

A User Study on the Adoption of Context-Aware Destination Mobile Applications

Shu-Lu Hsu, Fang-Yi Chu

Abstract—With the advances in information and communications technology, mobile context-aware applications have become powerful marketing tools. In Apple online store, there are numerous mobile applications (APPs) developed for destination tour. This study investigated the determinants of adoption of context-aware APPs for destination tour services. A model is proposed based on Technology Acceptance Model and privacy concern theory. The model was empirically tested based on a sample of 259 users of a tourism APP published by Kaohsiung Tourism Bureau, Taiwan. The results showed that the fitness of the model is well and, among all the factors, the perceived usefulness and perceived ease of use have the most significant influences on the intention to adopt context-aware destination APPs. Finally, contrary to the findings of previous literature, the effect of privacy concern on the adoption intention of context-aware APP is insignificant.

Keywords—Mobile Application, Context-Aware, Privacy Concern, TAM.

I. INTRODUCTION

THE rapid growth of mobile technologies has placed increased focus on context-aware computing, which refers to an application feature that changes, depending on the environmental conditions of the user throughout the operation of the application [1]. The concept of context dependency goes even further by determining the whole scenarios in which a user accesses a service. It can offer information that satisfies the user's demand at that moment and, therefore, increases the acceptance of mobile services.

The main changes introduced by mobile technologies into the tourism sector are linked to the way in which services are offered, interaction between customers and suppliers and the way in which the companies in the sector operate. In the world of globalization, competition among cities, regions and countries often make use of a growing number of resources to appeal to potential visitors. With regard to the use of mobile services, the tourism sector is beginning to exploit the potentials offered by such omnipresent access and is developing products providing tourist information on cities, as well as commercial applications and booking and payment services, which have already been implemented in several places [2].

Mobile applications have become new communication channels, vital to the tourist industry, and indeed for the

destinations themselves as they can use them to improve the travel experience and encourage tourist loyalty. Full bloom of mobile services depends on both user adoption and technology improvement. While there has been an increasing amount of mobile services, little attention has been given to user adoption of advanced context-aware mobile applications, especially proposed for tourism of specific destinations. With context-aware computing often involving tracking peoples' environmental conditions, many studies highlighted the importance of keeping people's information private [3]. Based on the technology acceptance model (TAM) and privacy concern theory, this study are: (1) to examine the effects of the characteristics of APP on users' perceived usefulness and perceived ease of use; (2) to examine the effects of perceived usefulness and perceived ease of use of APP on the attitude of users; (3) to explore the effect of attitude toward APP on the adoption intention of users; (4) to identify the impacts of users' privacy concern on the attitude toward APP and the adoption intention of users.

II. CONCEPTUAL BACKGROUND AND HYPOTHESIS DEVELOPMENT

A. Technology Acceptance Model

The Technology Acceptance Model was first proposed by Davis in 1989 [4] based on the theory of reasonable action and the theory of planned behavior. TAM is intended to provide a theoretic foundation and parsimony, to explain and predict the adoption intention of information technology users. Davis [4] and Davis et al. [5] presented two factors that determine user's acceptance or rejection of information technology, namely perceived usefulness (PU) and perceived ease of use (PE). Users who perceive higher ease of use of an information technology think it is easier to use, generating a positive attitude towards adopting the technology. If the perceived ease of use is low, then user attitude toward use is negative. Moreover, perceived ease of use can strengthen perceived usefulness, while attitude and perceived usefulness have significantly positive effects on adoption intention. In addition, this model has been validated through examining various types of information technologies pertinent to individual and organization adoption (see [6] for a review of literature).

In the past ten years, there are many empirical studies on travelers' acceptance of new tourism technologies. Among them, few studies used TAM to study acceptance of mobile tourism technologies [7]. Kim, Park, and Morrison [8] extended TAM model to explain the factors influencing tourist acceptance of mobile devices. They found that trip experience and technology experience positively influence PU and PE and

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that the two factors positively affect travelers' attitudes toward using mobile devices and their intention to use within the tourism context. Given the extensive validations in the literature, the flexibility of TAM makes it suitable for various technologies [9]. Hence, TAM is conceived as an extremely appropriate baseline model for this study. Thus, we have the following hypotheses:

- H1. The attitude toward using a context-aware destination APP (CAD-APP) positively influences the adoption intention of the APP.
- H2. The PU of a CAD-APP positively influences the attitude toward using the APP.
- H3. The PE of a CAD-APP positively influences the attitude toward using the APP.
- H4. The PE of a CAD-APP positively influences the PU of the APP.

B. Context-Aware Destination Mobile Application

With the proliferation of destination choices and increasing competition, it has become critical for destinations to find innovative ways to differentiate their products and create experiences that provide distinct value for the tourist. One critical way for destinations to do is to understand the latest developments and changes in the application of mobile technology to tourism.

The growing number of users and a wide variety of applications make the smartphone fundamentally alter current use and understanding of the transportation network and travel. Smartphones and Apps appear to dramatically change the face of the tourism industry and offer great potential to assist tourists by providing access to online information at anytime and anywhere [10]. Several studies have been done to confirm the mobile services valued by tourists [11], [12] and indicate that tourists' choices can be changed by the use of Apps [13].

The growth of mobile technologies has placed increased focus on "context-aware" computing, which refers to a program or application feature that changes, depending on the environmental conditions of the user throughout the operation of the application [14]. So far, user location is the context that is most widely accepted as a key for context-aware services. Originating from Olivetti Research Lab's 'Active Badge' [15], several location-aware appliances have been developed. GPS, RFID, and access points are generally used to acquire location data, which are then used in proactive personalized services such as tour guide systems.

In literature the term context-aware appeared in [16] the first time. Ryan et al. [17] referred to context as the user's location, environment, identity and time. Dey [18] defines context as the user's emotional state, focus of attention, location and orientation, date and time, as well as objects and people in the user's environment. Dey and Abowd [19] refer to context as "any information that can be used to characterize the situation of entities (i.e., whether a person, place or object) that are considered relevant to the interaction between a user and an application, including the user and the application themselves." Thus a system is context-aware if it uses context to provide relevant information and/or services to the user, where

relevancy depends on the user's task [20].

TAM postulates that external variables such as system characteristics intervene indirectly by influencing PE and PU. Dey [20] suggested the following features of context-aware mobile applications: proactivity (or intelligibility), localization, personalization, mobility, and privacy. Plank and Faggi [21] presented four key characteristics of mobile communications as: place and time independence (i.e. mobility), identity and context detection, interaction capabilities, and personal relatedness. Alqatan et al. [22] proposed the main characteristics of context-aware technologies used for promoting destinations are the following: (1) Mobility, which relates to the capacity of users to utilize specific services in any place and at any time. (2) Localization, which enables companies to offer products and services to potential customers depending on their location. (3) Convenience, size and user-friendliness are attributes making mobile devices a highly suitable tool in comparison with a desktop PC. (4) Personalization, which when applied to mobile devices is a unique characteristic that differs from traditional home PCs or computers in public venues which could be used by numerous people. All these particular features of mobile context-aware technologies are successfully adapting to destination promotion requirements. To sum up, it appears that the characteristics of a context-aware destination APP have substantial effects on PE and PU of the APP. Conjoin the viewpoints of Plank and Faggi [21] and Alqatan et al. [22], we suggest the key characteristics of a context-aware destination APP are: localization, mobility, personalization, and proactive. Thus, it is expected:

- H5. The characteristics of a CAD-APP significantly affect the PE of the APP.
- H6. The characteristics of a CAD-APP significantly affect the PU of the APP.
- H7. Localization, mobility, personalization, and proactivity are critical characteristics of a CAD-APP.

C. Privacy Concerns of Context-Aware Mobile Applications

The context-aware technologies that raise myriad privacy issues due to their capability to collect, store, use, and disclose the locations of those who use them. According to the research in context-aware computing, privacy is an essential issue [23], [24], and the subject is often addressed in terms of how sensitive information is kept secured in the application. Privacy has been studied in a variety of online contexts and has been ranked as the top concern of Internet users, with various surveys reporting large majorities of online users being concerned about privacy [25]. Unfortunately, context-related privacy has received relatively less attention to date.

The commercial potential and rapid growth of context-aware mobile services have been accompanied by concerns over the collection and dissemination of personal information by service providers and merchants. The concerns center on the confidentiality of accumulated user's context data and other personal information, and the potential risks that users experience over the possible breach of confidentiality [26]. Context information often reveals the position of a person in real time, rendering the potential intrusion of privacy a critical

and acute concern. In general, users are quite concerned that the context data that is being used on mobile platforms could be used by service providers and other entities to track their location and behaviors [20]. Indeed, the Big Brother imagery looms in the popular press where context-aware services are discussed [27].

Privacy research has indicated that quite a few people feel uncomfortable disclosing demographical data [28], and that they dislike being 'tracked' for the purpose of gathering their contextual data [26], [29]. Privacy is a general concern, also for stationary application such as web-based applications, and studies focusing on keeping sensitive information safe are numerous. Junglas et al. [30] indicated that privacy concerns represent a major inhibiting factor in the adoption of context-aware services. Thus, the following hypotheses are postulated:

- H8. The user's privacy concern has a negative effect on his attitude towards adopting a CAD-APP.
- H9. The user's privacy concern has a negative effect on the adoption intention of CAD-APP.

Fig. 1 shows the proposed model based on the above analysis. PU and PE predict attitude and intention toward use. The link between PE and PU is also included. We draw upon Davis's extension of TAM to include an external variable, system characteristic, as an antecedent variable of PU and PE. Finally, the research model includes two control variables, which from past research on factors that influence PU, PU, attitude, or adoption intention. The first one is to predict attitude toward using and intended adoption of the CAD-APP without the influence of differing level of familiarity with destination. The second control variable is user's experience of APP use. The study includes experience of APP use in predicting PU and PE, since much user's perceptions of information technology (IT) is influenced by his experience in using IT.

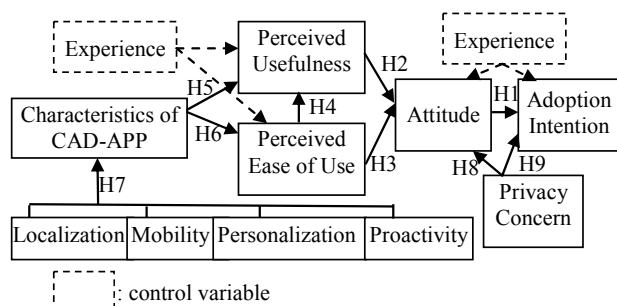


Fig. 1 The research model

III. AN EMPIRICAL STUDY WITH KAOHSIUNG TRAVEL APP

A. Action Kaohsiung Tourism APP

In this empirical test, the proposed model was examined through the use of a CAD-APP called Action Kaohsiung Tourism APP (AKT APP) published by Kaohsiung Tourism Bureau, Taiwan. The AKT APP, available for download for both iOS and Android, offers multiple options to travelers to Kaohsiung, including the current activity information in the

Kaohsiung area, attraction information, MRT route map, travel advice and consulting services, emergency aid information, up-to-the-minute, weather, and useful information for sightseeing, cuisine and delicacy, and accommodation. To demonstrate and promote the Kaohsiung Travel APP, the Kaohsiung Tourism Bureau posted an online introductory video of features and instruction of the APP on YouTube web site.

The AKT APP is the earliest officially published and the most well known city tourism APP in Taiwan. The APP intended to help travelers find points of Interest (POI) such as gifts and souvenirs, entertainments, transportation information, hotels, and restaurants in Kaohsiung in order to help them schedule their time more efficiently and increase the probability that they will visit places that they'll actually enjoy. By taking location, among other personal information, into the consideration, the system aims to provide better information and suggestions to users. An online introductory video of features and instruction of AKT APP, offered by Kaohsiung Tourism Bureau, is shown to survey subjects.

B. Questionnaire Design

Based on the hypothesized model (Fig. 1) developed through a detailed review of the related literature on user acceptance of technology, context-aware technology and privacy concern, a 35-item questionnaire was devised as a measurement scale for the research. Since the questionnaire from the literatures was originally developed in English, a university graduate with special training in English-Chinese translation translated it into Chinese. Another trained translator performed a back-translation to ensure that the original translation was accurate. After the draft was designed, a pretest was performed on users and experts familiar with CAD-APPs to modify ambiguous expressions. Based on the respondents' feedback, the questionnaire was adjusted to improve its readability and ensure its accuracy and appropriateness.

The first part of the questionnaire was intended to ensure the subject watching the introductory video and to understand their basic data and experience of using 3G mobile applications. All the measurement scales were nominal. The second part measured the subject's perception of each construct in the research model.

A pilot of the questionnaires was conducted by a group of 50 undergraduates and graduates from one university in Taiwan, who completed the questionnaire after they had accessed to and watched the online introductory video of Kaohsiung Travel APP. An exploratory factor analysis was performed on the data collected from the pilot study and the Cronbach's alpha value for each construct surpassing the standard threshold value of 0.7 [31], thus revealing good reliability.

C. Subjects

In 2013 Taiwan has a mobile phone penetration rate of 126.4%, with 3G or 3.5G phone users accounting for 79.7% of all users, and rising fast [32]. Therefore, this study focused on Taiwanese consumers as research subjects. All participants were required to have experiences of downloading one or more

APPs from a mobile application store. The sample was collected via the web-based survey with the survey message and the hyperlink address of the web questionnaire posted on several popular online forums and Taiwan tourism-related Facebook pages.

IV. DATA ANALYSIS, RESULTS AND DISCUSSION

Excluding unqualified answers (for instance, where the respondent gave wrong answer to a question related to the online introductory video), 259 valid responses were collected. Among the total valid responses, 79 respondents were males (48.6%) and 97 were females (51.4%). In terms of educational background, Master and Bachelor degrees accounted for 33.2% and 64%, respectively, and all the other subjects were high school diploma. In terms of experience of APP use, 32.6% downloaded for more than 20 APPs, 22.4% downloaded less than 5 APPs.

Data analysis was performed using Partial Least Squares (PLS). PLS can provide not only the examinations of all paths in the proposed model (structure model), but also supplementary analyses with underlying items (measurement model). Unlike covariance based approaches, PLS requires minimal demands on measurement scales, sample size, and distributional assumptions [33]. Chin [34] further recommended "rule of 10" guideline for PLS users: at least 10 cases per measured variable for the larger of (1) the largest latent factor block, or (2) the dependent variable with the largest number of incoming causal arrows in the model. In this research model, the first condition yields a minimum sample size required of 80, which is well exceeded by given sample size of 259. We used Smart PLS version 2.0 for data analysis. Smart PLS is a software application for the design of structural equation models on a graphical user interface. We conducted our analysis in two stages. First, we tested the measurement model to ensure that the constructs had sufficient psychometric validity and then we addressed the structural model in which the hypotheses were examined.

Measurement reliability was assessed using internal consistency scores, calculated by the composite reliability (CR) scores [33]. Internal consistencies of all variables are considered acceptable since they exceed 0.7, signifying acceptable reliability [31]. The CRs for all constructs range from 0.920 to 0.952. In addition, all items exhibit high loadings on their respective constructs. Thus, all constructs in the model exhibit good internal consistency. Convergent and discriminate validities are supported when the PLS indicators: (1) load much higher on their hypothesized factor than on other factors (own-loadings are higher than cross-loadings), and (2) when the square root of each construct's average variance extracted (AVE) is larger than its correlations with other constructs [34]. By comparing inter-construct correlations and AVE, all constructs share more variance with their indicators than with other constructs since all AVEs are well above 0.50 [35]. Thus, it can be concluded that the construct validity of this research variables can fulfill the statistical quality criteria.

Fig. 2 presents the structural measurement model using the PLS algorithm. The number in the circles in Fig. 2 means R^2 ,

which denotes to coefficient of determination. R^2 provides a measure of how well future outcomes are likely to be predicated by the model, the amount of variability of a given construct.

The structural model in PLS was assessed by examining the path coefficients, t-statistics and R^2 value [34]. R^2 is used to indicate the strength of the predictive model and the amount of variability of a given construct. The amount of variance in PU, PE, attitude, and adoption intention explained by the model was 0.487 and 0.245, 0.537, and 0.61, respectively.

To calculate the significances of the path coefficients, a bootstrapping procedure was carried out that yielded t values. Path coefficients with t values higher than 1.65 are significant at a 5% level. Fig. 2 shows the results of the hypotheses (H1 to H9) and the corresponding standard Beta coefficients. The proposed model shows 48.7% of the variance in PU was explained by SC and PE. All path coefficients showed statistically significant ($p < 0.01$) except the effects of privacy concern. The construct of system characteristic contributed to PU and PE with standard $\beta = 0.386$ and $\beta = 0.39$, respectively, which can be considered as strong influences. PE contributed to PU with standard $\beta = 0.39$ by which the influence is also significant. Both PU and PE significantly affect user's attitude toward using CAD-APP with standard $\beta = 0.559$ and $\beta = 0.248$, respectively. The adoption intention is only influenced by the construct of user's attitude with standard $\beta = 0.61$. Finally, among the four characteristics of CAD-APP, only the weight of proactivity is insignificant.

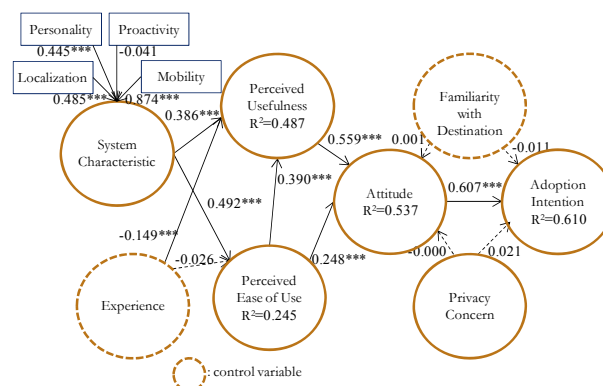


Fig. 2 The structural model: PLS results

V. DISCUSSION

Results from the study support that PU and PE are consistently important factors in formulating user's attitude and intention to adopt a CAD-APP. The characteristics of a CAD-APP significantly affect the users' perceived ease of use and perceived usefulness toward the APP. The following discussions of the research findings are divided into three sections. The first section discusses hypotheses H1–H6 generated from core elements of TAM. The second section examines hypothesis H7 in the verified critical constituents of CAD-APP characteristics. The last section explains the effects of privacy concern on user's attitude and intention toward adoption.

Fig. 2 indicates the adoption intention of CAD-APP significantly influenced by user's attitude toward usage. The result confirms the relationship between attitude and acceptance behavior of information technology and that both the perceived usefulness and ease of use have positive impact on user's attitude toward usage. That is, the higher perception of usefulness or ease of use toward the CAD-APP is, the more positive users' attitude and intention toward adopting the APP is. The results concur with the finding of Lai [7] that the PU and PE positively relate to travelers' attitudes toward using mobile devices and their intention to use them within the tourism context.

The result of this study is strongly supportive of the effects of system characteristics on PU and PE, with the hypothesized links, H5 and H6, being significant. Moreover, localization, mobility, and personalization, are significant characteristics of CAD-APP. The results confirm that a CAD-APP is characterized by its ability to support users (1) to utilize specific tourism services in any place and at any time. (2) to obtain specific tourism services depending on their location. (3) to get personalized services or products based on their preferences are critical features of mobile context-aware APPs affecting user's PE and PU. To provide proactive services, a CAD-APP is designed to automatically generate recommendations based on users' context. However, comparing with the previous three features, the weight of proactivity is slight. The result implies that a CAD-APP can be self-triggered to capture a priori what its users want is not a substantial feature to user.

Another important aspect is security and privacy concern. Contextual information mostly considers user profile information and other sensitive information. However, the effects of privacy concern on user's attitude and intention toward usage are insignificant. The findings discord with earlier privacy concern research, such as [36], that privacy is a predictor of users' adoption intention of mobile location-based service. The difference may be explained in terms of user's trust of Action Kaohsiung Tourism APP, used in this study, which was published by Kaohsiung city government. Besides, as suggested by [26], [37], adopting context-aware technology is a trade-off between system-specific concerns and perceived system specific benefits. Our finding indicates that the perceived benefit, in terms of usefulness and ease of use, has more effect on adoption intention than privacy concern. Regarding the effects of control variables, only the relationship between experience of APP use and perceived usefulness is significant. The negative path coefficient notifies that the more experienced user will assess better how useful an APP is and thus be choosier about its usefulness.

VI. IMPLICATIONS

The mobile APP is becoming people's commodities in everyday life. Most people who have the smartphone such as iPhone or Android phone usually download and use the APPs for tourism services. Therefore, we investigated the antecedents of adoption of context-aware APP within the tourism background.

This study has contributed to the understanding of the major features of system contribute to the perception and adoption intention of a context-aware destination APP. From a theoretical perspective, our proposed model provides several insights into the effects of context-aware mobile applications for destination tourism. Firstly, consumers will more appreciate a context-aware destination APP when it is able to support users' localization, personality, and mobility requirements. Our results confirm that TAM is conceived as an extremely appropriate baseline model for this study. Finally, in view of mobile tourism services, the perceptions of usefulness and ease of use more significantly influence the user's adoption intention of context-aware mobile tourism services than privacy concern does.

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