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Location-Based Mobile Decision Support Systems and Their Effect On User Performance

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ABSTRACT

The proliferation and convergence of wireless communications, location technologies, information systems, the Internet, and mobile devices has given rise to new types of decision support utilities commonly referred to as location-based mobile decision support systems (M-DSS). A location-based M-DSS can be described as an information system that exploits knowledge about where a user is located, enables ubiquitous information access, and provides context-related decision support. Drawing on technology acceptance and decision-making theories, this research explores critical factors in the design, use, and performance of location-based M-DSS. In doing so, this research consists of two parts. First, relevant features of location-based M-DSS as well as their relative importance are determined. Secondly, the relationship between location-based M-DSS use and user performance is examined for a novel application in the golf industry.

Keywords

Technology Design, Mobile Decision Support Systems, Location Technologies, User Performance.

INTRODUCTION

The design and use of decision support systems (DSS) continue to be of major interest to both academics and practitioners (Bhargava and Power, 2001; Todd and Benbasat, 1992). Over the past decades, DSS have evolved from distributed computing systems to group and web-based DSS. Most of the studies on decision support have been aimed in determining the effects of system design parameters on user performance, decision quality, and system effectiveness in relatively static environments (Sharda, Barr, and McDonnell, 1988; Todd and Benbasat, 1992). With the recent proliferation and convergence of wireless communications, location technologies, information systems, the Internet, and mobile devices, a new set of decision support utilities for mobile environments has emerged. Location-based mobile decision support systems (M-DSS) can be described as information systems that exploit knowledge about where a user is located, enable ubiquitous information access, and provide context-related decision support. Applications of location-based M-DSS can be found in transportation, logistics, inventory, and telematics related areas, where users often require real-time access to spatial information to make decisions (Mennecke and Strader, 2001).

The added dimensions of spatiality and mobility to DSS, however, create new challenges and lead to several interesting research questions. Two questions of high relevance are: (1) how should location-based M-DSS be designed? (2) What impact will the use of location-based M-DSS have on user performance? Little empirical research exists addressing these issues. The purpose of this study is therefore twofold. First, relevant design, content, and application features of location-based M-DSS as well as their relative importance are determined. Second, the relationship between location-based M-DSS use and user performance is examined. In doing so, this study contributes to both information systems and human-computer interaction literature and aids practitioners in designing more useful and effective location-based M-DSS.

THEORETICAL BACKGROUND AND RESEARCH MODEL

The identification of factors that lead to technology use has been of significant interest to both academics and practitioners. A theory relevant to this study is the technology acceptance model (TAM). The purpose of TAM is to explain the use, intention to use, and acceptance of technology (Davis, Bagozzi, and Warshaw, 1989). More specifically it identifies the impact of external factors on users' internal beliefs, attitudes, and intentions. One of the predictors of technology usage in TAM is perceived usefulness (PU), which is defined as a user's subjective assessment of a technology's potential contribution to job performance (Goodhue and Thompson, 1995). Based on findings in the literature, Phase I of this study identified four factors – (1) Timeliness, (2) Trust, (3) Information Richness, and (4) Ease of Use – that lead to the PU of location-based M-DSS. The justification for the inclusion of these factors and the corresponding hypotheses are presented next.

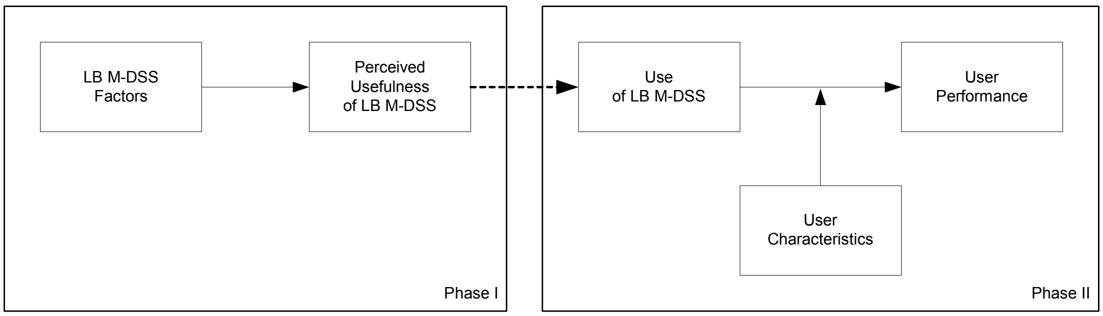

Figure 1. Basic Research Model

Timeliness

The effectiveness and usefulness of DSS has been shown to be dependent on many different factors. One important factor is the timeliness of information provided (Sharda et al., 1988). Timeliness is defined as the degree to which a DSS provides the user with current and appropriate information. In mobile settings, the importance of information timeliness is amplified, as decisions have to be made at specific times and locations. If information is not delivered at the time and place needed or requested, users will not be able to make appropriate decisions. Information timeliness is therefore an important criterion to the PU of location-based M-DSS. Hypothesis 1: Timeliness is positively related to the perceived usefulness of location-based M-DSS.

Trust

The importance of trust and its relationship to user behavior and technology acceptance has been studied extensively in the literature. Pavlou (2003) showed that trust plays an important role in the user's decision-making process. In addition, both source and media credibility lead to a user's trust in information (Dennis and Kenney, 1998). Hence, decision makers will consider a location-based M-DSS useful if they trust the source and media through which the decision alternative is provided. Hypothesis 2: Trust is positively related to the perceived usefulness of location-based M-DSS.

Information Richness

An equally important factor in computer-mediated communication is information richness. Information richness is the ability of a medium to carry information that changes users' understanding within a given amount of time (Daft, Lengel, and Trevino, 1987). "Rich" information is capable of changing users' understanding more quickly than "lean" information (Dennis and Kinney, 1998). Due to the inherent resource limitations and device constraints of location-based M-DSS it is therefore pertinent to provide the "richest" level of information to the user. Hypothesis 3: Information Richness is positively related to the perceived usefulness of location-based M-DSS.

Ease of Use

Ease of use is defined as the extent to which a person believes that using a technology will be free of effort (Davis et al., 1989). It is an important construct in the technology acceptance model, where it has been shown to have a significant influence on usage of and intentions to use a technology, as well as on the PU of that technology (Dishaw and Strong, 1999). Hypothesis 4: Ease of Use is positively related to the perceived usefulness of location-based M-DSS.

User Performance

There is ample evidence in the literature describing the positive relationship between PU and use of technology (Davis et al. 1989; Goodhue, 1995). The purpose of this study is not to validate these findings. Instead, the second part of the study focuses on understanding the relationship between technology use and user performance. While studies on technology use and computer-mediated decision support have shown to improve decision making quality and user performance, most research has focused on DSS in static environments (Bhargava and Power, 2001). The emergence of location-based M-DSS shifts the focus to mobile environments. Phase II of the study, therefore, explores the relationship between the use of location-based M-DSS, user characteristics, and user performance (see Figure 1.)

The evaluation and measure of user performance often depends on the context in which it is being studied. Several studies define performance as the level of decision accuracy (Todd and Benbasat, 1992), decision quality (Sprague, 1980), or task completion time (Sharda et al., 1988). It has been further shown that user performance consists of both intangible and tangible metrics. DeLone and McLean (1992) show that technology use can result in intangible or subjective performance improvement, based on the opinion of the user. The link between technology use and tangible performance metrics, which are based on fact, has been shown in a number of studies. This research considers both of intangible and tangible performance components in the context of location-based M-DSS.

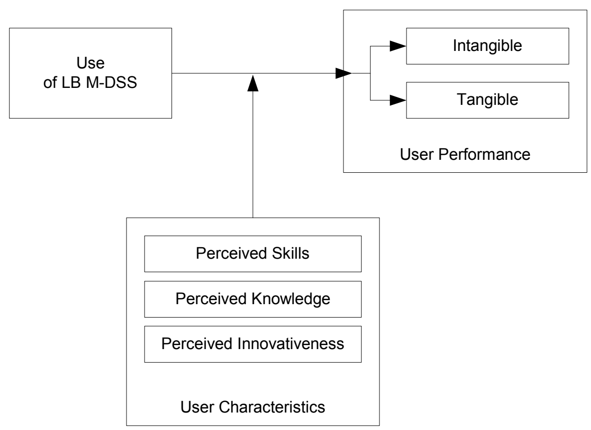

Figure 2. Relationship between Location-Based M-DSS Use and User Performance

Based on the previous discussion, the following hypothesis regarding the relationship between location-based M-DSS use and user performance is presented (see Figure 2). Hypothesis 5: The use of location-based M-DSS will result in increased intangible and tangible performance.

Moderating Effects of User Characteristics

In previous studies, it has been shown that user characteristics impact the relationship between use and performance (Dishaw and Strong, 1999). User characteristics considered relevant to the purpose of this study are (1) user skills, the level of a user's ability to perform a task (Goodhue and Thompson, 1995), (2) knowledge, a user's familiarity with the environment in which a task is performed and the task itself (Goodhue, 1995), and (3) innovativeness, a user's level of interest and usage of new technologies (Dishaw and Strong, 1999). This research posits that user characteristics moderate the relationship between the use of location-based M-DSS and user performance, such that:

Hypothesis 6a: For lower levels of user skill, the use of location-based M-DSS will lead to greater improvement in both tangible and intangible performance measures.

Hypothesis 6b: For lower levels of user knowledge, the use of location-based M-DSS will lead to greater improvement in both tangible and intangible performance measures.

Hypothesis 6c: For higher levels of user innovativeness, the use of location-based M-DSS will lead to greater improvement in both tangible and intangible performance measures.

RESEARCH METHODOLOGY

This section describes the development and testing of the survey instrument, sample selection procedure, and data collection methodology of the study.

Instrument Development

The survey instrument used in this study is based on previously used and validated scales from the Information Systems literature. Similar to previous studies, the survey uses a 5-point Likert scale for all items to ensure sufficient variability among the responses. Items in each scale are modified to fit the context of location-based M-DSS. Before administering the survey to the study's complete sample, a pre-test with a smaller sample was performed to ensure the validity and reliability of the modified items and scales within the location-based setting, and rectify any problems regarding readability or format of the survey instrument.

Sample Frame and Unit of Analysis

The objective of this research is to understand the factors that impact the design, use, and performance of location-based M-DSS. However, finding an adequate sample frame for location-based M-DSS is not a trivial matter. First, location-based M-DSS are relatively new technologies and their adoption is still in the early stages. Second, testing the impact of use on performance for location-based M-DSS is difficult given the spatial and mobile characteristics of these systems. In order to overcome these problems, the study considers a novel application of location-based M-DSS, namely personal mobile global positioning systems (GPS) used in the golf industry. A personal GPS device provides golfers with location and time specific information, such as precise pin placement, distance to the green, and distance to nearby hazards. With this information, golfers are better-informed players and can make more effective decisions regarding which club to select and where to hit the ball.

Data Collection

Using golfers as a unit of analysis presents various difficulties that must be addressed. Golf is a highly subjective game (regardless of intent, even the best golfers are subject to high variability in performance) and people play it for very different reasons (some golfers play seriously while others play only for fun and recreation.) The data collection methodology employed in this study is designed to address these difficulties. The sample will be constructed by randomly selecting golfers in the metropolitan Atlanta area to play a round of golf using a location-based M-DSS, which is provided by a leading personal GPS device manufacturer. Prior to using the device, each golfer will be asked a series of questions regarding the perceived usefulness of the GPS device. Next, golfers will be given a modified scorecard where they can (1) record their score on each hole, and (2) indicate whether or not they used the mobile device on a given hole. Collecting information on a hole-by-hole basis enables the study to control for the inherent variability of performance in golf. Low and high outlier scores will be discarded, and the remaining holes will be used to calculate a mean score for each golfer. Furthermore, the study will control for hole and course difficulty using the USGA handicap system, which requires each golf course in the United States to normalize the difficulty of each hole and the difficulty of the course based on a national standard (For more information on the USGA handicap system, visit http://www.usga.org/). After completing a round of play (18 holes), a second set of questions will be asked regarding intangible performance experienced by the golfer (e.g. fun and enjoyment) as well as demographic and experiential data (e.g. skills, knowledge, and innovativeness.)

EXPECTED FINDINGS AND CONCLUSIONS

The proliferation and convergence of wireless communications, location technologies, information systems, the Internet, and mobile devices has given rise to new types of decision support utilities commonly referred to as location-based mobile decision support systems (M-DSS). This study first explores critical factors in the design, use, and performance of location-based M-DSS and then uses a novel application in the golf industry to empirically test the relationship between location-based M-DSS use and user performance. The findings of this study will provide both academics and practitioners a clearer understanding of what leads to the perceived usefulness of location-based M-DSS and what impact the use of the technology has on individual performance. The authors will present the final results of the study at the conference.

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