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Social acceptance of location-based mobile government services for emergency management

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ABSTRACT

Location-based services deployed by governments can be used to assist people manage emergencies via their mobile handsets. Research delineating the acceptance of public services in the domain of emergency management has been scantly investigated in information systems. The main aim of this study is to assess the viability of location-based mobile emergency services by: (i) exploring the issues related to location-based services and their nationwide utilisation for emergency management; (ii) investigating the attitudinal and behavioural implications of the services; and (iii) examining the social acceptance or rejection of the services and identify the determinants of this acceptance or rejection. The results reveal that both attitude and perceived usefulness demonstrate a good prediction power of behavioural intention. Although perceived ease of use was found not to be a predictor of attitude, the results affirm its influence on perceived usefulness. The results also demonstrate the role of trust as the most influential determinant of individual perception of the usefulness of the services. Further, the results indicate that only the collection of personal location information, as a perceived privacy concern, had a significant negative impact on trust. Implications and future research are also discussed.

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1. Introduction

Emergencies and disasters have been part of our existence since the recording of history and will always be part of the continuing cycle of life and death. The 2001 terror attacks on New York City, the 2004 Indian Ocean Tsunami, the 2010 Haiti earthquake, and the 2012 Hurricane Sandy in the United States and Canada are just a few telling examples of what societies can endure. According to the United Nations' International Strategy for Disaster Reduction Platform (2005), one of the main reasons for the loss of life in an emergency event is lack of early warning information. Therefore, in response to the lack of timely information, governments around the world have been exploring mobile phones as an additional feasible channel for disseminating information to people in emergency situations. The Short Message Service (SMS) and the Cell Broadcast Service (CBS) currently represent the feasible services that could be utilised for geo-specific emergency purposes as they can operate with almost all kinds of mobile handsets available today (Aloudat and Michael, 2010). We call such a service "location-based mobile government service for emergency management".

Samsioe and Samsioe (2002) argued that an electronic service that has location capabilities should be able to fulfil the following three separate activities so as to be accurately defined as a location-based service (LBS): (i) estimate the location of the device; (ii) produce a service based on the estimated location; and (iii) deliver the location-enhanced service to that

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device. Accordingly, location-based services (LBS) for emergency management would involve the following: first, the location of the mobile handset can be estimated by using Cell-ID related technologies (Spiekermann, 2004); second, the mobile telecommunications network can produce an emergency information service, formed as an SMS or CBS, on events such as fire, flood, heavy rain, or hurricane, around the estimated location; and third, the warning message can then be sent to mobile handsets in the vicinity of the emergency to alert people.

After examining the related literature, it is clear that there is a marked scarcity of theoretical and empirical research that touches on the issues pertaining to the nationwide deployment of LBS for emergency management by governments. Furthermore, early studies have neglected the assessment of the acceptance and adoption of these services, along with their determinants, in the public domain. Accordingly, we seek to fill this gap by assessing the viability of location-based mobile government services within the national emergency management arrangements; Australia as a case study. To achieve this, we aim to investigate the social acceptance or rejection of location-based mobile government emergency services in Australia and identify the determinants of the acceptance or rejection.

The rest of this paper is organised as follows. Section 2 reviews the existing literature on the issues related to utilising LBS for emergency management. Section 3 develops a research model that demonstrates the acceptance of the services and their determinants. Section 4 describes the research method applied in this study. Section 5 reports the data analysis conducted to test the research model and Section 6 provides a discussion of the results. The contributions and limitations of this study and directions for future research are discussed in Section 7.

2. Issues related to LBS and emergency management

2.1. Visibility of LBS as a solution for emergency management

An individual may not be aware of the possible utilisation of location-based mobile phone services for emergency management and, therefore, it could be argued that the direct advantages or disadvantages of such utilisation would not be visible to him or her (Karahanna et al., 1999; Kurnia and Chien, 2003). An early explanation of these common phenomena came from Zajonc (1968) who defined it as the "mere exposure effect". This describes the case where a person does not know or has little knowledge about a phenomenon, but by repeatedly exposing him or her to related stimulus objects, the repetition is capable of changing his or her beliefs towards the phenomenon either positively or negatively.

One of the key attributes of the Diffusion of Innovation (DOI) Theory by Rogers (1962) is *observability*, which was later segmented by Moore and Benbasat (1991) into two distinct constructs of *demonstrability* and *visibility*. The interpretation of *visibility* surmises that an innovation may not be new, but its benefits could be unknown to the public or even to governments. This is probably the case with LBS where these services have been available for several years, yet their general usage rates, specifically in the domain of emergency management are still extremely limited worldwide (Frost and Sullivan research service, 2007; O'Doherty et al., 2007; Aloudat and Michael, 2011).

2.2. The quality features of location-based emergency services

Service quality is defined as "a global judgement, or attitude, relating to the superiority of the service" (Parasuraman et al., 1988, p. 16).The quality of a service is, therefore, a result of subjective understanding, evaluation, and judgement of its merits. This understanding could, unfortunately, raise several judgement-related issues regarding the desired features of a service. Such issues could be easily augmented in the world of electronic services (e-services), such as LBS, especially in the absence of widely accepted and reliable instruments to quantifiably measure the quality features of an e-service. As a direct result of the absence of "agreed-upon" e-service quality models for all kinds of e-services, researchers have been compelled to use traditional service quality scales, such as the SERVQUAL model of Parasuraman et al. (1988), to measure the quality features of e-services (Liljander et al., 2002). In these traditional models however the interpersonal character of the delivery has the main impact on determining the quality of the service and, therefore, such models cannot truly be applied to the paradigm of e-services (Boshoff, 2007). Several studies suggested alternative instruments to measure e-service quality. Examples include Kaynama and Black (2000), and Zeithaml et al. (2000, 2002). But, Boshoff (2007) strongly argued that most of these proposed instruments had flaws since they were either too narrowly focused on a specific kind of e-services or failed to address the e-service from the perspective of the medium through which the service is provided or delivered.

In general, the quality of an e-service has been discerned as a multifaceted concept with different dimensions proposed for different service types (Zeithaml et al., 2002; Zhang and Prybutok, 2005). Unfortunately, in the context of LBS there is no existing consummate set of dimensions that can be employed to measure the quality features of the services and, subsequently, to measure their impact on an individual's opinion about the utilisation of the services for emergency management. Therefore, defining a dimensional measurable set for location-based mobile phone emergency services would not be a straightforward task since there is almost no scholarly research regarding such a set. Nonetheless, the quality dimensions of a location-based mobile phone service that are expected to be relevant to emergency situations were adapted from Liljander et al. (2002), but were revised to accurately reflect the quality measurements of LBS in their new context (i.e. emergency management). The dimensions include *reliability*, *responsiveness*, *customisation*, *assurance/trust*, and *user interface*.

The interpretation of the *reliability* concept follows Kaynama and Black (2000), Zeithaml et al. (2002)

It is reasonable to postulate that the success of a location-based mobile phone emergency service depends on the ability of the solution provider to disseminate the service information to a large number of people in a timely fashion. Due to the fact that fast response to changing situations or to people's emergent requests is considered as providing timely information, then timeliness is closely related to responsiveness (Lee, 2005). Therefore, investigating the *responsiveness* of the LBS would be relevant in this context. In general, examining the influence of *currency*, *accuracy*, and *responsiveness* quality features on public opinion is expected to provide an insight into the extent to which LBS is generally considered sufficiently trustworthy to be utilised for emergency management.

The *User interface* dimension comprises factors such as aesthetics, which could not be evaluated in this exploratory research as respondents will not have access to the LBS enabled applications for emergency management. *Customisation* refers to the state where information is presented in a tailored format to the user. Since LBS is customised based on the location of the recipient's mobile handset and also on the type of information being sent, customisation is already an intrinsic quality in the core features of location-based mobile phone emergency services. Therefore, the service quality dimensions that are expected to impact on the acceptance or rejection of location-based mobile phone emergency service, and accordingly are investigated include:

(1) Perceived currency: the perceived quality of presenting up-to-the-minute service information during emergencies.
(2) Perceived accuracy: the individual's perception about the conformity of location-based mobile phone emergency service with its actual attributes of content, location, and timing.
(3) Perceived responsiveness: the individual's perception of receiving a prompt information service in the case of an emergency (Parasuraman et al., 1988; Liljander et al., 2002; Yang et al., 2003).

2.3. Risks of utilising LBS for emergency management

Risk of varying types exists on a daily basis in human life. Koller (1988) believed that the nature of the situation determines the type of risk and its potential effects. In extreme situations such as emergencies, risk perceptions stem from the fact that the sequence of events and the magnitude of the outcome are usually unknown or cannot be totally controlled. Risky situations affect public confidence in technology used in such situations (Im et al., 2008). Uncertainty is a salient element of risk. Two distinct types of uncertainty have been differentiated by Bensaou and Venkatraman (1996): behavioural and environmental. In the context of LBS, behavioural uncertainty arises when users cannot ascertain the behavioural actions of other LBS parties, especially in extreme events. Risk perceptions may be projected here in several forms. First, a personal risk could be perceived because the LBS user may not be able to guarantee that the service provider will fulfil its expected role under extreme emergency conditions. Physical, psychological, and social risk perceptions could all be envisaged here as personal risks (Jacoby and Kaplan, 1972). Second, the decision might hold a perception of economic risk as it might lead to a monetary loss in private properties or assets. Third, a privacy risk may be perceived since there can be some concerns that the service provider would act opportunistically in emergencies in a way that would disclose valuable personal information to other parties, collect an inordinate amount of information, or use the collected information for purposes other than and beyond the emergency situation itself and without any prior consent from the LBS user.

The second type of uncertainty is environmental, which originates because emergencies, by their nature, cannot usually be predicted in their exact timing or severity. Thus, the LBS user may reasonably assume that in an extreme condition the underlying infrastructure supporting location-based mobile phone emergency services would be compromised as in any other telecommunications model. Several risk perceptions may also be projected here. First, a perception of a personal risk could originate when the user is uncertain whether or not the LBS infrastructure would cope with the emergency situation, which might lead to a potential risk to the personal safety or the safety of important others (i.e. family members, friends, or working companions). Again, physical, psychological and social risk perceptions could all be conceived here as personal risks (Jacoby and Kaplan, 1972). Second, a perception of a performance risk emanates from the possibility that the location-based emergency service may suffer or not perform as it is intended or desired. There may not be a perception of a direct personal risk to the individual's own safety, but the idea of a service failure when it is most needed could increase concerns about service performance and resilience in emergencies. A third environmental risk could be perceived financially when there is a possibility of monetary loss of private property or assets due to service failure (Featherman and Pavlou, 2003).

2.4. Trust in LBS for emergency management

Trust has long been regarded as an important aspect of human interactions and mutual relationships. Basically, any intended interaction between two parties proactively requires an element of trust predicated on the degree of certainty in one's expectations or beliefs of the other's trustworthiness (Mayer et al., 1995; Li, 2008). In the "relatively" uncertain environments of e-services, including LBS (Kaasinen, 2005; Lee, 2005), uncertainty leads individuals to reason about the capabilities of LBS and its expected performance in emergency situations, which eventually brings them to either trust the service by willingly agreeing to use it or distrust the service by simply refusing to use it. In emergencies, individuals may consider the possible risks associated with LBS before using such services. Therefore, individuals are likely to trust the service and engage in a risk taking relationship if they perceive that the benefits of using LBS surpass its risks. However, if high levels of risk are perceived, then it is most likely that individuals will not have trust in the service and, therefore, will not engage

in risk-taking behaviour by using it (Mayer et al., 1995). Consequently, it could be posited that trust in an LBS is a pivotal determinant of utilising the services for emergency management where great uncertainty is always present.

Trust has generally been defined as the belief that allows a party to willingly become vulnerable to the trustee after having taken the characteristics of the trustee into consideration, whether the trustee is another person, a product, a service, an institution, or a group of people (McKnight and Chervany, 2001). In our context, the definition encompasses trust in the government providing the service and trust in the technology and underlying infrastructure through which the service is provided (Carter and Bélanger, 2005). But, since willingness to use the location-based mobile phone emergency service is an indication that the person has considered the characteristics of both the service and the service provider, including any third parties, then it is highly plausible to say that investigating trust propensity in the service will provide a prediction of trust in both the service and its provider. The ability to provide such a prediction is based upon the importance of trust in the service and its underlying technologies, which has been clearly recognised before in acceptance and adoption literature (Kini and Choobineh, 1998; Kim et al., 2001). It could be argued, however, that trust should be examined with the proposition that the person knows or, at least, has a presumption of knowledge about the service, its benefits, and the potential risks associated with its utilisation. Nonetheless, it should be noted here that trust, per se, is a subjective interpretation of the actual trustworthiness of the service, given the current extremely limited utilisation of LBS in the domain of emergency management.

2.5. Privacy concerns pertaining to LBS emergency services

A classical and commonly quoted definition of privacy is that it is "the claim of individuals, groups, or institutions to determine for themselves when, how, and to what extent information about them is communicated to others" (Westin, 1967, p. 7).

In the context of LBS, the traditional commercial use of the services where a high level of detail about the user's information is regularly available for the mobile service provider, may not raise much sensitivity towards privacy from users since the user's explicit consent is a prerequisite for initiating the services in most cases. However, in emergencies, pertinent government departments and law enforcement agencies have the power to temporarily set aside the person's right to privacy by not informing the person when, where, and for how long his or her personal information would be collected and/or monitored. This is based on the assumption that the consent of the person is already implied when location information is collected and/or monitored in emergency situations. Nonetheless, the idea of their personal information perennially availability to other parties and the belief that the individual has incomplete control or no control over the collection and/or surveillance, the extent, the duration, the timing, or the amount of information being collected could raise privacy concerns.

Good intentions are generally assumed in the relation between the government and its people, as governments usually communicate with the individuals in regard to what kind of data will be collected in emergencies, the extent of the collection, and when data will be collected. However, the implications of suspending consent of the person, even temporarily, may have long-term adverse effects and negative impacts on public perception of LBS solutions in general. This also has the potential to generate debate on the right of the individual in an absolute privacy state and the power of governments to dispense with that right of privacy (Perusco et al., 2006), even when the services are suggested by the government for emergency management purposes.

Four privacy concerns have been identified by Smith et al. (1996). They are *collection*, *unauthorised secondary use, errors in storage, and improper access* of the collected data. These concerns can be examined when investigating privacy concerns pertaining to LBS (Junglas and Spitzmuller, 2006). *Collection* is defined as the concern that extensive amounts of location information or other personal identifiable information would be collected by the government when using LBS during emergencies. *Unauthorised secondary use* is defined as the concern that information is collected for emergency purposes using LBS, but will ultimately be used for other purposes by the government without the explicit authorisation/consent of the individual for those other uses. *Errors in storage* describe the concern that the procedures taken to protect against accidental or deliberate errors in storing the location information while utilising LBS are inadequate. *Improper access* is the concern that the stored location information is accessed by parties in the government who do not have the authority to do so.

3. Research model and hypotheses development

A special adaptation of the Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975; Ajzen and Fishbein, 1980) has been introduced by Davis (1986, 1989) in the form of a Technology Acceptance Model (TAM). According to TRA, the actual behaviour of an individual is determined by the individual's intention to perform that behaviour. Such intention is the result of a joint function and/or influence of the subjective norms and the individual's attitude towards engaging in that specific behaviour. TAM postulates that the usage of a technology (i.e. the actual adoption of the technology) can be predicted as behaviour by the individual's intention to use the technology. The individual's intention to use can be determined by his or her attitude towards using that technology. In TAM, both the attitude and intention are postulated as the main predictors of accepting the technology. The attitude is presumed to act as a mediator between the behavioural intention and two key influential beliefs: the perceived ease of use of the technology, and its perceived usefulness. TAM posits a direct link between perceived usefulness and behavioural intention. The model also posits that the perceived usefulness of the technology is directly influenced by the perceived ease of use of that technology.

Firstly and based on original TAM, the following hypotheses are formulated:

H1. Intention to use location-based mobile phone emergency services is positively related to attitude towards the services.

H2. Intention to use location-based services in emergencies is positively associated with perceived usefulness of the services.

H3. Attitude towards location-based mobile phone emergency services is positively associated with perceived usefulness of these services.

H4. Attitude towards using location-based mobile phone emergency services is positively associated with perceived ease of use of the services.

H5. Perceived ease of use of location-based services has a positive impact on perceived usefulness of the services for emergency management purposes.

Due to its parsimony and predictive power, TAM has been widely applied, empirically validated, and extended in many studies related to user acceptance of information technology, (see for example, Venkatesh, 2000; Venkatesh and Davis, 2000; Pavlou, 2003; Djamasbi et al., 2010; Mouakket and Al-Hawari, 2012). However, TAM is a general model that only provides overall information about technology acceptance and usage and does not specify the determinants of perceived usefulness and perceived ease of use as the two main beliefs included in the model. Therefore, further information is needed regarding the specific factors that may affect a certain technology's usefulness and ease of use from individual perspective; as this can guide the design and development of the technology in the right direction (Mathieson, 1991). Indeed, Venkatesh and Davis (2000) suggested that user behavioural beliefs included in TAM could be affected by external variables. TAM also theories that the effects of external variables on intention to use are mediated by perceived usefulness and perceived ease of use (Venkatesh, 2000). As such, this research utilises visibility, perceived risk, perceived service quality, perceived privacy concerns, and trust as external factors affecting perceived usefulness and perceived ease of use in TAM.

The rest of the research hypotheses, presented in the following sections, are completely consistent with the structural formulation of TAM and do not violate in any way TAM's grounded theory of TRA. All the hypothesised effects of the external constructs in the proposed research model would only be exhibited on the internal variables of the model (i.e. attitude and intention) through the full mediation of TAM's internal beliefs (i.e. perceived usefulness and perceived ease of use). Any other arrangement beside those mentioned must be considered as another model, and not TAM.

3.1. Effect of perceived service quality on perceived usefulness

It could be posited that an individual perception of how useful LBSs are in emergencies would be highly influenced by the degree to which the individual perceives the services to be accurate, current, and responsive. The research conceptual model follows the same rationale as TAM, which postulates the perceived ease of use of a technology as a direct determinant of its perceived usefulness. Perceived ease of use is defined as the degree to which the individual believes that using LBS would be free of physical and mental effort (Davis, 1989). It is then justifiable to postulate that ease of use is directly related to technical service quality features of LBS since the individual's evaluation of the service's ease of use is closely associated with the convenient design of the service itself. This is perhaps why ease of use has been conceived by several researchers as one of the core dimensions of service quality (Zeithaml et al., 2002; Yang et al., 2003; Zhang and Prybutok, 2005). Building upon this and following the trails of TAM, the currency, accuracy, and responsiveness service quality constructs are theorised in the research model as direct determinants of the perceived usefulness of the location-based mobile phone emergency service. The following hypotheses are proposed:

H6a. There is a positive relationship between perceived responsiveness of the location-based mobile phone emergency service and its perceived usefulness.

H6b. There is a positive relationship between the perceived currency of the location-based mobile phone emergency service and its perceived usefulness.

H6c. There is a positive relationship between the perceived accuracy of the location-based mobile phone emergency service and its perceived usefulness.

3.2. Effect of visibility on perceived usefulness

Visibility is defined as the extent to which the actual use of location-based mobile phone emergency service is observed as a solution by the individual. Following a line of reasoning in former studies, such as Karahanna et al. (1999) and Kurnia and Chien (2003), the perception of an individual of the usefulness of the location-based mobile phone emergency service is positively related to the degree to which the service solution is visible to that individual. The following hypothesis is presented:

H7. Perceived usefulness of the location-based mobile phone emergency service increases as the visibility of the service application increases in the context of use.

3.3. Effect of perceived risk on perceived usefulness

As it is practically rational to believe that the individual would perceive different types of risk during an emergency situation, it might be quite difficult to examine each risk facet as being separate to others since they can be inextricably intertwined in such situations. Therefore, following the theoretical reasoning of Pavlou (2003), the perceived risks will be investigated as a higher-order uni-dimensional concept that embraces the two types of uncertainty identified earlier, that is, behavioural and environmental.

A number of former studies have shown that public perceptions of the inherent risks in e-services can be a pivotal barrier to the acceptance of the services (Campbell and Goodstein, 2001; Featherman and Pavlou, 2003; Pavlou and Gefen, 2004; Heijden et al., 2005; Lee and Rao, 2005; Xu et al., 2005; Junglas and Spitzmuller, 2006; Horst et al., 2007). But, more importantly, in the mobile telecommunications environment people feel more vulnerable to the risks of the underlying technologies since there are always concerns about information loss or delivery failure because of the nature of the media through which information is usually delivered to them (Bahli and Benslimane, 2004).

Based on the interpretations of Pavlou and Gefen (2004) and Heijden et al. (2005), the perceived risk is defined as the individual belief as to the potential loss and the adverse consequences of using location-based mobile phone emergency services and the probability that these consequences may occur if the services solution is used for emergency management. Bearing in mind the high degree of uncertainty that is usually associated with emergency situations, it is argued that perceptions of risk would have a highly negative impact on individual perception of the usefulness of location-based mobile phone emergency services. Therefore, the following hypothesis is presented:H8 Perceived risks from using location-based mobile phone emergency services have a negative influence on the perceived usefulness of the services.

3.4. Effect of trust on perceived usefulness

Despite the general consensus of the existence of a mutual relationship between trust and risk, the two concepts should be investigated separately when examining their impact on public acceptance of LBS since they usually show different sets of antecedents (Junglas and Spitzmuller, 2006). Trust and perceived risks are primarily essential constructs when uncertainty is present (Mayer et al., 1995). However, each has a different type of interrelationship with uncertainty. While uncertainty augments the risk perceptions of using location-based mobile phone emergency services trust reduces the individual's concerns regarding the possible negative consequences of using the services, thus alleviating the uncertainty around services performance. Therefore, since trust in the LBS can lessen uncertainty associated with the services, thus reducing the perceptions of risk, it is theorised that the perceived risk is negatively related to an individual's trust in the service. This is in line with a large body of former empirical research, which supports the influence of trust on perceptions of risk (Gefen et al., 2003). In addition, by reducing uncertainty trust is assumed to create a positive perspective regarding the usefulness of the services and provide expectations of an acceptable level of performance. Accordingly, trust is postulated to positively influence the perceived usefulness of location-based mobile phone emergency services and, therefore, the following hypotheses could be proposed:

H9. Trust in location-based mobile phone emergency services positively influences the perceived usefulness of the services.

H10. Trust in location-based mobile phone emergency services negatively impacts the risks perceived from using the services.

3.5. Effects of perceived privacy concerns on usefulness, trust, and risk

Perceived privacy concerns are expected to have a direct negative impact on the perceived usefulness of LBS. In addition, other prominent constructs of trust and perceived risks are also assumed to have mediating effects on the relationship between perceived privacy concerns and perceived usefulness since both constructs (i.e. trust and perceived risks) could be reasonably regarded as outcomes of the individual assessment of the privacy concerns (Junglas and Spitzmuller, 2006). For instance, if a person is not greatly concerned about the privacy of his or her location information, then it is most likely that that individual trusts the services, thus perceiving them to be useful. On the other hand, if the perceptions of privacy concerns are high, the individual would probably not engage in a risk taking behaviour, due to the high levels of risks perceived, thus resulting in lower perceptions of the usefulness of the services. Building on this reasoning, the perceived privacy concerns are theorised in the research model as direct determinants of both trust and risk perceptions. While the perceived privacy concerns are postulated to have a negative impact on trust in the services, they are theorised to positively influence on the perceived risks associated with using LBS.

Reductions in information privacy are generally the product of two types of activities: observing information about the person and sharing this information with others (Bridwell, 2007). Accordingly, the influences of two pertinent privacy concerns (i.e. collection and unauthorised secondary use) on individual acceptance of location-based mobile phone emergency services are proposed as the bases for the following hypotheses:

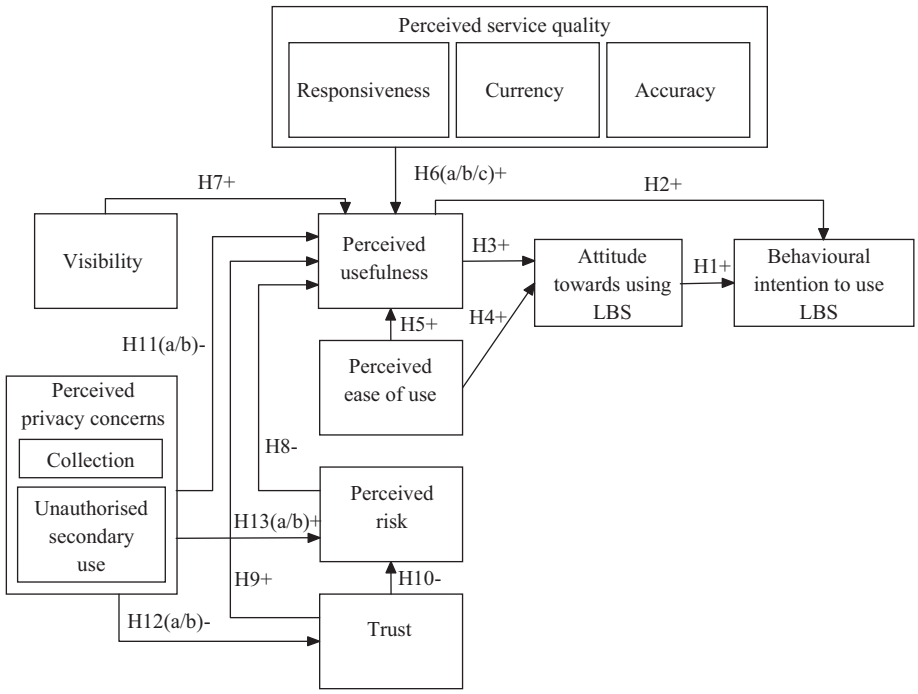

Fig. 1. A conceptual model of location-based mobile phone emergency service acceptance.

H11a. Collection as a perceived privacy concern negatively impacts the perceived usefulness of location-based mobile phone emergency services.

H11b. Unauthorised secondary use as a perceived privacy concern negatively impacts the perceived usefulness of location-based mobile phone emergency services.

H12a. Collection as a perceived privacy concern has a negative impact on trust in location-based mobile phone emergency services.

H12b. Unauthorised secondary use as a perceived privacy concern has a negative impact on trust in location-based mobile phone emergency services.

H13a. Risks perceived from using location-based mobile phone emergency services are positively associated with perceived privacy concerns about collection.

H13b. Risks perceived from using location-based mobile phone emergency services are positively associated with perceived privacy concerns about unauthorised secondary use.

Based on the proposed hypotheses, the research conceptual model is illustrated in Fig. 1.

4. Research method

4.1. Research context

Rapid proliferation of mobile platforms presents a real opportunity for the Australian Government to utilise location-based mobile services as an integral information lifeline in times of perils, especially now when Australians are becoming increasingly mobile; not only in the way they move, live and communicate, but also in the way they acquire information relevant to their whereabouts and various daily life activities. Utilising location-based services for emergency management has the potential to augment the overall levels of safety by increasing the situational awareness among people about threatening events in their immediate surrounds, thus helping to avoid unnecessary casualties, injuries or damages. The value of location-based mobile emergency services in Australia was realised after the Australian Federal, States and Territories Gov-

ernments announced in 2009 their future intentions to utilise mobile services under the National Emergency Warning System (NEWS).

Location-based mobile services could help to find a solution to one of the intrinsic issues in most conventional emergency warning systems today that usually require the recipient to be anchored to an information channel at the time information is disseminated for one to receive an alert or warning message. However, given the current lack of research, not only in Australia but also globally, in relation to understanding the various implications of a nationwide utilisation of various mobile government location-based services for personal safety and public warning purposes, this study contends the pressing need for such a research. The results of this study would be of high importance to government, business and society at large.

4.2. Survey questionnaire

As attitude and intention are postulated as the main predictors of social acceptance or rejection of location-based mobile government emergency services, the researchers used a survey to examine and understand public attitudes and intentions towards using the services once the services are introduced by the Australian Government for emergency management solutions in the future. A five-point Likert rating scale was used in the questionnaire part of the survey. Each set of items or questions reflects a construct in the research conceptual model. The items and the studies from which the items were adapted can be found in Appendix A. At the end of the questionnaire, an open-ended question was used to solicit general comments, opinions, and additional information from the survey participants about the services.

4.3. Survey testing

Validating and testing the survey are essential processes in empirical information systems research (Straub, 1989). The survey testing was carried out in three separate steps. First, an observational study was conducted with two persons, both with minimal knowledge about location-based services. This lack of former knowledge was necessary to calculate the average time needed for each person to become acquainted with the topic of the study and complete the survey. Second, 600 pilot surveys were randomly distributed by hand. The results of the pilot survey provided the researchers with the needed grounds for testing the survey before its large-scale deployment. Third, the internal reliability of the survey was evaluated. Reliability reflects the internal consistency of the scale items measuring the same construct for the selected data if the survey is redeployed on the same population. After revision, values for all measurements were higher than the common threshold value of 0.7. The evaluation results (i.e. Composite reliability and Cronbach's alpha scores) of the internal reliability are presented in Table 1.

4.4. Main survey

After survey testing, around 1350 surveys were mailed randomly by hand to households in the Illawarra region and the City of Wollongong, New South Wales, Australia. Participants were asked to return their copies to the researchers in a reply-paid envelope provided with the survey within three weeks. Three hundred and four filled surveys were returned, yielding an acceptable 22.52% response rate. Amongst the 304 surveys, 59 were returned with comments in their open-ended question. However, after excluding all unusable partial responses, 290 surveys remained for the statistical analysis.

Table 1
The internal consistency and discriminant validity of the research constructs.

	Composite reliability	Cronbach's alpha	PACC	ATT	PPCOL	PCUR	PEOU	INT	PRES	PRSK	TRU	PPUSU	PU	VIS
PACC	0.837	0.722	0.80											
ATT	0.916	0.864	0.40	0.89										
PPCOL	0.899	0.855	0.10	−0.07	0.83									
PCUR	0.890	0.818	0.67	0.42	0.03	0.85								
PEOU	0.944	0.922	0.39	0.31	−0.07	0.36	0.90							
INT	0.907	0.874	0.35	0.47	−0.08	0.29	0.41	0.81						
PRES	0.867	0.794	0.72	0.43	0.09	0.70	0.34	0.33	0.79					
PRSK	0.923	0.876	−0.12	−0.23	0.21	−0.11	−0.08	−0.19	−0.07	0.89				
Trust	0.909	0.850	0.37	0.47	−0.18	0.32	0.39	0.53	0.35	−0.36	0.88			
PPUSU	0.925	0.887	0.13	−0.02	0.63	0.11	0.05	−0.014	0.15	0.15	−0.12	0.90		
PU	0.843	0.756	0.44	0.51	−0.03	0.42	0.51	0.57	0.42	−0.23	0.54	0.03	0.76	
VIS	0.912	0.882	0.18	0.13	−0.31	0.29	0.28	0.09	0.16	0.04	0.04	−0.19	0.19	0.85

PACC: perceived accuracy; ATT: attitude; PPCOL: perceived privacy-collection; PCUR: perceived currency; PEOU: perceived ease of use; INT: intention; PRES: perceived responsiveness; PRSK: perceived risk; PPUSU: perceived privacy-unauthorised secondary use; PU: perceived usefulness; VIS: visibility.

5. Data analysis

5.1. Description of the survey population

The data of the survey subjects were summarised and reported in aggregated form to maintain anonymity and confidentiality of all respondents. Out of the 290 replies to the survey, 110 were female (37.9%) and 180 were male (62.1%). The sample showed that 43.1% ($N = 125$) of the respondents were between 18 and 25 years old, 21.7% ($N = 63$) were between 26 and 34 years old, 18.6% ($N = 54$) were between 35 and 44 years old, 12.4% ($N = 36$) were between 45 and 54 years old, 3.4% ($N = 10$) were between 55 and 64 years old, and only two people who were aged 65 or above completed the survey.

5.2. The partial least squares analysis results

The Smart PLS 2.0 M3 software (Ringle et al., 2005) was used to analyse the two components of the research model together: the calculation of the measurement model (i.e. the outer model) and the assessment of the structural model (i.e. the inner model) (Barclay et al., 1995).

5.2.1. The measurement model

Assessment of measurement models should examine: (1) individual item reliability, (2) internal consistency, and (3) discriminant validity (Barclay et al., 1995). To evaluate item reliability, Barclay et al. (1995) recommended accepting only items with a loading of 0.707 or more. However, Hair et al. (2006) argued that items with a factor loading of 0.5 or more are significant enough and could be retained. The measurement items of the research model were loaded heavily on their respective constructs (reported in Appendix A), with all loadings considerably above 0.5, thus demonstrating adequate reliability for all items.

Because all reliability scores are above 0.7 (i.e. Composite reliability and Cronbach's alpha scores reported in Table 1) the internal consistency criteria are also met (Nunnally and Bernstein, 1994).

The third step in assessing the measurement model involves examining its discriminant validity where two conditions should be met. First, the off-diagonal elements in Table 1 represent correlations of all latent variables, whereas the diagonal elements are the square roots of the average variances extracted (AVE) of the latent variables. The AVE of any latent variable should be greater than the variance shared between the latent variable and other latent variables (Barclay et al., 1995), i.e. the diagonal elements should be greater than corresponding off-diagonal elements. Data shown in Table 1 satisfy this requirement. Second, the indicators should load more highly on their respective construct than on any other construct, with all correlations being significant at ($p \leqslant 0.05$) level at least. Data reported in Table 2 satisfy this condition.

5.2.2. The structural model

The general aim of the structural model is to give an explanation of the theorised relationships (i.e. the hypotheses) amongst the constructs. Fig. 2 illustrates the results and also shows R^2 values obtained for each endogenous variable (i.e. intention, attitude, usefulness, risk, and trust) in the structural model.

As shown in Fig. 2, the attitude towards using location-based mobile phone emergency services ($b = 0.241$, $p < 0.00.1$) was a significant predictor of behavioural intention to use the services, thus supporting H1. The perceived usefulness ($b = 0.444$, $p < 0.001$) was also an influential predictor of intention, thus validating H2. Both attitude and perceived usefulness demonstrated a good prediction power of intention with R^2 at 0.365, indicating an explanation level at 36.5% of the variance of behavioural intention to use the services in the future. Perceived usefulness ($b = 0.471$, $p < 0.001$) was a significant predictor of attitude, thus validating H3. However, H4 was not supported since perceived ease of use did not have any significant influence on attitude. On the contrary, the effect of perceived ease of use ($b = 0.273$, $p < 0.001$) on perceived usefulness was significant, thus validating H5.

Both the perceived usefulness and perceived ease of use were able to explain more than 26% of the variance of the attitude towards using the service, while the antecedents of the perceived usefulness were able to explain more than 45% of its variance with R^2 at 0.454.

The positive effects of trust on perceived usefulness ($b = 0.341$, $p < 0.001$) and negatively on perceived risk ($b = -0.334$, $p < 0.001$) were significant, thus validating H9 and H10, respectively. The privacy concern of collection ($b = -0.175$, $p < 0.05$) had a significant negative impact on trust in the service, which supports H12a.

Hypotheses H6a, H6b, H6c, H7, H8, H11a, H11b, H12b, H13a and H13b were all not statistically supported and, therefore, should be rejected.

5.3. The research conceptual model "goodness-of-fit"

The "goodness-of-fit" measure provides a reasonable indication of how well the sampled data fits the conceptual model being proposed (Gefen et al., 2000). However, since there is no direct "goodness-of-fit" measure generated by the partial least squares method, the measure can be generally estimated based on the adequacy of three main indexes that include

Table 2
Cross loadings of the constructs and their items.

	Accuracy	Attitude	Collection	Currency	Ease of use	Intention	Responsiveness	Risk	Trust	Unauthorised secondary use	Usefulness	Visibility
ATT1	0.371477	0.888722***	-0.047038	0.383191	0.297293	0.358971	0.417832	-0.20[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ATT2	0.354747	0.906249***	-0.063336	0.359981	0.238681	0.365463	0.374566	-0.205447	0.387784	-0.052528	0.423098	0.148384
ATT3	0.346799	0.8641***	-0.077415	0.365549	0.285785	0.497253	0.343609	-0.200211	0.453326	-0.034645	0.484125	0.061887
INT1	0.170901	0.297207	-0.083185	0.091027	0.253832	0.775863***	0.160158	-0.164666	0.389019	-0.051656	0.393336	-0.004283
INT2	0.343449	0.553092	-0.1448	0.305754	0.304061	0.811184***	0.313335	-0.174349	0.511952	-0.061667	0.510565	0.129805
INT3	0.266002	0.287265	-0.015146	0.240709	0.394836	0.836183***	0.236296	-0.137955	0.420428	-0.020789	0.430989	0.024011
INT4	0.203439	0.272406	-0.024242	0.17672	0.350486	0.802256***	0.227375	-0.101095	0.342041	0.043215	0.390306	0.004097
INT5	0.366807	0.39868	-0.013357	0.307708	0.382084	0.843074***	0.366903	-0.162475	0.446466	0.04369	0.534567	0.159153
PACC1	0.796354***	0.317263	0.119179	0.610307	0.305772	0.19969	0.619661	-0.107264	0.296012	0.168835	0.302895	0.130008
PACC2	0.684931***	0.22982	0.156216	0.407471	0.21231	0.223034	0.510806	-0.05659	0.176145	0.226506	0.223553	0.046439
PACC3	0.894954***	0.386204	0.019857	0.567838	0.380555	0.366815	0.605634	-0.111334	0.37588	0.01628	0.466109	0.202161
PCUR1	0.496451	0.384452	-0.036154	0.886075***	0.36189	0.35314	0.606906	-0.128142	0.354077	0.043391	0.434774	0.298787
PCUR2	0.552622	0.274233	0.091418	0.813798***	0.236979	0.189668	0.531185	-0.09755	0.192587	0.089329	0.275732	0.203323
PCUR3	0.684212	0.394015	0.058861	0.861445***	0.300732	0.166764	0.658749	-0.053251	0.229443	0.168182	0.343914	0.223455
PEOU1	0.384957	0.342583	-0.065943	0.35302	0.905406***	0.360747	0.345033	-0.082683	0.334769	0.011365	0.469798	0.267072
PEOU2	0.338747	0.278394	-0.131186	0.318566	0.894132***	0.357654	0.284348	-0.095249	0.387258	0.027917	0.451397	0.260671
PEOU3	0.320102	0.195663	-0.017117	0.275475	0.881926***	0.389132	0.258877	-0.090858	0.322696	0.080284	0.438517	0.235868
PEOU4	0.359967	0.289338	-0.040988	0.342265	0.920547***	0.385553	0.34184	-0.007736	0.343559	0.073089	0.476503	0.23828
PPCOL1	0.145722	-0.021552	0.892465***	0.051867	-0.072968	-0.045588	0.158954	0.120976	-0.143253	0.516707	0.008951	-0.215085
PPCOL2	0.03335	-0.078053	0.91242***	-0.023749	-0.095524	-0.066312	0.028085	0.238159	-0.207494	0.488445	-0.062251	-0.272111
PPCOL3	0.161118	-0.032126	0.831034***	0.10222	-0.03536	-0.121424	0.138129	0.182508	-0.122044	0.63801	-0.017094	-0.238313
PPCOL4	-0.016779	-0.134346	0.675386***	-0.006474	0.004109	0.02257	-0.011832	0.076388	-0.081365	0.501393	-0.021477	-0.360428
PPUSU1	0.079907	-0.050664	0.618721	0.057056	0.044634	0.020541	0.09329	0.197071	-0.065472	0.920235***	0.017043	-0.250859
PPUSU2	0.140019	-0.003436	0.556916	0.108439	0.051875	-0.023043	0.151242	0.113744	-0.161673	0.942349***	0.030269	-0.129716
PPUSU3	0.185783	0.03748	0.496418	0.194377	0.043709	-0.066748	0.203005	0.033843	-0.080224	0.827693***	0.04277	-0.076728
PRES1	0.495585	0.319752	0.057776	0.550715	0.255924	0.164721	0.779585***	-0.060032	0.295631	0.082291	0.326338	0.167423
PRES2	0.61405	0.370233	0.062951	0.576471	0.297731	0.221274	0.868393***	-0.087629	0.292221	0.137992	0.340924	0.172277
PRES3	0.518519	0.280344	0.165321	0.473744	0.216793	0.353224	0.662963***	0.022004	0.214413	0.145899	0.308631	0.065493
PRES4	0.635093	0.367048	0.019742	0.609489	0.308688	0.315735	0.8313***	-0.081069	0.285778	0.106523	0.352969	0.104037
PRSK1	-0.127401	-0.160486	0.117728	-0.115514	-0.035925	-0.16479	-0.076277	0.863572***	-0.296395	0.09543	-0.192667	0.15432
PRSK2	-0.079968	-0.238296	0.234024	-0.08289	-0.041525	-0.187054	-0.060767	0.908311***	-0.325305	0.154362	-0.196586	0.002508
PRSK3	-0.118176	-0.213744	0.190174	-0.104379	-0.119302	-0.148109	-0.048926	0.913633***	-0.34257	0.139403	-0.23193	-0.014071
PU1	0.358372	0.41911	-0.006994	0.340283	0.483112	0.493559	0.320287	-0.113768	0.422552	0.070015	0.769922***	0.2128
PU2	0.215817	0.251233	0.069534	0.227863	0.276652	0.209	0.210249	-0.115828	0.24025	0.004218	0.597077***	0.055779
PU3	0.324916	0.415549	-0.032917	0.312925	0.354944	0.518852	0.308711	-0.162849	0.457719	0.029505	0.838834***	0.103693
PU4	0.410307	0.421954	-0.09104	0.381439	0.41034	0.436813	0.41025	-0.29093	0.484385	-0.018005	0.812849***	0.166736
TRUST1	0.357258	0.4564	-0.16891	0.2784	0.335081	0.413294	0.304038	-0.260142	0.861124***	-0.121874	0.475262	0.071024
TRUST2	0.2703	0.353959	-0.182646	0.272596	0.296676	0.49855	0.275237	-0.328204	0.893251***	-0.123011	0.451304	0.039697
TRUST3	0.358976	0.426356	-0.125221	0.280064	0.380563	0.479818	0.330675	-0.355884	0.878189***	-0.067555	0.505815	-0.001193
VIS1	0.209159	0.120691	-0.329992	0.275721	0.311739	0.168097	0.142563	0.030616	0.103021	-0.188002	0.229621	0.906266***
VIS2	0.115804	0.102686	-0.227079	0.210441	0.211774	0.120031	0.102682	0.028428	0.002175	-0.114776	0.122162	0.855305***
VIS3	0.125294	0.108627	-0.22693	0.281808	0.170094	-0.089927	0.207944	0.04971	-0.005297	-0.181069	0.129674	0.81923***
VIS4	0.084719	0.082597	-0.189298	0.177368	0.185591	0.023943	0.070156	0.06293	-0.059618	-0.118365	0.068398	0.815785***

*** denotes significance at 0.001 level.

[a]Denotes significance at 0.001 level.

(i) construct reliability (internal consistency) being above 0.7 for all the constructs of the conceptual model, (ii) high acceptable R^2, and (iii) significant path coefficients (t-statistics) between the constructs (Barclay et al., 1995; Gefen et al., 2000).

As illustrated in Table 1, all the reliability scores from two separate tests (i.e. composite reliability test and Cronbach's alpha scores) exceeded the 0.7 threshold, indicating high internal consistency for all constructs in the research model. The R^2's of the attitude and intention constructs were above 25%, a highly acceptable prediction level in empirical research (Arlinghaus and Griffith, 1995; Gaur and Gaur, 2006). Although 10 out of the 17 path coefficients were insignificant, the path coefficients to the main predictors of social acceptance of location-based mobile phone emergency services (i.e. attitude and

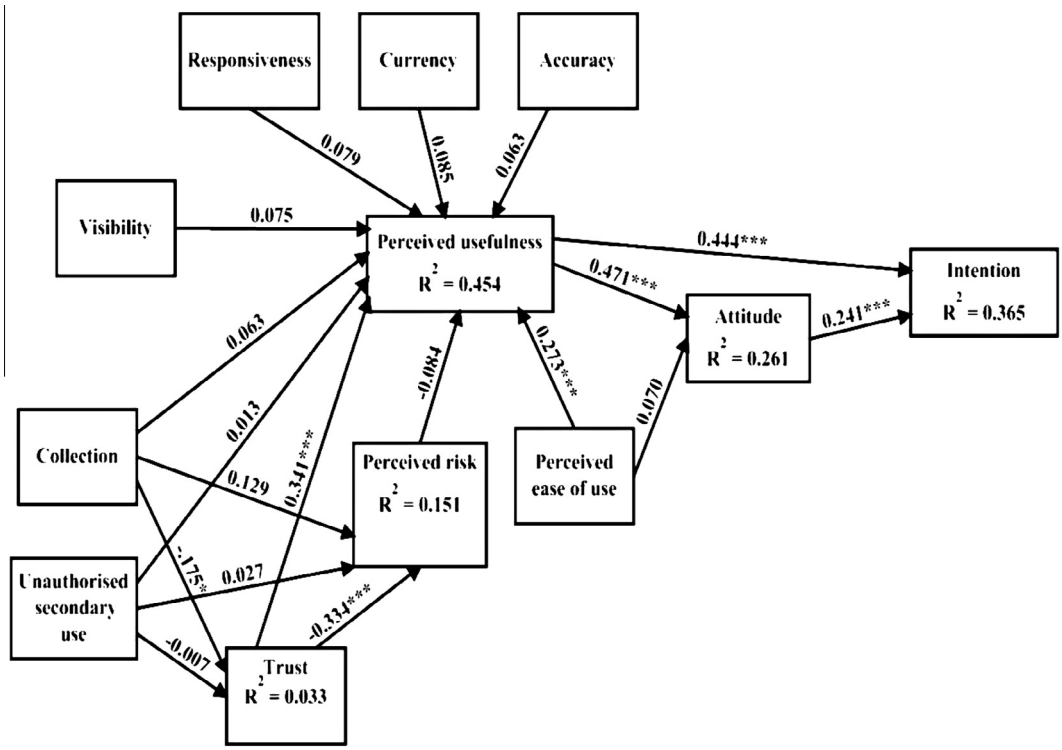

Fig. 2. The partial least squares (PLS) results of the research conceptual model.

intention) evinced extremely high significance levels at $p < 0.001$, with all coefficients to be above the 0.2 threshold indicated by Chin (1998) as implying a very meaningful relationship. Accordingly, the goodness-of-fit for this research model is established since the analysis of the two components of the partial least squares model; the measurement model and the structural model, have shown good results in almost all of the statistical tests performed.

6. Discussion of the findings

6.1. Perceived usefulness

The perceived usefulness of LBS for emergency management was the key driver behind the individual positive attitude towards using the services and his or her behavioural intention towards using the services in the future. The services were perceived to be highly useful despite (i) the risks that are perceived to be associated with the utilisation of this kind of electronic services, (ii) the probability of the excessive collection of personal location information by governments utilising the services, and (iii) the probability of the unauthorised secondary use of the collected information. The findings about the usefulness of LBS completely support the few earlier studies of LBS acceptance, such as Chang et al. (2006) and Junglas and Spitzmuller (2006), in which the role of usefulness was identified as a key driver of individuals' attitudes and intentions towards using the services despite concerns about the privacy of their locational information.

Reflecting on the arguments presented earlier, the antecedents of perceived usefulness of LBS for emergency management were: perceived quality features of the service, trust in the service and service providers, the social risks perceived in utilising the service, the privacy concerns perceived with the utilisation of the service, visibility of the service application, and perceived service ease of use. These antecedents were collectively successful in explaining more than 45% of the usefulness variance of the LBS for emergency management. This high level of explanation in the service usefulness variance, standing at 45.4%, provides reasonable indicators of the issues that can be brought into focus if there is ever a pressing need by governments to improve public perception of the usefulness of LBS for emergency management, thus positively enhancing the overall social acceptance of the services.

6.2. Perceived ease of use

The findings evince weak evidence for the existence of any direct effect of perceived ease of use of LBS on the individual's attitude towards using the services. Therefore, it could be suggested that the public, in general, are willing to accept the util-

isation of LBS for emergency management regardless of how easy or difficult they are to use. Nevertheless, the findings did verify the high impact of perceived ease of use of the services on the perceived usefulness of the services, which provides a strong indication that people would perceive the services to be more useful if they were easier to use. Accordingly, there is a reasonable ground to suggest that the perceived ease of use of the services has an indirect influence on an individual's attitude towards using the services through the mediating role of the perceived usefulness of the services.

In general, these findings can inform the design of LBS solutions. Designers will need to contrive service offerings with easy-to-use design interfaces once the services are utilised for emergency management, making the services as intuitive as possible to use during emergency situations, and comprehensible to everyone, including the young, the elderly, and the non-technologically inclined.

6.3. Visibility

In general, visibility of LBS emergency management solutions can provide the opportunity for many people to observe and judge the application of the services in the usage context, providing an effective and direct means for the individual to evaluate the usefulness of the services (Karahanna et al., 1999). However, the findings show that visibility of LBS solutions is not statistically significant in determining the perceived usefulness of the services. One rational explanation for this result is that LBS are not yet widely utilised for emergency management and, therefore, the individual cannot easily observe the application of the services in the context of emergencies. However, a highly intuitive rationale is that the specific usage context (i.e. emergency management) eliminates the importance of observing the application of the LBS by the public for these services to be judged as useful, since any means, service, or technology that is used for emergencies is perceived, by the very nature of these situations, to be useful, regardless of how visible its application to the public.

6.4. Quality features

Investigating the quality features of LBS emanated from the need to understand the acceptable degree of service quality anticipated by the prospective user when the service is utilised for emergency management, given the fact that limited knowledge about the actual service quality dimensions of the service is currently available. However, the findings demonstrate the insignificant role of the perceived quality features of LBS in shaping the individual perception of the usefulness of the services for emergency management. One can then speculate that the findings reflect uncertainty about the performance impact of LBS in terms of accuracy, currency, and responsiveness on the usefulness of the services, which can only be grounded in the fact that the services have not yet been widely implemented for emergency management. Even with the insignificant impact, in statistical terms, of the perceived service quality features on the perceived usefulness of the services, service quality features did actually emerge in the answers to the open-ended question as one of the important issues pertaining to the possible nationwide utilisation of the services for emergency management in Australia.

6.5. Perceived social risks

The social risks perceived from using LBS had an extremely weak impact on the perceived usefulness of the services. One explanation for this insignificant impact is that the public may perceive location-based services to be a part of the well-established mobile telecommunications networks, thus being mature enough to permit the useful delivery of safety information or warning notifications during emergency situations without any potential high risks. Taking this into consideration, the risks associated with the use of LBS for emergency management are actually part of the risks impacting the entire cellular network infrastructure and not necessarily only impacting these particular services.

6.6. Privacy concerns

Perceived privacy concerns, including excessive collection of personal location information and the unauthorised secondary use of that information, were both posited to play determining roles in (i) diminishing individual trust in LBS, (ii) augmenting the risks perceived from using the services for emergency management, and (iii) negatively impacting the perceived usefulness of the services. However, the findings indicate that only the collection of personal location information, as a perceived privacy concern, had a significant negative impact on trust in the services while all other effects are statistically too insignificant to be reported.

It is of particular interest that unauthorised secondary use was without any effect on trust, unlike the collection of personal location information. One reason might stem from the very nature of the act of collection itself. Usually, when location data for a location-based service is collected, it would be done automatically and the individual is typically unaware of this collection process (Junglas et al., 2008). Nonetheless, the findings suggest that this automated process of collection, even in emergency management settings, whether the process is known to the individual or not, signifies a personal lack of control for the individual over his or her collected data. This contributed to a greater degree towards distrusting use of LBS for emergency management than any other privacy concern.

The findings also reveal that the two privacy concerns, collection of personal location information and unauthorised secondary use, did not have any significant influence in increasing perception of social risks from using LBS for emergency man-

agement. This indicates that there is some threshold level that must be reached in the privacy concerns hierarchy of effects before such risks are perceived (Drennan et al., 2006). Nonetheless, some did perceive the privacy concerns to be important even in emergency situations, reflected in the significant negative impact of the collection of personal location information on trust in the services. Still, it is argued that the negative impact of privacy concerns will not be enough to prevent the public from engaging in a risk taking relationship when they perceive the benefits of utilising LBS for emergency management as surpassing their perceived risks.

Although the impacts of the collection and unauthorised secondary use on service usefulness are insignificant in statistical terms, the unexpected positive effects of the two constructs on usefulness (as illustrated in Fig. 2) imply that people are inclined to concede a degree of privacy in return for potential benefits in extreme situations such as emergencies. One explanation for this might be that people may perceive the outcome of the extensive collection of their locational data and the secondary use of that data in an emergency situation to be always in their favour when these activities (i.e. collection and secondary use) are practised by the government. The findings could also suggest that the context of emergencies is quite sufficient to produce an adverse impact on some of the ''traditionally negative'' aspects of information privacy concerns.

6.7. Trust

The definition of trust in LBS encompasses individual trust in the government controlling and providing the services and trust in the technology and underlying infrastructure through which the services are provided (Carter and Bélanger, 2005). The findings show the highly significant role of trust as the most influential determinant of individual perception of the usefulness of the services, suggesting that reducing uncertainty is indeed a key component in social acceptance of the services that deserves on-going attention from the government.

The findings about the significant role that trust plays strongly corroborate several previous studies about the need to investigate trust in empirical research of location-based services (Kaasinen, 2005; Junglas and Spitzmuller, 2006; Rao and Troshani, 2007).

The findings of this study also demonstrate the pronounced role of trust in ameliorating the social risks perceived to arise from using the LBS for emergency management, thus breaking down these barriers to the usefulness of the services. These particular findings suggest that besides the significant direct influence of trust on perceived usefulness of the services, trust also indirectly influences usefulness of the services through perceived risks. This validates the earlier conceptualisation of the trust-risk relationship in the research model in this paper, in which the directionality of the relationship flows from trust to perceived risks.

Consequently, what is of a greater concern to the success of an emergency service offering is that people can willingly bestow their trust on the service, trust the message that is provided to them by the service in the case of an emergency, and, most importantly, trust the government as the provider and controller of these services.

6.8. Analysis of the open-ended question

Amongst the 304 surveys, 59 were returned with comments in the open-ended question. Twenty-three people discussed ''quality'' and others discussed ''product reliability'' features. The emphasis in the comments was that without quality and reliability LBS solutions for emergency management would be useless. For example, one respondent wrote: ''I have some concerns about the accuracy. Sometimes it may not direct you to the right position in the shortest available path''. Another 17 people said that they look forward to seeing LBS utilised for emergency management in the near future, but at the same time they were worried that their personal information would be used illegally or for other purposes. Further, 11 people mentioned the regulations and laws. They thought that the government should pay more attention to formulating laws and regulations surrounding the utilisation of the services if the government wants to apply LBS for emergency management. The final eight answers can be viewed as general hopes for such technologies as LBS to be utilised as soon as possible for emergency management in Australia. From the open answers, we can see that people cared about the quality, privacy, laws, and regulations related to LBS. Consequently, it is highly recommended that governments should take such opinions into consideration before applying LBS within emergency management arrangements.

7. Implications

This study adds to the scholarly literature in a relatively new area and in which there has been little research investigating the public offerings of location-based services in the domain of emergency management. Although there have been several studies about the technical feasibility aspects for utilising LBS as advanced mobile government location-enabled applications for personal safety and public warning purposes there is however scant theoretical and empirical research concerning the investigation of different aspects in relation to the utilisation of the services in the domain of emergency management, such as the behavioural, social, technical, administrative, regulatory, and legal aspects. This is an evident gap in the current body of research and this paper makes a significant contribution to that body of research.

The findings of this paper also contribute to the current theories and models of acceptance by providing empirical evidence to support the retention of the attitude construct in the attitude-behaviour relationship of TAM. This is grounded upon the significant role of attitude in influencing behavioural intention towards using LBS for emergency management, thus enhancing the overall ability to predict social acceptance or rejection of these services. The findings completely validate, and are in line with, several social psychology studies in which the role of attitude as an important determinant of behavioural intention has been strongly emphasised (Ajzen, 2002; Dennis et al., 2004). The retention of attitude as one of the endogenous constructs within the nomological structure of TAM provides an additional momentum to arguments seeking to preserve the theoretical integrity of the Model and, consequently, the Model's base theory of TRA. At the same time, this paper strongly signals the importance of examining individual attitude in acceptance research, especially when studying social acceptance of new government initiatives and services.

Although the research model was explicitly employed to predict social acceptance of location-based mobile government services for emergency management, the model can be easily viewed as a generic model that can credibly serve as a candidate model for future studies to predict acceptance of location-based services in other usage contexts, applications, scenarios, and/or settings. This is because all of the theorised constructs of the model are highly relevant to the intrinsic characteristics of LBS. Examples would include law enforcement applications of LBS, such as investigating their surveillance implications, capturing location-based evidence, and the social and ethical issues pertaining to the application of the services for counter-terrorism, arrest support, traffic violations, or riot control.

An issue that has been largely overlooked in the acceptance literature in respect to LBS is the quality features of these services, and the degree to which the perceptions of service quality actually impact on accepting the services. One of the main contributions of this study is the introduction of a highly justifiable theoretical foundation for investigating perceived quality features of LBS in the context of emergency management. Given the general lack of dedicated measurements for such quality features in the literature, it is argued that the service quality scales that were developed in this research, including accuracy, currency, and responsiveness, could be naturally adapted when researching acceptance of LBS, not only in the context of emergencies, but also in other usage contexts and settings.

Several opportunities for further empirical research have emerged from this study, but the most worthwhile is an examination of public opinion after national implementation and deployment of LBS for emergency management. Such a study could investigate, in the long term, how and why the determinants of acceptance change or reshape after the adoption and diffusion of the services, and whether or not the relationships between these determinants are consistent over time. This type of work reflects arguments by Karahanna et al. (1999) of the need to examine and, at the same time, differentiate between the beliefs of the individual in the pre-adoption phase (symbolic adoption), where one's assessment leads into one's decision to accept or reject the LBS for emergency management, and those beliefs in the post-adoption phase (actual adoption), which is marked by actual usage or take-up of the services.

Another interesting starting point for further research is the contradictions that were found between this study and most of the previous research about the influence of privacy concerns on an individual's acceptance of LBS. Although it has been shown that the usage context of emergencies was quite sufficient to alleviate perceptions of privacy concerns, and despite the fact that it was not significant in statistical terms, a future cross-sectional comparative research taking into account several usage contexts is needed to further ascertain the role of the context of usage on the perceptions of location information privacy concerns.

8. Conclusions

Disasters and large scale emergencies that have the potential to disrupt the orderly manner of the civil society are considered national security challenges today. As Australians are becoming increasingly mobile in the way they acquire information about their whereabouts, the Australian government is contemplating the introduction of nationwide location-enabled mobile phone warning and alerting methods and techniques. Mobile government emergency applications, specifically location-based mobile phone emergency services are presented as a valuable addition within the envisaged emergency management apparatuses of the government for safeguarding people during emergencies anywhere and anytime. Indeed, governments have a responsibility to their citizens to inform and protect them against both conventional and unconventional threats, being natural or human-made.

Given the importance of this topic in the context of Australia and the fact that only very few studies tackled the utilisation of location-based mobile services in emergency management worldwide, this study aimed to investigate the social acceptance or rejection of location-based mobile government emergency services along with their determinants. The overall results of this study indicated that Australians are willing to accept such services in emergency situations. Indeed, our results indicated that behavioural intention is a function of both attitude and perceived usefulness. Perceived ease of use, according to results, has no influence on attitude. Further, the results confirmed that perceived usefulness is a strong direct predictor of attitude. Interestingly, the role of trust in determining individual perception of the usefulness of the services was found to be highly influential. Finally and from privacy concerns' perspective, the results indicated that collection of personal location information is the only factor that has a significant negative impact on trust.

This study does not come without limitations and this can be addressed in future research. Although the response rate of the survey of this study was proven to be statistically adequate, a desirable goal was to obtain a higher response rate than the one acquired to have additional confidence in the generalizability of the findings. One possible solution for future research is

to employ additional surveying techniques, such as the anonymous web-based surveying approach, along with the traditional mail survey approach to potentially increase the overall response rate. Further, as this study was designed and tested in the Australian context, future comparative cross-national studies between Australia and other countries would also be quite compelling. Such studies would shed light on the role of culture and government, such as the role and influence of government administration, in creating disparities in the factors determining the acceptance or rejection of location-based emergency services. Finally, due to time constraints, we could not afford conducting a longitudinal study although it may be useful here given that human behaviour is quite dynamic.

Appendix A. Measures and factor loadings of constructs*

Construct name	Item code	Statement	Factor loading
Attitude: Agarwal and Prasad (1999) and Van der Heijden et al. (2001)	ATT1	I like the idea of using location-based services for hazardous and emergency situations	0.888
	ATT2	I consider using location-based services for emergencies a good idea	0.906
	ATT3	In general, the idea of using location-based services for emergency management might be beneficial to my family and me	0.864
Intention: Junglas and Spitzmuller (2005)	INT1	If my mobile phone company offers me the option of using specific location-based services relevant to emergency situations for an additional monthly fee (e.g. only $5) I would use the services within the next three months	0.775
	INT2	If my mobile phone company offers me free location-based services I will make use of the offer	0.811
	INT3	If LBS-enabled mobile phones become available I intend to buy one within the next three months	0.836
	INT4	If location-based services are widely used by my friends, I will start using them within the next three months	0.802
	INT5	In general, if the government offer location-based services for emergency management I intend to make use of the services	0.843
Trust: Mayer et al. (1995) and Junglas and Spitzmuller (2005)	TRUST1	I trust the government use of LBS for managing hazardous and emergency situations	0.861
	TRUST2	I think location-based services are trusted applications that can deliver warning notifications during emergencies	0.893
	TRUST3	In my opinion, location-based services are mature mobile phone services that can be trusted for emergency management	0.878
Perceived risk: Pavlou and Gefen (2004)	PRSK1	There is a considerable risk involved in using location-based services for emergencies	0.863
	PRSK2	My decision to use location-based services for managing emergencies would be risky	0.908
	PRSK3	There is too much uncertainty associated with using location-based services for managing hazardous and emergency situations	0.913
Perceived usefulness: Davis (1989)	PU1	The government use of location-based services for emergency management can save lives	0.769
	PU2	Using location-based services in emergencies would be invaluable	0.597
	PU3	Using location-based services for managing emergencies can guarantee my safety and well-being	0.838
	PU4	Overall, I find location-based services to be useful for	0.812

(*continued on next page*)

Measures and factor loadings of constructs* (*continued*)

Construct name	Item code	Statement	Factor loading
		hazardous and emergency situations	
Perceived ease of use: Davis (1989)	PEOU1	Learning how to use location-based services would be easy for me	0.905
	PEOU2	I think my interaction with location-based services would be clear and understandable when they are used for emergencies	0.894
	PEOU3	I would find it easy to get location-based services to do what I want them to do	0.881
	PEOU4	In general, I think I would find location-based services easy to use	0.920
Visibility: Karahanna et al. (1999)	VIS1	At my work, school or amongst my friends, I can see location-based services being used	0.906
	VIS2	I have seen others using location-based services on their mobile phones	0.855
	VIS3	It is easy for me to foresee others using location services in public	0.819
	VIS4	I have seen location-based services being used before	0.815
Perceived currency: Churchill (1979)	PCUR1	I would expect the message content delivered to my phone to have up-to-the-minute information during hazardous or emergency situations	0.886
	PCUR2	I would be concerned if the information provided to me was not up-to-date during emergencies	0.813
	PCUR3	I think location-based services should always have the latest information in order to be reliable	0.861
Perceived accuracy	PACC1	I would expect the message of the location-based service delivered to me to be always accurate when being used for emergencies	0.796
	PACC2	I would find it unacceptable to receive inaccurate information when using location services during an emergency	0.684
	PACC3	Overall, location-based services are reliable to be used for emergency management only when they are accurate	0.894
Perceived responsiveness	PRES1	I would expect location-based services to be timely when being used for emergencies	0.779
	PRES2	If I used location-based services, I would always expect a prompt response during hazardous situations	0.868
	PRES3	I do mind if there is a delay in response to a location service query I have made during an emergency situation	0.662
	PRES4	Overall, location-based services should offer safety information in a timely manner when they are used for emergency management	0.833
Collection: Smith et al. (1996) and Junglas and Spitzmuller (2005)	PPCOL1	It would bother me if my location information is always collected by the location-based service provider during emergencies	0.892
	PPCOL2	I am concerned that the service provider will collect too much location data about me during emergency situations	0.912
	PPCOL3	I am not comfortable with the idea that the service provider is able to collect location information about me at any time in emergencies	0.831

Measures and factor loadings of constructs* (*continued*)

Construct name	Item code	Statement	Factor loading
	PPCOL4	I would rather not provide my location information to the service provider even in emergency situations	0.675
Unauthorised secondary use: Smith et al. (1996) and Junglas and Spitzmuller (2005)	PPUSU1	The service provider should never disclose my location information even during emergency situations	0.920
	PPUSU2	In emergencies, the service provider should never use my location information for any other purposes unless it has been authorised by me	0.942
	PPUSU3	The service provider should not share my location information with 3rd parties without my consent during emergencies	0.827

*All constructs are measured using a five-point Likert rating scale (Strongly disagree–Strongly agree). The number of respondents is 290 ($N = 290$).

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