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An Integrated Adoption Model of Mobile Cloud Services: Exploration of Key Determinants and Extension of Technology Acceptance Model

Eunil Park [a], Ki Joon Kim [b,*]

[a] Graduate School of Innovation and Technology Management, Korea Advanced Institute of Science and Technology (KAIST), Daejeon, Republic of Korea
[b] Interaction Science Research Center, Sungkyunkwan University, Seoul, Republic of Korea

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ABSTRACT

This study identifies and investigates a number of cognitive factors that contribute to shaping user perceptions of and attitude toward mobile cloud computing services by integrating these factors with the technology acceptance model. A structural equation modeling analysis is employed on data collected from 1099 survey samples, and results reveal that user acceptance of mobile cloud services is largely affected by perceived mobility, connectedness, security, quality of service and system, and satisfaction. Both theoretical and practical implications of the study's findings are discussed.

1. Introduction

Mobile devices, such as tablet computers and smartphones, have become essential tools for communication (Dinh et al., 2011). In particular, users increasingly benefit from mobile cloud computing that provides instant access to wireless networks and stored data on remote servers. With its efficiency and convenience, mobile cloud computing is now considered one of the fastest growing areas of information and communication technology (ICT), as well as related industrial and academic fields (Satyanarayanan, 1996). While earlier mobile devices and services faced a number of challenges (e.g., difficult user interfaces, security threats, limited resources) in maintaining and providing adequate services (Ali, 2009; Satyanarayanan, 1996), mobile cloud computing has gained significant public interest as a suitable and realistic next-generation computing service that offers a potential solution to these challenges.

In spite of the rapidly growing popularity of cloud computing in the mobile environment, only a few studies have examined how user perceptions are shaped in mobile cloud computing, and these studies provide little information on how psychological factors involved in the mobile context determine user acceptance of the service. Therefore, this study first identifies user perceptions of mobility, security, connectedness, service and system quality, and satisfaction as key components of mobile cloud services and then examines how these factors affect user perceptions and acceptance of the services. More importantly, this study integrates these psychological factors with the technology acceptance model (TAM) and develops a new research model to predict the adoption of mobile cloud services by confirming the convergent, discriminant, and internal validity of the proposed model via structural equation modeling (SEM).

* Corresponding author. Address: Interaction Science Research Center, Sungkyunkwan University, 326 International Hall, 53 Myeongnyun-dong 3-ga, Seoul 110-745, Republic of Korea. Tel.: +82 2 740 1867; fax: +82 2 740 1856.
E-mail addresses: pa1324@kaist.ac.kr (E. Park), veritate@skku.edu (K.J. Kim).

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The present study is organized as follows. Section 2 provides a definition and overview of mobile cloud services. Section 3 discusses key characteristics of mobile cloud services and examines their psychological effects on user acceptance by developing an integrated research model. Sections 4 and 5 report the data collection procedure and results of the statistical analysis. This study then concludes with a discussion of the theoretical and practical implications of the study findings in Section 6.

2. Mobile cloud services

Mobile cloud computing is defined as "an infrastructure and system where both the data storage and data processing happen outside of the mobile device" (Dinh et al., 2011). Since its emergence, cloud computing has gained significant industrial and consumer attention as a promising mobile paradigm in which data processing and storage occur in a network "cloud" via a wireless connection. Cloud computing technologies can reduce the maintenance and development costs of mobile services and applications, promote research on efficient methods and promising solutions for ubiquitous environments and green IT systems, and provide users with various mobile services at low cost (Aepona, 2010).

Greater storage capacity is one of the key advantages of mobile cloud services. Users can access their stored data via cloud servers from a variety of electronic devices with wireless connectivity, while utilization and sharing of the data are processed remotely within the servers (Vartiainen and Mattila, 2010). Well-known examples of such cloud services are iCloud and Google Drive, which provide data storage and sharing service for images, movie clips, games, and documents. Given that these multimedia files tend to be large and mobile devices typically have smaller storage area compared to conventional computers, storage capacity has always been an important technical limitation of mobile-platform devices and services. However, mobile cloud services now offer a practical solution to this issue by allowing users to save large files in the cloud server via the wireless networks (e.g., 3G, LTE, Wi-Fi) of their mobile devices. Mobile clouds significantly increase data storage capacity and therefore allow more convenient data management and synchronization in a ubiquitous online workspace.

Long-lasting battery life is an essential component of mobile technology due to the associated portability and mobility. The electronics industry has long invested in energy-efficient technology by working to develop low-power CPU, storage disk, and display screen (Davis, 1993; Paulson, 2003; Mayo and Ranganathan, 2003). However, these attempts require changes in hardware structure and cannot be directly applied to mobile technology without significant increases in costs and technological advancements. As a feasible solution to this challenge, cloud computing allows migration of the complex processing from a mobile device (resource-limited) to remote cloud servers (resource-rich). Prior studies have demonstrated that such computational offloading shortens program executions and therefore extends battery life. For example, Rudenko et al. (1998) reported that performing large matrix calculations in the cloud computing environment rather than on a mobile device can save up to 50% of the energy used. In addition, Cuervo et al. (2010) found that cloud applications significantly reduce energy consumption in computer games.

Saving files on cloud servers is an effective way to enhance reliability and reduce potential threats to data loss. The majority of cloud service providers are equipped with their own means of security and backup systems that protect user data. They also provide users with various security-related services and software, including personal authentication, virus scanning and detection, and protection of private information (Oberheide et al., 2008). Furthermore, cloud computing services can be applied to protect copyrighted online contents (e.g., books, movies, MP3s) and prevent unauthorized distribution of these materials (Zou et al., 2010).

Due to these strengths and advantages, mobile cloud computing has emerged as an attractive platform for the upcoming era of Web 3.0. In 2007, Schmidt (2007), CEO of Google, referred to Web 3.0 as a computing application model and defined it as applications that are pieced together so that they (1) are relatively small, (2) are very fast and customizable, (3) can operate on any device (PC or mobile), and (4) store data in the cloud. These characteristics of the predicted Web 3.0 precisely correspond to the key components and strengths of mobile cloud computing, suggesting the significant potential of mobile cloud computing as the future mainstream technology.

3. User acceptance model of mobile cloud services

3.1. Technology acceptance model (TAM)

TAM consists of two main beliefs known as perceived ease of use and perceived usefulness, which Davis (1989, 1993) defined as "the degree to which a person believes that using a specific system would be free of mental and physical efforts" and "the degree to which a person believes that using a specific system would enhance his/her job performance," respectively. Numerous studies have successfully utilized and replicated TAM to predict user acceptance of novel technologies and systems and demonstrated that perceived ease of use and perceived usefulness largely determine user attitude toward a specific technology, while attitude and perceived usefulness significantly affect behavioral intention to use the technology.

The TAM framework has been particularly useful in exploring user acceptance of recent novel mobile technologies and services, including smartphones (Joo and Sang, 2013; Park and Chen, 2007), mobile banking (Lee and Chung, 2009), mobile games (Ha et al., 2007), and long-term evolution (LTE) services (Park and Kim, 2013). By extension, TAM is also likely to be applicable to examining the adoption of mobile cloud services and is likely to show causal relationships among the