Towards a Conceptual Model of User Acceptance of Location-Based Emergency Services

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Abstract

This paper investigates the introduction of location-based services by government as part of an all-hazards approach to modern emergency management solutions. Its main contribution is in exploring the determinants of an individual's acceptance or rejection of location services. The authors put forward a conceptual model to better predict why an individual would accept or reject such services, especially with respect to emergencies. While it may be posited by government agencies that individuals would unanimously wish to accept life-saving and life-sustaining location services for their well-being, this view remains untested. The theorised determinants include: visibility of the service solution, perceived service quality features, risks as perceived by using the service, trust in the service and service provider, and perceived privacy concerns. The main concern here is to predict human behaviour, i.e. acceptance or rejection. Given that location-based services are fundamentally a set of electronic services, this paper employs the Technology Acceptance Model (TAM) as a special adaptation of the Theory of Reasoned Action (TRA) to serve as the theoretical foundation of its conceptualisation. This technology-specific adaptation within the nomological structure of TRA allows this research to put forward the variables of TAM, the attitude towards using the service and intention to use, as the main predictors of acceptance or rejection. It also enables this research to theorise the internal beliefs of TAM, that is, perceived usefulness and perceived ease of use amongst the determinants of acceptance or rejection. A series of propositions are drawn upon the mutual relationships between the determinants and a conceptual model is constructed using the determinants and guided by the propositions. It is argued the conceptual model presented would yield to the field of location-based services research a justifiable theoretical approach competent for exploitation in further empirical research in a variety of contexts (e.g. national security).

Keywords: location-based emergency services, acceptance, visibility, service quality,

risk, trust, privacy.

1 Introduction

Emergency management (EM) activities have long been practiced in civil society. Such activities evolved from simple precautions and scattered procedures into more sophisticated management processes that include preparedness, protection, response, mitigation and recovery strategies (Canton 2007). In the twentieth century, governments have been utilising technologies such as sirens, speakers, radio, television and internet to communicate and disseminate time-critical information to citizens about impending dangers, during and after hazards. Over the past decade, location-based services (LBS) have been implemented, or considered for implementation, by several countries to geographically deliver warnings, notifications and possibly life-saving information to people (Krishnamurthy 2002; Weiss et al. 2006; Aloudat et al. 2007; Jagtman 2010).

LBS take into account the pinpoint geographic position of a given device (handheld, wearable, implantable), and provide the user of the device with value added information based on the derived locational information (Küpper 2005; Perusco and Michael 2007). The location information can be obtained by using various indoor and/or outdoor positioning technologies that differ in their range, coverage, precision, target market, purpose and functionality. Radio frequencies, cellular telecommunications networks and global navigation satellite systems are amongst the main access media used to determine the geographic location of a device (Michael 2004; Perusco and Michael 2007). The collected location information can be stored for the purpose of further processing (e.g. analysing the whereabouts of a fleet of emergency service vehicles over a period of time) or combined with other relevant information and sent back to the user in a value-added form (e.g. traffic accidents and alternative routes). The user can either initiate a request for the service or it is triggered automatically when the device enters or leaves or comes in the vicinity of a defined geographic area.

The conventional use of LBS in emergency management is to find the almost exact location of a mobile handset after an emergency call or a distress short message service (SMS). Although the accuracy of the positioning results ranges from a few metres up to several kilometres, the current objective by several governments is to regulate the

telecommunications carriers to provide the location information within accuracies between 50 to 150 metres. This type of service is generally known as wireless E911 in Northern America (i.e. Canada and the United States), E112 in the European Union, and similarly, but not officially, E000 in Australia.

But, even with proximate levels of accuracy LBS applications have the ability to create much more value when they are utilised under an all-hazards approach by government. For example, with LBS in use, government agencies pertinent to the emergency management portfolio can collaborate with telecommunications carriers in the country to disseminate rapid warnings and relevant safety messages to all active mobile handsets regarding severe weather conditions, an act of terrorism, an impending natural disaster or any other extreme event if it happened or was about to happen in the vicinity of these mobile handsets. For that reason, LBS solutions are critically viewed by different governments around the world as an extremely valuable addition to their arrangements for emergency notification purposes (Aloudat et al. 2007; Jagtman 2010).

However, in relation to LBS and EM almost no study has undertaken the responsibility of exploring an individual's acceptance of utilising the services for emergency management. One might rightly ponder on whether any individual would ever forego LBS in a time of emergency. Nonetheless, despite the apparent benefits of this type of electronic service, their commercial utilisation has long raised numerous technical, social, ethical and legal issues amongst users. For example, the quality of the service information being provided, to issues related to the right of citizen privacy, and issues concerning the legal liability of service failure or information disclosure have been raised (O'Connor and Godar 2003; Tilson et al. 2004; Perusco et al. 2006; Perusco and Michael 2007; Aloudat and Michael 2011). Accordingly, the contribution of this paper is to discuss the potential determinants or drivers of a person's acceptance or rejection for utilising location-based services for emergency management, and propose a conceptual research model that comprises the drivers and justly serves as the theoretical basis needed for further empirical research.

The rest of this paper is organised as follows: Section 2 is a discussion of the factors expected to impact on a person's perceptions towards the services, and presentation of

the theoretical propositions of the expected relationships between the factors. Section 3 introduces the conceptual model and its theoretical foundation. Section 4 outlines the steps taken for pretesting the model via a pilot survey and provides the analysis results of the data collected. Section 5 concludes the paper and discusses the implications of this research work, including the theoretical contributions to the scholarly literature.

2 Determinants of acceptance or rejection

A review of acceptance and adoption literature was conducted to identify, critically assess and then select the factors that would most likely influence individuals' beliefs regarding the use of LBS for emergencies. This approach has been completely justified by Taylor and Todd (1995), and Venkatesh and Brown (2001) on the basis that there is a wealth of information systems (IS) acceptance research, which minimises the need to extract beliefs anew for each new acceptance setting. The adopted working definitions for the selected factors are summarised in Table 1.

Table 1: Summary of the constructs and their definitions

Factor	Description of the adopted working definition	Based upon
Individual's attitude towards the use of LBS	Individual's positive or negative feelings towards using LBS in emergencies.	Fishbein and Ajzen (1975)
Individual's intention to use LBS	Individual's decision to engage or not to engage in using LBS in emergencies.	Fishbein and Ajzen (1975)
Trust	The belief that allows a potential LBS user to willingly become vulnerable to the use-case outcome of LBS, having taken the characteristics of LBS into consideration, irrespective of the ability to monitor or control the services or the service provider.	Mayer et al. (1995), McKnight and Chervany (2001)
Risk as perceived by the potential user	Individual's belief of the potential loss and the adverse consequences of using LBS in emergencies and the probability that these consequences may occur if the services are used.	Pavlou and Gefen (2004), Heijden et al. (2005)

Perceived usefulness	Individual perception that using LBS for managing emergencies is useful.	Davis et al. (1989)
Perceived ease of use	The degree to which the prospective user expects LBS to be free of effort.	Davis et al. (1989)
Visibility	The extent to which the actual use of LBS is observed as a solution to its potential users	Agarwal and Prasad (1997)
Perceived service qualities	Individual's global judgment relating to the superiority of the service.	Parasuraman et al. (1988)
Perceived currency	Prospective user's perception of receiving up-to-the-minute service information during emergencies.	Zeithaml et al. (2000), Yang et al. (2003)
Perceived accuracy	Prospective user's perception about the conformity of LBS with its actual attributes of content, location, and timing.	Zeithaml et al. (2000), Yang et al. (2003)
Perceived responsiveness	Prospective user's perception of receiving a prompt LBS service during emergencies.	Parasuraman et al. (1988), Liljander et al. (2002), Yang et al. (2003)
Privacy concerns as perceived by the prospective user	Individual's concerns regarding the level of control by others over personal identifiable information.	Stone et al. (1983)
Collection	The concern that extensive amounts of location information or other personal identifiable data will be collected when using LBS during emergencies.	Smith et al. (1996), Junglas and Spitzmuller (Junglas and Spitzmuller 2005)
Unauthorised secondary use	The concern that LBS information is collected for emergency purposes but will be used for other purposes without explicit consent from the individual.	Smith et al. (1996), Junglas and Spitzmuller (Junglas and Spitzmuller 2005)

A further discussion of each proposed factor and the criteria behind its selection are presented in the following sections.

2.1 *The visibility of location-based emergency services*

Many individuals may not be aware of the possible utilisation of location-based services in emergency management and, therefore, it could be argued that the direct advantages and disadvantages of such utilisation are not be visible to them (Pura

2005; Chang et al. 2007). Individuals who are not aware of the existence of LBS or, basically do not know anything about the capabilities of this type of electronic services in the domain of emergency management, may not develop an appreciation, or even depreciation, towards the services unless they were properly and repeatedly being introduced (exposed) to LBS emergency management solutions. In other words, people may not be able to accurately judge the advantages or disadvantages of LBS unless the application of LBS is visible to them. It should be noted however, that the exposure effect does not necessarily increase the perceived functionality of the services, but it can greatly enhance or degrade the perceptions of an individual about the usefulness of the services, thus influencing their acceptance or rejection of the services (Thong et al. 2004).

One of the key attributes of the Diffusion of Innovation (DOI) Theory by Rogers (1995) is the construct of *observability*, which is "the degree to which the results of an innovation are observable to others" (p. 16). Innovation is "an idea, practice, [technology, solution, service] or object that is perceived as new by an individual" (Rogers 1995, p. 135). Later, *observability* was perceived by Moore and Benbasat (1991) as two distinct constructs of *demonstrability* and *visibility. Demonstrability* is "the tangibility of the results of using an innovation," and *visibility* is "the extent to which potential adopters see the innovation as being visible in the adoption context" (Agarwal and Prasad 1997, p. 562). Further interpretation of *visibility* surmises that, an innovation, application, solution, technology or service may not be new but it could be unknown for its prospective users. This probably is the case with LBS and their application, where the services have been around for several years now, yet their general usage rates, especially in the contexts of emergency management are still extremely limited worldwide (Frost and Sullivan research service 2007; O'Doherty et al. 2007; Aloudat and Michael 2010).

The main contribution of the DOI theory to this paper is the integration of its *visibility* construct in the proposed conceptual model. *Visibility* is defined as the extent to which the actual utilisation of LBS in EM is observed as a solution to its potential users. Considering the arguments above and following a line of reasoning in former studies, such as Karahanna et al. (1999) and Kurnia and Chien (2003), the following proposition is given:

Proposition *P1*: The perception of an individual of the usefulness of location-based services for emergency management is positively related to the degree to which the services as a solution are visible to him or her.

2.2 *The quality features of location-based emergency services*

A classic definition of service quality is that it is "a judgment, or attitude, relating to the superiority of the service" (Parasuraman et al. 1988, p. 16). The quality is, therefore, a result of personal subjective understanding and evaluation of the merits of the service. In the context of emergency management, individuals may not always have comprehensive knowledge about the attributes of LBS in such context or the capabilities of the services for emergencies. Consequently, individuals may rely on indirect or inaccurate measures to judge such attributes. Therefore, there is a need to create verifiable direct measurements in order to present the subjective quality (perceived) in an objective way (determinable dimensions) in order to examining the impact of the quality features of LBS on people's opinions towards utilising the services for EM.

The quality of electronic services (e-services) has been discerned by several researchers 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 impact of LBS quality features on people's acceptance of the services. Nonetheless, a set by Liljander et al. (2002) can serve as a good candidate for this purpose. The set of Liljander et al. was adapted from the well-known work of Parasuraman et al. (1988); the SERVQUAL model, but they redesigned the model to accurately reflect the quality measurements of e-services. The dimensions of Liljander et al. (2002) include *reliability*, *responsiveness*, *customisation*, *assurance/trust*, and *user interface*.

Since LBS belongs to the family of e-services, most of the aforementioned dimensions in Liljander's et al. model are highly pertinent and can be utilised to the benefit of this research. In addition, as the dimensions are highly adaptable to capture

new media (Liljander et al. 2002) then it is expected that these dimensions would be capable of explaining people's evaluation towards the introduction of LBS into the modern emergency management solutions. Moreover, the few number of these dimensions are expected to provide a parsimonious yet reliable approach to study the impact of LBS quality features on people's opinions without the need to employ larger scales such as Zeithaml's et al. (2000), which comprises eleven dimensions, making it almost impractical to be employed along with other theorised constructs in any proposed conceptual model.

The interpretation of the *reliability* concept follows Kaynama and Black (2000), Zeithaml et al. (2000) and Yang et al. (2003) definitions as the accuracy and currency of the product information. For LBS to be considered reliable, the services need to be delivered with the best possible accurate state and within the promised time frame (Liljander et al. 2002). This is highly relevant to emergency situations, taking into account that individuals are most likely on the move and often in time-critical circumstances that always demand accurate and current services.

Since it is reasonable to postulate that the success of LBS utilisation in emergency situations depends on the ability of the government, as the provider of the service, to disseminate the service information to a large number of people in a timely fashion, and due to the fact that fast response to changing situations, or to peoples' emergent requests, is considered as providing timely information to them then timeliness is closely related to responsiveness (Lee 2005). Therefore, investigating the *responsiveness* of LBS would also be relevant in this context.

Liljander's et al. (2002) *user interface* and *customisation* dimensions are not explicitly pertinent to EM. The dimension of *User interface* comprises factors such as aesthetics, something that cannot actually be relevant to an emergency situation. *Customisation* refers to the state where information is presented in a tailored format to the user. This can be done for and by the user. As LBS are customised based on the location of the recipient and the type of information being sent to the user then customisation is already an intrinsic quality in the core features of these services.

Therefore, the service quality dimensions that are expected to impact on people's acceptance of LBS for EM include:

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

Although perceived service quality is a representation of a person's subjective expectations of LBS, and not necessarily a true interpretation of the actual attributes of the service, it is expected nonetheless that these perceptions would convey an accepted degree of quality the prospective user anticipates in LBS, given the fact that limited knowledge about the actual quality dimensions are available to them in the real world.

It could be posited that an individual's perception of how useful LBS are in emergencies can be highly influenced by the degree to which he or she perceives the services to be accurate, current and responsive. Here, the conceptual model follows the same rationale of TAM, which postulates *perceived ease of use* as a direct determinant of the *perceived usefulness*. *Perceived ease of use* is defined as "the degree to which an individual believes that using a particular system would be free of physical and mental effort" (Davis 1989, p. 320). It is justifiable therefore to postulate that *ease of use* is related to the technical quality features of LBS since the evaluation of an individual to the service easiness is highly associated with the convenient design of the service itself. This explains why *ease of use* has been conceived before by several researchers as one of the dimensions of the service quality (Zeithaml et al. 2002; Yang et al. 2003; Zhang and Prybutok 2005).

Building upon the mentioned arguments and following the trails of TAM, LBS quality features of *currency, accuracy* and *responsiveness* are theorised in the conceptual model as direct determinants of the *perceived usefulness* and, accordingly, the following propositions are defined:

Proposition *P2a*: There is a positive relationship between the perceived currency of location-based services and the perceived usefulness of the services for emergency management.

Proposition *P2b*: There is a positive relationship between the perceived accuracy of location-based services and the perceived usefulness of the services for emergency management.

Proposition *P2c*: There is a positive relationship between the perceived responsiveness of location-based services and the perceived usefulness of the services for emergency management.

2.3 *Risks associated with using location-based emergency services*

Risk of varying types exists on a daily basis in a human's life. In the extreme situations, such as emergencies and disasters, perceptions of risk stem from the fact that the sequence of events and magnitude of the outcome are largely unknown or cannot be totally controlled. If one takes into account that risky situations generally affect the confidence of people in technology (Im et al. 2008), then the decision of an individual to accept LBS for EM might be influenced by his or her intuition that these electronic services could be easily disrupted since the underlying infrastructure may suffer heavily in severe conditions usually associated with such situations, especially in large-scale disasters. A telling example is Hurricane Katrina, in 2005, which caused serious disruptions throughout New Orleans, Louisiana, and rendered inoperable almost every piece of public and private infrastructure in the city. As a result, uncertainty about the intensity of extreme situations coupled with their unforeseeable contingencies may have long-term implications on one's perceptions towards the use of all technologies, including LBS, in life-threatening situations, such as emergencies.

Since it is practically rational to believe that individuals would perceive different types of risk in emergencies, then it might be highly difficult to examine particular facets of risk as being separate to one another since they can all be inextricably intertwined. Therefore, following the theoretical justification of Pavlou (2003), perceived risk is theorised in the conceptual model as a high-order unidimensional concept.

Perceived risk is defined as the individual's belief of the potential loss and the adverse consequences of using LBS in emergencies and the probability that these consequences may occur if the services are used. Bearing in mind the high uncertainty that is usually associated with such events, this paper puts forward the following proposition:

Proposition *P3*: The risks perceived in using location-based services for emergency management have a negative influence on the perceived usefulness of the services.

2.4 *People's trust in location-based emergency services*

Trust has long been regarded as an important aspect of human interactions and their 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). Uncertainty in e-services, including LBS, leads individuals to reason about the capabilities of the services and their expected performance, which eventually brings them to either trust the services by willingly accept to use them or distrust the services by simply reject to use them. In emergencies, individuals may consider the possible risks associated with LBS before using this kind of services. Therefore, individuals are likely to trust the services and engage in a risk taking relationship if they perceive the benefits of LBS outweigh the risks. However, if high levels of risk are perceived, then it is most likely that individuals do not have enough trust in the services and, therefore, will not engage in a risk-taking behaviour by using them (Mayer et al. 1995). Consequently, it could be posited here that trust in LBS is a pivotal determinant of accepting the services, especially in emergency situations where great uncertainty is always present.

Trust has generally been defined as the belief that allows a person 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 the context of LBS, the definition encompasses trust in the service provider (i.e. government in collaboration

with telecommunications carriers) and trust in the services and their underlying infrastructure. This definition is in agreement with the generic model of trust in e-services, which encompasses two types of trust: trust in the government agency controlling and providing the service and trust in the technology and underlying infrastructure through which the service is provided (Tan and Thoen 2001; Carter and Bélanger 2005; Horkoff et al. 2006).

Since the willingness to use the services can be regarded as an indication that the person has taken into account the characteristics of both the services and the provider of the services, including any third parties in between, then it is highly plausible to say that investigating trust propensity in the services would provide a prediction of trust in both LBS and their provider. Some could reasonably argue that trust should be examined with the proposition that the person knows or, at least, has a presumption of knowledge about the services, their usefulness and the potential risks associated with them. Nonetheless, it should be noted here that trust is, ipso facto, a subjective interpretation of the trustworthiness of the services, given the limited knowledge of the actual usage of LBS in the domain of emergency management in the real world.

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 the acceptance of LBS since both usually show a different set of antecedents (Junglas and Spitzmuller 2006). Trust and perceived risks are essential constructs when uncertainty is present (Mayer et al. 1995). However, each of the two has a different type of relationship with uncertainty. While uncertainty augments the risk perceptions of LBS, trust reduces the individual's concerns regarding the possible negative consequences of using the services, thus alleviating uncertainty around their performance (Morgan and Hunt 1994; Nicolaou and McKnight 2006).

Therefore, as trust in LBS lessens the uncertainty associated with the services, thus reducing the perceptions of risk, this paper theorises that *perceived risk* is negatively related to an individual's *trust* in LBS. This is in line with a large body of previous empirical research, which supports the influence of trust on the perceptions of risk (Gefen et al. 2003). Furthermore, 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, the following propositions are defined:

Proposition *P4*: Trust in location-based services positively influences the perceived usefulness of the services for emergency management.

Proposition *P5*: Trust in location-based services negatively impacts the risks perceived from using the services for emergency management.

2.5 *Privacy concerns pertaining to location-based emergency services*

In the context of LBS, privacy pertains mainly to the locational information of the person and the degree of control he or she exercises over this type of information. Location information is regarded as highly sensitive data that when collected over a period of time or combined with other personal information can infer a great deal about a person's movements and in turn reveal more than just one's location. Indeed, Clarke and Wigan (2008) noted that knowing the past and present locations of a person could, amongst other things, enable the discovery of the person's behavioural patterns in a way that could be used, for example, by governments to create a suspicion, or by the private sector to conduct target marketing.

Privacy concerns could originate when individuals become uncomfortable of the perception that there is a constant collection of their personal location information, the idea of its perennial availability to other parties, and the belief that they have incomplete control over the collection, the extent, the duration, the timing or the amount of data being collected about them.

The traditional commercial use of LBS, where a great level of detail about the service application are regularly available for the end user, may not create much sensitivity towards privacy since in most cases the explicit consent of the user is a prerequisite for initiating these services. This is completely true in the markets of the United States, Europe and Australia (Gow 2005; Code of Practice of Passive Location Services in the UK 2006; The Australian Government: Attorney General's

Department 2008). However, in emergencies pertinent government departments and law enforcement agencies have the power to temporarily waive the person's right to privacy based on the assumption that the consent is already implied when collecting location information in such situations (Gow 2005; Pura 2005).

The implications of waiving away the consent, even temporarily, may have long-term adverse effects on people's perspectives towards the services in general. It also has the potential to raise a debate on to what extent individuals are truly willing to relinquish their privacy in exchange for a sense of continuous security (Perusco et al. 2006). The debate could be easily augmented in the current political climate of the so-called "war on terror" where governments have started to bestow additional powers on themselves to monitor, track, and gather personal location information in a way that never could have been justified before (Perusco and Michael 2007). As a result, privacy concerns are no exception to emergency management.

Four privacy concerns have been identified previously by Smith et al. (1996). They are *collection*, *unauthorised secondary use, errors in storage, and improper access* of the collected data. These concerns are also pertinent 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 when using LBS for emergency management. *Unauthorised secondary use* is defined as the concern that LBS information is collected for the purposes of emergency management but ultimately is used for other purposes and without explicit consent from the individual. *Errors in storage* describe the concern that the procedures taken against accidental or deliberate errors in storing location information are inadequate. And *improper access* is the concern that the stored location information is accessed by parties who do not have the authority to do so.

Two particular privacy concerns, *collection* and *unauthorised secondary use,* are integrated into the conceptual model. These concerns are expected to have a direct negative impact on the *perceived usefulness* of LBS. Other prominent constructs of *trust* and *perceived risk* are assumed to have mediating effects on the relationship between *privacy concerns* and *perceived usefulness* since both constructs (i.e. *trust* and *perceived risk*) could be reasonably regarded as outcomes of the assessment of

the individual of the privacy concerns. For instance, if a person does not have much concern about the privacy of his or her location information then it is most likely he or she trusts the services, thus perceiving LBS to be beneficial and useful. On the other hand, if the perceptions of privacy concerns were high then the individual would not probably engage in a risk taking behaviour, resulting in lower perceptions of the usefulness of the services.

Accordingly, *Perceived privacy concerns* are theorised in the conceptual model as direct determinants of both *trust* and *perceived risk*. While *perceived privacy concerns* are postulated to have a negative impact on the *trust* in the services, they are theorised to have a positive influence on the *risks perceived* from using location-based services for emergency management.

Considering the abovementioned arguments, the following propositions are made:

Proposition *P6a*: Collection, as a perceived privacy concern, negatively impacts the perceived usefulness of location-based services for emergency management.

Proposition *P6b*: Unauthorised secondary use, as a perceived privacy concern, negatively impacts the perceived usefulness of location-based services for emergencies.

Proposition *P7a*: Collection, as a perceived privacy concern, has a negative impact on trust in location-based services.

Proposition *P7b*: Unauthorised secondary use, as a perceived privacy concern, has a negative impact on trust in location-based services.

Proposition *P8a*: The risks perceived from using location-based services for emergency management are positively associated with the perceived privacy concern of collection.

Proposition *P8b*: The risks perceived from using location-based services for emergency management are positively associated with the perceived privacy concern of unauthorised secondary use.

3 A conceptual model of location-based emergency services acceptance

The determinants of LBS acceptance are integrated into a conceptual model that extends and builds upon the established theory of reasoned action (TRA), applied in a technology-specific adaptation as a technology acceptance model (TAM). See Figure 1.

TAM postulates that usage or adoption behaviour is predicted by the individual's intention to use location-based emergency services. The behavioural intention is determined by the individual's attitude towards using the services. Both the attitude and intention are postulated as the main predictors of acceptance. The attitude, in turn, is influenced by two key beliefs: perceived ease of use and perceived usefulness of LBS. TAM also grants a basis for investigating the influence of external factors on its internal beliefs, attitude, and intention (Davis et al. 1989).

As illustrated in the model in Figure 1, a set of propositions that reflect the theoretical relationships between the determinants of acceptance are presented as arrowed lines that start from the influential factor and end into the dependent construct. The theorised factors supplement TAM's original set and are totally in agreement with its theoretical structural formulation. That is, all of the hypothesised effects of the factors would only be exhibited on the internal constructs (i.e. attitude and intention) through the full mediation of the internal beliefs (i.e. perceived usefulness or perceived ease of use).

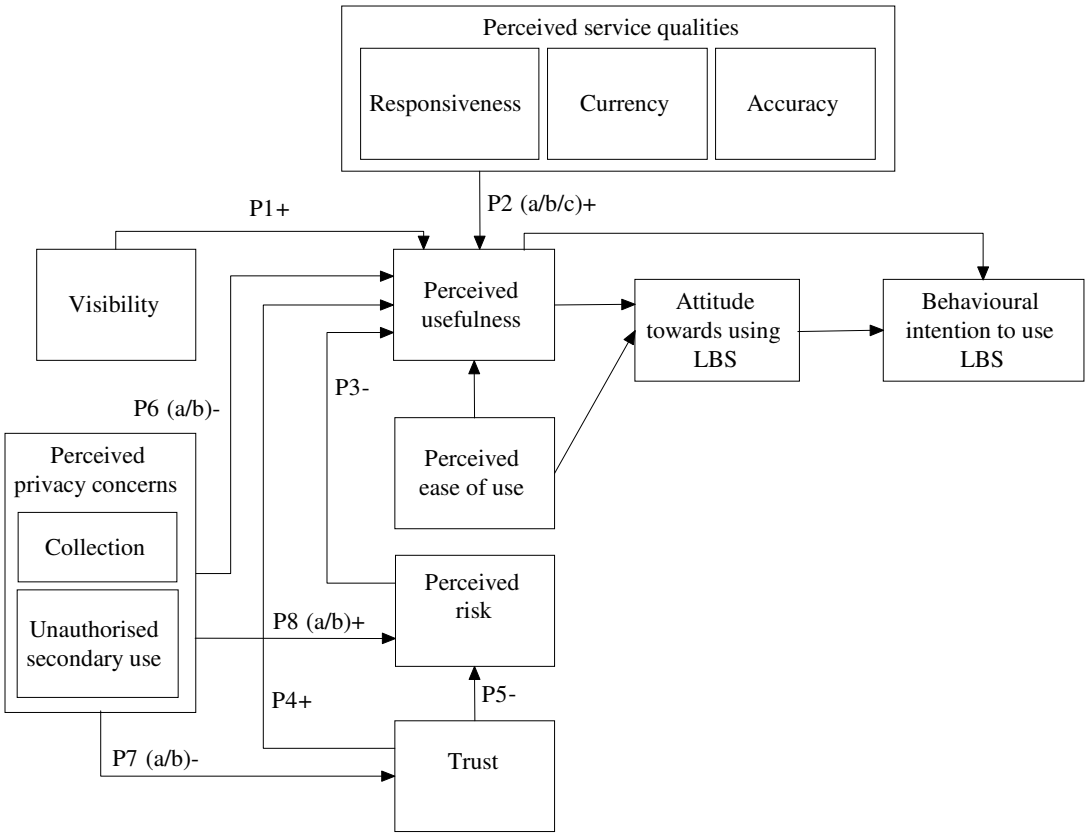

Figure 1: The conceptual model of location-based emergency services acceptance

4 Model pretesting

A pilot survey was conducted in order to test the reliability of the model's constructs. IS literature places great emphasis on the importance of the piloting stage as part of the model's development (Baker 1999; Teijlingen and Hundley 2001). In essence, the pilot survey is an experimental study that aims to collect data from a small set of subjects in order to discover any defects or flaws that can be corrected, before the conceptual model is tested in a large scale survey (Baker 1999; Zikmund 2003).

4.1.1 Measurement of constructs

To increase construct measurement reliability, most of the items in the survey, which have been tested and validated in former studies, were adapted to reflect the specific context of this research i.e. location-based services. It should be emphasised here that the use of existing items in the literature is completely a valid approach (Churchill 1979).

The scales of TAM's *perceived usefulness* and *perceived ease of use* were measured based on the original scales of Davis (1989). *Attitude* measurement items were adopted from two studies by Agarwal and Prasad (1999) and Van der Heijden et al. (2001). *Intention to use* items were measured using scales adopted from Junglas and Spitzmuller (2005). *Trust* measurements were adopted from Mayer et al. (1995) and Junglas and Spitzmuller (2005). Pavlou and Gefen (2004) *perceived risk* items were adopted given the emphasis on emergency management. The items of the *visibility* construct were adopted from a study by Karahanna et al. (1999). The items of *perceived privacy concerns* were adopted from Smith et al. (1996) and Junglas and Spitzmuller (2005). The statements of *perceived service qualities* were not directly available but have been operationalized based on the recommendations of Churchill (1979), who suggested that each statement should express limited meaning, its dimensions should be kept simple and the wording should be straightforward.

4.1.2 Survey design

The survey included an overview and introduction of the application of location-based services in emergency management. In addition, the survey provided the participants with four vignettes. Each vignette depicted a hypothetical scenario about the possible uses of LBS applications for managing potential hazardous situations. The scenarios covered specific topics to emergencies such as an impending natural disaster, a situation where a person was particularly in need of medical assistance, severe weather conditions and a national security issue. Two of the vignettes were designed to present location-based services in a favourable light, and the other two vignettes were designed to draw out the potential pitfalls and limitations of LBS in EM. Through the use of vignettes, participants were encouraged to project their true perceptions about the services while, at the same time, involved with creating a meaning related to their potential use in these events. Creating this meaningful attachment in context was very important, as it acted to inform participant responses, given the utilisation of LBS in EM is still in its nascent stages worldwide.

A self-administrated questionnaire was used to collect data from participants. A five-point Likert rating scale was used throughout the questionnaire. The survey which predominantly yielded quantitative results also included one open-ended question in order to solicit more detailed responses from the participants.

4.1.3 The sample of the pilot survey

Six hundred pilot surveys were randomly distributed by hand, in November 2008, to households' mailboxes in the Illawarra region and the City of Wollongong, New South Wales, Australia. Participants were asked to return their copies to the researcher within three weeks in the enclosed reply-paid envelope provided with the survey.

Although, this traditional approach is time-consuming and demands a lot of physical effort, it was favoured as it is more resilient to social desirability effects (Zikmund 2003), where respondents may reply in a way they think it is more socially appropriate (Cook and Campbell 1979). In addition, it is generally associated with high perceptions of anonymity, something that may not be completely assured or guaranteed by other methods of data collection since they tend to disclose some personal information, such as name, telephone number, email address or IP address, which may cause privacy infringements (Zikmund 2003; Michaelidou and Dibb 2006).

The main concern was to end up with a low response rate, an issue several researchers have noted before (Yu and Cooper 1983; Galpin 1987; Zikmund 2003). Indeed, a total of 35 replies were returned, yielding an extremely low response rate of 5.8%. Two incomplete replies were excluded, leaving only 33 usable surveys for the final analysis.

Although it is a desirable goal to end up with a high response rate to have more confidence in the results, and to be able to comment on the significance of the findings (Emory and Cooper 1991; Saunders et al. 2007), it should be noted that the pilot study's main objective is to serve as an initial test (pretest) of the conceptual model and does not, in any away, attempt to generalise its results to a new population. Therefore, the generalisability of the findings is not an issue of contention here (Morgan and Hunt 1994).

Nonetheless, there is much discussion in the litrature of what constitutes a "good" response rate of the pilot survey; hence, its acceptable sample size. Hunt et al. (1982), for example, stated that several researchers simply recommended a "small" sample size, others indicated a sample size between 12 and 30 as sufficient to fulfil the requirements of the analysis. Anderson and Gerbing (1991) pretested a methodology

for predicting the performance of measures in a confirmatory factor analysis with a sample size of 20. They posited the consistency of this small sample size with the general agreement between researchers that the number should be relatively small. Reynolds et al. (1993) noted that the sample size of pilot surveys is generally small when discussed in the literature, ranging from 5 to 100, an depending on the goal of the study.

The main concern, however, when assessing the effect of a low response rate on the validity of the survey is when taking into account the nonresponse bias (Cummings et al. 2001; Fowler 2001). The bias stems from the possibility that only the sample population who are interested in the topic of the pilot survey would provide their responses back (Fowler 2001). Nonetheless, if non-respondents' characteristics are systematically similar to those of the respondents, then the nonresponse bias is not necessarily reduced by an increased response rate (Cummings et al. 2001).

Kanuk and Berenson (1975) in a comprehensive literature review of the factors influencing response rates to mail surveys, examined the significant differences between respondents and non-respondents, taking into account a broad range of personality traits, socio-economic and demographic characteristics. The researchers concluded that the only consistent difference was that respondents tend to be better educated.

Since respondents of this pilot survey were of all levels of education, as illustrated in Table 2, where for example, 7 respondents had a secondary education while 7 had post-graduate degrees, representing the low-level educated and the well-educated population, then it is argued that non-respondents did not differ significantly from the survey's responders, suggesting that nonresponse bias was not present, and therefore, low response rate is not an issue here. Thus, the pilot survey with its low response rate, and for which no systematic differences between respondents and non-respondents exist is considered valid for the analysis.

The traditional benchmarks in mail survey studies that positioned a 50 percent response rate as adequate and 70 percent as very good (Babbie 1998) should be reappraised. Current trends of thinking reject these unconditional criterion levels and assertively demand for a contextual approach where response rate is considered in

conjunction with the goal of the study, its design and the nature of its sample (Fife-Schaw 2000; Fowler 2001).

Table 2: Respondents education

Education level	Frequency	Percent	Valid Percent	Cumulative Percent
Still at school	1	3.0	3.0	3.0
Secondary education	7	21.2	21.2	24.2
Certificate level including skilled vocational	5	15.2	15.2	39.4
Advance diploma or diploma level	5	15.2	15.2	54.5
Bachelor degree	4	12.1	12.1	66.7
Graduate diploma or graduate certificate level	4	12.1	12.1	78.8
Postgraduate degree	7	21.2	21.2	100.0
Total	33	100.0	100.0	

4.1.4 Reliability of the measurements

Reliability expresses the extent to which the measures in the instrument are free of random errors, thus yielding similar consistent results if repeated (Yin 2003; Zikmund 2003). Reliability reflects the internal consistency of the scale items measuring the same construct for the selected data. Hence, it is basically an evaluation of the measurement accuracy (Straub 1989). Nunnally and Bernstein (1994) recommended the calculation of Cronbach's alpha coefficients to assess reliability. Straub (1989) suggested an alpha value of 0.80 as the lowest accepted threshold. However, Nunnally and Bernstein (1994) stated that 0.60 is accepted for newly developed measures, otherwise, 0.70 should serve as the lowest cut-off value.

The common threshold value of 0.7 was selected as the minimum acceptable level based on the recommendations of Nunnally and Bernstein (1994) and Agarwal and Karahanna (2000). The results of the analysis are presented in Table 3, revealing acceptable values for nearly all measurements except *perceived accuracy* which was found to be 0.684. Accordingly, one highly complex item was excluded and the

revised construct was put again through another round of validation, after which a higher acceptable coefficient of 0.724 was yielded.

Another reliability scale assessment, through the computation of composite reliability, was also conduted. It is similar in interpretation to Cronbach's alpha test, but it applies the actual loadings of the items and does not assume weight equivalency among them (Chin 1998). Moreover, Raykov (1997) showed that Cronbach's test may under-estimate the reliability of the congeneric measures, leaving the researcher with lower-bound estimates of the true reliability scores. As illustrated in Table 4, the results show that all scores far exceed the 0.7 recommended threshold (Hair et al. 2006). Consequently, these results bring more confidence in the conceptual model and its constructs as they have demonstrated high internal consistency under the evaluation of two separate reliability tests.

Table 3: Cronbach's alpha reliability statistics

Scale	Cronbach's alpha stage 1	Number of Items	Cronbach's alpha stage 2	Number of Items
Attitude	.894	3	.894	3
Intention to use	.778	5	.778	5
Trust	.908	3	.908	3
Perceived risk	.928	3	.928	3
Perceived usefulness	.869	4	.869	4
Perceived ease of use	.951	4	.951	4
Visibility	.795	4	.795	4
Perceived service qualities				
Perceived currency	.913	3	.913	3
Perceived accuracy	.684	4	.724	3
Perceived responsiveness	.837	4	.837	4
Perceived privacy concerns				
Collection	.840	4	.840	4
Unauthorised secondary use	.868	3	.868	3

Table 4: Composite reliability statistics

Scale	Number of Items	Composite reliability
Attitude	3	.935
Intention to use	5	.844
Trust	3	.942
Perceived risk	3	.954
Perceived usefulness	4	.911
Perceived ease of use	4	.964
Visibility	4	.859
Perceived currency	3	.944
Perceived accuracy	3	.842
Perceived responsiveness	4	.896
Collection	4	.888
Unauthorised secondary	3	.898

5 Conclusion and Implications

Despite the large body of research that has been written to augment our understanding of the determinants of acceptance and adoption of location-based services in various usage contexts, the scarcity of theoretical and empirical studies that examine people's acceptance of LBS in the realm of emergencies is noted. This is clearly a gap in the current research in which this study makes a significant contribution. This paper is a discussion of unexplored determinants in relation to user acceptance of location-based emergency services. These include the visibility of LBS applications in the context of emergency management, the privacy of individuals and their perceived concerns regarding extensive collection and unauthorised secondary use of the collected data by governments, risks as associated with using LBS for EM, trust in the services and in the service provider, and the current, accurate and responsive quality features of the services being offered for emergency management.

This paper proposed a conceptual model based on the aforementioned determinants that should serve as the theoretical basis for future empirical examination of acceptance. The model significantly extends and builds upon the theory of reasoned action, applied in a technology-specific adaptation as a technology acceptance model.

Although the conceptual model was built specifically to predict an individual's acceptance of LBS for emergency management, the model can nonetheless be used as

a generic candidate model in empirical studies to predict people's acceptance of location-based services in other security usage contexts, applications, scenarios or settings. This is made possible due to the fact that all of the theorised factors of the model are highly relevant to the intrinsic characteristics of LBS. Examples of where the model would be deemed particularly useful include law enforcement applications, such as matters related to the surveillance implications of location-based services, and location-based evidence captures and social issues pertaining to the application of the services, such as arrest support, traffic violations or riot control.

In addition, the proposed model can be used not only to identify the predictors of acceptance but also to help the service providers to design their solutions in a way that can fairly meet the end user expectations. For instance, the model identifies perceived usefulness, perceived ease of use and perceived service quality features as expected determinants of acceptance. Once empirically tested, the impact of these factors can provide guidelines to developers of the services to accommodate the right service requirements that reflect acceptable performance standards for the potential users.

Finally, the application of location-based services in today's society has the potential to raise concerns amongst users. These concerns could easily be augmented in highly sensitive settings, such as emergency management or counter-terrorism solutions. While this paper presents theoretical foundations, it is hoped the knowledge obtained here can be considered by governments and interested researchers towards the formation of developing more successful deployment and diffusion strategies for location-based emergency services globally. The purpose of this paper is to help in channelling such strategies in the right direction.

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