USER ACCEPTANCE AND ADOPTION OF WEATHER APPS ON SMARTPHONES: EXPLORATORY FINDINGS

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Abstract

In view of the widespread penetration and adoption of LBS supported Information Communication Technology (ICT) devices (particularly smartphones), this paper seeks to explore aspects of user acceptance, trust, and value of downloaded weather apps on smartphones. This research builds on previous user acceptance studies with its focus on mobile devices. Using Exploratory Factor Analysis (EFA), this research identified four underlying dimensions of user acceptance: Ease of Use, Trust, Value, and Ease of Adoption. The results of this study further affirm that aspects of Ease of Use and Ease of Adoption were elevated with respondents who downloaded a weather app for use on their smartphone. Future research could aim to further embed the identified factors of user acceptance of weather apps on smartphones across a broader range of ICT devices, including an expanded set of geographical locations and smartphone user groups.

Keywords: Location Based Services, weather apps, information systems, smartphones, TAMM.

Introduction

Before the Information Technology (IT) revolution and ensuing widespread availability of the Internet and computing devices [1, 2], weather information was broadcast through various non-electronic and electronic media [3]. However populations are now receiving routine and vital weather information through various ICT devices, such as personal computers, laptops, tablets, phablets and smartphones [4, 5]. As one example, weather information derived from a variety of meteorological technologies is ultimately broadcast to end users as general forecasts and weather warnings as text and Graphical User Interface (GUI) displays of radar and satellite imagery.

In view of the growing dependence of technology for weather information, this research aims to examine weather applications (apps) used on smartphones. Weather apps, for example, can now deliver weather information from the global meteorological organisations to various ICT devices of end users; notably the smartphone [6]. By means of a suitable technology user acceptance model, identified from an extensive review of extant literature, this research will endeavour to determine the influence of particular constructs found within the model, with an emphasis on the influence that core characteristics of Ease of Adoption, Ease of Use, Trust and Perceived Value have upon user acceptance of Information Systems (IS) based weather apps used on smartphones.

Literature Review

Technology is by nature progressive, with new and updated device innovations constantly being released. In response, many adaptations and extensions of the seminal Technology Acceptance Model (TAM) by Davis [7] have been developed, including the Technology Acceptance Model 2 (TAM2) by Venkatesh and Davis [8], and the Unified Theory of Acceptance and Use of Technology model (UTAUT) by Venkatesh, Morris, Davis and Davis [9]. However of particular interest to this paper is the Technology Acceptance Model for Mobile Services (TAMM) by Kaasinen [10]. As illustrated in Fig. 1, TAMM forms a modification and extension of the original TAM model by Davis [7], replacing Perceived Usefulness with Perceived Value and two new perceived product characteristics influencing Intention to Use, namely Trust and Perceived Ease of Adoption [10].

For example, according to Kaasinen et al. [11], in those workplace environments for which TAM was originally developed [12], trust was implied to the user; as the delivery of information and services and usage of personal data was considered reliable. However in the TAMM model, Trust is included as a new, distinct element of user acceptance that can be tested, as evidenced by Kaasinen [10].

Method

A quantitative, web–based survey instrument was utilised in this study. The Internet provides a particularly appealing means for data collection. The advantages of reduced response time, lowered cost, ease of data entry, flexibility in format, and an ability to capture additional response–set information are common to Web–based data

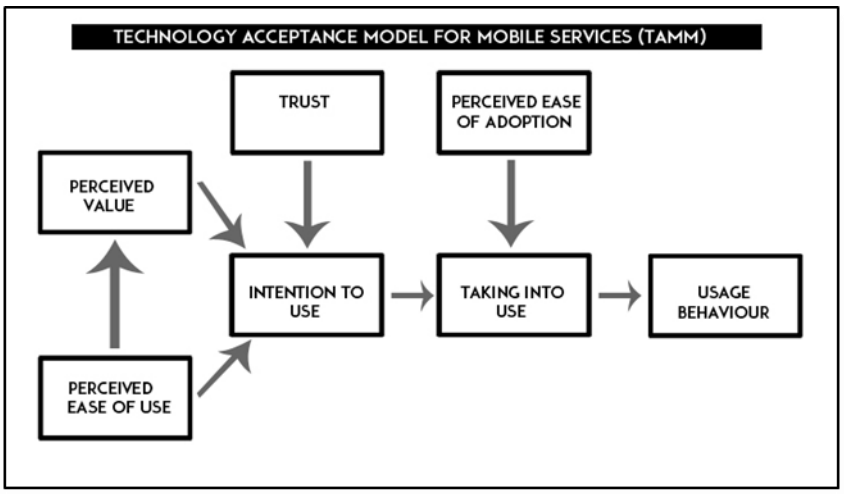

Figure 1. Technology Acceptance Model for Mobile Services [10]

collection across a variety of disciplines [13]. Respondents invited to participate in the research encompassed users of weather apps on smartphones from a specific target population, namely students and staff from Southern Cross University, a regionally university based in Australia. Thus a nonprobability self–selection sampling technique was utilised for the data collection. Exploratory Factor Analysis (EFA) was utilised during the analysis phase of this study to determine the underlying dimensions of user acceptance of smartphone-based weather apps, based on the perspective of a sample of smartphone users. In utilising EFA, it is important to review the number of cases/sample size when considering the use of factor analysis as an analytical tool. Hair Jr. et al. [14] suggest that the sample size should be 100 or larger. Others postulate the need for higher sample sizes, with Hutcheson and Sofroniou [15] recommending at least 150–300 cases, and Cattell [16] supporting a 250 case/sample rule.

Data Analysis

Data analysis was carried out using SPSS. Data collection resulted in 178 usable responses being received. To establish whether the data appeared to be normal, indicators such as mean, standard deviations and measures for skewness and kurtosis were inspected [17]. Additionally, the 5 per cent trimmed mean (a measure provided by SPSS) for each TAMM item was ascertained. The difference between the original mean and the new trimmed mean was very small across the measures utilised in the analysis. Thus, there is a reasonable assumption that normality has been met.

Hair Jr. et al. [14] maintains that in studies using approximately 200 cases, factor loadings to be significant should be above .40, however when factor analysis involves 100 cases, a higher factor loading should be determined as the minimum cut-off [14]. The current research utilised the results from 178 respondents for data analysis; and thus recognises a minimum factor loading of .45 when analysing factors. Correlations within the rotated component matrix, meeting this minimum measure are highlighted in Table 1.

TABLE I. **PRINCIPLE COMPONENT MATRIX - 4-FACTOR SOLUTION**

	Factor 1	Factor 2	Factor 3	Factor 4
Ease to Navigate Menus	.840			
Ease to Become Skilled	.743			
Ease to Interact	.731			
Ease to Configure	.706			
Ease to Customise	.657			
Ease to Learn	.625			
Ease to Understand Features	.556			
Ease to Start Using		.849		
Ease to Locate on Phone		.798		
Ease to Start Using Download		.773		
Ease to Locate App Store		.763		
Complexity of Install		.534		
Accuracy			.912	
Reliability			.871	
Usefulness			.744	
Entertainment				.855
Appeal				.723
Enjoyment				.716
Factor Mean (on 7 point scale)	5.8355	6.2831	5.3390	4.7697

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalisation[a]

a. Rotation converged in 6 iterations

The principal components analysis identified 4 factors with eigen values greater than 1. The scree test of the data was also inspected appearing to give support for only 4 factors to be extracted. Thus it was determined a 4 factor solution proved to be a meaningful factor solution. The named factors are shown in Table 2.

TABLE II. **FACTOR NAMES AND ASSOCIATED VARIABLES/MEASURES**

Factor Name	**Variables**
Ease of Use	Usage variables such as ease of learning, ease of gaining usage skills, ease of understanding the features of the app, ease of configuration, ease of navigation, ease of interaction and customisation.
Ease of Adoption	Several adoption-based variables including locating the app for download, in addition to the downloading process itself; complexity of app installation, ease of locating the app on the smartphone, and ease of initial use.
Trust	Trust-themed variables such as reliability, accuracy and usefulness.
Value	Given a strong theme of value throughout the three variables being entertainment, enjoyment, and appeal.

The factor means were found to differ across all four factors (as noted in Table 2).

Participants who downloaded a weather app scored the factor, Ease of Adoption (Factor 2) very highly, with the mean for this factor being 6.2831. Possible reasons for this result could be that users who are motivated to download a weather app do so with an expectation of seamless usage adoption. The overall findings from the 178 respondents thus identified (Perceived) Ease of Adoption as the dimension indicative of the most important components of user acceptance.

The factor named Ease of Use (Factor 1) also scored highly, with a factor mean of 5.8355 (on a 7 point scale). It should be noted that regardless of type of smartphone (i.e. utilising either iOs, Android or Windows as its operating system), most respondents found the skills in each of the measures (contained within the factor) easy to acquire. This was evidenced by the overall results for all five measures of Ease of Use having their mean on the positive side of the midpoint Likert scale. The measures (questions) posed to respondents were drawn from previous TAM research and applied to the TAMM model.

The Trust factor for users of a downloaded weather app scored on the positive side of the midpoint, with a mean of 5.3390. The Trust factor may be enhanced with greater accuracy, reliability, and usefulness on a downloaded weather app. This may include features such as synoptic weather charts, extended marine forecasts and more extensive rain radar coverage.

The Value factor, whilst retaining the lowest mean of all of the factors (4.7697) for users of a downloaded weather app, still scored on the positive side of the scale midpoint. This showed that respondents using a downloaded app were of the opinion that their app was enjoyable, appealing and entertaining. As there are collectively hundreds of weather apps available from Google Play Store, iTunes and Windows, the appeal of an app relates to a value placed on the app from the perspective of the user. Therefore users may expect that by downloading a third party weather app, visual appeal aspects may be enhanced.

Conclusion

Derived from the original Technology Acceptance Model by Davis [7], the Technology Acceptance Model for Mobile Services (TAMM) by Kaasinen [10] was used in the current research as a core theoretical framework. The original research by Kaasinen [10, 18], utilised TAMM in testing weather apps in the context of a pilot study of location aware SMS for weather and road conditions on mobile phones. In this context of the current paper, the key research question (of user acceptance and adoption of downloaded weather apps on smartphones) was addressed and supports the theoretical framework, the Technology Acceptance Model for Mobile Services (TAMM) and its constructs: Perceived Ease of Use, Perceived Value, Trust, Intention to Use, Perceived Ease of Adoption, Taking into Use and Usage Behaviour. The TAMM was found in this research to be a stable, robust and valid model for predicting usage behaviour of LBS weather applications on smartphones. In particular, the four factors (Ease of Adoption, Ease of Use, Trust and Value) highlighted in this study may form an important practical foundation for those involved in the growing market of LBS services, as such factors speak to both the growth and acceptance of such services [11, 19].

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