases, view terrain [$F(1, 148)= 7.22$, $p<0.05$] and explore for fun [$F(1, 150)$ 6.65=, $p<0.05$] of service seeking tasks, and outdoor recreation [$F(1, 148)= 4.76$, $p<0.05$] as trip mode (see Table 4.21). However, sex did not have an effect on the usage under other recreation situations.

By contrast to prior and on-site phases, sex showed a significant effect on the usage of WebGIS during the recollection phase in which the male group (*M*= 2.26, *SD*= 1.12) on the average had higher usage rates than did female respondents (*M*= 1.73, *SD*=

0.94). Sex also had a significant effect on the usage regarding service seeking tasks of terrain knowledge and explore for fun, and the trip mode of outdoor recreation. Under terrain knowledge, the male group (*M*= 3.04, *SD*= 1.10) appeared to use WebGIS more than did the female group (*M*= 2.54, *SD*= 1.73). The similar result applied to explore for fun situations where males' usage (*M*= 3.13, *SD*= 1.25) was more than that of females (*M*= 2.60, *SD*= 1.28) as well as to the outdoor recreation mode where females (*M*= 2.91, *SD*= 1.20) used the WebGIS less frequently for their outdoor recreation than did males (*M*= 3.33, *SD*= 1.18).

Surprisingly, males used WebGIS more for recollection purposes than did female respondents. The terrain knowledge and outdoor recreation were related in terms of the information needs in preparing for the trip. This result may be influenced also by the sex differences as shown by the participation in outdoor recreation. Also, the results showed that males had more chances to use WebGIS not for practical purposes, but just for fun.

Table 4.21

Results of ANOVA summary tables- Sex on recreation situations

Construct	Variable	Groups	*SS*	*df*	*MS*	*F*	*p*
Experience phase	Recollection Phase	Between	10.528	1	10.528	9.903	.002
		Within	159.472	150	1.063		
		Total	170.000	151			
Service seeking tasks	Terrain knowledge	Between	9.333	1	9.333	7.222	.008
		Within	191.260	148	1.292		
		Total	200.593	149			
Service seeking tasks	Explore for fun	Between	10.667	1	10.667	6.648	.011
		Within	240.701	150	1.605		
		Total	251.368	151			
Trip mode	Outdoor recreation	Between	6.726	1	6.726	4.760	.031
		Within	209.114	148	1.413		
		Total	215.840	149			

Occupation

ANOVA and Welch ANOVA were conducted to determine the occupation effects on the usage of WebGIS under recreation/trip situations. The Welch Statistics revealed that there were significant differences on the usage when the service seeking task was sharing [$Fw(1,146.68)= 8.01$, $p<0.05$] and when the trip mode was business [$Fw(1, 130.14)= 6.80$, $p<0.05$], but no significant differences were found in other recreation situations (see Table 4.22).

Occupation showed effects on sharing among service seeking tasks. The student group ($M= 2.05$, $SD= 1.2$) used more WebGIS to carry out the sharing tasks than did the professional group ($M= 1.60$, $SD= 0.76$), whereas the professional group ($M= 3.4$, $SD= 1.15$) showed more usage for business trips than did the student group ($M= 2.85$, $SD= 1.38$).

Table 4.22

Results of ANOVA summary table: Occupation

Construct	Variable	Statistic(a) Welch	*df1*	*df2*	*p*
Service seeking tasks	Share	8.005	1	146.684	.005
Trip mode	Business	6.798	1	130.143	.010

Age

ANOVA and Welch ANOVA were conducted to examine the effect of age on the WebGIS usage under recreation/trip situations. The results indicated that the age factor affected the usages under the local recreation mode [$F(4, 147)= 2.48$, $p<0.05$], business trip mode [$Fw(4, 46.10)= 3.28$, $p<0.05$], and prior recreation/trip phase [$Fw(4, 45.85)= 4.26$, $p<0.05$] (see Table 4.23, 4.24).

Regarding the business trip mode, the Games-Howell tests were conducted to locate the source of differences between age groups. The results indicated that there was difference between the age of 18-25 (*M*= 2.80, *SD*= 1.36) and 36-45 (*M*= 3.94, *SD*= 1.06), but no significant differences were found between other age groups. The group of 36-45 showed the most frequent use of WebGIS to assist their business trip planning than did other groups and showed a significant difference with the group of 18-25 (see Table 4.25).

For the usage prior to the trip, there were significant differences between the age of 26-35 (*M*= 4.29, *SD*= 0.64) and 46-55 (*M*= 3.63, *SD*= 0.58) and no significant differences indicated between other age groups. The "prior to travel" phase of the trip had the most frequent uses when compared to other phases. The results indicated that the age group of 46-55 had the lowest usage prior to travel than other groups, especially as contrasted to the age of 26-35 (see Table 4.25).

Since the Tukey test was not sensitive enough to detect the difference between age groups under the local recreation mode, the test of LSD as a follow up test was applied. The results of the follow up tests indicated that there were significant differences between the age group over 55 (*M*= 2.25, *SD*= 1.14) and other groups. The group of those over 55 less frequently use WebGIS for local recreation information than other groups (see Table 4.25).

Table 4.23

Results of ANOVA summary tables: Recreation situations

Construct	Variable	Groups	*SS*	*df*	*MS*	*F*	*p*
Trip mode	Local	Between	13.929	4	3.482	2.484	.046
		Within	206.071	147	1.402		
		Total	220.000	151			

Table 4.24

Results of Welch ANOVA summary tables: Recreation situation

Construct	Variable	Statistic(a)Welch	*df1*	*df2*	*p*
Experience phase	Prior Phase	4.262	4	45.851	.005
Trip mode	Business	3.284	4	46.102	.019

Table 4.25

Recreation situation Post-Hoc analyses

	(I) Age	(J) Age	Mean Difference (I-J)		Std. Error	*p*
Trip mode: Local	18-25	26-35	-.140		.255	.584
		36-45	-.227		.328	.491
		46-55	.477		.285	.096
		Over 55	.836	(*)	.370	.025
	26-35	36-45	-.087		.364	.812
		46-55	.617		.326	.060
		Over 55	.976	(*)	.403	.017
	36-45	46-55	.704		.385	.070
		Over 55	1.063	(*)	.452	.020
	46-55	Over 55	.359		.422	.396
Recreation experience phase: Prior Phase	18-25	26-35	-.419		.169	.105
		36-45	-.191		.210	.891
		46-55	.246		.171	.601
		Over 55	.179		.350	.985
	26-35	18-25	.419		.169	.105
		36-45	.228		.205	.801
		46-55	.665	(*)	.165	.002
		Over 55	.598		.348	.451
	36-45	18-25	.191		.210	.891
		26-35	-.228		.205	.801
		46-55	.438		.207	.241
		Over 55	.370		.369	.851
	46-55	18-25	-.246		.171	.601
		26-35	-.665	(*)	.165	.002
		36-45	-.438		.207	.241
		Over 55	-.067		.348	1.000
	Over 55	18-25	-.179		.350	.985
		26-35	-.598		.348	.451
		36-45	-.370		.369	.851
		46-55	.067		.348	1.000

Table 4.25 (*Continued*)

	(I) Age	(J) Age	Mean Difference (I-J)		Std. Error	*p*
Trip mode: Business	18-25	26-35	-.361		.305	.761
		36-45	-1.138	(*)	.311	.009
		46-55	-.200		.264	.942
		Over 55	-.200		.359	.980
	26-35	18-25	.361		.305	.761
		36-45	-.776		.371	.243
		46-55	.161		.332	.988
		Over 55	.161		.412	.995
	36-45	18-25	1.138	(*)	.311	.009
		26-35	.776		.371	.243
		46-55	.938		.338	.065
		Over 55	.938		.416	.194
	46-55	18-25	.200		.264	.942
		26-35	-.161		.332	.988
		36-45	-.938		.338	.065
		Over 55	.001		.382	1.000
	Over 55	18-25	.200		.359	.980
		26-35	-.161		.412	.995
		36-45	-.938		.416	.194
		46-55	.000		.382	1.000

* The mean difference is significant at the .05 level.

Education

The results of ANOVA and Welch ANOVA indicated that there are significant differences between the education levels as related to the WebGIS usage for the task of customization, $F(3, 150)= 3.37$, $p<0.05$ (see Table 4.26).

Post hoc comparisons using Tukey HSD test showed the mean scores for the high school group (*M*= 2.21, *SD*= 1.37) was significantly different from other education groups. However, there was no difference between the education groups of those who had attended college (*M*= 3.40, *SD*= 1.25), those who had bachelor's degrees (*M*= 3.21, *SD*= 1.32), and those who had masters or higher degrees (*M*= 3.31, *SD*= 1.17) (see Table 4.27).

Table 4.26

Results of ANOVA summary table: Education on Service seeking tasks

Construct	Variable	Groups	*SS*	*df*	*MS*	*F*	*p*
Service seeking tasks	Customization	Between	16.007	3	5.336	3.366	.020
		Within	239.386	151	1.585		
		Total	255.394	154			

Table 4.27

Age on Service seeking tasks Post-Hoc analyses

Dependent Variable	(I) Education	(J) Education	Mean Difference (I-J)		Std. Error	*p*
Service seeking tasks: Customization	High School	Attended College	-1.186	(*)	.385	.013
		Bachelor's Degree	-.994	(*)	.382	.050
		Master and up	-1.098	(*)	.382	.024
	Attended College	High School	1.186	(*)	.385	.013
		Bachelor's Degree	.192		.261	.883
		Master and up	.088		.261	.987
	Bachelor's Degree	High School	.994	(*)	.382	.050
		Attended College	-.192		.261	.883
		Master and up	-.104		.257	.977
	Master and up	High School	1.098	(*)	.382	.024
		Attended College	-.088		.261	.987
		Bachelor's Degree	.104		.257	.977

* The mean difference is significant at the .05 level.

Income

Based on the result of ANOVA and Welch ANOVA, income did not show effects on the usage under different recreation/trip situations.

4.53 The effect of personal variables on usages of geo-information

This section aimed to examine the effects of personal variables on the WebGIS usage of geo-information regions and types. For the geo-information regions, the principles of these two geo-information characteristics were stated in Chapter three. The three geo-information regions focused were local, city, and natural areas and the five geo-information types assessed were road maps, aerial photographs, three-dimensional images, photo/videos, and text/links. One-way ANOVA and corresponding follow up analyses were conducted to evaluate the effects of each personal variable with the geo-information characteristics. Each sub-section was reported based on the personal characteristics. The specific sub-research questions are shown below.

Access speed

The results showed the access speed had no effect on the geo-information regions. The local, city, and natural areas shared similar usage levels regardless of the different speeds of access.

Among the geo-information regional and format characteristics, the results of the ANOVA showed a statistically significant effect for the usage of aerial photographs, $F(2, 150) = 9.22$, $p<0.05$ (see Table 4.28). The Tukey analyses identified the differences were between the usage of those owners who had medium speed ($M = 2.58$, $SD = 1.02$) and those who had the speed of fast access ($M = 3.50$, $SD = 1.08$) and very fast access ($M = 3.89$, $SD = 1.12$). However, there was no difference between the fast and very fast access levels (see Table 4.29). The speed of Internet access influenced the readiness to access the aerial photographs but had no effect on accessing road maps, three-dimensional images, video/photos, or text. Aerial photographs usually consist of much greater amount of information to present the color and texture information, as well as, cover massive range in order to satisfy the need for geographical searching. Therefore these files require longer process time and better Internet performance to achieve the time lag tolerance of the users.

Table 4.28

Results of ANOVA: Access on geo-information types

Construct	Variable	Groups	*SS*	*df*	*MS*	*F*	*p*
Geo-information types	Aerial Photograph	Between	21.483	2	10.741	9.223	<.001
		Within	174.687	150	1.165		
		Total	196.170	152			

Table 4.29

Access on geo-information types Post Hoc analyses

Dependent Variable	(I) Access	(J) Access	Mean Difference (I-J)		Std. Error	*p*
Geo-information types: Aerial Photo	Medium	Fast	-.921	(*)	.271	.002
		Very Fast	-1.310	(*)	.306	<.001
	Fast	Medium	.921	(*)	.271	.002
		Very Fast	-.389		.210	.157
	Very Fast	Medium	1.310	(*)	.306	<.001

Sex

There was a significant association between sex and two of three geo-information regional characteristics, the local area, $F(1, 146)= 4.43$, $p<0.05$ and the natural area, $F(1, 147)= 4.18$, $p<0.05$ (see Table 4.30). However, male and female respondents had similar usage levels related to the information for city areas. To both of local and natural areas, as results, males had the tendency to search more frequently on local areas [male (*M*= 2.89, *SD*= 1.13), female (*M*= 2.49, *SD*= 1.18)] and natural areas [male (*M*= 3.16, *SD*= 1.16), female (*M*= 2.77, *SD*= 1.17)] than did female respondents. The differences were also found in the use of aerial photographs of geo-information types, $F(1, 150)= 9.94$, $p<0.05$. The male respondents (*M*= 3.77, *SD*= 1.12) appeared to utilize the aerial photographs more than females (*M*= 3.20, *SD*= 1.09).

Table 4.30

Results of ANOVA: Sex on geo-information characteristics

Construct	Variable	Groups	*SS*	*df*	*MS*	*F*	*p*
Geo-information regions	Local area	Between	5.924	1	5.924	4.427	.037
		Within	195.393	146	1.338		
		Total	201.318	147			
Geo-information regions	Natural area	Between	5.658	1	5.658	4.176	.043
		Within	199.175	147	1.355		
		Total	204.832	148			
Geo-information types	Aerial Photo	Between	12.181	1	12.181	9.942	.002
		Within	183.792	150	1.225		
		Total	195.974	151			

Occupation

There was a significant difference between professionals and students on the geo-information with regards to the usage of city information, $F(1, 146)= 4.57$, $p<0.05$ (see Table 4.31). Students (*M*= 3.79, *SD*= 0.95) used WebGIS to find information for city locations more frequently than did professionals (*M*= 3.43, *SD*= 1.06) (see Table 4.32). The use of aerial photographs also showed to be significantly associated with occupations, $Fw(1, 138.34)= 4.15$, $p<0.05$ (see Table 4.31). Professionals (*M*= 3.71, *SD*= 0.93) were likely to use aerial photographs more than did students (*M*= 3.36, *SD*= 1.20) (see Table 4.32).

Table 4.31

Results of ANOVA: Occupation on geo-information

Construct	Variable	Groups	*SS*	*df*	*MS*	*F*	*p*
Geo-information region	City area	Between	4.477	1	4.477	4.573	.034
		Within	142.948	146	.979		
		Total	147.426	147			

Table 4.32

Results of Welch ANOVA: Occupation on geo-information

Construct	Variable	Statistic(a) Welch	*df1*	*df2*	*p*
Geo-information type	Aerial Photo	4.150	1	138.341	.044

Age

Age was found to be associated with the usage of geo-information for local areas, $F_w(4, 47.33) = 3.47$, $p<0.05$ (see Table 4.33). The differences were between the "18-25" age group ($M= 2.74$, $SD= 1.22$) and those over 55 ($M= 2.00$, $SD= 0.71$), and those 26-35 ($M= 3.06$, $SD= 1.26$) and those over 55 and not between other groups. The group of respondents over 55 used less WebGIS for local information than did the age groups of 18-25 and 26-35 (see Table 4.34). The age group of over 55 may have different perspectives related to the need for local information since that they are more likely to be familiar with the area near where they reside and establish other personal information channels, such as friends or relatives instead of using the computer to search for information.

The use of road maps among geo-information types was found to be significantly different between age groups, *Fw*(4, 45.81)= 3.07, $p<0.05$ (see Table 4.33). The result of Games-Howell tests indicated that the differences between the groups were between the age of 26-35 (*M*= 4.53, *SD*= 0.62) and 46-55 (*M*= 4.00, *SD*= 0.60), and there were no differences between other age groups. The results were similar to other age effects. The age group of 46-55 had an average lower usage than other groups, especially the age groups 26-35 (see Table 4.34).

Table 4.33

Results of ANOVA: Age on geo-information

Construct	Variable	Statistic(a)	df1	df2	*p*
Geo-information region	Local area	3.469	4	47.329	.015
Geo-information type	Road map	3.069	4	45.812	.025

Table 4.34

Age on geo-information Post-Hoc analyses

Dependent Variable	(I) Age	(J) Age	Mean Difference (I-J)		Std. Error	*p*
Geo-information region: Local area	18-25	26-35	-.325		.270	.749
		36-45	.177		.336	.984
		46-55	.148		.234	.969
		Over 55	.739	(*)	.245	.040
	26-35	36-45	.502		.378	.676
		46-55	.474		.291	.487
		Over 55	1.065	(*)	.300	.009
	36-45	46-55	-.028		.353	1.000
		Over 55	.563		.360	.535
	46-55	Over 55	.591		.268	.205

Table 4.34 (*Continued*)

Dependent Variable	(I) Age	(J) Age	Mean Difference (I-J)		Std. Error	p
Geo-information type: Road Map	18-25	26-35	-.231		.149	.531
		36-45	-.200		.187	.821
		46-55	.300		.161	.349
		Over 55	.223		.233	.871
	26-35	36-45	.031		.193	1.000
		46-55	.531	(*)	.167	.021
		Over 55	.454		.238	.345
	36-45	46-55	.500		.202	.122
		Over 55	.423		.263	.508
	46-55	Over 55	-.077		.245	.998

* The mean difference is significant at the .05 level.

Education

A significant relationship was found between education levels and the search for information about natural areas, $F(3, 148)= 3.05$, $p<0.05$ (see Table 4.35). The result of Tukey tests indicated that the differences were between those respondents who attended college ($M= 2.74$, $SD= 1.05$) and those who had a masters degree or higher education ($M= 3.40$, $SD= 1.05$) and the differences were not between other groups (see Table 4.36). On the average, people who have master degree and higher education more frequently used WebGIS to find the information for natural areas than did other education groups.

Table 4.35

Results of ANOVA summary table: Education on geo-information

Construct	Variable	Groups	*SS*	*df*	*MS*	*F*	*p*
Geo-information region	Natural areas	Between	12.103	3	4.034	3.048	.031
		Within	195.870	148	1.323		
		Total	207.974	151			

Table 4.36

Education on geo-information Post-Hoc analyses

Dependent Variable	(I) Education	(J) Education	Mean Difference (I-J)		Std. Error	*p*
Geo-information region: Natural area	High School	Attended College	.184		.354	.954
		Bachelor's Degree	.120		.350	.986
		Master and up	-.467		.349	.541
	Attended College	Bachelor's Degree	-.064		.243	.993
		Master and up	-.652	(*)	.242	.039
	Bachelor's Degree	Master and up	-.587		.236	.066

* The mean difference is significant at the .05 level.

Income

The result of ANOVA indicated that income levels affected the usage of aerial photographs at the alpha level of 0.05, $F(4, 149)= 2.493$, $p<0.05$ (see Table 4.37). The result of a Tukey test showed the difference between the income level of $20,000-39,000 (*M*= 2.83, *SD*= 1.04) and those above $80,000 (*M*= 3.91, *SD*= 0.97) (see Table 4.38). The income level above $80,000 utilized aerial photo graphics more frequently than the lower income level at $20,000-$39,000.

Table 4.37

Results of ANOVA: Income on geo-information

Variable	Groups	*SS*	*df*	*MS*	*F*	*p*
Aerial Photo	Between	12.310	4	3.078	2.493	.045
	Within	183.956	149	1.235		
	Total	196.266	153			

Table 4.38

Income on geo-information Post-Hoc analyses

Dependent Variable	(I) Income	(J) Income	Mean Difference (I-J)		Std. Error	*p*
Geo-information type: Aerial Photo	Less than $20,000	$20,000-$39,000	.633		.292	.196
		$40,000-$59,000	.117		.280	.994
		$60,000-79,000	-.165		.285	.978
		Above $80,000	-.442		.269	.473
	$20,000-$39,000	$40,000-$59,000	-.517		.361	.609
		$60,000-79,000	-.798		.365	.191
		Above $80,000	-1.076	(*)	.353	.023
	$40,000-$59,000	$60,000-79,000	-.282		.356	.933
		Above $80,000	-.559		.343	.482
	$60,000-79,000	Above $80,000	-.278		.348	.931

* The mean difference is significant at the .05 level.

4.6 Adoption Attributes

The aim of this section was to explore how adoptive variables related to (1) use indices, and (2) functionality interactions. The adoption variables considered were perceived usefulness, perceived ease of use, perceived playfulness, and attitude. These variables were the determinants of the extended TAM models that have led to the use intention and actual use. Multiple regression analyses were performed to determine the relationship between the adoption variables and the use indices, which were use intention and actual use in WebGIS context. Also, the relationship between the adoptive variables and the functionality interactions were also examined using multiple regression analyses. Functionality interactions, in concept, were the levels of interaction with WebGIS in general. In this study, the functionality interactions were measured as the scores sum of functions utilized.

Before conducting multiple regression analyses, the major assumptions were examined. First, the independent variables were chosen based on attributed research, not randomly chosen. Second, the independent variables are assumed to be measured without error. This assumption refers to the reliability of the predictors. This study ensured the reliability by, first, the literature support and the reliability tests constructs. Third, the residuals are assumed to be independent and normally distributed with equal variances. This assumption was supported by the random pattern of scatter plots that had residual against predicted value and the fitted P-P plots for each analysis conducted. Moreover, the assumption that the criterion and predictor set are linearly related was supported by the plot of dependent variables and predictors which indicated the predictors have a certain degree of relationship with the criterion.

4.61 The effect on use variables

The predictors (i.e. attitude, perceived usefulness, ease of use) were selected based on the TAM model for technology acceptance. In addition, the predictor "perceived playfulness" in the model was also selected based on the extended TAM model in Web context. Since there has not been evaluation specifically in the WebGIS context, the proposed predictor set for WebGIS context was adopted from these two literature streams. In addition, since the predictor set was theory supported, the researcher conducted multiple regression with the predictor simultaneously entered in the evaluating model.

Use intention scores were regressed on adoptive indices. This predictor set accounted for 62.3% of the variance in use intention scores (R^2= 0.623), which was highly significant, $F(4, 148)$= 63.71, p<0.05 (see Table 4.39, 4.40). In the model, use intention was the dependent variable and usefulness, ease of use, playfulness, and attitude were the predictors. About 62% of the variability in use intention would be known. When each predictor was assessed individually, only two factors, attitude (β= 5.53, p<0.05) and usefulness (β= 7.657, p<0.05) contributed significantly to the prediction of participation. Ease of use (β=-0.90, p>0.05) and playfulness (β=-1.48, p>0.05) have relatively little influence on use intention in WebGIS context (see Table 4.41).

Table 4.39

Regression model summary: Adoption/ Use intention

Model	*R*	R^2	Adjusted R^2
Use intention	.795	.633	.623

Table 4.40

Results of ANOVA: Adoption/ Use intention

Model		*SS*	*df*	*MS*	*F*	*p*
Use intention	Regression	256.772	4	64.193	63.715	<.001
	Residual	149.111	148	1.008		
	Total	405.882	152			

Table 4.41

Regression Coefficients: Adoption/Use intention

DV	IV	Unstandardized Coefficients		Standardized Coefficients	
		B	Std. Error	*Beta*	*p*
Use intention	(Constant)	1.333	.487		.007
	Ease of Use	-.065	.072	-.059	.369
	Usefulness	.264	.034	.537	<.001
	Playfulness	-.065	.044	-.083	.141
	Attitude	.435	.079	.403	<.001

Actual use for recreation scores were also regressed on the adoption indices. The adoption indices accounted for 44.0% of variance in actual use for recreation (see Table 4.42). The model was highly significant, $F(4, 150)= 31.29$, $p<0.05$ (see Table 4.43). When each predictor was assessed individually, usefulness ($\beta= 0.45$, $p<0.05$) and attitude ($\beta=0.38$, $p<0.05$) were significant predictors of actual use in the WebGIS context (see Table 4.44).

Table 4.42

Regression model summary: Adoption/ Actual use

Model	*R*	R^2	Adjusted R^2
Actual use	.674	.455	.440

Table 4.43

Results of ANOVA: Adoption/ Actual use

Model		*SS*	*df*	*MS*	*F*	*p*
Actual use	Regression	63.819	4	15.955	31.293	<.001
	Residual	76.478	150	.510		
	Total	140.297	154			

Table 4.44

Regression Coefficients: Adoption/ Actual use

DV	IV	Unstandardized Coefficients		Standardized Coefficients	
		B	Std. Error	*Beta*	*p*
Actual use	(Constant)	.709	.344		.041
	Ease of Use	-.048	.051	-.074	.348
	Usefulness	.129	.024	.447	.001
	Playfulness	-.047	.031	-.103	.128
	Attitude	.238	.055	.377	.001

4.62 The effect on the functionality interaction

Standard multiple regression was conducted to allow the evaluation on the relationship between functional interactions and adoption indices. The adoption indices estimated were usefulness, ease of use, playfulness and attitude and the dependent variable, "functional interaction scores", were measured by the sum of the usage scores of functionality items. The adoptive indices accounted for 26.2% variances of the interaction scores ((R^2= 0.262) (see Table 4.45), which was highly significant [F(4, 136)= 12.06, p<0.05] (see Table 4.46). Assessing the predictors respectively, playfulness (β=0.35, p<0.05) was the only predictor that significantly contributed to the interactions with WebGIS. Other predictors, ease of use (β=-0.25, p>0.05), usefulness (β=0.10, p>0.05), and attitude (β=0.20, p>0.05) had less influence on the interaction level with WebGIS (see Table 4.47). Differently from the choice of use which was sensitive to the perceived attitude and usefulness, interacting with WebGIS was sensitive to the sense of playfulness.

Table 4.45

Regression model summary: Interaction/Adoption

Model	R	R^2	Adjusted R^2
Interaction/Adoption	.512	.262	.240

Table 4.46

Results of ANOVA: Interaction/Adoption

Model		*SS*	*df*	*MS*	*F*	*p*
Interaction/Adoption	Regression	3934.302	4	983.575	12.056	<.001
	Residual	11095.571	136	81.585		
	Total	15029.872	140			

Table 4.47

Regression Coefficients: Interaction/Adoption

		Unstandardized Coefficients		Standardized Coefficients	
DV	IV	*B*	Std. Error	*Beta*	*p*
Interaction	(Constant)	21.350	4.538		<.001
	Ease of Use	-.175	.669	-.025	.794
	Usefulness	.306	.337	.098	.365
	Playfulness	1.760	.425	.349	<.001
	Attitude	1.298	.750	.193	.086

4.7 Recreation Constructs

The purpose of this section was to investigate how each recreation construct related to (1) functionality interaction, (2) perceived usefulness, and (3) perceived playfulness. Recreation constructs assessed were four intent formation stages - curiosity, ideation, comparison, and target information; three recreation phases - prior, on-site, and recollection phases; four recreation/trip modes - local business, leisure, and outdoor recreation; as well as seven service seeking tasks -location, route knowledge, customization, service finding, terrain knowledge, sharing, and fun seeking. The dependent variables evaluated were the functional interaction which was the total interaction scores of the combination of the function usages, perceived usefulness which was supported, in the last section, as the most influential adoption construct to the choice of use, as well as the playfulness, the most influential construct to the functionality interaction in the last section.

Multiple regression analyses were conducted to investigate the relationship between the dependent variables and the recreation options under each construct. Also, regression assumptions were inspected to ensure eligibility prior to conducting the analyses. A stepwise method was chosen to analyze the regression models since this part was exploratory and needed to distinguish the power of options under each recreation construct.

4.71 The relationship of recreation construct and geo-information with functional interaction

The options of each recreation construct were regressed with the functional interactions using stepwise methods to evaluate the relative importance of the options of the construct to the functionality interaction.

Intent formation stages

Functional interactions were regressed on intent formation stages. This predictor set accounted for 28.5% variance in interaction scores, which was significant, $F(2, 135)= 28.30$, $p<0.05$. Among the stages, only two stages, curious stage ($\beta= 0.36$ $p<0.05$) and comparison stage (β= 0.29, p<0.05) had significant influences on interaction scores. The influences of idea and information focus stages were not significant to functional interactions. The results indicated that when people use WebGIS to satisfy their curiosity and compare their trip alternatives, they appeared to use more functions that WebGIS services offered than those who used WebGIS to determine their destination or find focused information for their predetermined destination.

Recreation experience phases

The three recreation phases were regressed with the dependent variable, functionality interaction. The variable set explained 29.6 % variance in interaction scores. The regression model was significant at α= 0.05 level, F(1, 138)= 42.338 , p<0.05. The three phases all had significant contributions to the WebGIS functionality interaction. In comparison, the phase of recollection had the most contribution (β=0.37, p<0.05) followed secondly by the phases "on site" (β=0.18, p<0.05) and "prior to trip" β=0.17, p<0.05. The results suggested that though people tended to use WebGIS less intensely in the recollection phase, the engagement level was higher than in either the prior phase or on site use.

Recreation modes

Leisure, local, business, and outdoor recreation modes were regressed in the model with interaction scores. The recreation modes were significantly related with the interaction scores F(2, 136) = 27.06 , p<0.05. Respectively, local recreation (β=0.44, p<0.05) and leisure trip (β= 0.17, p<0.05) significantly contributed to the interaction scores and accounted for 28.5% of the interaction scores (see Table 4.48). The result showed that people who looked for local recreation and leisure trip information usually had more interactions with WebGIS.

Service seeking tasks

Among service seeking tasks, the tasks to obtain terrain knowledge (β= 0.36, p<0.05), find services (β= 0.20, p<0.05), acquire have route information, (β= 0.21, p<0.05) and share with others (β= 0.20, p<0.05) were significantly associated with interaction scores. The variable set significantly predicted the interaction scores [F(4, 131) = 31.28, p<0.05] and accounted for 47.3% interaction variation (see Table 4.48). The functionality interaction seemed to be associated with a combination of tasks rather than a single dominant one. With the exceptions of location, customization, and fun seeking, which had no significant association with interaction scores; people who use WebGIS for the purposes of viewing terrain, find routes and services, and sharing with other were likely to have more interaction with the functions offered.

Geo-information regions

As results indicated, the geo-information regions were significantly associated with interaction scores, F(2, 135)= 25.15, p<0.05, and accounted for 26.1% interaction variation. The variable of local areas (β= 0.35, p<0.05) and natural areas (β= 0.28, p<0.05) significantly contributed to the interactions with WebGIS (see Table 4.48). The focuses of local and natural areas information led to more functional interactions with WebGIS.

Geo-information types

Interaction scores were regressed on geo-information types. This predictor set accounted for 29.1% of the variation of interaction scores. Among five types of geo-information (β= 0.24, p<0.05), photo/video (β= 0.35, p<0.05), text, and three-dimensional simulation (β= 0.23, p<0.05) were significantly associated with interaction scores (see Table 4.48). The results showed that the use of photo/video, text, and three-dimensional simulation led to more intense interaction with WebGIS.

Table 4.48

The relationship of recreation construct and geo-information with functional interaction

Construct	Variables	Significant variables	β	R^2
Intent formation stages F(2,135)=28.30, p<0.05	Curiosity Idea Comparison Focused information	- Curiosity - Comparison	0.36 0.29	28.5%
Experience phases F(3, 136)= 0.52, p<0.05	Prior Onsite Recollection	- Recollection - Onsite - Prior	0.37 0.18 0.17	29.6%
Recreation/trip modes F(2, 136)= 27.01, p<0.05	Local Business Leisure Outdoor	- Local - Leisure	0.44 0.17	28.5%
Service seeking tasks F(4, 131)= 31.28, p<0.05	Location Route knowledge Customization Service finding Terrain knowledge Sharing Fun seeking	- Terrain knowledge - Service finding - Route knowledge - Sharing	0.36 0.20 0.21 0.20	47.3%
Geo-information regions F(2,135)= 25.15, p<0.05	Local area City area Natural area	- Local area - Natural area	0.35 0.28	26.1%
Geo-information types F(3,135)= 19.86, p<0.05	Road maps Aerial photos 3-D images Photo/video Text/link	- Photo/video - Text/link - 3-D images	0.21 0.24 0.23	29.1%

4.72 The relationship of recreation construct and geo-information with perceived usefulness

Perceived usefulness was evident as the most significant adoptive construct to use. Therefore, this section has usefulness as the dependent variable to further detect the connection between usefulness and the option of each recreation and geo-information construct. The option of each recreation construct and geo-information characteristics was regressed with perceived usefulness scores using stepwise analysis to evaluate their associations and importance to the perceived usefulness scores.

Intent formation stages

Intent formation stages were significantly regressed on the usefulness scores, $F(2,148) = 38.25$, $p<0.05$. The intent formation stages, "comparison" ($\beta = 0.35$, $p<0.05$) and "focused information" ($\beta = 0.24$, $p<0.05$) were significantly associated with usefulness. The regression model accounted for 33.2% of the variation of usefulness (see Table 4.49). Respondents felt WebGIS was useful at stages in which they needed to compare alternatives and to find information for predetermined destinations.

Recreation experience *phases*

Prior and on-site phase ($\beta = 0.24$, $p<0.05$) were significantly associated with usefulness, $F(2,151) = 86.31$, $p<0.05$, with the determination power of 52.7%. In terms of usefulness in the prior phase ($\beta = 0.58$, $p<0.05$) and on-site phase ($\beta = 0.24$, $p<0.05$), there was significant contribution (see Table 4.49). The result indicated the users considered

WebGIS services to be useful to their preparation for trips, as well as, when they were at the destination and needing more information.

Recreation modes

Among recreation modes of local recreation, business trip, leisure trips, and outdoor recreation, leisure trip (β= 0.59, p<0.05) and local recreation (β= 0.17, p<0.05) significantly contributed to the sense of usefulness (see Table 4.49). The regression model significantly predicted the perceived usefulness, F(2,149)= 60.09, p<0.05, with the power of determination of 44% (see Table 4.49). WebGIS services were useful to their leisure trips and when they needed information for their local recreation.

Service seeking tasks

Service seeking tasks were significantly regressed on the perceived usefulness scores F(2, 146) = 42.48, p<0.05. Location (β= 0.25, p<0.05), route (β= 0.45, p<0.05), and explore for fun (β= 0.15, p<0.05) significantly contributed to the regression model. The model explained 45.5% of the variation of usefulness scores (see Table 4.49). Route information contributed the most to the model, following by the tasks of location knowledge and explore for fun. Using WebGIS for location and route information were the most useful functions. Surprisingly, users experienced usefulness when they carried no specific recreation or trip plan, but use a WebGIS to explore just for fun.

Geo-information regions

The predictor of city areas (β= 0.43, p<0.05) was the only significantly predictor contributing to the regression model [F(1, 149) = 34.57, p<0.05] which explained, however, 18.3% of the variation of usefulness (see Table 4.49). Information of city areas was considered the most useful features above information related to local or natural areas.

Geo-information types

Geo-information types were significantly regressed with usefulness scores [F(2, 150)= 25.36, p<0.05] with the power to explain 24.3% of the usefulness scores. Road map (β= 0.42, p<0.05) and text/link (β= 0.18, p<0.05) were significant predictors of usefulness scores (see Table 4.49). Among the types of geo-information, road maps and the description or link providing more information about users' interested matters were considered the most useful geo-information formats.

Table 4.49

The relationship of recreation construct and geo-information with perceived usefulness

Construct	Variables	Significant variables	β	R^2
Intent formation stages F(2,148)= 38.25, p<0.05	Curiosity Idea Comparison Focused information	• Comparison • Focused information	0.35 0.24	33.2%
Experience phases F(2 ,151)=86.31, p<0.05	Prior Onsite Recollection	• Prior • Onsite	0.58 0.24	52.7%

Table 4.49 (*Continued*)

Construct	Variables	Significant variables	*β*	*R2*
Recreation/trip modes *F*(2,149)=60.09, *p*<0.05	Local Business Leisure Outdoor	• Leisure • Local	0.59 0.17	44.0%
Service seeking tasks *F*(3, 146)=42.48, *p*<0.05	Location Route knowledge Customization Service finding Terrain knowledge Sharing Fun seeking	• Route knowledge • Location • Fun seeking	0.45 0.25 0.15	45.5%
Geo-information regions *F*(1 ,149)=34.57, *p*<0.05	Local area City area Natural area	• City area	0.43	18.3%
Geo-information types *F*(2,150)=25.36, *p*<0.05	Road maps Aerial photos 3-D images Photo/video Text/link	• Road maps • Text/link	0.42 0.18	24.3%

4.73 The relationship of recreation construct and geo-information with perceived playfulness

Perceived playfulness was the most significant determinant for the level of interaction with WebGIS. Hence, the analyses further detected usefulness as the dependent variable and explored the associations between usefulness and those recreation and geo-information characteristics. The option of each recreation construct was regressed with the functional interactions using stepwise analysis to evaluate the relative importance of the options of the construct to the functionality interaction.

Intent formation stages

Intent formation stages were significantly associated with the sense of playfulness with the power to determine 33.6% variation of playfulness [$F(1, 149)= 77.00$, $p<0.05$]. The curiosity stage ($\beta= 0.58$, $p<0.05$) was the only significant predictor of playfulness (see Table 4.50). WebGIS was considered most playful at the stage in which users needed preliminary information and discovery.

Recreation experience phases

Predictors of recreation experience phases significantly regressed with playfulness scores [$F(2, 151)= 18.16$, $p<0.05$] with the power to explain 18.3% of the playfulness variation (see Table 4.50). Different from perceived usefulness, perceived playfulness connected the most with the recollection phase ($\beta= 0.36$, $p<0.05$), followed secondly by the on-site phase ($\beta= 0.16$, $p<0.05$) (see Table 4.50). As the result indicated, users felt more playful when they used WebGIS services at the phase of recollection after they came back from their activity and recollected the experiences with WebGIS services.

Recreation modes

Recreation modes significantly predicted the perceived playfulness scores [$F(1, 150)= 17.34$, $p<0.05$] explaining 9.8% of the variation of playfulness (see Table 4.50). Among the recreation modes, outdoor recreation significantly predicted the playfulness scores ($\beta= 0.32$, $p<0.05$) (see Table 4.50). The result indicated that users enjoyed using the service more when they use WebGIS to prepare their outdoor recreation.

Service seeking tasks

Service seeking tasks significantly connected with the construct of playfulness [$F(2, 147) = 77.00$, $p<0.05$]. The model explained 45.3% of the playfulness variation. Fun seeking ($\beta= 0.62$, $p<0.05$) and customization ($\beta= 0.17$, $p<0.05$) contributed significantly to the prediction model on perceived playfulness. Interestingly, users enjoy using the service the most when they use WebGIS just for fun, as well as, when creating their own maps and the information for their specific trip (see Table 4.50).

Geo-information regions

Geo-information regions significantly predicted perceived playfulness [$F(2, 148)= 19.44$, $p<0.05$] and explained 19.7% of the variation of playfulness scores. City areas ($\beta= 0.33$, $p<0.05$) and local areas ($\beta= 0.24$, $p<0.05$) were significant predictors of playfulness in the model (see Table 4.50). The results indicated that searching and interacting with the information at city areas and local areas provided respondents with the sense of playfulness when using WebGIS.

Geo-information types

Also, geo-information types significantly predicted the sense of playfulness [$F(1, 149)= 77.00$, $p<0.05$]. The model explained 19.8% of the variation of perceived playfulness. Aerial photo ($\beta= 0.42$, $p<0.05$) was the only significant predictor of playfulness scores (see Table 4.50). The results showed the users enjoyed interacting with aerial photographs to obtain and observe the real world objects through WebGIS services.

Table 4.50

The relationship of recreation construct and geo-information with perceived playfulness

Construct	Variables	Significant variables	β	R^2
Intent formation stages $F(1, 149) = 77.00$, $p<0.05$	Curiosity Idea Comparison Focused information	• Curiosity	0.58	33.6%
Experience phases $F(2, 151) = 18.16$, $p<0.05$	Prior Onsite Recollection	• Recollection • Onsite	0.36 0.16	18.3%
Recreation/trip modes $F(1, 150) = 17.34$, $p<0.05$	Local Business Leisure Outdoor	• Outdoor	0.32	9.8%
Service seeking tasks $F(2, 147) = 62.61$, $p<0.05$	Location Route knowledge Customization Service finding Terrain knowledge Sharing Fun seeking	• Fun seeking • Customization	0.62 0.17	45.3%
Geo-information regions $F(2, 148) = 19.44$, $p<0.05$	Local area City area Natural area	• City area • Local area	0.33 0.24	19.7%
Geo-information types $F(1, 151) = 38.54$, $p<0.05$	Road maps Aerial photos 3-D images Photo/video Text/link	• Aerial photos	0.45	19.8%

4.8 Summary

This chapter presented the results of the objectives of this study. The primary goals were to explore the effects of the attitude-behavioral, situational, artifact, and personal perspectives on WebGIS utilization behavior.

The effects of recreation situations showed, except for the intent formation stages, the factors of experience phases, trip modes, and service seeking tasks had significant differences in their usages across their categories (see Table 4.51). It has also been shown that the different geo-information regions and types received different attention from the users. The similar results also applied in the functionality interactions by the categories of targeting, viewing, information alliance, operation assistance, multi-media, and geo-information processing, as well as by the complexity levels (see Table 4.51).

Table 4.51

The summary of WebGIS usage in recreation/trip situation, geo-information, functionality

The usage of WebGIS in recreation trip situations		
Recreation characteristics	Significant	Differences in Category
Intent formation stages	No	• None
Experience phases	Yes	• Prior > On-site > Recollection
Trip modes	Yes	• Leisure> Local, Business, Outdoor
Service seeking tasks	Yes	• Location, Route > Customization, Service, Terrain, For fun> Share
The use of WebGIS geo-information		
Geo-info. characteristics	Significant	Differences in Category
Geo-info. region	Yes	• City> Local, Natural area
Geo-info. types	Yes	• Road map> Aerial photo > 3D, Photo/video, Text/link
The use of WebGIS functionality		
Functionality characteristics	Significant	• Differences in Category
Functionality category	Yes	• Targeting, Viewing> Information alliance, Operation assistance> Multi-media, Geo-information
Functionality level	Yes	• Basic> Medium> Advanced

The results from these analyses demonstrated that some personal variables showed more effects than others on adoption, recreation situations, and geo-information characteristics (see Table 4.51, 4.52, 4.53). Age, occupation, and sex were such examples. Sex did not show differences on overall adoption, however, surprisingly, sex showed differences on several recreation situations, such as experience phases, service seeking tasks, and trip mode; sex also showed differences on geo-information use in terms of the use of natural area information and aerial photographs. In this study, since the variables "occupation" and "age" were significantly correlated, the similar patterns of influences were shown on other variables, such as, perceived ease of use, trip mode, and the preferences of geo-information. Comparing to occupation, age seemed to be a more influential factor in the utilization of WebGIS.

Table 4.52

The summary of effects of personal variables on adoption constructs

Personal variables	Significant	Differences in Category
Access speed	Playfulness	• Very fast> Medium
Sex	None	• None
Occupation	Ease of use	• Student> Professional
Age	Use intention	• 26-35> 46-55
	Total adoption	• 18-25, 26-35, 36-45> 46-55
	Ease of use	• 18-25, 26-35> 46-55
		• 36-45> 46-55, Over 55
	Usefulness	• 18-25, 26-35, 36-45 > 46-55
	Playfulness	• 18-25>46-55
Education	None	• None
Income	None	• None

Table 4.53

The summary of effects of personal variables on WebGIS usage of recreation/trip situation and geo-information

The effect of personal variables on usages by recreation/trip situations

Personal variables	Construct	Significant	Differences in Category
Access speed	Service seeking tasks	• Explore for fun	• Very fast> Medium speed
Sex	Experience phase	• Recollection	• Male> Female
	Service seeking tasks	• Terrain knowledge • Fun	• Male> Female • Male> Female
	Trip mode	• Outdoor recreation	• Male> Female
Occupation	Service seeking tasks	• Share	• Student> Professional
	Trip mode	• Business	• Professional> Student

The effect of personal variables on usages by recreation/trip situations

Personal variables	Construct	Significant	Differences in Category
Age	Experience phase	• Prior phase	• 26-35 >46-55
	Trip mode	• Local • Business	• 18-25, 26-35, 36-45> Over 55 • 36-45> 18-25
Education	Service seeking tasks	• Customization	• Attend college, Bachelor's degree, Master and up> High school
Income	None	• None	• None
Speed	Geo-info. type	• Aerial photo	• Fast, Very fast> Medium speed
Sex	Geo-info. region	• Local area • Natural area	• Male> Female • Male> Female
	Geo-info. type	• Aerial photo	• Male> Female
Occupation	Geo-info. region	• City area	• Student> Professional
	Geo-info. type	• Aerial photo	• Student> Professional

Table 4.53 (*Continued*)

Effect of personal variables on usages of geo-information characteristics

Independent variable	Construct	Significant	Differences in Category
Age	Geo-info. region	• Local area	• 18-25, 26-35> Over 55
	Geo-info. type	• Road map	• 26-35> 46-55
Education	Geo-info. region	• Natural area	• Master's degree and up> Attended college
Income	Geo-info. type	• Aerial photo	• Above $80,000> $20,000-$39,000

In the relationship between adoption and utilization, the factor "usefulness" and "playfulness" played major roles in determining the usages and interactions with WebGIS (see Table 4.54). Thus, the study further examined the relationship between recreation situations and WebGIS use to understand how WebGIS services were interactive, useful, and playful in the specific recreation situations.

The results in Table 4.55 indicated that different recreation constructs reacted differently with interactions, usefulness, and playfulness. For example, the curiosity stage, within the construct of intent formation stages, was significantly associated with interaction levels and playfulness. However, the respondents did not felt that the assistance offered by WebGIS was useful at the curiosity stage during trip planning. Other examples showed the similar patterns about the effects of recreation phases. Before departing for the trip, WebGIS was considered useful and when at the recollection phase the users considered WebGIS playful. Regarding information formats, users perceived road maps and texts were useful. However, in terms of playfulness, users had positive reactions to the format of aerial photographs, and had more interactions with WebGIS when they interacted with photos/videos, texts, and three-dimensional images.

The conclusion, implications of the findings and recommendations for future research are discussed in the next chapter.

Table 4.54

The relationship between adoption and use/ functionality interaction

IV	DV	Significant variables	*β*	R^2
Ease of use Usefulness Playfulness Attitude	Use intention	• Usefulness • Attitude	0.54 0.40	62.3%
	Actual use	• Usefulness • Attitude	0.45 0.37	44.0%
	Interaction	• Playfulness	0.35	24.0%

Table 4.55

T*he relationship of recreation construct and geo-information with functional interaction/usefulness/playfulness*

DV	IV	Significant variables	*β*	R^2
Intent formation stages	Functionality interaction	• Curiosity • Comparison	0.36 0.29	28.5%
	Usefulness	• Comparison • Focused information	0.35 0.24	33.2%
	Playfulness	• Curiosity	0.58	33.6%
Experience phases	Functionality interaction	• Recollection • Onsite • Prior	0.37 0.18 0.17	29.6%
	Usefulness	• Prior • Onsite	0.58 0.24	52.7%
	Playfulness	• Recollection • Onsite	0.36 0.16	18.3%
Recreation/trip modes	Functionality interaction	• Local • Leisure	0.44 0.17	28.5%
	Usefulness	• Leisure • Local	0.59 0.17	44.0%
	Playfulness	• Outdoor	0.32	9.8%

Table 4.55 (*Continued*)

DV	IV	Significant variables	β	R2
Service seeking tasks	Functionality interaction	• Terrain knowledge • Service finding • Route knowledge • Sharing	0.36 0.20 0.21 0.20	47.3%
	Usefulness	• Route knowledge • Location • Fun seeking	0.45 0.25 0.15	45.5%
	Playfulness	• Fun seeking • Customization	0.62 0.17	45.3%
Geo-information regions	Functionality interaction	• Local area • Natural area	0.35 0.28	26.1%
	Usefulness	• City area	0.43	18.3%
	Playfulness	• City area • Local area	0.33 0.24	19.7%
Geo-information types	Functionality interaction	• Photo/video • Text/link • 3-D images	0.21 0.24 0.23	29.1%
	Usefulness	• Road maps • Text/link	0.42 0.18	24.3%
	Playfulness	• Aerial photos	0.45	19.8%

CHAPTER V

SUMMARY, DISCUSSION OF FINDINGS, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS FOR FUTURE RESEARCH

5.0 Introduction

The aims of this research were to explore (1) how WebGIS utilization can be measured and defined in recreation and tourism studies, and (2) how WebGIS services are utilized as a recreation/tourism information channel in the underlying dimensions of recreation/tourism attributes, personal characteristics, attitude-behavioral aspects, and artifact interactions. For the first aim, the dimensions and measurements of WebGIS utilization in recreation and tourism were identified by a series of instrument development studies. For the second aim, this study utilized the instrument developed in phase one to investigate the relationships between study dimensions by conducting an array of statistical tests. The detailed results of the two phases were presented in two previous chapters.

In this chapter, the major findings are summarized and discussed with the theoretical and empirical references. The implications of the results for conceptual and practical aspects are prepared. At the end of this chapter, recommendations for future research on the related topics are suggested.

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5.1 Summary of Main Results

For the first study purpose, developing an instrument that could measure WebGIS utilization and be exploratory in nature, this research included the development of a four-dimension framework to describe WebGIS utilization based on theories, models, expert judgments, and trial tests. The four dimension model describes WebGIS utilization in the attitude-behavioral, recreation situational, artifact, and personal aspects. The constructs intermediately manage the connections between dimensions in conceptual level and measurements in operational level. The measurements under each construct later were employed to communicate with the study subjects. The dimensions and constructs for describing WebGIS utilization identified in the instrument development processes are summarized in Table 5.1 and Table 5.2. Because utilization can be measured in many ways depending on which view the study takes, many of other measurements were proposed in the instrument development process. Based on the criteria founded on context inspections and expert consultations, the later analytical assessments focused on the measurements developed within the context specific for this study.

Table 5.1

The dimensions and constructs identified to describe WebGIS

Dimension	Description	Operational constructs
Personal	• User characteristics	• Access • Sex • Occupation • Age • Education • Income
Attitude-Behavioral	• The level of adoption	• Ease of use • Usefulness • Playfulness • Attitude • Use intention • Actual use
Situational	• Recreation/trip situations	• Intent formation stages • Recreation experience phases • Trip modes • Service seeking tasks
Artifact	• Geo-information features • Tool functionality	• Geo-information regions • Geo-information types • Functionality interactions

Table 5.2

The dimensions, constructs, and description identified to describe WebGIS

Dimension/Construct	Description
Attitude-behavioral dimension	
Perceived usefulness	The degree to which users believe that using a particular system would enhance their task performance.
Perceived ease of use	The degree to which the users expect the new technology adopted to be free of effort regarding its transfer and utilization.
Perceived playfulness	The extent of playfulness and fun users perceived.
Attitude toward use	The users' evaluation of their levels of likeness and approval according to their experiences.

Table 5.2 (*Continued*)

Dimension/Construct	Description
Attitude-behavioral dimension	
Use intention	The degree of willingness to use the system in the future and recommend it to others.
Actual use	The degree to which the users have had experience with the services.
Recreation dimension	
Intent formation stages	The degree to which users approached WebGIS services at a specific planning stages from curious, getting ideas, evaluating alternatives, to seeking target information.
Recreation experience phases	The degree to which users approached WebGIS services at a specific trip phases: prior to departure, during trips, & after returning from trips.
Recreation/trip modes	The degree to which users approached WebGIS services in a specific trip mode including local recreation, business trips, leisure trips, and outdoor recreation.
Service seeking tasks	The degree to which users approached WebGIS services for a specific tasks which includes finding location, planning route, customizing geo-information, getting terrain knowledge, sharing information, and exploring for fun.
Personal dimension	
Resource accessibility	The speed of users' primary Internet access.
Social/ economic characteristics	The social economic indices, including occupation, age, sex, education, and income level.
Artifact dimension	
(1) Geo-information characteristics	
Geo-information regions	The degree to which users perceived the region of geo-information would be useful for their tasks.
Geo-information types	The degree to which users perceived the type of geo-information would be useful for their tasks.

Table 5.2 (*Continued*)

Artifact dimension	
(2) Functionality interaction	
Targeting	The degree to which users used the search function to target information displayed.
Viewing	The degree to which users used the various view functions, such as pan, scale, and tilts to inspect geo-information.
Information alliances	The degree to which users used the functions that provides the connections to other services and knowledge.
Multi-media	The degree to which users used multi-media functions to view, download/upload, and share information.
Operation assistance	The degree to which users used functions that helps to initiate operations, such as print, copy, and help instructions.
Geo-information processing	The degree to which users used functions that process geo-information, such as show and hide layers for better display, measure distances, and analyze the relationships objects of geo-information.

Phase one of this study resulted in an instrument to measure the defined WebGIS utilization dimensions. The next phase analyzed the results from phase one of the study to detect the relationships between the underlying utilization dimensions. The following sections present the summarized findings in data analyses by the objectives of phase two of this study.

The objective one of the data analyses resulted in understanding as to how usages vary with different recreation situations, types of geo-information, and types of functionalities (see Table 5.3). First, the summary table demonstrated how the recreation situations influenced the WebGIS usage. The recreation attributes presented different use intensities in terms of applying WebGIS for the specific recreation situation users encountered, with the exception of the construct of "intent formation stages." This recreational variable had similar WebGIS usages among its options. The results also indicated different usages among various geo-information regarding regions and information formats, as well as, among the functionalities offered.

Table 5.3

The use of *WebGIS in the dimensions of recreation situations, geo-information, and functionality*

Dimension	Construct	The construct in which the options influence WebGIS usages
Recreation situations	• Intent formation stages	No
	• Recreation experience phases	Yes
	• Trip modes	Yes
	• Service seeking tasks	Yes
Geo-information	• Geo-Information regions	Yes
	• Geo-Information types	Yes
Functionality	• Functionality categories	Yes
	• Functionality levels	Yes

The objective two in analyses generated the results to recognize how the personal variables were related to the other three dimensions. Table 5.4 presents the relationships between the personal variables and the other three dimensions: attitude-behavioral dimension, recreational situations, and artifact aspects. Also, Table 5.4 demonstrates the effects of personal variables to the options under utilization constructs. The information presented collected the effects rooted on each personal variable. The constructs and options listed were the items significantly related to the personal variable.

In addition, the information of directional trends in the table illustrates the general orientation based on the analyses between each category and the personal variable.

Table 5.4

Personal variables to the use of WebGIS

Personal variable	Construct	Option	Directional trend *
Access speed	- Adoption	• Playfulness	Faster speed
	- Service seeking tasks	• Explore for fun	Faster speed
	- Geo-info. types	• Aerial photo	Faster speed
Sex	- Experience phases	• Recollection	Male
	- Service seeking tasks	• View terrain	Male
		• Explore for fun	Male
	- Trip mode	• Outdoor rec.	Male
	- Geo-info. regions	• Local areas	Male
		• Natural areas	Male
	- Geo-Info. types	• Aerial photo	Male
Occupation	- Adoption	• Ease of use	Student
	- Service seeking tasks	• Sharing	Student
	- Trip mode	• Business trips	Professional
	- Geo-info. regions	• City areas	Student
	- Geo-Info. types	• Aerial photo	Student
Age	- Adoption	• Use intention	Younger than 45
		• Total adoption	Younger than 45
		• Ease of use	Younger than 45
		• Usefulness	Younger than 45
		• Playfulness	Younger than 45
	- Experience phases	• Prior phase	Younger than 45
	- Trip mode	• Local recreation	Younger than 55
		• Business trips	Older than 35
	- Geo-info. regions	• Local areas	Younger than 55
	- Geo-Info. types	• Road maps	Younger than 45
Education	- Service seeking tasks	• Customization	More than high school
	- Geo-info. regions	• Natural areas	More than master's degree
Income	- Geo-Info. types	• Aerial photo	More than $80, 000> $20,000-$39,000

*The category listed had more intense usage than other categories

The third objective of this study was to explore how adoption variables related to the extent of usages and interactions with WebGIS. The main results are presented in Table 5.5 in which the major determinants were identified. The constructs "usefulness" and "attitude" played a great role in "actual use" and "use intention". Interestingly, playfulness was the key to determine the depth of interaction between users and WebGIS functionality.

The goal of the objective four was to further explore (1) how recreation situations are related with the WebGIS interactive levels, (2) how recreation situations are related to usefulness, and (3) how recreation situations are related to playfulness. The results showed construct "usefulness" and "playfulness" had effects on the overall use (see Table 5.5). The detailed results of objective four are demonstrated in Chapter IV in a matrix format. The significant determinants are listed in order (see Table 5.6) by contributions to the dependent variables—interaction level, the sense of usefulness, and the sense of playfulness.

Table 5.5

The major attitude-behavioral determinants to WebGIS use

DV (use indices)	**Use intention**	**Actual use**	**Interaction**
Major determinants	• Usefulness • Attitude	• Usefulness • Attitude	• Playfulness

Table 5.6

The major determinants to WebGIS interaction, usefulness, and playfulness

Recreation situations	Dependent variable		
	Interaction	**Usefulness**	**Playfulness**
Intent formation stages	• Curiosity • Comparison	• Comparison • Focused information	• Curiosity
Experience phases	• All three phases	• Prior • On-site	• Recollection • On-site
Trip modes	• Local recreation • Leisure trips	• Leisure trips • Local recreation	• Outdoor recreation
Service Seeking tasks	• Terrain knowledge • Service finding • Route knowledge • Sharing	• Route knowledge • Location knowledge • Fun seeking	• Fun seeking • Customization
Geo-info. regions	• Local areas • Natural areas	• City area	• City areas • Local area
Geo-info. types	• Photos/videos • Text/link • 3-D images	• Road maps • Text/link	• Aerial photographs

5.2 Discussion

The concept of "utilization" is often associated with a wide spectrum of meaning. Knowing how people use a certain product or service is vital to many professions. Although WebGIS services have been an important recreation information channel, it has been evident that there is a lack of understanding of the relationships between the users and this information channel. In the previous “use and users” studies, much of the focus has been in the “look” and “feel” of interfaces, which are factors that account for a small portion of the utilization behavior (Berry, 2000). Another stream of the studies have concentrated on the mental process (Bunch, 2006), which, however, has not yet produced an inclusive picture of utilization factors.

This study was founded on Activity Theory, which emphasizes the role of the process between subject and object. More specifically, the theory posits that human activities are formed based on the subjects’ goals and motives, their environments consisting of time and space, as well as the importance of the artifact per se. In this study, the four dimensions of WebGIS uses were determined based on the strong ideological aspect of Activity Theory. Since the applications of Activity Theory have been under development, the design and evaluation of the study constructs were supported from other theories, models, and expert judgments to ensure the concreteness of the study frame. In comparison to the former studies, this four-dimensional model was developed based on theoretical foundations and posits a holistic view of human/computer interaction, which contributes a richer and more comprehensive portrait of the parameters of WebGIS utilization in recreation contexts.

The results of global tests by constructs were evident for understanding that the WebGIS usages were situational. In this study, various trip modes, experience phases, and motives differentiated the use of WebGIS. A certain situation consisted of a specific time, space, and resources impacted WebGIS usages. The options under this construct were distinguished by the stages in the trip-planning spectrum from curiosity to the actual trip. The results showed that people had similar WebGIS usage across different planning stages. Therefore, people consistently use WebGIS when they need recreation information to satisfy their curiosity, to stimulate their recreation ideas, to evaluate their trips, and to perform focused information search on their predetermined trips.

Due to the differences of the measuring instruments and study frameworks, most of the findings from previous studies were not directly comparable to the results of this study. Hence, the results were compared alternatively with the related field of general tourism information search, which also includes face-to-face contact, use of friend, television, magazines, agents, and other information sources. The impacts of situational factors were supported with the results of previous general information search studies (Berkman & Gilson, 1986; Burton-Jones & Hubona, 2005; Chen, 2000a, 2000b; Fodness & Murry, 1998; Grønflaten, 2008; Gursoy, 2003; Gursoy & Chen, 2000; Lo, *et al*., 2002; Luo, *et al*., 2004; Rompf, *et al*., 2005; Snepenger, *et al*., 1990).

Users also preferred to use certain types and regions of geo-information among the choices. In addition, respondents revealed preferences for certain functions in actual operations with WebGIS functionalities. As with the use of stand-alone GIS, the users of WebGIS tended to use the basic functions more often. This result was consistent with previous studies in the stand-alone GIS context (Peng & Tsou, 2003).

The factors of personal variables have been important in the studies of information search especially in the fields of recreation and tourism. However, there has been little information that can be used with direct comparisons to the effects of personal variables on WebGIS uses for recreation.

The effect of each personal variable in this research supported and contradicted the findings of former general tourism information studies. First, sex showed to be effective in information search behavior that indicated the differences in searching criteria and strategies applied, as well as the rooted differences in recreation preferences and/or constraints between male and female (Gilbert & Hudson, 2000; Hudson, 2000; Lefrancois, Leclerc, & Poulin, 1997; Shaw, 1994). In addition, the factor of sex also had more influence on the use of geo-information, especially in the use of the information for local and natural areas, and the use of aerial photographs. Several studies showed females have higher self-confidence for non-spatial domains than for spatial domains (Clifton & Gill, 1994). In regard to these results, while some scholars suggested the brain organization is the cause of the differences, others argued the differences on spatial data uses between male and female are more related to self confidence than biological sex (Johnson & McCoy, 2000). However, differently from the effect of other dimensions, male and female respondents showed parallel levels of adoption of WebGIS in this study. Without specifying the recreation situation, male and female perceived similarly in terms of the senses of usefulness, ease of use, and playfulness toward WebGIS.

In this study, the effect of the personal income level variable was not as influential in comparison to the results of general information search. This inconsistency may have resulted from the lesser monetary cost of the Internet search when compared to other forms of information search, which may cost more because of such fees as telephone charges and buying magazines (Gursoy & McCleary, 2004).

In this study, the factor of age differentiated more effects in all three dimensions than other personal variables. The results indicating that the age factor was influential were supported by the earlier studies (Gitelson & Crompton, 1983; Fesenmaier & Vogt, 1992), but not later ones (Lo at al., 2002; Luo, *et al*., 2004). These results suggest that recreation/tourism information sources and channels have been familiar to and commonly used by the general public in recent digital information environments. Age affected more WebGIS utilization than other personal factors in dimensions of adoption level and recreation situations. Generally, the differences revealed by the age factor are spread out across study dimensions. With the exception of the ”intent formation stages” and ”service seeking tasks,” age groups showed differences in almost all adoption constructs and in recreation situations, such as usages before taking off on a trip and when the trip modes were local and for business. Differently from sex, another influential factor, which showed no difference in WebGIS adoption, age factor made more profound effects in all dimensions of WebGIS adoption.

Interestingly, the main effects of the “access speed” factor concentrated on the enjoyment related components. In the dimension of adoption, the Internet speed was a hindrance to the sense of playfulness. In addition, the Internet speed was related to the use of aerial photographs which may bring enjoyment to users by providing the picture-like photos, and in recreation situations, the factor of speed made differences on the use motive to explore for fun. Depending on the data storage structures of different formats of geo-information, WebGIS servers need different time to react to the requests sent by end users. More complex data require faster Internet speed to avoid time lag during processing large files, such as aerial photographs, which contain much information in fine scale. As a consequence, once the time lag of the responses was not tolerable, users’ negative attitudes to the service were produced. Another possibility was that people who enjoyed Web application as a platform to have entertainment, to learn, and to communicate usually were willing to pay the cost for faster speed access.

Although the occupation variable seemed to be associated with age and income level, the results showed the independence of occupation from age and income as a variable related to WebGIS utilization. People in different occupational groups made similar judgments as to how useful and playful the WebGIS was, but made different judgments as to how easily WebGIS can be operated. The main difference made between occupational groups was related to the recreational situations. This result was supported by the findings of the Internet usage study conducted by Bonn, Furr, and Susskind (1998); however, the findings were contradicted by a study in the field of tourism information search (Luo, *et al*., 2004). Given occupation categories, students preferred the functions that they can use to share information with their friends more than did the professionals, and students more intensely used the information on city areas and in the format of aerial photographs than did professionals. Conversely, professionals used more WebGIS for planning their business trips than did students.

The effects of the education factor were more frequently supported by results of earlier studies (Fesenmaier & Vogt, 1992; Dodd, 1998) than by recent literature (Lo, *et al*., 2002; Luo, *et al*., 2004). However, in general, education as a factor in tourism information search showed more non-significant than significant influences. Within this study context, intriguingly, education levels showed differences on the ”customization“ variable, in which the users put their effort into organizing and/or creating different types of geo-information for a specific trip. This task usually requires more effort than retrieving information directly from the default.

As a variable, educational factors had an effect on the interests in searching information on natural areas. This result was supported by the findings of previous studies that people with higher education had greater appreciation for and interest in the natural environments (Brau, 1993; Liere & Dunlap, 1980; Shen & Saijo, 2007). This implied the possibility of a specific niche connecting education to the recreation activity preferences and interests to the natural environment; however, there was not enough information about the actual purposes of people with higher education to use the geo-information of natural areas.

Exploring the attitudinal-behavioral determinants to WebGIS, the results of this study were highly supported by former studies using both the original or extended TAM models (Davis *et al*., 1989; Davis, 1989, 1992, 1993; Venkatesh, *et al*., 2003), which had usefulness and ease of use as the main factors of the models. In addition to the two factors, this study had the construct "playfulness" as one of the fundamental constructs, which has been considered respectively in previous studies of Web technology context (Hu, *et al*., 1999; Legris *et al*., 2003). The results of this study indicated that the construct of usefulness, as in previous studies, was a powerful predictor of use intention and actual use of technology applications. Often the level of adoption has been associated with the level of usage. In order to explore the relationships between adoption constructs and depth of WebGIS uses, the study examined interaction levels measured by uses of WebGIS functionalities.

Surprisingly, the results showed that the construct "playfulness" was the determinant of the depth of use. This result contributed to a novel path in terms of detecting the depth rather than the general use. The sense of usefulness was the fundamental driver for users to access WebGIS, compared to other computer programs; however, the sense of playfulness and enjoyment, rather than usefulness, was the major reason to engage users for deeper use. Theoretically, usefulness and playfulness were different concepts. Playfulness was considered to be an intrinsic motivation and usefulness was in the extrinsic motivation realm (Moon & Kim, 2001). These conceptual dissimilarities were reflected in the information search behaviors in WebGIS contexts.

The following results were specific to recreation situations and adoption constructs that previous studies had not yet covered. Once the analyses confirmed that the sense of usefulness and playfulness were the key determinants to WebGIS usage and depth, this study explored the recreation situations that related to these constructs.

By comparing the situational constructs that had significant contributions to the sense of usefulness, playfulness, and interactions, interestingly, the findings as to the significant factors were distinct. For example, when users were at the curious stage or the very beginning stage to plan a trip, they tended to have more interactions with WebGIS. This result was similar to WebGIS use behaviors when users apply WebGIS to compare their alternatives. However, when considering the sense of usefulness, users experienced WebGIS as useful when they used it to compare their alternatives and help them to find more information on the destination in which they were interested, but not useful to give stimulation or ideas.

Different from usefulness, users felt WebGIS services were playful when they use WebGIS as an integrated platform to discover and satisfy their curiosity. The similar patterns of distinction were consistent among the constructs of interaction, usefulness, and playfulness. The properties of the three constructs appeared to be separated from each other, while the typical situations and information were considered useful, such as using WebGIS for leisure trips, for location and route information, for city information, and the use of road maps and read texts. Another dissimilar set of situations attracted users to form the sense of playfulness. For example, users experienced playfulness when they used WebGIS more for outdoor recreation and for aerial photographs.

Regarding the functionality interaction, as Nyerges (1995) modeled, the considerations can be categorized into three levels: First, the declarative level. In this level users present the knowledge to the functionality; that is, users recognize the existence of certain functionalities. If so, users become prepared to advance to the second level, in which users know how to perform such functionality. Once users progress into the third level, they would know how to operate multiple functionalities and understand the interactions among those functions to obtain the best results. The results seemed to support that the determinant "playfulness" may be the crucial element as to whether users are able to enter higher interaction levels, which require more cognitive efforts and thus users are able to obtain opportunities to optimize challenges and abilities to retain enjoyment (Csikszentmihalyi, 1997).

5.3 Conclusions and Implications

Over the years, recreation and tourism industries have been searching for ways to communicate with the public. The options for that communication have been limited by communication techniques. Although traditional methods, such as brochures, publications, radio announcements, television advertising, and word of mouth have commonly been implemented in the field, the practitioners and researchers could not overlook the restrictions of those communication techniques.

Especially, the field of public recreation, in comparison to commercial recreation, applied more limited and passive approaches communicating with its supporting public. These limited and passive approaches have been challenged with the fact that people's strategies and choices to obtain recreation information have been changing with the ubiquitous access of the Internet. With the goals to reach a greater potential population and actively promote the benefits of recreation, the fields of recreation and tourism are much encouraged to harness the information channel of the Internet. Comparing with individual websites, WebGIS, evolved from stand-alone GIS, offered an integrated platform that has the ability to satisfy people's information needs by offering rich information and interactive functionality. The highly visualized natural and informative characteristics of WebGIS bring many possibilities to the field of recreation and tourism.

WebGIS has different audiences from traditional stand-alone GIS. WebGIS has the general public as the main audience and does not require intensive training prior to use. The functionalities of WebGIS also have different focuses from stand-alone GIS. In the field, there are many cases applying the concepts of traditional GIS that were designed for expert use. Many agencies seek benefits of WebGIS from the expert model, which introduced many complex functions and information with scientific-looking interfaces to the general public. It is easy to overlook these important differences between the expert model and the model appropriate for the public use, and it is dangerous to begin the program with inappropriate methods and then expect the right effects.

By clearly distinguishing the differences, this study refocused the context of WebGIS. This study compared favorably to prior literature, but did not follow the former literature related to GIS to develop a new typology of WebGIS functionality. The typologies found in the former literature adopted cartography views, in which objects were maps, but not geographic information systems as a whole for users. Hence, the study established a typology based on previous studies from different fields, as well as actual WebGIS practices. The following typology was proposed to illustrate functionalities in the WebGIS context:

- *Targeting*: The functions facilitating the capture of extent of interests.
- *Viewing*: The functions facilitating visual interaction with users. This category may contain basic and advanced viewing functions.
- *Information alliance*: The functions providing connections to other sources of information. This category contains two directions: business/service oriented information and knowledge-oriented information.
- *Multi-media*: These functions are embedded with multi-media to display information, such as displaying photos, videos, downloading/uploading, and publishing information with others. This category is divided into passive, active, and sharing sub-categories.
- *Operation assistance:* These functions refer to the accessories of the WebGIS service that assist users to generate documents, such as to print, and to initiate the operations with the WebGIS, such as the instruction of the system.
- *Geo-information processing:* These functions help users to process various geo-information. More specifically, the sub-categories are: geo-information extraction (e.g. the control of layers shown); geo-information creation (e.g. creating customized maps); measuring (e.g. measuring time or distance information); geo-information gathering (e.g. obtaining coordinate information);

and geo-information manipulation (e.g. importing data to publish or other advanced manipulation).

This new typology customized for WebGIS consists of actual functionalities that have already been provided widely, thus the users have concrete knowledge and/or experiences with those functionalities. In addition, the new typology includes different levels of complexity to assure that the efforts users need to devote are within the reasonable spectrum for the general public. This typology is suitable for multi-purposes in WebGIS management serving the general public. For example, this typology is suitable as a checklist in the planning phase of WebGIS implementation to allocate resources, and as a decision making tool to select communication strategies for target audiences. One of the major benefits to involve users in a utilization study is to be able to efficiently and effectively serve users who are considered the core of service provision. More understanding about users and their behavior yields better communications between users and the recreation/tourism agencies.

With the information obtained in this study, the agencies may have sufficient tools to decide their priorities and select appropriate WebGIS features, with the consideration of their targeted audiences and matching with their organizational missions. For example, it is valuable to have the realization that WebGIS use is situational; that is, people approach WebGIS more or less depending on the situations, time, and spaces they encounter. In addition, referring to the summarized result matrix, the agencies interested in providing WebGIS services can understand the relative influences of the factors and users' preferences. For example, when the managers with limited budgets want to develop a brand new WebGIS program, they may start with finding the most popular uses of WebGIS directly from the summarized result matrices (see Table 5.1 to Table 5.6) to set their priorities. These managers would then know what the most popular uses are likely to be.

The findings may be that the reasons for people to access WebGIS are, in terms of the popularity, first to find a location and route, then to customize their own geo-information, then to use WebGIS to find services they need, and then finally to view terrain, or to have fun. The least important reason to use WebGIS is to share the information with others. Regarding functionality provision, the targeting and viewing function is essential to offer; the linking to other information is the second tier functionality to offer; the accessories that assist user operation is also necessary. However, multi-media or more complicated geo-information processing functionalities, if resources are limited, were optional to offer.

When the target audiences are within a specific range of age, the WebGIS managers can refer the information to the resulting summary matrices. From the matrices, the WebGIS managers may consider the study results that people who are younger than about 45 years old are the main demographic of WebGIS use; student groups value the function that enables them to share the geo-information with their friends, while people who are in workforce tend to use WebGIS when they need information for their businesses trips. If the recreation agency wants to focus on the target clients, this information may helpful and valuable to be taken into account.

For the WebGIS agencies with greater ambitions, the functions offered may incorporate more playfulness to engage users and encourage users to discover their sophisticated services. The practices may include opportunities to focus more on the information to stimulate users' curiosity, to enhance the functions that facilitate users' recollection process through WebGIS, to emphasize the conveniences for users to customize their own geo-information, and to provide more advanced format of geo-information.

Conventional WebGIS sites, as Miller (2006) argued, tend to trade off information richness and depth with speed and ease of use. These trade-offs may include the limited recreation information offered, the lack of polygon layers, the limited queries beyond automatic ones. For recreational and travel information use, the WebGIS providers may also need to refocus on the needs and wants from angles of recreation seekers in terms of the content of information and the degree of closeness to their everyday life.

Moreover, this research provides some insights that dedicate to the future development of WebGIS-related products and/or services. Understanding the attributes and features that the audiences seek when interacting with WebGIS are necessary foundations to improve WebGIS services and keep the evolution continuing.

5.4 Recommendations for Future Research

The activity process between users and WebGIS can be complex and viewed via different philosophies. However, the integration of philosophies and approaches across disciplines should be encouraged. The experiences from reviewing concepts and methods across diverse studies have inspired the investigator's acknowledgement to the benefits that integration can bring. For example, there is a need for further research to apply different research approaches. The task tracking approaches that uses recording techniques to review the use logs for assigned recreation/tourism information tasks would help further understandings of users' choices of various WebGIS services and/or the sequential flows in the process.

It would also be beneficial to include integrated knowledge of technology understanding from the field of information systems, and the theoretical frameworks from the field of psychology for future WebGIS research. Given this combination, the evaluation tools could involve not only the technical side of WebGIS, but also the human mind.

An important area for future research in the years to come will be the analysis of information needs through WebGIS in behavioral studies of recreation and tourism. The results of this study were based on users' experiences with WebGIS. The investigation of preferences and demands would be useful to further assist resource allocation on WebGIS in recreation/tourism organizations.

The sources and channels of recreation/tourism information are diverse. Perhaps future researchers could evaluate the relative strength of WebGIS in light of personal recreation/tourism decision-making and how WebGIS influences organizational management of recreation/tourism agencies.

The concepts of intrinsic and extrinsic motivation have made a great contribution to the studies of recreation/tourism. Answers to questions about how these two motivation concepts come to play in the recreation/tourism information search using WebGIS would add depth to motivation theories, as well as the knowledge of the use of spatial information.

Since this study was exploratory in nature, many findings were fresh and had very little information that could explicitly document essential facts, it would be useful to have some advanced studies in the near future that can yield rationales and possible applicability to the results of this study. The future research may start from each separate dimension to have supporting evidence about the origins of the facts. In addition, future studies may refer to the four-dimensional framework or the instrument developed in this study to other utilization scenarios, for example, using this four-dimensional instrument to evaluate WebGIS utilization in other cultures.

Although the TAM model has been examined in other contexts, it has not been tested in regards to WebGIS. This study tested some elements that were essential to form the complete model; however, because the TAM model consists of three levels, more relationships are needed to be examined using path analysis of multiple regressions to clarify the association between the levels. In addition, although the TAM model has been fully supported with the fact that the construct “usefulness” is the most important determinant to whether the product will be used, this study found that ”playfulness” , rather than ”usefulness“, was the determinant to the depth of WebGIS uses. Future research is therefore necessary to conduct follow-up examinations about this finding and integrate the results into WebGIS practice.

In addition, this study examined the relationships between recreation situations and the six functionality categories. If prospective studies can identify connections between recreation situations and the total of sixteen functionality sub-categories, it would be even more helpful regarding the decision making in WebGIS practices.

In approaching the study differently, qualitative research and data would answer the research questions in another direction. This may include investigations as to how the information retrieved from WebGIS is used, thus this approach could contribute to WebGIS-related studies due to its ability to have elaborated interpretations. We are hopeful that qualitative approach would provide more detailed results that may add depth to the body of knowledge.

The Activity theory is one of the few theories that values the artifact aspect in human behavior. Although the theory has been well valued, it has been developed mainly in conceptual levels. Prospective studies would be encouraged to establish instruments that constitute the theory's four principles. Additional research focusing on these aspects would be of great interest and value in understanding the roles of those principles and their influences on interactions between recreation information seekers and information channels. For example, with the "hierarchical structure" principle, future studies can clarify the hierarchy associations of the elements of "motive," "goals," and "conditions" defined in the theory, and the "external" and "internal" processes in human artifact interactions that explicate the developmental cycles between objects and subjects. The findings of these further studies would bring additional understanding to how the product/service evolution occurs on the basis of users' learning.

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APPENDICES

APPENDIX A

First Round Delphi Panel Cover Letter

The Research of WebGIS for Recreation and Tourism

Preliminary Survey for Delphi panel

You are invited to participate in the development of a survey because of the fit between your professional background and this study topic. Your participation is extremely important. The information you provide would be tremendously valuable to the study.

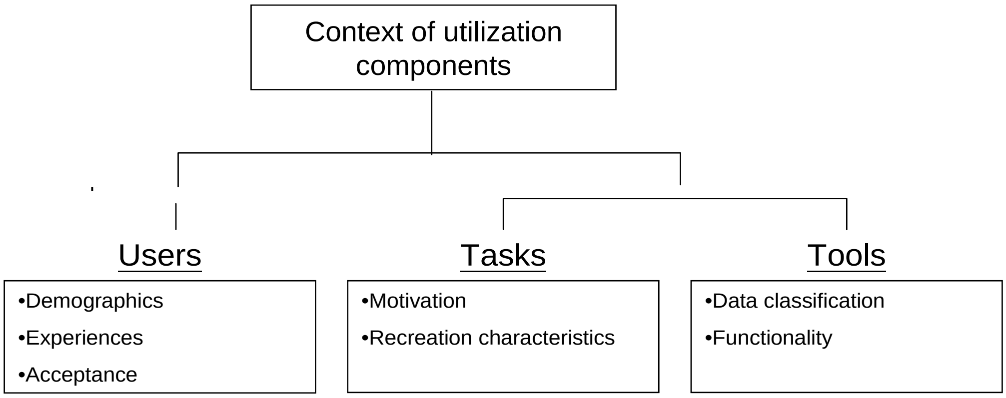
I would request that you respond voluntarily to a series of two rounds of reviews of this instrument as we attempt to improve its application to my doctoral study. The time of each round of review is about one hour. The information you provide will be treated confidentially. There are no known risks involved in completing the survey. Your responses will yield the important guidelines to this survey development regarding questionnaire item reduction, revision, and refinement.

The following two sections provide the background and instructions of this preliminary survey.

Survey background:

This preliminary survey is developed to explore the user profile and utilization of Web-based geographic information system related to recreation and tourism. Development and refinement of this survey will help us understand this new, but influential, phenomenon in recreation and tourism.

This survey attempts to systematically investigate the pattern of utilization in terms of user, task, and tool aspects. Under each aspect, several foci are implemented to measure specific use of Web-based geo-information service. The figure below demonstrates an overview of the framework of this survey.



Survey instructions:

At this stage of the survey development, we would need your help to:

- Rank the importance of each question item to its corresponding construct,
- Provide thoughts, suggestions, and concerns to question items' content, sequence, and wording.

Web-based geo-information system refers to the service which represents a body of knowledge that focuses on various aspects of geographic, spatial, and spatial-temporal context through the Web. The system is capable of capturing, storing, analyzing, and displaying geographically referenced information such as Google Maps, Google Earth, ParkInfo (http://www.parkinfo.org), and the Geographic Service of National Park Service (http://www.nps.gov/gis/data_info/).

When responding to the items please think of your experiences with Web-based geo-information systems and take your role as (Geography, GIS industry, Recreation, or Leisure) professional.

By completing the survey, you are giving consent. If you have any questions about the survey, or about being in this study, you may contact me by email: kaowen@okstate.edu or by phone: 405-762-9068. If you have questions about your rights as a research volunteer, you may contact Dr. Shelia Kennison, IRB Chair, 219 Cordell North, Stillwater, OK 74078, 405-744-1676 or irb@okstate.edu.

Sincerely

Grace Chang
Ph.D. Candidate
Leisure Studies
Oklahoma State University

APPENDIX B

Second Round Delphi Panel Cover Letter

The Research of WebGIS for Recreation and Tourism

Instrument Development- 2nd Delphi round

First of all, thank you for returning the Delph-1 questionnaire of the WebGIS for recreation and tourism study. In the first questionnaire, Delphi-members have ranked and given suggestions to 84 items divided over 18 constructs. Based on the first round of Delphi review, the responses yield the item refinements and item reduction to 62 items and 14 constructs. The aim of the Delphi-2 questionnaire is to generate the systematic indicators for further survey development regarding item reduction, revision, and refinement.

Survey instruction:
At this stage of the survey development, you will:

- Evaluate whether the item measures the construct.
- Evaluate whether the item is well understood.
- Provide thoughts, suggestions, and concerns to individual items.
- Provide thoughts, suggestions, and concerns to the instrument as a whole.

Survey background:
This preliminary survey is developed to explore the user profile and utilization of Web-based geographic information system related to recreation and tourism. Development and refinement of this survey will help us understand this new, but influential, phenomenon in recreation and tourism.

This survey attempts to systematically investigate the pattern of utilization in terms of user, task, and tool aspects. Under each aspect, several foci are implemented to measure specific use of Web-based geo-information service.

Web-based geo-information system refers to the service which represents a body of knowledge that focuses on various aspects of geographic, spatial, and spatial-temporal context through the Web. The system is capable of capturing, storing, analyzing, and displaying geographically referenced information such as Google Maps, Google Earth, ParkInfo (http://www.parkinfo.org), and the Geographic Service of National Park Service (http://www.nps.gov/gis/data_info/).

Web-based GIS has many levels of use and functions. It serves different purposes, for instance, ecology analysis, business decision making, and recreation and travel information provision which is the focus of this study.

When responding to the items please think of your experiences with Web-based geo-information systems and take your role as (Geography, GIS industry, Recreation, or Leisure) professional.

By completing the survey, you are giving consent. If you have any questions about the survey, or about being in this study, you may contact me by email: kaowen@okstate.edu or by phone: 405-762-9068. If you have questions about your rights as a research volunteer, you may contact Dr. Shelia Kennison, IRB Chair, 219 Cordell North, Stillwater, OK 74078, 405-744-1676 or irb@okstate.edu.

Sincerely

Grace Chang
Ph.D. Candidate
Leisure Studies
Oklahoma State University

APPENDIX C

Electronic Survey Cover Letter

The Research of WebGIS (Internet Mapping System) for Recreation and Tourism

Dear Respondent,

I am inviting you to participate in my research project to find out what people are looking for when they use internet mapping services for their recreation and trips. I want to understand what people like best, what they think about their experiences with internet mapping services and how recreation/tourism agencies can be improved for better mapping services. I have a short survey about using mapping services for recreation/trips which I hope you will fill out. It should take you about ten to fifteen minutes to complete. The recreation related agencies will consider what I discover through this survey to provide better services to make sure everybody's experience with Internet mapping services is the best it can be.

You will see that the survey includes questions about your experience using mapping services for your recreation or trip. If you choose to participate in my survey, please fill in your answers in the survey. You should not put your name on the survey when you fill it out, and I promise that I will respect your privacy. I will make sure that your answers cannot be linked to you personally.

There are no risks to you or to your privacy if you decide to join my study by filling out this survey. But if you choose not to participate, there are no penalties. Even if you decide not to respond I would be very happy to share my results with you if you are interested. To get a copy of my results please contact me.

By completing the survey, you are giving consent. If you have any questions about the survey, or about being in this study, you may contact me by email: kaowen@okstate.edu or by phone 405-744-9370. If you have questions about your rights as a research volunteer, you may contact Dr. Shelia Kennison, IRB Chair, 219 Cordell North, Stillwater, OK 74078, 405-744-1676 or irb@okstate.edu.

Sincerely

Grace Chang
Ph.D. Candidate
Leisure Studies
Oklahoma State University

APPENDIX D: The Study Survey

Oklahoma State University
College of Education
School of Applied Health and Educational Psychology

The Research of WebGIS (Internet Mapping System) for Recreation and Tourism

Dear Respondent,

I am inviting you to participate in my research project to find out what people are looking for when they use internet mapping services for their recreation and trips. I want to understand what people like best, what they think about their experiences with internet mapping services and how recreation/tourism agencies can be improved for better mapping services. I have a short survey about using mapping services for recreation/trips which I hope you will fill out. It should take you about ten to fifteen minutes to complete. The recreation related agencies will consider what I discover through this survey to provide better services to make sure everybody's experience with Internet mapping services is the best it can be.

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Sincerely

Grace Chang
Ph.D. Candidate
Leisure Studies
Oklahoma State University

The Research of WebGIS (Internet Mapping System) for Recreation and Tourism

What is WebGIS?

WebGIS Examples: Google Maps, Google Earth, Yahoo! Maps, MSN Virtual Earth, GlobeXplorer, Geospatial One Stop, National Geographic MapMachine, and many more.

Description: Web-based Geographic Information Systems (WebGIS) is a hybrid of GIS and Internet technologies, also known as mapping systems on the Internet. It allows the users to acquire information from maps, aerial imagery, descriptive information, pictures and other information widely available in a visual, dynamic, and interactive format using any web browser.

Survey Starts Here

Please check the response you feel most describes your experience:

	Always	Frequently	Sometimes	Rarely	Never
How often do you use WebGIS for any reason?	○	○	○	○	○
How often do you use WebGIS when you need recreation/travel information?	○	○	○	○	○

Thinking about the WebGIS services you have used, how would you rate these statements?

	Always	Frequently	Sometimes	Rarely	Never
I like to use WebGIS to find the information I want.	○	○	○	○	○
I have a favorable attitude toward WebGIS.	○	○	○	○	○
WebGIS is easy to use.	○	○	○	○	○
Interacting with WebGIS is clear and understandable.	○	○	○	○	○
WebGIS is useful for finding recreation/travel information.	○	○	○	○	○
Using WebGIS, I plan matters about my recreation/travel more quickly.	○	○	○	○	○
Using WebGIS, I plan matters about my recreation/travel more easily.	○	○	○	○	○
Using WebGIS, I make better recreation/travel plans.	○	○	○	○	○

Using WebGIS is playful.	○	○	○	○	○
Using WebGIS is fun.	○	○	○	○	○

Use intention:

	Always	Frequently	Sometimes	Rarely	Never
How likely would you be to use WebGIS in the future for your recreation/trip?	○	○	○	○	○
How likely would you be to recommend WebGIS to others?	○	○	○	○	○

I use WebGIS to:

	Always	Frequently	Sometimes	Rarely	Never
Satisfy my curiosity about many places.	○	○	○	○	○
Get ideas about where to go and what to do.	○	○	○	○	○
Compare my alternatives for a specific travel.	○	○	○	○	○
Collect more information for the places I want to go.	○	○	○	○	○

I use WebGIS:

	Always	Frequently	Sometimes	Rarely	Never
Before taking off on a trip.	○	○	○	○	○
During my recreation travel.	○	○	○	○	○
After I return home from my recreation/trip to recollect my trip.	○	○	○	○	○

I use WebGIS because:

	Always	Frequently	Sometimes	Rarely	Never
I want to find out the locations of the places I want to go.	○	○	○	○	○
I want to know my travel routes.	○	○	○	○	○
I want to create my own maps with marks of the places and how to move from one place to another.	○	○	○	○	○
I want to find recreation/travel services, such as, campground availability or accommodation.	○	○	○	○	○
I want to view landscapes or terrain around areas.	○	○	○	○	○
I want to share my experiences with others by posting pictures or stories.	○	○	○	○	○
To explore just for fun.	○	○	○	○	○

Type of trips:

I use WebGIS to find out the information for my:

	Always	Frequently	Sometimes	Rarely	Never
Local recreation.	○	○	○	○	○
Business trips.	○	○	○	○	○
Leisure travel.	○	○	○	○	○
Outdoor recreation.	○	○	○	○	○

Type of places:

I use WebGIS to find out the recreation/trip information about:

	Always	Frequently	Sometimes	Rarely	Never
My local community.	○	○	○	○	○
Major cities.	○	○	○	○	○
Natural areas.	○	○	○	○	○

How useful or useless are the following types of information provided by WebGIS for your recreation/trip?

	Very Useful	Somewhat Useful	Neither Useful Nor Useless	Somewhat Useless	Totally Useless
Road maps	○	○	○	○	○
Aerial photographs	○	○	○	○	○
3-D simulations	○	○	○	○	○
Photos or videos	○	○	○	○	○
Texts and links	○	○	○	○	○

Functionality:

Based on your experiences, please indicate how often do you use these functions provided by WebGIS services for your recreation/trips?

	Always	Frequently	Sometimes	Rarely	Never
Search by key words	○	○	○	○	○
Zoom in, Zoom out, Change scale, or Pan to move views	○	○	○	○	○
Tilt or Rotate the view to see low and high of the terrain	○	○	○	○	○
Link to the lists of business partners to locate the recreation/trip services I need	○	○	○	○	○
Use links or texts attached for more information to my target places	○	○	○	○	○

View pictures, videos, or 3D simulation	○	○	○	○	○
Download/upload pictures, videos, or 3D simulation	○	○	○	○	○
Print or copy search results	○	○	○	○	○
Use Help function for use instructions	○	○	○	○	○
Share information with others (eg. email image or create link)	○	○	○	○	○
Show and hide different layers over the viewing area	○	○	○	○	○
Add marks, paths, or areas to customize my own map	○	○	○	○	○
Use the tool on the website to measure distances or areas	○	○	○	○	○
Use the tool on the website to measure estimated travel time	○	○	○	○	○
Get the coordinate information of destinations	○	○	○	○	○
Import my own geographic data into the service	○	○	○	○	○
Do more advanced manipulations or analyses than import data	○	○	○	○	○
Other (specify) ______	○	○	○	○	○

For each of the following items, please check the most appropriate response.

Sex	○ Female	○ Male

What is the speed of your primary Web access?	○ Slow	○ Medium	○ Fast	○ Very Fast

Which one of the following best describes the place you live?	○ Urban Area	○ Suburban	○ Rural area

Occupation	○ Professional	○ Student	○ Others (Please specify) ______

Age	○ Less than 18	○ 18-25	○ 26-35	○ 36-45	○ 46-55	○ 56-65	○ Over 65

What is the highest level of education that you achieved?	
○	Attended high school
○	Graduated high school
○	Vocational technical school
○	Attended college
○	Bachelor's degree

○	Master's degree
○	Doctoral degree

Which of the following broad categories best describe your total income in 2008?	
○	Less than $20,000
○	$20,000-$39,999
○	$40,000-$59,999
○	$60,000-$79,999
○	Above $80,000

We appreciate any additional comments or suggestions you may have! (Please write in the space below)

Please use "Submit Form" below to finish the survey

Submit Form   Reset Form

THANK YOU FOR TAKING TIME TO COMPLETE THIS SURVEY

Grace Chang
kaowen@okstate.edu

Appendix E

Institutional Review Board Approval

Oklahoma State University Institutional Review Board

Date: Tuesday, December 09, 2008

IRB Application No ED08180

Proposal Title: User and Utilization of WebGIS for Recreation and Tourism

Reviewed and Processed as: Exempt

Status Recommended by Reviewer(s): Approved Protocol Expires: 12/8/2009

Principal Investigator(s):

Kaowen Chang	Lowell Caneday
2303 Bridlewood Dr.	184 Colvin Center
Stillwater, OK 74074	Stillwater, OK 74075

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

X The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Beth McTernan in 219 Cordell North (phone: 405-744-5700, beth.mcternan@okstate.edu).

Sincerely,

Shelia Kennison, Chair
Institutional Review Board

Oklahoma State University Institutional Review Board

Date:	Monday, March 30, 2009	Protocol Expires:	12/8/2009
IRB Application No:	ED08180		
Proposal Title:	User and Utilization of WebGIS for Recreation and Tourism		
Reviewed and Processed as:	Exempt **Modification**		

Status Recommended by Reviewer(s) **Approved**

Principal Investigator(s):

Kaowen Chang 2303 Bridlewood Dr. Stillwater, OK 74074	Lowell Caneday 184 Colvin Center Stillwater, OK 74075

The requested modification to this IRB protocol has been approved. Please note that the original expiration date of the protocol has not changed. The IRB office MUST be notified in writing when a project is complete. All approved projects are subject to monitoring by the IRB.

☐ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

The reviewer(s) had these comments:

The modification request to expand the survey sampling population to include the student population at OSU is approved.

Signature :

Shelia Kennison, Chair, Institutional Review Board

Monday, March 30, 2009
Date

VITA

Kaowen (Grace) Chang

Candidate for the Degree of

Doctor of Philosophy

Dissertation: AN ANALYTIC CHARACTERIZATION OF WEBGIS UTILIZATION IN RECREATION AND TOURISM INFORMATION SEARCH

Major Field: Health, Leisure, and Human Performance, Option in Leisure Studies

Biographical:

Personal Data: Born in Hsinchu, Taiwan, On April 26, 1975.

Education: Graduated from National Hsinchu Girls' Senior High School, Hsinchu, Taiwan in July 1993; received Bachelor of Science degree in Agronomy from National Chung-Hsing University, Taichung, Taiwan in July 1997; received Mater of Science degree in Horticulture Landscape Architecture from National Chung-Hsing University, Taichung, Taiwan in July 2001. Completed the requirements for the Doctor of Philosophy degree with a major in Health, Leisure, and Human Performance at Oklahoma State University, Stillwater, Oklahoma in July, 2009.

Experience: Employed as a research assistant for recreation projects and as executive editor of Journal of Landscape in Landscape Architecture program in Horticulture at Chung-Hsing University, Taichung, Taiwan, 1999-2001; employed as research assistant in U.S. Department of Agriculture, Stillwater, Oklahoma, 2003-2004; employed as a research assistant, 2005-2009, and as a teaching assistant, 2008-2009, at Leisure Studies, Oklahoma State University.

Professional Memberships: National Recreation and Park Association

Name: Kaowen (Grace) Chang Date of Degree: July, 2009

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: AN ANALYTIC CHARACTERIZATION OF WEBGIS UTILIZATION IN RECREATION AND TOURISM INFORMATION SEARCH

Pages in Study: 198 Candidate for the Degree of Doctor of Philosophy

Major Field: Health, Leisure, and Human Performance, Option in Leisure Studies

Scope and Method of Study: This research examines user behavior in the context of WebGIS use for recreation/tourism. The aim is to delineate the recreation and tourism information seekers' participation in WebGIS services and to explore the factors that significantly affect WebGIS use. The first phase of the study includes a series of instrument development processes that contains preliminary instrument generation. The instrument is organized in the form of a survey for quantitative analyses in phase two. The second phase of this study assesses the users' perceptions and practices in the aspects of attitude-behavior, personal characteristics, artifact features, and recreation/tourism attributes. This phase is quantitative in nature and aims to analyze the relationships between the underlying dimensions identified in the phase one.

Findings and Conclusions: An instrument based on a four-dimensional system developed in this study was established to measure WebGIS utilization in recreation and tourism information search. The results of global tests by constructs were evident to the understanding that the WebGIS usages were situational. Users also had preferences to use certain types or regions of geo-information among the choices. Respondents showed preferences for certain functions in actual operations with WebGIS functionalities. With personal characteristics, sex showed influential to information search behavior. In this study, the factor of age differentiated relatively more effects in all three dimensions. In general, education as a factor showed more non-significant than significant influences. People in different occupational groups made similar judgments as to how useful and playful the WebGIS was, but made different judgments as to how easily WebGIS can be operated. The main effects of the access speed concentrated on the enjoyment-related components. In this study, the effect of the personal income level variable was not influential. Exploring the attitude-behavioral determinants to the WebGIS, the results of this study were highly supported by former studies using the original or extended TAM models. Surprisingly, the results showed that the construct playfulness was the determinant for the depth of use.

ADVISER'S APPROVAL: Lowell Caneday