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Location-based mobile phone service utilisation for emergency management in Australia

Anas Aloudat
University of Wollongong

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Location-Based Mobile Phone Service Utilisation for Emergency Management in Australia

A thesis submitted in fulfilment of the requirements for the award of the degree

Doctor of Philosophy

From

University of Wollongong

By

Anas Aloudat

School of Information Systems and Technology

Faculty of Informatics

2010
Author’s Certification

I, Anas Aloudat, declare that this thesis, submitted in fulfilment of the requirements for the award of Doctor of Philosophy degree, in the School of Information Systems and Technology, University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. The document has not been submitted for qualifications at any other academic institution.

Anas Aloudat

8 December 2010
To the 173 people who lost their lives in the Black Saturday Victorian Bushfires in Australia on February 7, 2009.
Abstract

Mobile alerts, notifications and location-based emergency systems are now an established part of mobile government strategies in an increasing number of countries worldwide. In Australia the national emergency warning system was instituted after the tragic Victorian Bushfires of February 2009 to enable the provision of public information from the government to the citizen at the time of an emergency. But, moving on from the traditional short message service notification to a more advanced location-based service, this study is an investigation of the major issues faced by government, business and society at large, towards the realisation of a fully fledged national location-enabled emergency system for personal mobile devices in Australia. The investigation is carried out with the main stakeholders of location-based services in Australia through a self-administered mail survey with the general public, in conjunction with a series of in-depth semi-structured interviews with key informants. The quantitative data is analysed mainly using the partial least squares method. The qualitative data is analysed using content analysis techniques. The findings show social acceptance of a national location-based mobile phone emergency service in Australia, in spite of general concerns about infringements in privacy. People acceptance of the service is largely driven by the trust placed in the government as the controller of the service, and in the service as an admissible useful means for managing emergencies. A number of barriers to the nationwide utilisation of the location-based mobile phone emergency service are identified and discussed, and a discourse of recommendations presented for the purpose of setting realistic objectives and expectations for the service in Australia. This study significantly contributes to the body of practical knowledge towards the development of more informed deployment and diffusion strategies for location-based emergency services in Australia. It also contributes to the scholarly literature offering new insights on the issues pertaining to the public offerings of location-based services in the domain of emergency management where comparable studies have been rather limited. In addition, the study contributes meaningfully to the current theories of acceptance by providing empirical evidence to retain the role of the attitude construct in the attitude-behaviour relationship, especially when studying the social acceptance of new electronic government applications and initiatives. Limitations of this research work and prospective directions for investigation are also presented.
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“All the credit is due to Allah, The Lord of all the Worlds, and only the mistakes have been mine”

Malik Al-Shabazz (Malcolm X)

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List of publications

Book chapters


Journal articles


Refereed conferences


Conference proceedings


National workshops


One Year Higher Degree Research Scholarship


Memberships and affiliations

- Member of the Research Network for a Secure Australia (since November 2006).
- Member of the Civil Emergency Alert Services Association (since December 2007).
- Member of the Disaster Preparedness and Emergency Response Association, (since January 2009).
- Member of the IEEE (since January 2009).
- Member of the IEEE Communications Society (since January 2009).
- Member of the IEEE Society on Social Implications of Technology (since January 2009).

Academic activities

- Reviewer for the IEEE International Symposium on Technology and Society (ISTAS2010).
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<tbody>
<tr>
<td>2G</td>
<td>2nd Generation</td>
</tr>
<tr>
<td>3G</td>
<td>3rd Generation</td>
</tr>
<tr>
<td>4G</td>
<td>4th Generation</td>
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<tr>
<td>ABC</td>
<td>Australian Broadcasting Corporation</td>
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<tr>
<td>ACMA</td>
<td>Australian Communications and Media Authority</td>
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<tr>
<td>A-GPS</td>
<td>Assisted-GPS</td>
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<tr>
<td>AMBER</td>
<td>America's Missing: Broadcast Emergency Response</td>
</tr>
<tr>
<td>AOA</td>
<td>Angle of Arrival</td>
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<tr>
<td>Asymp. Sig.</td>
<td>Asymptotic Significance</td>
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<tr>
<td>ATM</td>
<td>Automatic Teller Machine</td>
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<tr>
<td>AVE</td>
<td>Average Variance Extracted</td>
</tr>
<tr>
<td>BS</td>
<td>Base Station</td>
</tr>
<tr>
<td>C2G</td>
<td>Citizen-to-Government</td>
</tr>
<tr>
<td>CAP</td>
<td>Common Alerting Protocol</td>
</tr>
<tr>
<td>CBS</td>
<td>Cell Broadcast Service</td>
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<tr>
<td>CCTV</td>
<td>Closed-Circuit Television</td>
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<tr>
<td>Cell-ID</td>
<td>Cell Identification</td>
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<tr>
<td>CHORIST</td>
<td>Integrating Communications for enHanced envirOnmental RISk management and citizens safeTy</td>
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<tr>
<td>CIWS</td>
<td>Community Information Warning System</td>
</tr>
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</tr>
<tr>
<td>DSL</td>
<td>Digital Subscriber Line</td>
</tr>
<tr>
<td>DVTS</td>
<td>Dynamic Voice Translation System</td>
</tr>
<tr>
<td>E-911</td>
<td>Enhanced 911</td>
</tr>
<tr>
<td>EM</td>
<td>Emergency Management</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
</tr>
<tr>
<td>EM</td>
<td>Expectation-Maximisation</td>
</tr>
<tr>
<td>EMA</td>
<td>Emergency Management Australia</td>
</tr>
<tr>
<td>EMS</td>
<td>Enhanced Message Service</td>
</tr>
<tr>
<td>E-OTD</td>
<td>Enhanced Observed Time Difference</td>
</tr>
<tr>
<td>ESO</td>
<td>Emergency Service Organisation</td>
</tr>
<tr>
<td>ETSI</td>
<td>European Telecommunications Standards Institute</td>
</tr>
<tr>
<td>ETWS</td>
<td>Earthquake and Tsunami Warning System</td>
</tr>
<tr>
<td>EWN</td>
<td>Early Warning Network</td>
</tr>
<tr>
<td>EWS</td>
<td>Emergency Warning System</td>
</tr>
<tr>
<td>FCC</td>
<td>Federal Communications Commission</td>
</tr>
<tr>
<td>FEMA</td>
<td>Federal Emergency Management Agency</td>
</tr>
<tr>
<td>G2C</td>
<td>Government-to-Citizen</td>
</tr>
<tr>
<td>GAGAN</td>
<td>Geo Augmented Navigation system</td>
</tr>
<tr>
<td>GPS</td>
<td>Global Positioning System</td>
</tr>
<tr>
<td>GSM</td>
<td>Global System for Mobile Communications</td>
</tr>
<tr>
<td>GST</td>
<td>Goods and Services Tax</td>
</tr>
<tr>
<td>GZSS</td>
<td>Quazi Zenith Satellite System</td>
</tr>
<tr>
<td>HREC</td>
<td>Human Research Ethics Committee</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and Communication Technology</td>
</tr>
<tr>
<td>IMEI</td>
<td>International Mobile Equipment Identity</td>
</tr>
<tr>
<td>IN</td>
<td>Intelligent Networks</td>
</tr>
<tr>
<td>IP</td>
<td>Internet Protocol</td>
</tr>
<tr>
<td>IPAWS</td>
<td>Integrated Public Alert and Warning System</td>
</tr>
<tr>
<td>IPND</td>
<td>Integrated Public Number Database</td>
</tr>
<tr>
<td>IST</td>
<td>Information Systems and Technology</td>
</tr>
<tr>
<td>IT</td>
<td>Information Technology</td>
</tr>
<tr>
<td>JMA</td>
<td>Japan Meteorological Agency</td>
</tr>
<tr>
<td>LBS</td>
<td>Location-Based Service</td>
</tr>
</tbody>
</table>
LoS  Line of Sight
Ltd.  Limited
LTE  Long Term Evolution
MAR  Missing at Random
MBMC  Multimedia Broadcast/Multicast
M-Government  Mobile Government
MI  Message Indicator
MMS  Multimedia Messaging Service
MoLI  Mobile Location Information
NDIS  Natural Disaster Information System
NEWS  National Emergency Warning System
NGO  Non-Government Organisation
NSW  New South Wales
OD  Over Dose
ODRL  Open Digital Rights Language
OPC  Office of the Privacy Commissioner
OTDOA  Observed Timed Difference of Arrival
PLS  Partial Least Squares
PM&C  Prime Minister and Cabinet
PSAP  Public Safety Answering Point
R&D  Research and Development
RFI  Request for Information
RFID  Radio Frequency Identification
ROI  Return on Investment
SARS  Severe Acute Respiratory Syndrome
SEM  Structural Equation Modelling
SERVQUAL  Service Quality
SES  State Emergency Services
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEWS</td>
<td>Standard Emergency Warning Signal</td>
</tr>
<tr>
<td>SIM</td>
<td>Subscriber Identity Module</td>
</tr>
<tr>
<td>SISAT</td>
<td>School of Information Systems and Technology</td>
</tr>
<tr>
<td>SLA</td>
<td>Service Level Agreement</td>
</tr>
<tr>
<td>SMS</td>
<td>Short Message Service</td>
</tr>
<tr>
<td>SMSA</td>
<td>Standardised Mobile Service Area</td>
</tr>
<tr>
<td>SMSC</td>
<td>Short Message Service Centre</td>
</tr>
<tr>
<td>TAM</td>
<td>Technology Acceptance Model</td>
</tr>
<tr>
<td>TNA</td>
<td>Technology-Neutral Architecture</td>
</tr>
<tr>
<td>TNR</td>
<td>Technology-Neutral Regulation</td>
</tr>
<tr>
<td>TOA</td>
<td>Time of Arrival</td>
</tr>
<tr>
<td>TPB</td>
<td>Theory of Planned Behaviour</td>
</tr>
<tr>
<td>TRA</td>
<td>Theory of Reasoned Action</td>
</tr>
<tr>
<td>UK</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>UNISDR</td>
<td>United Nations International Strategy for Disaster Reduction</td>
</tr>
<tr>
<td>US</td>
<td>United States</td>
</tr>
<tr>
<td>USO</td>
<td>Universal Service Obligation</td>
</tr>
<tr>
<td>UTAUT</td>
<td>Unified Theory of Acceptance and Use of Technology</td>
</tr>
<tr>
<td>VBRC</td>
<td>Victorian Bushfires Royal Commission</td>
</tr>
<tr>
<td>WA</td>
<td>Western Australia</td>
</tr>
<tr>
<td>WAP</td>
<td>Wireless Application Protocol</td>
</tr>
<tr>
<td>WARN Act</td>
<td>Warning, Alert, and Response Network Act</td>
</tr>
<tr>
<td>Wi-Fi</td>
<td>Wireless Fidelity</td>
</tr>
<tr>
<td>WiMAX</td>
<td>Worldwide Interoperability for Microwave Access</td>
</tr>
<tr>
<td>WLAN</td>
<td>Wireless Local Area Network</td>
</tr>
<tr>
<td>XML</td>
<td>Extensible Markup Language</td>
</tr>
</tbody>
</table>
“People need information as much as water, food, medicine or shelter. Information can save lives, livelihoods and resources. It may be the only form of disaster preparedness that the most vulnerable can afford”

International Federation of Red Cross and Red Crescent Societies (2005).
1 Introduction

The introduction begins by relating the background to the potential utilisation of location-based mobile phone services for emergency management in Australia. The research problem of this study is then formulated and presented, as are the aim and objectives. An overview of the research design and the chosen research methods are then provided. The structure of the study is then outlined with a brief description for each of the ensuing chapters of the thesis. Finally, the boundaries of the research scope of the study are defined and the key assumptions of the research are stated.

1.1 General background to this research

Emergencies and disasters have been part of our existence since the recording of history and shall always be in the continuum cycle of life and death. The sacred books of Judaism, Christianity and Islam speak of many disasters that have befallen ancient societies. The account of Noah’s flood could be regarded as the first recorded large-scale disaster that humans were faced with on earth (Gen. 6:17; Qur’an 29:14). But even today, the risks of a wide range of known and previously unknown hazards continue to challenge society. The New York terrorist attacks (2001), the Indian Ocean Tsunami (2004), Hurricane Katrina (2005), and the bushfires in Australia (2009) are just a few telling examples of what societies have endured. Despite technological advancements that the world has witnessed, nations still remain at the mercy of large-scale emergencies and disasters.

Emergencies are generally hard to predict, control or manage. Their complexity, surrounding uncertainty, timing, consequences and potential severity always pose significant challenges to governments, aid agencies and the affected population at every stage of their occurrence. These extreme situations are unique contexts in which people are in continuous need of information. The lack of timely and accurate safety information where it is most needed has the potential to turn an ordinary hazardous event into a critical situation that could result in tragic or devastating consequences.
This is especially true now, with the increased frequency of emergencies and disasters in recent years not only in Australia but worldwide (Coyle and Meier 2009; United Nations News Centre 2010). According to the United Nations’ International Strategy for Disaster Reduction Platform for the Promotion of Early Warning (2005), one of the main reasons for the loss of life in emergency events is the lack of early warning information. Unfortunately, this same issue was amongst the key reasons that played a role in the tragic bushfire disaster on February 7, 2009 in Australia, which left 173 dead and destroyed over 2000 homes and businesses (The Victorian Bushfires Royal Commission 2009).

In response to emergencies and disasters, emergency management activities have long been practised by people and governments. Such activities evolved however from simple precautions and scattered procedures into more sophisticated management processes and systems that included preparedness, protection, response, mitigation and recovery strategies (Canton 2007). In this regard, governments have long been utilising various techniques and technologies, such as signage, sirens, speakers, radio, television, landline telephones and the internet, to communicate and disseminate critical time-sensitive information to people about impending dangers, as events have occurred and immediately following events. Since different methods of warning are not equally effective at providing an alert or notification in different physical and social settings (Mileti and Sorensen 1990), governments around the world have been exploring the utilisation of new feasible channels. These have included proprietary solutions and private infrastructures to effectively improve communication from and with people during emergencies. In this sense, the mobile telecommunications networks (or cellular network) has been effectively exploited by several governments in recent years as a means to provide an additional flow of information beside the conventional channels of communication, fortunately, because of the dramatic advances in these cellular networks, specifically in their spread, range and functionality (Kolodziej and Hjelm 2006).

Amongst the very first initiatives for a national mobile government emergency service was the Enhanced 911 (E911) in 1996, by the United States’ Federal Communications Commission (FCC). The FCC sought to enhance the quality and reliability of the 911 emergency call service by requiring the telecommunications carriers to locate and
deliver the almost pinpoint geographic location of a mobile handset anywhere in the United States, to the nearest Public Safety Answering Point (PSAP), after the handset user has initiated an emergency phone call or a distress short message service request for help (Küpper 2005; Kaplan and Hegarty 2006). Several other initiatives do exist elsewhere in the world today. Most notably, the E112 standard which is used within the GSM networks and is, at the same time, the European Union standard emergency service number (The Australian Communications and Media Authority 2004).

Beside the personal mobile phone emergency service, mobile technologies have also been suggested, trialled and implemented in several countries to disseminate warnings and notifications to affected areas across all phases of an emergency or disaster (Moon 2004; Fernandes 2008; Chochliouros et al. 2009; Samarajiva and Waidyanatha 2009; Jagtman 2010b). It is quite true that the mobile telecommunications network is highly dependent on infrastructure, such as base stations, towers and power lines, and a large-scale emergency or disaster can significantly impact the effectiveness of the underlying infrastructure. The availability and pre-positioning of mobile cell towers and generators have greatly increased the resiliency of cellular networks in the recent years and the persistent transmission technologies in these networks has also proven to be reliable in areas devastated by severe events (Kiefer et al. 2008). Before a specific event, critical information messages about the risk or evacuation measures can be disseminated via the cellular network to people who are in the vicinity of the risk. During the event, experience has shown that safety messages through the mobile handset often have the best chance of working, despite damaged infrastructure, because these messages rely on persistent transmission technologies (Kiefer et al. 2008). After the event, messages can also be provided even in an environment where much of the critical infrastructure remains dysfunctional (McAdams 2006; Kiefer et al. 2008).

Nonetheless, moving on towards a more advanced location-enabled component of the mobile government emergency service seems to be the next rational step in the evolution path of emergency management. Once the location-based emergency service is utilised for personal mobile handsets, the service would have the capability of correlating its warning or notification information with the almost exact physical location of the active mobile handset of the intended recipient at the specified point in time and within the defined area of an emergency. These interrelated processes imply a
highly complex interplay between government agencies, telecommunications carriers and the general public. It is an interplay that has the ability to generate issues and pose critical challenges to all parties towards a viable location-based mobile phone emergency service in Australia.

1.1.1 Emergency management in Australian and the location-based mobile phone service

In Australia, recent trends revealed that the preferred method of communication amongst people is the mobile handset (The Victorian Department of Treasury and Finance 2009). This is manifested in the penetration of mobile handsets in the country that according to Gartner Inc., have exceeded the saturation point, in excess of 100%, by the end of 2006 and the rate is increasing each year. At the same time, the penetration of landline telephones is decreasing (Gupta and Ingelbrecht 2008; cited in The Victorian Department of Treasury and Finance 2009). See Table 1.1 and Table 1.2.

Table 1-1: Population and mobile phone penetration in Australia*.

<table>
<thead>
<tr>
<th>Year</th>
<th>Mobile phone penetration</th>
<th>Population (Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>99.3%</td>
<td>20.4</td>
</tr>
<tr>
<td>2007</td>
<td>104.4%</td>
<td>20.6</td>
</tr>
<tr>
<td>2008</td>
<td>108.6%</td>
<td>20.8</td>
</tr>
<tr>
<td>2009</td>
<td>111.4%</td>
<td>21.0</td>
</tr>
<tr>
<td>2010</td>
<td>113.7%</td>
<td>21.2</td>
</tr>
<tr>
<td>2011</td>
<td>115.8%</td>
<td>21.4</td>
</tr>
<tr>
<td>2012</td>
<td>117.3%</td>
<td>21.6</td>
</tr>
</tbody>
</table>

*Adapted from Gupta and Ingelbrecht (2008), cited in The Victorian Department of Treasury and Finance (2009).

Table 1-2: Landline phone penetration in Australia*.

<table>
<thead>
<tr>
<th>Year</th>
<th>Household Penetration of landline telephones</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>88.2%</td>
</tr>
<tr>
<td>2007</td>
<td>85.0%</td>
</tr>
<tr>
<td>2008</td>
<td>80.5%</td>
</tr>
<tr>
<td>2009</td>
<td>73.5%</td>
</tr>
<tr>
<td>2010</td>
<td>66.5%</td>
</tr>
<tr>
<td>2011</td>
<td>61.5%</td>
</tr>
<tr>
<td>2012</td>
<td>57.7%</td>
</tr>
</tbody>
</table>

*Adapted from Gupta and Ingelbrecht (2008), cited in The Victorian Department of Treasury and Finance (2009).
This rapid proliferation of mobile handsets presents a real opportunity for the Australian Government to utilise the location-based mobile phone service 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 (Gleeson 2005), but also in the way they acquire information relevant to their whereabouts and various daily life activities (Vodafone Australia 2006). 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. In fact, location-based 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.

On February 7, 2009, the Black Saturday Victorian Bushfires claimed 173 lives, the worst peacetime disaster in Australia’s recent history. At least eighteen months before this tragedy, the researcher began his investigation of the potential deployment of location-based services in the domain of emergency management in Australia by calling on key informants to share their experiences and insights about the future prospects of a national location-based mobile phone emergency system for personal safety and public warning purposes. On November 25, 2008, an in depth semi-structured interview was conducted with an official from the Victorian State Government. It was quickly realised that the complexity of a national emergency system with location-based capabilities meant that operational and non-operational stakeholders would have to work together closely towards a long-term viable solution that could effectively be utilised by relevant government authorities to communicate with people via their active mobile handsets in affected zones of natural and human-made hazards. The researcher was highly encouraged when the opportunity of the location-based mobile phone emergency service functioning within a national emergency framework in Australia was partially realised after the Australian Federal, States and Territories Governments announced in 2009 their future intentions to utilise the service under the National Emergency Warning System (NEWS) (The Victorian Department of Treasury and Finance 2009). 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-enabled services for personal safety and public warning purposes, this study contends the pressing need to carry out further research. Such a research direction is of high importance to government, business and society at large.

1.2 The research problem

To a large extent, research into public offerings of location-based services i.e. from government to citizen has been limited worldwide. Save for feasibility studies about particular mobile government location-enabled applications, there is a marked scarcity in theoretical and empirical research that touches on the issues pertaining to these applications- specifically with respect to the nationwide deployment of location-based mobile phone services for emergency management by governments. The scarcity of relevant research looking at the behavioural, social, technical, administrative, regulatory and legal implications of the location-based emergency service is noted despite the substantial body of previous research that has been explored, examined and elaborated before various issues in reference to location-based services in almost every other possible usage context, such as in the tourism industry (Chang et al. 2006), commercial offerings (Minch 2004; Gow 2005; Pura 2005; Gadzheva 2007; Navratil and Grum 2007; Perusco and Michael 2007; Junglas et al. 2008), paid safety services (Joore 2008), services for elderly users (Osman et al. 2003) and national security (Tootell 2005, 2007).

In addition, to the best of the researcher’s knowledge there is no publicly available study that has undertaken the responsibility of examining the attitudinal and behavioural implications of the nationwide introduction of location-based mobile phone government services for the purpose of public warning. That is, the individual attitude towards using the service and his or her intention to use the service in the case of an emergency. Moreover, there has been relatively little to no research in the investigation of the social acceptance or rejection of location-based mobile phone emergency services for the purpose of public warning and the identification of the determinants of this acceptance or rejection.
Accordingly, there is a clear gap in the current body of knowledge directed towards establishing the viability of the location-based mobile phone service within the government emergency management arrangements. The implications of the possible nationwide introduction of the service has never previously been investigated in a comprehensive fashion, including, the identification of the critical barriers to this introduction and the appropriate mechanisms to successfully realise the service.

All the aforementioned research issues are particularly true in the Australian context, even though the landscape has changed since the Victorian bushfires in 2009, as shall be discussed in detail in the following chapters.

**1.3 Aim and objectives of this research study**

The aim of this study is to assess the viability of the location-based mobile phone service within the national emergency management arrangements of Australia. That is, to assess the degree to which the service is capable of existing and developing under a national emergency warning system. To achieve this aim the following objectives must be met:

1. Investigate the potential social issues that may arise from a nationwide utilisation of the location-based mobile phone service for emergency management in Australia, such as location information privacy, information control, people’s trust in the service and in the government as the controller of the service, and the risks as perceived to be associated with using the service for emergency situations.

2. Examine the attitudinal and behavioural implications of the location-based mobile phone government emergency service. That is, predict and understand the Australian individual attitude towards using the service and his or her intention to use the service in the case of an emergency.

3. Investigate the social acceptance or rejection of the location-based mobile phone government emergency service in Australia and identify the determinants of this acceptance or rejection.
4. Explore and identify other important issues pertaining to the national utilisation of the location-based mobile phone emergency service in Australia, such as the administrative, regulatory and legal issues. Specifically, understand the roles, accountability and responsibilities of the main parties involved in the utilisation of the location service and the mutual relationships between the parties in the location service chain of activities during emergencies and disasters.

5. Identify the barriers to the nationwide utilisation of the location emergency service and offer recommendations towards setting realistic objectives and expectations for the service future in Australia.

1.4 Research design and methodology

Based on the argument of Klein and Myers (1999) that knowledge can be gained through exploring social constructions, such as shared meanings or issues, assigned by stakeholders to a phenomenon this study endeavours to gain insight about the possible nationwide utilisation of the location-based mobile phone service in Australia for emergency management by investigating the shared issues and concerns voiced by the key stakeholders of the service in Australia. Part of this investigation is of an exploratory nature and, therefore, it follows the interpretive paradigm since it is strongly argued that the interpretive paradigm and its underlying qualitative approach are the most appropriate for this type of exploratory investigation (Klein and Myers 1999).

However, while it is quite possible to explore a diversity of opinions under the interpretive approach (Ragin 1989; Klein and Myers 1999) not all answers can be attained since the interpretive paradigm is mainly of an exploratory inductive nature (Hecker et al. 2005). Accordingly, a combination of paradigms is needed to satisfy all of the objectives of this study. The post-positivist paradigm and its underlying quantitative methodology are also adopted here since it is possible under the prospects of the post-positivist paradigm to examine and explain the social acceptance or rejection of the location-based mobile phone emergency service and identify the determinants of this acceptance or rejection through exploiting relevant theories and models of acceptance (Onwuegbuzie 2002; Schulze 2003).
This study is carried out by employing a concurrent embedded research strategy; a design that is distinguished by the use of a single data collection phase during which the quantitative and qualitative data are collected concurrently (Creswell 2009). Under this research design, the findings of the quantitative method, which use the survey questionnaire as the main data collection method, are used to answer part of the research objectives which cannot be addressed by the qualitative approach. The latter qualitative approach employs the semi-structured interview and open-ended question in the survey as the data collection methods. Under the concurrent embedded strategy design the quantitative and qualitative findings reside side-by-side to provide this study with an overall compound assessment and understanding of the research problem that fundamentally requires both types of quantitative and qualitative data (Creswell 2009).

1.4.1 Using the survey method

A survey is employed as the main quantitative method to reach and target the population of interest (i.e. the general public of Australia). Surveying people would provide a justified reliable means to understand the attitude of the Australian towards using the location-based mobile phone emergency service and predict his or her behavioural intention to use the service in the case of an emergency. Understanding the individual attitude and intention towards using the service would facilitate the examination of the social acceptance or rejection of the possible national utilisation of the service since both the individual attitude and intention are postulated as the main predictors of this acceptance or rejection (Davis et al. 1989; Davis 1993; Pavlou 2003). The examination would also help to identify the determinants that would shape this acceptance or rejection.

The survey is also employs an open-ended question to qualitatively solicit opinions and more informed comments from the general public of Australia about the potential issues surrounding the possible national utilisation of the service.

The survey of this study is one of the earliest of its kind in Australia, if not arguably the first, to ask the people about the use of location-based services in the context of
emergencies, preceding all other comparable surveys, such as the one intended in February 2011 by the University of Queensland (Australian Associated Press 2010).

1.4.2 Using semi-structured interviews

The semi-structured interview is employed as the main qualitative method to explore the meanings the stakeholders of the location-based mobile phone service assign to the service (Klein and Myers 1999; Greeff 2005) in relation to its possible national utilisation for emergency management in Australia. The interviews will help to identify the specific benefits of the service for Australia, the matters of concern as perceived by the stakeholders in relation to the service utilisation and the recommendations of the stakeholders towards realising the service in Australia. In addition, the interviews will shed light on the expected role of each party involved in the utilisation of the location service and reveal the mutual relationships between the parties in the service chain of activities during emergencies and disasters. The participants of the interviews are selectively chosen from several domains, including independent experts with a wealth of knowledge and wide range of academic and scientific expertise, representatives and experts from the Australian mobile telecommunications industry, officials from Australian emergency service organisations and policy makers from Australian government departments related to emergency management arrangements and policies. The interviewees selected are all considered experts in the field of location based services and/or emergency management.

1.5 The structure of this thesis

This thesis, illustrated in Figure 1.1, is organised as follows:

- Chapter 2 (Background to the study) provides a comprehensive background about emergency, emergency management and location-based services, as the central themes in this study. The background is presented with respect to Australia’s emergency trends, its emergency management organisations and arrangements and the country’s warning and alerting systems, methods and techniques. The
background includes details about the conventional use of the location-based mobile phone service within the domain of emergency management, highlighting the shortage in research with respect to the requirements analysis for a location-based public warning system in the mobile telecommunications networks. A presentation of the principal details of the anticipated location-based mobile phone public warning system in Australia is given. Finally, several cases are presented where the location-based mobile phone public warning service or similar services have been trialled or implemented successfully worldwide.

- Chapter 3 (Issues in location-based service utilisation for emergency management, theory and model development) is a review of research issues in relevant literature to location-based services, discussed with specific respect to emergencies and disasters as the potential usage context of the service in Australia. This indispensable review enables the researcher to further investigate, with the stakeholders of location-based services, the relevant importance of the identified issues to the possible national utilisation of the location-based mobile phone emergency service. Since the investigation of this study extends to examine the potential impact of the identified issues on the social acceptance or rejection of the service, a comprehensive review of the prominent theories and models in acceptance and adoption literature is also carried out and presented in the chapter. From the review, a conceptual model is developed and proposed, drawing a set of research hypotheses to provide a theory-based recognition to the identified issues and, at the same time, offering a justified means to empirically examine the impact of the issues on the acceptance or rejection of the location service.

- Chapter 4 (Research design, data collection and data analysis techniques) is a discussion of the different design stages, data collection methods and data analysis techniques of this study. The chapter begins by underpinning the underlying paradigms of this research work and the nature of this research within the information systems research classifications. The identified paradigms and classifications provide the researcher with the justification for choosing the research strategy and its mixed quantitative and qualitative research approaches through which the objectives of the study are pursued and attained. Comprehensive details are provided about the data collection methods and data analysis techniques
employed under each approach. Finally, the human research ethical considerations that frame the design of this research endeavour and define the responsibilities of its researcher, at any given stage during the research process, are discussed in detail.

- Chapter 5 (A synthesis of the quantitative findings and discussion) details and discusses the synthesised quantitative findings from the analysis of the survey data on the issues pertaining to the national utilisation of the location-based mobile phone service for emergency management in Australia. The quantitative findings include the demographic and socio-economic characteristics of the sample population of the survey and the usage trends of location-based services amongst the surveyed population. In addition, the ranking results of the information control mechanisms perceived of being capable of providing the prospective user of the location-based mobile phone emergency service with control over his or her personal information under the utilisation of the service are presented. The rankings by importance of various emergency event types are shown with respect to the use of location-based mobile phone service utilisation. Finally, the analysis results of the survey questionnaire in relation to the research conceptual model and its hypotheses are fully detailed. A comprehensive discussion of these quantitative findings then follows immediately.

- Chapter 6 (A synthesis and discussion of the qualitative findings) is a critical synthesis and narrative discussion of the qualitative findings from the content analysis of the textual data of the semi-structured interviews and the respondents comments from the open-ended question in the survey. The findings that are presented include the issues that pertain to the potential national utilisation of the location-based mobile phone emergency service as articulated by the stakeholders of the service in Australia. The findings also include the identification of potential barriers to the national utilisation of the service and the recommendations of the stakeholders towards setting realistic objectives and expectations for the location service in Australia. The synthesised findings are categorised by shared themes under which relevant points of view and direct quotations from the stakeholders of the service are discussed.
• Chapter 7 (Conclusions, limitations and future work) is a presentation of the conclusions, which are drawn directly from this research work in the aim of appraising the viability of the location-based mobile phone emergency service in Australia. The presentation extends to discuss the implications of this research work, including the theoretical and empirical contributions to the scholarly literature and the body of practice knowledge. The limitations of this study are stated and finally, the prospective directions for further investigative opportunities arising from this research work are provided.
Figure 1.1: Structure of the thesis
1.6 Delimitations of scope and key assumptions

Delimitations are boundaries within the control of the researcher as opposed to limitations that are beyond his or her control (Perry 1998). Delimitations specific to this research were manifested in the research problem and its units of analysis. The scope of study is set with an explicit reference to Australia and not to any other country. Australia in this thesis refers to the Commonwealth of Australia and not to a specific State or Territory within the Commonwealth. In addition, the population considered in scope are those who resided in Australia, and who were 18 year old or over at the time of administering the survey and conducting the interviews.

The span of this research extends only to investigate the viability of location-based mobile phone services for emergency management within the national emergency management arrangements of Australia, and predominantly from an information systems perspective. Given the specific aim and objectives of this study, the scope is focused on emergencies and disasters as the social usage context of location-based services and does not investigate the services in any other context unless in relation to a given point discussed.

Several key assumptions used in this work should also be mentioned. First, the conclusions reached with respect to the objectives of this study and justifications of this research are rigorous to the extent that the type of knowledge obtained could be reasonably considered by the Australian Federal Government towards the formation of clearer deployment and diffusion strategies for location-based mobile phone services within the national emergency management arrangements of Australia. Second, information distilled from the literature is accurate representative of that recorded and that which is recorded is established upon valid and reliable research. Third, interviewees chosen are suitably experienced and competent practitioners. Fourth, the questions asked are suitable measures of the issues assessed (i.e. issues pertaining to location-based mobile phone service utilisation for emergency management in Australia). Fifth, the analysis techniques used are appropriate for this type of work and reflect what is commonly used in information systems research. Finally, the results drawn from the analysis are entirely accurate to the best of the researcher’s knowledge.
1.7 Overview of Chapter One

Chapter 1 served as an introduction to this study. A background is provided first in relation to the research that is carried out in the study, followed by presenting the domain of the research problem and the research gaps in the current body of knowledge in the literature of the location-based emergency services. The aim and objectives of this research endeavour are then stated and an overview of the research design and the employed research methods are given. The structure of this thesis is outlined and, finally, the delimitations of the research scope along with the key assumptions of this research work are stated.

The following chapter provides the reader with a context to understand emergency, emergency management and location-based services with specific reference to Australia wherever appropriate. The background information provided in Chapter 2 includes the presentation of Australia’s emergency management arrangements, the country’s emergency management committees and organisations and the currently deployed emergency service techniques, solutions and systems. The background extends to present location-based services, outline the emergency use origins of the services in the mobile telecommunications networks and discuss the main technologies utilised today within emergency management solutions for the purpose of delivering location-based public warning notifications. The chapter also include details the expected national location-based mobile phone system for public warning notifications in Australia. Finally, the background information of this chapter is supplemented with six global cases where location-based mobile phone services or similar location technologies have been utilised or are considered for utilisation for emergency management.
2 Background to the study

2.1 Introduction

This chapter provides a context for understanding emergency, emergency management, mobile government and location-based services, with specific reference to Australia. A comprehensive look is taken first into Australia’s emergency trends, its emergency management arrangements and organisations and the country’s warning and alerting systems, methods and techniques. An overview is given of the recently deployed National Emergency Warning System (NEWS) and the proposed amendments on the *Telecommunications Act 1997*, which are suggested by the Australian Federal Government in order to re-regulate the access to the Integrated Public Number Database (IPND) in order for the national warning system to function successfully.

By presenting Australia’s arrangements, organisations and efforts in the domain of emergency management with respect to this study, it was deemed critical to define *mobile government* (m-Government) in relation to the potential use of mobile government applications in emergency services. With mobile government defined, the stage is then set to discuss the decision by the Australian government towards the inclusion of a possible “location-enabled” emergency component into the country’s national emergency warning system. Accordingly, a discussion about location-based services follows in which a closer look is taken at understanding the services both generally and in context, the relation of the services with geographic information systems, the classifications of the services and the operational and non-operational stakeholders of the services. The discussion is extended to provide an overview about the use origins of location-based services in mobile telecommunications networks for emergency call and public warning notification purposes, including the presentation of the two main technologies (SMS and cell broadcasting) that are feasibly available today to convey the warning notification to the active mobile handsets located within the
defined geographic area(s) of an emergency. A comparison between the characteristics of the two technologies is also provided.

Given the relative lack of information about the requirements for a location-based emergency system in mobile telecommunications networks a basic requirement analysis based on the attainable relevant literature is also discussed in the chapter.

The background provided in this chapter is supplemented with a look at the current status in the utilisation of the location-based service for emergency call purposes in Australia and the current course of the Australian government towards determining the feasibility of a national location-based emergency component for public warning notification purposes within the NEWS.

Finally, to effectively complement the background and state of play provided in this chapter, several mini-cases are presented in which mobile alerts and location services have been trialled, implemented or suggested for implementation worldwide.

2.2 Emergency management in Australia

2.2.1 Defining emergency

Until recently, the predominant understanding of emergency was focused on some measure of the cost of the event, usually in terms of loss of life, extent of damage, or based on the event’s physical attributes such as its origin, nature or scale (Emergency Management Australia 2004b). Accordingly, emergencies have been traditionally associated with disasters when the number of casualties and the allocated resources to a given event have been high (Canton 2007). More contemporary viewpoints, especially from the social sciences have begun to question the validity of traditional classification schemes that have long defined emergencies and disasters or distinguished them according to their origin or scale. Social studies started to perceive these events as social constructions, defined by the nature and the volume of their impact on social systems (Quarantelli 1986; Rosenthal 1998; Perry 2007). The focus in understanding
emergencies has now shifted towards the actual situation created by such phenomena, rather than simply considering the physical attributes that caused them (Emergency Management Australia 2004b). This shift has come as a result of a growing realisation that although there are many different types of emergency events, whether natural- or human-caused, they all have comparable capacity to introduce social, economic, environmental and political consequences on the communities they impact (Buzan et al. 1998; Rosenthal 1998). Thus, an emergency impacts the organisation of human communities and can be thought of only within a larger framework involving the society as a whole (Gilbert 1998).

Managing emergencies with regard to their socially-constructed contexts is one of the reasons that has led the Australian Government to adopt an all-hazards approach in understanding and responding to risks associated to physical phenomena (Templeman and Bergin 2008). A hazard is any source of potential harm or a situation with a potential to cause loss (Emergency Management Australia 2004b). Emergency Management Australia (EMA) defines many types of hazards, which are broadly classified. Most of the known hazards are considered natural because they have their origins in the surrounding natural environment. Examples include bushfires, floods, cyclones, tsunamis, landslides, windstorms and earthquakes. Several other hazards are identified as technological, which are the result of failures in human-made systems and services, or the outcome of human actions. For example, these include urban structure fires, explosions and transportation incidents. Some hazards are classified as chemical, biological or radiological due to their specific origin. Some examples of these are toxic material releases, human epidemics and pandemics, exotic animal diseases and insect and vermin plagues. Remaining hazards can be classified as social in origin, which include civil unrests and acts of violence such as riots, sieges, shooting massacres, hijackings, sabotage and terrorism (Emergency Management Australia 2008). Table 2.1 summarises the different types of hazards.
Table 2-1: Types of hazards as classified in Australia

<table>
<thead>
<tr>
<th>Hazard classification</th>
<th>Hazard type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Natural hazard</strong></td>
<td>Bushfires</td>
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<tr>
<td></td>
<td>Cyclones</td>
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<tr>
<td></td>
<td>Earthquakes</td>
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<tr>
<td></td>
<td>Floods</td>
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<td></td>
<td>Hurricanes</td>
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<td></td>
<td>Land gales</td>
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<td></td>
<td>Landslides</td>
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<tr>
<td></td>
<td>Mudslides</td>
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<tr>
<td></td>
<td>Storm surges</td>
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<tr>
<td></td>
<td>Tidal waves</td>
</tr>
<tr>
<td></td>
<td>Torrential rain</td>
</tr>
<tr>
<td></td>
<td>Tsunamis</td>
</tr>
<tr>
<td><strong>Technological hazards</strong></td>
<td>Blackouts or main power failures</td>
</tr>
<tr>
<td></td>
<td>Explosions</td>
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<tr>
<td></td>
<td>Mining or industry incidents</td>
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<tr>
<td></td>
<td>Pollution</td>
</tr>
<tr>
<td></td>
<td>Smog</td>
</tr>
<tr>
<td></td>
<td>Transportation incidents</td>
</tr>
<tr>
<td></td>
<td>Urban structure fires</td>
</tr>
<tr>
<td><strong>Chemical, biological and radiological</strong></td>
<td>Chemical emissions</td>
</tr>
<tr>
<td><strong>hazards</strong></td>
<td>Epidemics / Pandemics</td>
</tr>
<tr>
<td></td>
<td>Exotic animal diseases</td>
</tr>
<tr>
<td></td>
<td>Insect or vermin plagues</td>
</tr>
<tr>
<td></td>
<td>Toxic spills</td>
</tr>
<tr>
<td><strong>Social in origin hazards</strong></td>
<td>Civil unrests</td>
</tr>
<tr>
<td></td>
<td>Hijacks</td>
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<tr>
<td></td>
<td>Riots</td>
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<td></td>
<td>Sabotages</td>
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<tr>
<td></td>
<td>Shooting massacres</td>
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<td></td>
<td>Sieges</td>
</tr>
<tr>
<td></td>
<td>Terrorism</td>
</tr>
</tbody>
</table>
2.2.2 Emergencies in Australia

The Commonwealth of Australia covers a landmass of approximately 7,692 million square kilometres with a population of about 22 million. Around 85 percent of the population live in cities within 50 kilometres of the coast, where much of the country's commercial and industrial activity takes place (Australia.gov.au Website 2010). Australia is divided into six States: New South Wales, Queensland, South Australia, Tasmania, Victoria and Western Australia, and two Territories: Australian Capital Territory and the Northern Territory. Each State or Territory has its own government, legislature and constitution. The legislature of Australia comprises a bicameral federal parliament, with a Prime Minister and Cabinet (PM&C).

As a physically large country with a diverse climate and geographic landscape, Australia experiences many types of hazards on a regular basis (Boughton 1998). In addition, communities across Australia continue to settle into hazard-prone areas, particularly in coastal and river valley regions, exposing themselves to risks from a variety of sources including cyclones, floods and bushfires (The Victorian Bushfires Royal Commission 2009). Even in regional areas, and as a result of inadequate risk assessments and mitigation actions, transport infrastructure, such as road and rail links, are usually flooded annually, which cause disruption of the carriage of commodities for communities and business, and the supply of materials for industry (The Australian Government: Department of Transport and Regional Services 2004).

Reliable information on the frequency of emergencies and disasters in Australia extends only from 1967; nonetheless, the number of these events has shown an upward trend in frequency over the last 20 years (The Victorian Bushfires Royal Commission 2009). The same trend is noted worldwide both in the developed and developing countries, caused by several factors including an increase in human activities in hazard-prone areas, military conflicts and climate change (Chochliouros et al. 2009; Coyle and Meier 2009; United Nations News Centre 2010).

Despite that the frequency of emergencies and the numbers of people who live or work in risk-prone areas have increased in Australia, deaths per 100,000 population have continued to fall due to better emergency management policies, arrangements and
applications (The Australian Government: Department of Transport and Regional Services 2004).

2.2.3 Defining emergency management

Throughout history, communities have battled hazards and responded to emergencies with the commensurate technology available to them. Organised attempts to counter emergencies, however, did not occur until much later in modern times (Haddow et al. 2006). These attempts have evolved from simple precautions and scattered actions into systematised and sophisticated policies, programs and applications that include preparedness, response, mitigation, recovery and protection strategies (Canton 2007). Modern emergency management (EM) can be defined as the discipline dealing with risk and risk avoidance and primarily concerned with developing and improving arrangements and programs that contribute to the goal of a safer, more sustainable community (Haddow et al. 2006).

2.2.4 Emergency management committees and organisations in Australia

Emergency and disaster management committees and organisations exist at National and State/Territory levels in Australia with specific responsibilities for local governments within their jurisdiction. The main emergency management bodies in Australia include:

1. Commonwealth Counter Disaster Task Force: A senior interdepartmental committee, chaired by the Department of the Prime Minister and Cabinet (PM&C). It is the peak Commonwealth body with emergency management responsibilities composed of representatives of Commonwealth Government departments and agencies with a significant role to play in the provision of disaster relief or rehabilitation assistance. On the advice of the Director General of Emergency Management Australia (EMA) agency, the Attorney-General’s Department, the
Chair may activate the committee during the response and recovery phase of a disaster in support of EMA’s activities (Emergency Management Australia 2004a).

2. The Australian Emergency Management Committee: Australia’s principal consultative emergency management forum. It is chaired by the Director General of EMA, and comprises chairpersons and executive officers of State and Territory emergency management committees. The Committee meets bi-annually to provide advice and direction on the coordination and advancement of Commonwealth and State interests in emergency management issues. As required, it establishes working parties to examine particular issues (Emergency Management Australia 2004a).

3. State and Territory Emergency/Disaster Management Organisations: Each State and Territory has established a committee of senior members of appropriate departments and agencies to consider emergency management matters. The names and functions of these organisations differ from State to State, but they are responsible for ensuring that proper plans and arrangements are made at State or Territory and local government level, to alert the public to and deal with emergencies and disasters (Emergency Management Australia 1996).

4. Emergency Management Australia (EMA): The Federal agency through which the Attorney-General exercises the responsibility of providing national leadership in the development of emergency management measures to reduce the impact of emergencies on the Australian community (Emergency Management Australia 2004b). EMA is mainly responsible for shaping and advancing emergency management strategies and policies throughout Australia, advocating emergency management education, and assisting states’ and territories’ local emergency management agencies. EMA plays also a key role in coordinating interstate and international assistance at times of major emergencies and disasters (Emergency Management Australia 2004b). EMA has an established collaborative relationship with other Commonwealth agencies such as the Department of Finance and Administration, Geoscience Australia and the Bureau of Meteorology. In doing so, EMA seeks to encourage an all hazards, all agencies approach to the prevention or mitigation of emergencies, preparedness for their impact, response to that impact and recovery from the consequences (Emergency Management Australia 2009b).
5. Other committees and organisations exist on the State level in Australia. The names and functions of these organisations and committees differ from State to State but there are similar patterns that have been developed between them in regard to their roles and functions that include the identification of various threats and hazards, the coordination of volunteers and community resources during significant emergency events, hazard management guidelines, declaration of state of emergency, emergency management training and education, and the arrangement of warnings in emergencies to the public (The Australian Government: Department of Transport and Regional Services 2004).

2.2.5 Emergency management arrangements in Australia

Under Australia’s constitutional arrangements, the country takes the Federal approach to emergency management in which the local, state and territory governments have responsibility within their own jurisdiction and have the laws, funding mechanisms and organisational arrangements in place to deal with emergencies. Each sphere of government has a different set of roles and responsibilities for emergency planning, preparedness and mitigation in relation to land, property and the environment, assets and infrastructures, agencies and programmes (Emergency Management Australia 2009a).

Given that individual States and Territories are highly autonomous, the approach to emergency planning and alerting in Australia is not standardised (The Australian Government: Department of Transport and Regional Services 2004). Nonetheless, there are similarities in approach that have emerged between States. For example, should a state of emergency be declared, a state-level emergency/disaster response and coordination committee/executive acts as the interface responsible of coordinating the state resources, seeking Commonwealth support if needed, and providing up-to-date reports to the media (Victorian State Parliamentary Offices 2003). When activated, the committee is mainly responsible for:

1. Information collection, analysis and dissemination of intelligence to emergency response agencies;
2. Coordination of the provision of resources required by divisional emergency response coordinators;

3. Allocation of resources on a priority basis;

4. Requesting Commonwealth physical resources;

5. Briefing the Coordinator in Chief; and

6. Dissemination of information to the media and general public (The Victorian Bushfires Royal Commission 2009).

The level of emergency response coordination depends on the scope of the emergency. In the first instance, the response to an emergency takes place at the municipal level. If the emergency calls for resources beyond those available at municipal level, the emergency response coordination is stepped up to the divisional level. An emergency that extends beyond the division will be progressed to the State level (The Victorian Bushfires Royal Commission 2009).

Although the prime responsibility for the protection of life, property and the environment rests with the states and territories, the Commonwealth Government is strongly committed to supporting local and state governments in developing their capacity for dealing with emergencies and disasters, providing physical assistance and mobilising resources to states or territories when they cannot reasonably cope during large-scale events (Emergency Management Australia 2009a).

On the national level, the basis for managing major emergencies and combating disasters is a partnership between the Federal, State and Territory, Local Governments, the community, and the private sector. Accordingly, this national framework for emergency management requires a high level of collaboration and coordination across all spheres of government, and with other non-government stakeholders as well (i.e. general public and the private sector) as well (Emergency Management Australia 2009a).
2.2.6 Emergency management Australia all-hazards approach

Australia has adopted both a comprehensive and integrated all-hazards approach to the development of its emergency management arrangements and programs. The approach can be summarised as follows:

2.2.6.1 The comprehensive approach

Under the comprehensive approach there is general acknowledgment that a potential threat could originate from various types of hazards, which have a comparable capacity to impact severely on communities and infrastructure. The all hazards approach to emergency management involves a recognition that most emergency event types cause similar problems and that many of the measures required to deal with them are generic (The Victorian Bushfires Royal Commission 2009).

Australia’s comprehensive approach to emergency management identifies four strategies that contribute to the reduction or elimination of hazards, and an increase in community and environment resilience. EMA (2004b) defined these strategies as follows:

A. Prevention/mitigation: Seek to eliminate or reduce the impact of hazards and/or to increase the resilience of the community subject to the impact of those hazards.

B. Preparedness: Concerned with establishing arrangements and plans and with providing education and information so as to prepare the community to deal with emergencies and disasters as they may arise.

C. Response: Covers the methods that are used to properly activate the preparedness arrangements and plans so as to deal with emergencies and disasters if and when they occur.

D. Recovery: Defines the set of arrangements practised to assist a community affected by an emergency or disaster in reconstruction of the physical infrastructure and restoration of emotional, social, economic and physical well-being.
These emergency management strategies, although tightly coupled, could be developed independently of each other (Haddow et al. 2006). Nonetheless, under the comprehensive approach to emergency management there is an emphasis that all of the activities, under these strategies, should effectively function as one seamless emergency management framework (Emergency Management Australia 2004b; Haddow et al. 2006).

2.2.6.2 The integrated approach

The integrated approach emphasises the need to coordinate different emergency management programs and strategies with the support of other government agencies, and with the community and the private sector (Emergency Management Australia 2004b). For the comprehensive approach to emergency management to be workable there should be effective arrangements for the coordination of the activities of governments and of the large number of organisations that need to be involved in emergency management activities, and these arrangements need to be set within a legislative and public policy framework (Emergency Management Australia 2004b).

2.2.7 Emergency warning and alerting methods and systems in Australia

Under emergency management arrangements in Australia, one of the main responsibilities of the government is to communicate and disseminate warnings and safety information to the general public in case of a large-scale emergency (The Australian Government: Department of Transport and Regional Services 2004). In principle, any means of ensuring that a warning is quickly disseminated to those actually or potentially affected is utilised in Australia. However, conventional broadcasting systems consisting primarily of local community radio stations and television networks are still the main channels that are currently used for disseminating alerts and warnings to the Australian public (Betts 2003).
Australians also rely on several other sources of information, including relevant government websites and hotlines, to stay up-to-date with the latest news about events as they unfold. In addition, traditional warning methods are used across the country including banners, door-to-door knocking and signage. See Figure 2.1. Australia also still relies on what are known as triggers, such as the Standard Emergency Warning Signal (SEWS) and sirens, which are merely techniques prompting the audience to listen carefully for a warning and/or to search for more information (The Victorian Bushfires Royal Commission 2009).

Figure 2.1: Fire danger rating sign. Adopted from the New South Wales Government Website (2010)

Other means and methods such as emails, landline and mobile phone calls, and short message service (SMS) have also been considered or used. For example, the State of Victoria in 2005 partnered with Telstra (the incumbent telecommunications operator) to trial the Community Information Warning System (CIWS) that was able to simultaneously telephone every household in a designated area. More than 660 calls were made, on an opt-in basis, to the residents of one specific area who had volunteered to participate in the trial (The Minister for Police and Emergency Services 2005).
In 2007, SMS and email alerts were considered by the Victorian State Government for the purposes of geographically targeting people in specified areas with information about terror attacks or natural disasters (Dunn and Collier 2007). However, it was not until 2009 that SMS technology was used for the first time to alert Victorians about severe weather conditions and bushfires (Dobbin 2009; Ife 2009).

Similar systems were also considered for implementation in other States as well. For example, in 2007, under a proposal by the New South Wales Premier, a warning system was proposed whereby Sydney residents would be able to opt-in for real time Government SMS and email air pollution health alerts across metropolitan Sydney. The proposal came in response to key recommendations from a Parliamentary air quality inquiry in 2006, which warned that 1600 people are dying every year from air pollution related illness in New South Wales. The project was under the Department of Environment authority (Benson 2007).

The New South Wales Government also proposed an electronic warning system that, in principle, should have allowed emergency service organisations (ESOs) to send SMS alerts to all mobile handsets in terrorism or emergency target zone across the State. The design concept identified the system’s need to be operable across all telecommunications carrier networks operating in Australia, and was to provide evacuation information, safety advice and alternate routes to avoid the emergency area (The Australian 2007).

A similar system is now active in Sydney, New South Wales. The SydneyAlert system is a free, opt-in service that is meant to alert general public in the event of an emergency in the Sydney and North Sydney Central Business Districts (CBDs). The system provides building managers, emergency wardens and security staff with safety information and instructions to help them manage and assist occupants, staff and others in their buildings during a serious incident. The system uses existing commercial communications networks to disseminate warnings, specifically SMS and e-mail. The State Emergency Operations Centre Controller, a senior NSW Police Officer, is the authority that determines if the system should be activated. This officer also determines who on the subscription list is contacted and what message is sent. The message is sent to the contact details supplied by those who have subscribed to SydneyAlert. The
message is simple, giving clear guidance on what needs to be done. Example messages include: “Evacuate to a safety site”, “Stay indoors and close windows”, or “All clear message and situation is back to normal” (New South Wales Government 2007).

The State of Queensland faces the risks of cyclones, bushfires, storm surges and floods on an annual basis. For these reasons, the Council of Townsville City in Queensland has started, in 2009, to provide an early warning service to its residents on an opt-in basis. The Early Warning Network (EWN) sends alerts 30 minutes ahead of severe weather conditions via a variety of electronic channels including email, SMS and landline phone call (Chudleigh 2009). The cost of each warning message sent is borne by the Council. This system is believed to be the “the world’s only location based early warning system for severe weather events” with the ability to pinpoint the area that information is needed “with accuracy to within 10m” according to EWN managing director Mr. Kerry Plowright (The Australian Early Warning Network 2009).

2.2.7.1 The national emergency warning system in Australia

Not until recently was the standardisation of a national emergency planning and alerting approach to public warning across Australia considered for actual implementation. A national emergency warning system has been the subject of discussions between the Commonwealth, States and Territories since 2004. In 2005, there was a prevailing view of the need to introduce a warning system on a national level, but it was not subject to agreement by all States and Territories (The Victorian Bushfires Royal Commission 2009). In 2005, the Prime Minister and Cabinet (PM&C) led a review to determine the Australian government arrangements of effective communications with the public during a crisis. Four Working Groups were established to complete the review. In October 2005, a report on Australia’s Ability to Respond to and Recover from Catastrophic Disasters was prepared by The Catastrophic Disasters Emergency Management Capability Working Group (Australian Emergency Management Committee 2005). The Working Group modelled four hypothetical scenarios, including a cyclone, a major earthquake, a tsunami and an influenza pandemic, to assist in identifying the likely impact of catastrophic events in different geographic areas of Australia. However, the review of the Working Group found that:
There is an overwhelming national need for the development of appropriate, effective and timely community information and warning systems. Such systems should be capable of being used in the lead up to, occurrence of, and recovery from natural disasters. The Working Group recognised that a number of States/Territories are attempting to develop such systems in isolation and the view is that such a disparate approach to what is a national need will be counter productive (Australian Emergency Management Committee 2005, p. 36).

By July 2008, The Council of Australian Governments (COAG) finally reached an agreement to establish a national telephone-based emergency warning system in Australia (The Australian Government: Attorney General’s Department 2009). But, according to the Prime Minister of Australia, privacy and data security restrictions in the Telecommunications Act 1997, combined with interstate disagreements over funding schemes, were the main reasons for delaying the system’s introduction till after the bushfires in Victoria in February 2009 (Bita and Sainsbury 2009b).

Following the worst bushfire season in Australia’s history in 2009, the Federal Australian Government, COAG and the States and Territories Governments identified the compelling need for the immediate deployment of the national emergency warning system, which would enable them to deliver warnings to landline and mobile telephones based on the billing address of the subscriber under emergency declarations (The Australian Government: Department of Broadband Communications and the Digital Economy 2009).

The first Emergency Declaration, see Figure 2.2, was signed on February, 11 2009, by the Honourable Senator John Faulkner, a Cabinet Secretary and Special Minister of the State, on behalf of the Victorian Government while the State of Victoria was experiencing the worst of the bushfires. This declaration facilitated to the Australian emergency service organisations (ESOs) access to Australia-wide consumer telecommunications for the purpose of disseminating of warning messages. On March 2, 2009, and with the fire risk and high wind predicted across the state, Telstra, Optus and 3 Hutchison (the three telecommunications carriers in Australia) sent blanket SMS on behalf of the Victorian Police to more than 3 million Victorian mobile phone
subscribers, warning the recipients of the extreme weather conditions expected the next
day and advising them to listen to the Australian Broadcasting Corporation (ABC) radio
for emergency updates (Dobbin 2009; Ife 2009). The messages were sent using
commercial services as part of a community service obligation, and not part of any state
or national emergency warning system (ABC News 2009).

Because of the extent of damage and loss in Victoria, which required a lot of time for
recovery and restoration, and also the prudential need to prepare Victorians who could
be in the affected reach of the next bushfire season, the declaration had been set to
expire after almost one year from its commencement date.

The declaration was made under Section 80J of the Privacy Act 1988. Section 80J is
primarily concerned with the declaration of an emergency or an event of a national
significance and only the Prime Minister of Australia or the Minister of relevance may
make such a declaration, as the case may be, if:

1. An emergency or disaster has occurred; and

2. The emergency or disaster is of such a kind that it is appropriate in the circumstances
   for this part to apply in relation to the emergency or disaster; and

3. The emergency or disaster is of national significance, whether because of the nature
   and extent of the emergency or disaster, the direct or indirect effect of the
   emergency or disaster, or for any other reason; and

4. The emergency or disaster has affected one or more Australian citizens or permanent
   residents, whether within Australia or overseas (The Australian Government: 
   Attorney General’s Department 2008).
Emergency (Victorian bushfires)
Declaration 2009 (No. 1)

Privacy Act 1988

I, JOHN FAULKNER, Cabinet Secretary, make this Declaration under section 80J of the Privacy Act 1988.

Dated 11 February 2009

Cabinet Secretary

1 Name of Declaration
This Declaration is the Emergency (Victorian bushfires) Declaration 2009 (No. 1).

2 Commencement
This Declaration commences on the day that it is signed.

3 Expiry
This Declaration expires on 9 February 2010.

4 Definition
Act means the Privacy Act 1988.

5 Declaration of emergency
For section 80J of the Act, the disaster mentioned in Schedule 1 is declared.

Figure 2.2: The first Emergency Declaration in 2009 due to the severe bushfires in Victoria
Telstra, Australia’s largest telecommunications carrier was awarded the contract of the National Emergency Warning System (NEWS) on September 29, 2009 (The State Government of Victoria 2009). NEWS was operational by October 2009 in all States and Territories except Western Australia (WA), which has chosen to keep delivering its emergency warning messages through the use of its own WA StateAlert system (The Victorian Department of Treasury and Finance 2009). Under the COAG agreement, States and Territories retain autonomy about the warning systems they choose to implement (The Australian Government: Attorney General’s Department 2009).

NEWS is meant to supplement, and not to replace, the range of traditional measures currently used to warn the public of emergencies, including the television and radio, public address systems, door knocking, sirens, signage and the internet (Gibbons 2009).

The second stage of NEWS is presently under deliberation, in particular the ability for Australian telecommunications carriers in meeting the long term requirements for a national emergency alerting and warning system utilising location-based technologies to identify active mobile handsets, of all carriers, within a defined emergency area (The Victorian Department of Treasury and Finance 2009). Figure 2.3 depicts the timeline towards NEWS in Australia.
Catastrophic Disasters Emergency Management Capability Working Group - Review of Australia’s ability to respond and recover from catastrophic disasters. Report wrote: “There is an overwhelming national need for the development of appropriate, effective and timely community information and warning systems.” It also emphasised the desirability of a national approach, and the potentially counter-productive consequences of disparate systems being developed in isolation.

Australia’s Path to a National Emergency Warning System

<table>
<thead>
<tr>
<th>Date</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct. ‘05</td>
<td>Council of Australian Governments (COAG) finally reached an agreement to establish a national telephone-based emergency warning system</td>
</tr>
<tr>
<td>11 Feb. ‘09</td>
<td>Emergency Declaration introduced as an amendment into Privacy Act 1988</td>
</tr>
<tr>
<td>2 Mar. ‘09</td>
<td>Police Send Millions of SMS out Victoria-wide to warn of hot and windy conditions</td>
</tr>
<tr>
<td>5 Aug. ‘09</td>
<td>Location Based Identification of Active Mobile Handsets for Emergency Notification Purposes (NEWS Phase II) Tender Released</td>
</tr>
<tr>
<td>15 July ‘09</td>
<td>National Emergency Warning System Tender Released (NEWS Phase I)</td>
</tr>
<tr>
<td>24 Sept ‘09</td>
<td>Telstra awarded the NEWS Contract</td>
</tr>
<tr>
<td>31 July ‘10</td>
<td>Victorian Bushfire Royal Commissioner’s Final Report Presented</td>
</tr>
</tbody>
</table>

Figure 2.3: Australia’s path towards a national emergency warning system: A timeline of events

For the first stage of NEWS to operate, access to the Integrated Public Number Database (IPND) was required in order to obtain the number and address upon which the warning message is disseminated (The Australian Government: Department of Broadband Communications and the Digital Economy 2009). IPND is an industry-wide, Commonwealth-owned database that contains all the residential and business phone numbers, both listed and unlisted, and other subscriber information such as name, address, and the type of service delivered by each number (i.e. landline, fax, mobile, pager, etc.) (The Australian Communications and Media Authority 2009). The IPND was established and is maintained by Telstra, as a condition of its carrier licence. All telecommunications carriers and service providers are required to provide Telstra with subscriber information in order to populate and maintain the database (The Australian Government: Department of Broadband Communications and the Digital Economy 2009).
Maintaining accurate IPND data is extremely important to ESOs as these organisations rely on IPND to respond to emergency calls from the public in a timely manner (The Australian Communications and Media Authority 2009).

In accordance with the States and Territories agreement to establish NEWS, the Federal Government immediately commenced drafting legislation to authorise access to the IPND. However, given the sensitive nature of the information contained in the IPND, the *Telecommunications Act 1997*, Sections 276 and 277, restrict access and prohibit disclosure or use of information from the database save for a few exceptions. These exceptions are explicitly specified in the legislation, which allow for the release of personal information for a number of reasons including emergency calls, law enforcement and national security purposes (The Australian Communications and Media Authority 2009). In 2009, the Federal Government introduced into Parliament *The Telecommunications Amendment (Integrated Public Number Database) 2009 Bill* that proposed amendments to the *Telecommunications Act 1997* in order to enable access to the IPND for NEWS purposes, in connection with the provision of telephony-based emergency warnings and for the supply of location-based emergency services (The Australian Government: Department of Broadband Communications and the Digital Economy 2009).

In light of the Victorian bushfires, the government sought advice from the Solicitor-General on an interim measure to allow immediate access to the IPND by any State or Territory who wished to implement a more limited system as soon as possible. This interim access was not a substitute for the amendments to the Telecommunications Act contained in the Bill and the planned future access arrangements for the IPND (Gibbons 2009).

The amendments to the Telecommunication Act contain a number of privacy protection provisions, which are intended to ensure that subscriber data obtained from the IPND is not used or disclosed for any other purpose than to provide telephone-based emergency warnings. Specifically, emergency agencies will only be permitted to access the data in the event of an actual emergency, in the event of a likely emergency or for testing purposes (i.e. to test whether in the event of an emergency the alert would have reached the people that it needed to) (Gibbons 2009).
The amendments provide the Attorney-General, as the Minister with portfolio responsibility for emergency management issues, with powers to specify, by legislative instrument, who can use IPND information in the event of an emergency or disaster (The Australian Government: Attorney General’s Department 2009). The amendments also contain accountability measures including a reporting requirement for any government agency that activates a telephony-based emergency warning using IPND data. The agency will be required to report each usage of IPND information to the Attorney General and to the Australian Communications and Media Authority (ACMA) as soon as practicable after each incident occurs (The Australian Government: Department of Broadband Communications and the Digital Economy 2009). Agencies will be required to report on the nature and location of the emergency or disaster, the number of telephone numbers disclosed, the number of persons to whom the numbers were disclosed and why. Agencies will also be required to report annually to ACMA and to the Office of the Privacy Commissioner (OPC) on each disclosure (The Australian Government: Department of Broadband Communications and the Digital Economy 2009).

2.3 The emergency service as a mobile government application

In the past few years, there has been an increase within government administration towards relying on the available wireless telecommunications channels as an extended means to enhance accessibility and reach of government services to citizens, businesses and different government entities, leading to what has become known today as mobile government (m-Government) (Kim et al. 2004). Currently, m-Government is an established platform and integrated part of electronic government (e-Government) practices around the world for the purpose of provisioning of or enabling the access to information and services via handheld devices, including mobile phones and other wireless devices (Kushchu and Kuscu 2003; Östberg 2003). Amongst the mobile government applications being practised today in an increasing number of countries around the world is the integration of mobile technologies, such as the short message service and cell broadcasting service, for the purposes of communicating and
disseminating blanket safety information and warning notifications to the affected areas (Moon 2004; Weiss et al. 2006; Fernandes 2008; Chochliouros et al. 2009; Samarajiva and Waidyanatha 2009). Moving forward, however, into a more advanced location-enabled emergency component of mobile government, correlating the warning message with the actual physical location of the active mobile handset at the time of an emergency, location-based mobile phone emergency service is already on the agenda of several countries, including Australia (The Victorian Bushfires Royal Commission 2009). The following sections explore several aspects of location-based services, including their use origins within the domain of emergency management. A dedicated section is also presented on the expected future role of the location-based mobile phone service within the national emergency warning system of Australia.

2.4 Location-based services

2.4.1 Understand location-based services

Terms such as location-based services, location-dependent services, location-related services, location-enabled services, location-sensitive services and location services have often been used interchangeably to describe the same type of services. See for examples Hjelm (2002), Jensen (2002), Holma et al. (2004), Lopez (2004), Spiekermann (2004), Bernardos et al. (2007) and Uhlirz (2007). Küpper (2005) has commented previously that one possible reason for this mixing of terminology might be due to the fact that the character and appearance of location-based services have been specified and implemented by different communities and industries, especially in the telecommunications sector and the ubiquitous computing area for a variety of applications.

In the context of location-based services (LBS), location always refers to a spatial geographical location that is associated with a physical point or region relative to the surface of the Earth (Dawson et al. 2007). Accordingly, LBS are classified as a subset of a larger set called context-aware services, which are electronic services that
automatically adapt their behaviour (e.g. filtering or presenting information) to one or more parameters (time, location, identity or activity) so as to reflect the context (personal, technical, spatial, social, or physical) of a target (person, animal or object) (Küpper 2005). See Figure 2.4.

Figure 2.4: Context-aware and location-based services. Adapted from Küpper (2005).

LBS as a concept denotes applications that utilise the available geographic location information of a target device, being fixed, handheld, wearable or implantable, in order to add value to the provided service (Perusco and Michael 2007; The 3rd Generation Partnership Project 2009). Astroth (2003) defines a location-based service as “any application that offers information, communication, or a transaction that satisfies the specific needs of a user in a particular place”. Harvey (2008) simply defines LBS as “technologies that add geographical functions to other technologies”. Gruber and Winter (2002) argue that a LBS is “any value-added service that takes into account a mobile agent’s actual location”, while Shiode et al. (2002) delineate LBS as “services that provide geographically-orientated data and information services to users across mobile telecommunication networks”. Samsioe and Samsioe (2002) argue, however, that an electronic service that has location capabilities, should be able to fulfil the following three separate activities to be accurately defined as an LBS:
1. Estimate the location of the device;

2. Produce a service based on the estimated location; and

3. Deliver the location-enhanced service to that device.

This terse definition excludes several services that employ location technologies in mobile telecommunications networks such as cell broadcasting services since these services cannot change their content when the physical location of a mobile handset changes. However, in the emergency management context, it should be understood that any service that provides information pertinent to the current location of the active mobile handset at a specific window of time can be viewed as a location-based service, regardless of the underlying delivery technology used to convey its information. Although this understanding may extend to other types of services as well, it is, nonetheless, an understanding that greatly harmonises several interpretations of LBS such as those depicted by Holma et al. (2004), Grothe et al. (2005), Guan et al. (2007), Oh and Haas (2007), Stojanović et al. (2007) and Aitenbichler (2008).

The text-based message is the most realised form of LBS, but there are several other possible forms where the service could be received including as a bitmapped image, voice message and multimedia message with rich content such as animated image formats, interactive maps or video. However, the final form of the delivered LBS depends on several factors that include existing and dedicated network resources, underlying technologies and protocols, market trends and handsets’ capabilities/limitations (Spiekermann 2004).

### 2.4.2 Location-based services and geographic information systems

Geographic information sciences (GI Sciences) are generally concerned with “the capture, storage, integration, management, retrieval, display, analysis, and modelling of spatial data” (Fotheringham and Wilson 2008). Geographic information systems (GIS) are a set of hardware and software systems used to create, manage, analyse and display that spatial data (Zadorozhny and Chrysanthis 2004). GIS combine data about the geographic location that are associated with several attributes of the natural and man-
GIS tools have been available for years but their price and sophistication limited their availability to only specialists and scientists. However, recent product deployments, such as Google Earth, Microsoft Live Search Maps and Yahoo!Maps, have helped put these tools into the hands of a much larger audience of non-specialists (Drummond and French 2008). These online tools currently offer new possibilities to people to gain free access to satellite imagery, aerial photography and street views with resolutions that are highly enough to identify detailed attributes of any structure on the Earth’s surface (Michael and Masters 2006).

GIS play an important role in the operation of location-based services. LBS content providers depend greatly on these systems as they provide efficient means to model the real world structures (e.g. buildings, streets, mobile cell towers) and terrain (e.g. mountains, rivers) into digital geographical data format, provisioning LBS users with relevant information, such as maps or spatial reference points, to match the user query and/or his or her particular location (Kang et al. 2007). GIS also aid in the deployment of location-based emergency services by providing the means to map several contexts of the same area over a period of time presenting it as a uniquely viewable spatial data set that helps identify environmental changes and patterns about local risk levels and natural disasters in that area (Elias et al. 2008; Fritsch 2008).

Michael and Michael (2009) postulated that without GIS much of location-based services functionality would not be plausible. Nonetheless, Michael and Michael argue that, while GIS is about maps, places, and points of interest, LBS assigns a meaning to this geographically referenced information through linking it to a particular person’s need within a specific period of time.

### 2.4.3 Classifications of location-based services

LBS can be classified into reactive (pull) and proactive (push) services. Reactive LBS are always initiated by the user, where he or she invokes the service via a device, being
fixed or handheld, to request certain functions or information. In this case, the service gathers locational data (either of the requester or of another target person or object), processes it, integrates it with other information pertinent to the desired location then returns the location-dependent result to the user. For example, as an information list of nearby points of interest (e.g. restaurants or theatres) including relevant information such as the distance from the current location, directions, contact numbers or postal address (Küpper 2005).

Proactive services are the other classification of LBS, in which the services are automatically initiated as soon as a predefined location event occurs, for example, if the user enters, leaves or comes into the vicinity of a certain area. The collected locational information could be stored by the service provider for the purpose of further processing or future requests, or it could be directly sent to the user, once it has been processed, in a value-added form (Scott-Young and Kealy 2002; Küpper 2005).

In contrast to reactive LBS, where the user is only located once, proactive LBS require the constant tracking of the mobile handset to detect changes in location events (Junglas and Spitzmuller 2005). Accordingly, it is still unclear to what extent proactive services can be widely used in mobile telecommunications networks since this type of service takes up disproportionate amounts of network resources as they require continuous updates of device locations. For example, in order for a service provider to be able to push updated traffic reports to its subscribers, the service provider needs to keep querying location activities of all devices entering, roaming or leaving the respective cell area (Spiekermann 2004).

### 2.4.4 The location-based services value chain: Key stakeholders

Effective deployment of location-based services requires the coordinated effort of multiple stakeholders in the services value chain, each of which provide specific components of the total solution (Astroth 2003). A stakeholder represents an autonomous entity like a person, a company or an organisation, each maintaining or performing one or several roles that characterise either the interests or functions it fulfils
from a technical perspective, or the impact it exercises on LBS from an economic or regulatory position (Küpper 2005).

The roles of the LBS stakeholders can be classified as operational and non-operational. The operational roles define the players that cooperate during the operation of the services, which requires each stakeholder to maintain technical infrastructure, ranging from users’ mobile handsets to service providers’ farm servers to carrier’s telecommunications networks, so as to facilitate the request and the provision of sub-services during LBS execution (Küpper 2005). During an LBS operation, the interaction between these actors takes place through reference points that are defined by a set of protocols and connectivity services offered by various networks, and are often determined by Service Level Agreements (SLAs). SLAs are agreed upon and adopted between the participating parties, prior to the provisioning of the services, for agreed quality of service and accounting conditions (Küpper 2005).

A non-operational stakeholder is one that does not directly engage in the technical operation of LBS but has an indirect impact on the services, either by dictating economic or regulatory circumstances of LBS operation or through the influence it exercises on the adoption of the services’ technical standards (Küpper 2005). An example from the Australian context could be the Australian Communications and Media Authority (ACMA), which exercises a direct influence in regulating, by law, the utilisation of location data to protect the privacy of individuals and for other purposes such as lawful interceptions (The Australian Communications and Media Authority 2004).

2.4.5 Geographical positioning techniques for location-based services

In the world of LBS, global navigation satellite systems (GNSS), Internet Protocol (IP) technologies and radio frequencies are the main access media used to determine the geographic location of a device (Michael 2004; Dawson et al. 2007; Perusco and Michael 2007).
The first location system in use was the satellite-based Global Positioning System (GPS) created, funded and controlled by the U.S. Department of Defence. The system was built and conceived primarily to serve military purposes but since the late 1990s the system was upgraded with new civilian signals making it freely available to the public and commercial use (Kaplan and Hegarty 2006). The result of this free availability of satellite positioning capabilities led to a real revolution in a wide range of applications that include air, sea and land traffic control, navigation solutions, freight management, and emergency services (Spiekermann 2004). Other comparable global navigation satellite systems are currently also in use or scheduled to operate in the very near future. Some of these include: the European Union satellite system of Galileo; the Global Orbiting Navigation Satellite System (GLONASS) of the Russian Federation; the Compass system of the People’s Republic of China; India’s Geo Augmented Navigation system (GAGAN); and the Quazi Zenith Satellite System (QZSS) of Japan (Samama 2008).

Global navigation satellite systems provide high levels of accuracies usually within 10 to 20 metres, but their availability is not always guaranteed, especially indoors, in urban canyons (i.e. in dense blocks of structures between high buildings), in tunnels, and in mountainous regions, as a clear line of sight (LoS) to the satellite is always required (Samama 2008). In addition, to receive signals from a GNSS system, a dedicated receiver is required or a specialised chip in needed to be equipped within the device in order to operate (Rizos 2005).

Currently, location data can be obtained by utilising one or more of many indoor and/or outdoor positioning determination technologies, classified as network-centric, terminal- or user-centric, and hybrid solutions, used to get an estimate of the coordinates of the device’s geographical location. Each method differs in its market, range, coverage, continuous availability, precision, purpose and functionality (Rizos 2005; Samama 2008). Some of the prominent examples of positioning technologies include the terrestrial radio measurement systems in mobile telecommunication networks and wireless location area networks (WLANs), radio frequency identification (RFID) systems, Bluetooth and Wireless Fidelity (Wi-Fi) access points, and several available hybridisation solutions (e.g. GSM with GPS) (Rizos 2005; Aitenbichler 2008; Samama 2008).
2.4.6 Location-based services in mobile telecommunication networks

As mentioned, the radio-based positioning systems are used in several domains but the well-known terrestrial cellular mobile-radio networks are by far the most prominent (Spiekermann 2004). In these networks, the location of the mobile handset can be identified by one or more positioning determination techniques that include GPS, Assisted-GPS (A-GPS), Cell Identification (Cell-ID) or Cell of Origin, Enhanced Observed Time Difference (E-OTD), Observed Timed Difference of Arrival (OTDOA), Multipath Pattern Matching (or fingerprinting), and several possible combinations from some of these technologies (Küpper 2005; Rizos 2005; Samama 2008). However, due to the fact that installing a positioning system is often a significant investment and can be quite expensive to maintain and operate, most of the telecommunications carriers around the world were and are still heavily relying on Cell-ID related technologies for mobile positioning purposes since these technologies are by far the most cost effective to apply (Spiekermann 2004), especially when high levels of location accuracy are neither mandatory nor necessary (Agrawal and Agrawal 2003).

Under Cell-ID technologies, the location was simply the identification of the base station communicating with the targeted active mobile handset. See Figure 2.5. Therefore, the accuracy differs according to the size of the cell itself, ranging from 100 metres in densely populated urban areas to 20 or 30 kilometres in rural areas (Samama 2008). In general, the accuracy of Cell-ID positioning results could be improved up to 50 percent by using one of several different techniques like the Angle of Arrival (AOA) or Time of Arrival (TOA), which both do not require any handset modifications but require modifications on base stations, making them also costly to implement in later stages (Samama 2008).
High levels of accuracy are certainly a quality that is desired in many LBS applications, especially in emergency services. Table 2.2 provides a general overview of the needed accuracy levels for most of the current LBS applications offered in today’s cellular networks.

Table 2-2: Overview of the location-based service applications and level of accuracy required. Adapted from Bellocci et al. (2003).

<table>
<thead>
<tr>
<th>Application</th>
<th>Requirement of accuracy level</th>
</tr>
</thead>
<tbody>
<tr>
<td>News, Traffic Information, Fleet Management, Remote Workforce Management.</td>
<td>Low</td>
</tr>
<tr>
<td>Yellow Pages, Local Advertisement, Location-Sensitive Billing.</td>
<td>Medium to Low</td>
</tr>
<tr>
<td>Gaming.</td>
<td>Medium</td>
</tr>
<tr>
<td>Directions, Personal Navigation, Asset Tracking, Sensitive Goods Transportation, Emergency.</td>
<td>High</td>
</tr>
</tbody>
</table>

2.4.7 Location-based emergency services in mobile telecommunications networks

Emergency services represent one of the most obvious and reasonable application areas where the deployment of location technology not only makes sense (Küpper 2005) but
can be life-sustaining tool as well. Still, utilising location-based emergency services are in their infancy in several countries around the world including Australia (Küpper 2005). Problems related to technical issues including location determination mechanisms and accuracy standards, and also issues related to identifying different requirements for these emergency services still need to be resolved (Togt et al. 2005; The European Telecommunications Standards Institute 2010)

In general, there are two types of location-based emergency service applications in mobile telecommunications networks (The European Telecommunications Standards Institute 2006a). The first is initiated by a person in the form of a phone call or a distress Short Message Service (SMS) in a life-threatening or time-critical situation. The second type is initiated usually by the government in collaboration with telecommunications carriers, in which safety alerts and early warning messages are disseminated (pushed) to all active mobile handsets located in designated threatened area(s) before, during or after a large-scale event. The fundamental idea behind the first type of location-based emergency service is for an emergency service organisation (ESO) (i.e. police force, fire brigade or ambulance service) to reach the caller (or the message sender) with some precision, based on the location information provided by the caller’s mobile service provider. Since in many cases the person will be unable to communicate his or her current location or simply does not know it, the ESO relies on handset data (Küpper 2005). The premise behind the second type of location-based emergency service application is to utilise the mobile handset as an additional information channel that is capable of reaching people wherever they are but within the threatened area.

2.4.7.1 Location-based emergency call and message service

In 1996, the Federal Communications Commission (FCC) in the United States launched the first initiative of its kind in the world, in which the Commission sought to enhance the quality and reliability of the American 911 emergency call service by requiring the telecommunications carriers to locate a person and to deliver the geographic position of his or her mobile handset to the nearest Public Safety Answering Point (PSAP). PSAP is the answering centre for calls to 911 that originate within specific geographic areas. The initiative is now a mandate that is known as the Enhanced 911 (E-911) after the
distinctive emergency number 911 of North America (Küpper 2005; Kaplan and Hegarty 2006). However, since the mandate needed the telecommunications carriers to do a lot of work to meet required accuracy levels far beyond what was possible with existing mechanisms of location management at that time the FCC adopted a phased approach to implementation to give enough time to all parties, specifically the carriers, to realise the needed enhancements (Spiekermann 2004; Küpper 2005). The implementation of E911 required considerable coordination amongst various stakeholders including public safety agencies, mobile carriers, technology vendors, equipment manufacturers and local exchange carriers. The enhancements were ruled to be carried out in two phases:

**Phase I:** This phase was implemented in April 1998. The requirements stipulated that a person’s location from the geographic coordinates of the serving cell from where the emergency call has been originated, and also to forward the person’s handset number to the nearest PSAP centre, allowing the centre to call back if the call is unintentionally interrupted. However, since the positioning mechanisms were mainly relying on Cell-ID technologies, accuracy levels were rather poor during this phase (Küpper 2005; Samama 2008).

**Phase II:** Phase two began in October 2001. The requirements in this phase ruled that each carrier be able to locate a person accurately within 50 to 100 metres in 67% of the received emergency calls, and 150 to 300 metres in 95% of all emergency calls in the carrier’s coverage area depending on the location technology used since the mandate did not specify which technology to use. As these accuracy levels were hard to meet by the cell-based approach mentioned earlier, more enhancements on networks’ infrastructures became inevitable and carriers started to switch to alternative positioning technologies to meet the requirements ruled by the FCC (Küpper 2005; Kaplan and Hegarty 2006).

In all cases, the FCC’s E-911 mandate has proven to be the pivotal driver behind the development, enhancement and deployment of high accurate location technologies that advanced the introduction of various location-based applications in mobile telecommunications networks including the overture to location-based emergency services not only in the United States but in several other countries around the world as
well (The Australian Communications and Media Authority 2004; Rizos 2005; Kaplan and Hegarty 2006).

2.4.7.2 Location-based mobile phone public warning notification system

Several location-based systems for public alert and warning purposes are currently being implemented or are on the way to being deployed in several countries worldwide. In the United States for example, and in response to a requirement in the Warning, Alert, and Response Network (WARN) Act, now signed into law, the FCC worked with commercial mobile service providers to create a specific addition to the Integrated Public Alert and Warning System (IPAWS), called the Commercial Mobile Alert System (CMAS), that would enable federal, state, local, and other non-federal authorities to broadcast geographically targeted alerts through mobile handsets within the area of an emergency (Moore 2009).

Basically, CMAS is intended to facilitate the dissemination of three types of alerts through mobile telecommunications networks: Presidential, imminent threats, and America's Missing: Broadcast Emergency Response (AMBER) Alerts (Penn 2009). The WARN legislation requires CMAS to provide individuals with instructions about what to do in response to a threat and to ensure the transmission of alerts in response to all threats to public safety, including natural disasters and human-made incidents, but only for threats that may pose a serious risk to public health and safety (Francica 2006).

The National Continuity Programs Directorate, within the Federal Emergency Management Agency (FEMA), has been given the responsibility of acting as the gateway and aggregator of alerts (i.e. receiving, verifying, and transmitting non-federal alerts) to be disseminated through CMAS. The National Continuity Programs Directorate is also responsible for implementing the IPAWS (Moore 2009).

IPAWS accepts alert and warning messages generated by emergency managers, mainly using an IPAWS’s web interface, in standards-based format known as the Common Alerting Protocol (CAP), which is an XML-based general data format for exchanging all-hazard emergency alerts and public warnings over all kinds of networks including
cellular networks ( Organisation for the Advancement of Structured Information Standards 2010). CAP formatted messages are then forwarded to FEMA’s aggregator to be disseminated through all distribution means the emergency manager is authorised to use including the commercial mobile networks as described by the WARN legislation (Penn 2009).

Although the WARN legislation has set a timetable for developing CMAS, there are however no deadlines to enforce this on the mobile telecommunications industry (Harkins 2007). Mobile service providers are not required by law to participate, however the legislation obligates each service provider who does not plan to participate to clearly indicate it to its potential customers at the point of sale (Mollman 2009). Participation is mandatory only when the President of the United States sends a message. In that case all telecommunications services providers must broadcast the Presidential message (Harkins 2007).

In the United States and in several other countries, the implementation of location-based public alerting and warning systems by the telecommunications carriers have been supported by a variety of measures, including legislation, contractual agreements and compensation mechanisms (Kidd et al. 2008). Table 2.3 summarises these measures by country.

<table>
<thead>
<tr>
<th>Country</th>
<th>Instrument</th>
<th>Technology</th>
<th>Carrier participation</th>
<th>Compensation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>Yet to be determined</td>
<td>Yet to be determined</td>
<td>Voluntary</td>
<td>Possibility of government financing</td>
</tr>
<tr>
<td>Finland</td>
<td>Legislation</td>
<td>Any technology may be used</td>
<td>Compulsory</td>
<td>Some financial compensation</td>
</tr>
<tr>
<td>United States</td>
<td>Legislation and contractual agreement</td>
<td>Cell broadcast + SMS</td>
<td>Proposed to be voluntary</td>
<td>Possibility of government financing</td>
</tr>
<tr>
<td>Japan</td>
<td>Contractual agreement</td>
<td>Cell Broadcast + other technologies (e.g. Paging Channels)</td>
<td>Voluntary</td>
<td>No financial compensation</td>
</tr>
</tbody>
</table>
2.5 Feasible technologies for the delivery of location-based warning notifications in the mobile telecommunications networks

Several technologies have emerged as feasible options capable, in theory, of delivering warning notifications and safety alert information based on the geographic location of the recipient. The 3rd Generation (3G) network standard multimedia broadcast/multicast service (MBMS), for example, can be used to broadcast (push) emergency messages to defined areas with rich multimedia content such as voice instructions and detailed evacuation maps (Ericsson Company 2007). However, as much as this technology is promising, it is not supported by all mobile telecommunications networks currently operating, making it unfeasible to be utilised, at least not for several years to come (Bakaimis 2005). Other comparable technologies might also provide promising platforms to deploy geo-specific emergency systems. Examples include, the Enhanced Message Service (EMS) and Multimedia Messaging Service (MMS), which both became extremely popular, especially with the rapid proliferation of mobile handsets that support digital pictures and internet functionalities (The National Communications System 2003). The main problem with these technologies is that legacy handsets, which are largely still in use, do not support advanced messaging functionalities, which rule out these technologies from being widely deployed as well.
It is noted, that all of the usage examples, which have been identified worldwide, were deployed using the Short Message Service (SMS) technology, the Cell Broadcast Service (CBS) technology or a combination of the two. As will be presented later in this chapter, these two technologies do fulfil most of the basic and current requirements of emergency alerting and warning systems. Both could be utilised for geo-specific emergency purposes and both would operate with almost all mobile handsets available today (The European Telecommunications Standards Institute 2006a).

2.5.1 Short message service

SMS is a well-known and accepted asynchronous protocol of communication. It is capable of transmitting a limited size of binary or text messages to one or more recipients. SMS offers a virtual guarantee for message delivery to its destination (The European Telecommunications Standards Institute 2006a). In case of an unavailable network coverage or temporary failure, the message is stored in the Short Message Service Centre (SMSC) network component and delivered when the destination becomes available. Also, the message is delivered if the mobile handset is engaged with a voice and/or data activity. SMS messages do not consume much bandwidth although the network resources might become overloaded if an immense number of SMS messages and/or phone calls have been initiated simultaneously. Delays can occur and may result in delivery failure, especially during times of emergencies and disasters.

SMS does not provide any geo-specific location information by itself. However, such information can be obtained from other resources in the telecommunications network (e.g. the Cell-ID). SMS has the potential to be used for location-based mobile phone emergency services, where mass SMS messages can be directed to specific mobile numbers when they have been identified to exist in designated area(s).

2.5.2 Cell broadcasting service

Cell broadcasting technology is a service delivered by mobile service providers where uniform text messages are broadcast indiscriminately to all mobile handsets in a specific
geographic area. The messages can be broadcast to one cell tower or all cells in a carrier network (The European Telecommunications Standards Institute 2006a). Unlike SMS, the nature of CBS does not allow for two-way interactive communication which largely explains why the technology has not been widely deployed for commercial applications (Celltick Company 2003). Some few proprietary solutions however exist today which allow two-way communication but they all require specific Subscriber Identity Module (SIM) toolkits and special back-end content management systems to operate (Celltick Company 2003, 2007).

The cell broadcasting spectrum has the capacity of about 64000 different logical channels, with the potential to use each channel for a different type of service messaging (e.g. weather updates, traffic reports, public health advice, commercial advertisements, etc.) (Chochliouros et al. 2009). Some channels however are reserved to broadcast specific messages, for example, the “cell/area info display” service that allows a serving cell to broadcast its geo-specific information (Name or ID) directly to its mobile handsets by utilising channel 050. The broadcast information appears on the handset’s screen in its idle state. Figure 2.6 illustrates an info display message example from Vodafone Australia.

![Vodafone Australia cell broadcasting info service in two different geographic areas.](image)

Given it is a broadcasting service; the CBS does not require the identification or the foreknowledge of any mobile handset number. Comparable to the known radio service, only the activated channel would receive the broadcast. The handset has to be switched
on to a specific CBS channel to start receiving messages. A message will not be received if the handset is switched on after broadcasting.

CBS is conveyed on dedicated channels using a fraction of the bandwidth that is normally used for mobile phone calls and SMSs. Therefore, it does not place additional demand on carrier resources or suffer any degradation when the network becomes highly congested during emergency events (International Federation of Red Cross and Red Crescent Societies 2009).

### 2.5.3 Comparing the short message service and cell broadcasting service for the delivery of location-based warning notifications

Table 2.4 provides a comparison between the characteristics of SMS and CBS, the main two technologies utilised for location-based emergency services. The characteristics were adapted from documentation provided by the The National Communications System (2003) and The European Telecommunications Standards Institute (2006a). Other resources are mentioned where relevant.

Table 2-4: Characteristics of SMS and CBS for location-based emergency systems.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Short Message Service</th>
<th>Cell Broadcast Service</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transmission form</strong></td>
<td>Uni-cast and Multicast communication.</td>
<td>Broadcast service. Message received indiscriminately by every mobile handset within the broadcasting range.</td>
</tr>
<tr>
<td><strong>Transmission capacity</strong></td>
<td>Depends on network infrastructure. Usually the SMS warning system has the capacity to send 300 messages per second (The Office of the Emergency Services Commissioner 2009).</td>
<td>Being broadcast, it is independent of the number of mobile handsets that receive the message.</td>
</tr>
<tr>
<td><strong>Handset compatibility</strong></td>
<td>All handsets support SMS.</td>
<td>Most handsets support CBS except few legacy devices (e.g. Nokia 3310) (Celltick Company 2003).</td>
</tr>
<tr>
<td><strong>Handset number dependency</strong></td>
<td>Dependent. Foreknowledge of mobile number(s) is essential. Only pre-registered numbers notified.</td>
<td>Independent. Message is received on the activated broadcasting channel. All handsets within a cell notified.</td>
</tr>
<tr>
<td>Characteristic</td>
<td>Short Message Service</td>
<td>Cell Broadcast Service</td>
</tr>
<tr>
<td>--------------------------</td>
<td>------------------------------------------------------------</td>
<td>-------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Location dependency</strong></td>
<td>Independent. User receives the message anywhere.</td>
<td>Dependent. Only targeted cell(s) receive the message.</td>
</tr>
<tr>
<td><strong>Geo-location information</strong></td>
<td>Obtained by identifying the location for each handset separately.</td>
<td>No handset location identification. The location of the target serving cell(s) is known for the broadcaster beforehand.</td>
</tr>
<tr>
<td><strong>Geo-Scalability</strong></td>
<td>Determining the physical location of each mobile handset can be done, but it is quite complex and time consuming (The 3rd Generation Partnership Project 2008).</td>
<td>Geo-scalable from a single cell site coverage area to a whole country.</td>
</tr>
<tr>
<td><strong>Delivery time</strong></td>
<td>Under normal conditions, delivery can be almost instantaneous, but a large number of messages require considerable time.</td>
<td>20 seconds to 2 minutes to all mobile handsets (The Japanese government even requires an alert to arrive on all mobile handsets within 4 seconds, of which 35 million persons are in Tokyo alone) (Sanders 2009).</td>
</tr>
<tr>
<td><strong>Service barring</strong></td>
<td>No barring.</td>
<td>Received only if the broadcast reception is set to “ON” status.</td>
</tr>
<tr>
<td><strong>Reception</strong></td>
<td>Message is received once the mobile is switched on.</td>
<td>No reception if the handset is switched on after broadcasting.</td>
</tr>
<tr>
<td><strong>Congestion and delay</strong></td>
<td>Subject to network congestion. Immense number of SMS may produce delays even for SMS priority messages (One2many Company 2009).</td>
<td>Congestion is unlikely as CBSs are sent on dedicated channels. Almost no delays except if received in poor coverage area.</td>
</tr>
<tr>
<td><strong>Delivery failure</strong></td>
<td>Network overload might cause delivery failure.</td>
<td>Busy mobile handsets might fail to process a CBS message.</td>
</tr>
<tr>
<td><strong>Delivery confirmation</strong></td>
<td>Delivery confirmation is supported.</td>
<td>No confirmation of delivery.</td>
</tr>
<tr>
<td><strong>Repetition rate</strong></td>
<td>No repetition rate.</td>
<td>Can be repeated periodically within 2 to 32 minutes intervals.</td>
</tr>
<tr>
<td><strong>Language format</strong></td>
<td>Identical to all recipients.</td>
<td>Messages with different languages can be broadcast on multiple channels simultaneously.</td>
</tr>
<tr>
<td><strong>Message content</strong></td>
<td>Identical to all recipients.</td>
<td>Different messages can be sent to different areas.</td>
</tr>
<tr>
<td><strong>Message length</strong></td>
<td>140–160 characters in length. Can concatenate up to five messages.</td>
<td>93 characters. Can concatenate up to 15 ‘pages’ to produce a single message of up to 1200 bytes of data.</td>
</tr>
<tr>
<td><strong>Message retrieval</strong></td>
<td>Can be retrieved from the handset inbox.</td>
<td>If the user does not save the message manually they may not be able to retrieve it again (Kidd et al. 2008).</td>
</tr>
<tr>
<td><strong>Support for people</strong></td>
<td>Does not accommodate any disability</td>
<td>Accommodates disability</td>
</tr>
<tr>
<td>Characteristic</td>
<td>Short Message Service</td>
<td>Cell Broadcast Service</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td><strong>with special needs</strong></td>
<td>related technologies.</td>
<td>related technologies (Kidd et al. 2008).</td>
</tr>
<tr>
<td><strong>Spamming</strong></td>
<td>Some mobile service providers support internet connectivity. Internet-based SMS spamming is possible.</td>
<td>Not possible for an outsider except through uncontrolled access to mobile network infrastructure and lack of safeguards by an irresponsible service provider.</td>
</tr>
<tr>
<td><strong>Availability</strong></td>
<td>Available but lacks rapid and scalable geo-location mechanisms. Needs to overcome loading and delay issues in sending SMS to mobile handsets in target areas (Kidd et al. 2008). Subject to inter-carrier agreements.</td>
<td>Available but needs modifications in most cases. Needs to overcome issues related to international standardisation of emergency channel addresses. User requirements need further work (e.g. some people may be particularly less inclined to work with this technology due to lack of familiarity) (Kidd et al. 2008). Subject to inter-carrier agreements.</td>
</tr>
</tbody>
</table>

### 2.6 Basic requirements analysis for a location-based mobile phone emergency system

Several national authorities, international standardisation organisations, and a number of researchers have previously attempted to identify and document different requirements for different public emergency warning systems that should in principle allow support for all current and future emergency event types. In these projects and studies, many aspects were regarded including legislative, regulatory, administrative, operational, technical, and organisational requirements.


In general, defining the requirements serves several objectives such as establishing a standardised way of developing and implementing a system, prioritising the system’s future functionalities while providing guidance on the system’s expected performance levels, and preventing duplicative reporting for the system’s stakeholders (The United States Department of Homeland Security 2008).

With regard to location-based mobile phone emergency systems, no explicit requirements, including legal and administrative requirements, currently exist anywhere in the world (Togt et al. 2005). Nonetheless, based on the concepts and principles outlined in the above-mentioned projects and studies, this research identifies the very basic requirements for a location-based mobile phone emergency warning system deployed as part of a larger public alerting and warning system. These requirements should include, but are not limited to:

1. Ability to be integrated or used along with other alerting and warning systems.

2. Be fully accessible to the right authorities.

3. Be only accessible by the right authorities.

4. Be flexible to allow support for all current and future types or categories of emergency events and not to be designed to support specific type(s) of emergencies or events requiring notification.

5. Ability to operate independently of a specific telecommunications carrier network.

6. The underlying technology should be supported by all telecommunications carriers in the country.

7. Be able to accommodate newer technologies to enable futuristic enhanced transfer modes (e.g. messages with large data content such as video within the warning notification in order to send, for example, a map of safe area or emergency facilities).
8. Have the ability to provide sufficient privacy and authentication checking mechanisms to ensure mobile location security.

9. Support both pre-planned and dynamic notification events.

10. Reach an unrestricted number of people, ranging from hundreds in rural areas to millions in urban and metropolitan cities.

11. Deliver messages simultaneously to a large number of recipients.

12. Deliver the message in near real-time or within a planned specified time.

13. Reach the appropriate recipients, as efficiently as possible, through the ability of the underlying technology to segment the message recipients by geographic locations.

14. Allow the opportunity to send different messages to different groups of people (e.g. recommend different safety areas for different groups or messages can be targeted at people in the immediate vicinity of an emergency to do one thing, and people travelling to the vicinity to do another).

15. Reach all kinds of existing mobile handsets including legacy devices that are largely still in use.

16. Support delivery of messages to those with special needs and unique devices, such as handsets for hearing and vision impaired persons.

17. Reach the residents of remote areas, and roaming people from other mobile telecommunications networks, including visitors from other countries.

18. Support the transmission in languages in addition to English to the extent where it is practical and feasible.

19. Be able to deliver the message under network-congested conditions.

20. Have a message redelivery mechanism when the initial message delivery fails.

21. Have a message reiteration mechanism for as long as the message is valid.
In addition to the base requirements for the location-based emergency system, the requirements for the service/message itself should consider, but is not limited to, the following:

1. Message creation is driven by the country’s specific characteristics and its own list of emergencies.

2. Message template is consistent across different warning sources from different emergency authorities.

3. Message is based on standardised digital format (e.g. CAP) for expressing and disseminating consistent warning message simultaneously over different informative and media channels.

4. Specifically recognisable as being an emergency message that cannot be mistaken for an ordinary message.

5. Credible, secure and authentic.

6. Location-specific, to minimise social anxiety.

7. Relevant, to ensure that recipients realise that the warning relates to their personal situation.

8. Timely, to prevent wrong actions and to provide those at risk with enough time to take protective action.

9. Accurate, to indicate the severity level of the event.

10. Complete, to offer sufficient details about the situation.

11. Concise, to avoid lengthy messages.

12. Provide adequate instructions to recipients regarding what should and should not be done to protect themselves.

13. Fully clear and comprehensible to all people including young and senior recipients.

14. Positive, rather than negative to instruct people on what to do.
2.7 Location-based mobile phone service utilisation for emergency management in Australia

Unlike in the United States, technical feasibility in the context of location accuracy standards for emergency purposes in the mobile telecommunications networks does not exist yet in Australia. In addition, the commitment for telecommunications carriers are less restrictive since Australian regulators, primarily the ACMA, do not enforce any accuracy levels on carriers (The Australian Communications and Media Authority 2004). At present, a call from a mobile handset to an emergency call service is accompanied by very broad mobile location information (MoLI) relating to what is known as a standardised mobile service area (SMSA). These SMSAs can range in size from 2,000 to 500,000 square kilometres, according to the cell’s size from where the emergency call is originated, and are thus too broad to assist ESOs to find someone in an emergency. Rather, the SMSAs are used by the emergency call person to identify the requested ESO answering point that is closest to his or her location, a process known as jurisdiction determination (The Australian Communications and Media Authority 2004).

Many aspects of these services are regulated and monitored by ACMA under the primary legislation, namely the Telecommunications (Consumer Protection and Service Standards) Act 1999 and Telecommunications Act 1997, and through two subordinate legislative instruments: (i) Telecommunications (Emergency Call Service) Determination 2002; and (ii) Telecommunications (Emergency Call Persons) Determination 1999 (The Australian Communications and Media Authority 2004).

The primary emergency service number in Australia is 000, which is equivalent to the American 911. Two other secondary emergency service numbers are also used in the country: 106 and 112. The 106 emergency call service number is for the exclusive use of text-based telecommunications users, allowing people who are deaf or have hearing or speech impairment to text the emergency call service and request assistance from an ESO. The 112 number can be used by a user with a GSM mobile handset. The 112 emergency number is an international GSM standard developed mainly through ETSI and can be used with any GSM network around the world. The number also became the
European Union standard emergency service number (The Australian Communications and Media Authority 2004).

High accuracy location techniques to provide accurate MoLI in emergency situations are yet to be implemented in Australia but one future aim is to reach accuracy levels within 50 to 500 metres (The Australian Communications and Media Authority 2004). Currently, location methods that can identify the mobile base station being used to carry an emergency handset call, thus providing MoLI generally within 500 metres to 30 kilometres of accuracy, are available and ready to be used in Australia but prior to 2009 were not extensively deployed by the country’s telecommunications carriers (The Australian Communications and Media Authority 2004). However, this is expected to change as the feasibility of high accuracy location methods are currently under investigation after the Federal Australian Government, Council of Australian Governments (COAG) identified the compelling need for these methods in Australia following the tragic 2009 bushfires season (The Victorian Bushfires Royal Commission 2009). The delivery of warning messages to mobile handsets based on the physical location of the handset at the time of the emergency is scheduled to be investigated in the second stage of a recently deployed National Emergency Warning System (NEWS), with a view to implementation for the 2009–2010 bushfire season (The Victorian Bushfires Royal Commission 2009).

Accordingly, in regard to the second type of location-based emergency service application, which is initiated by government agencies to people in the case of an emergency, The Government of Victoria on behalf of COAG went to tender in August 2009. The Government sought responses from the mobile phone industry in Australia for determining the capacity and capability of the Australian telecommunications carriers in meeting the long term future requirements for a national emergency alerting and warning system utilising location-based mobile phone technologies to identify active mobile handsets, of all carriers, within a defined emergency area (The Victorian Department of Treasury and Finance 2009). The tender document stated that the underlying technology should be capable of the following:

1. The technology will have the ability to receive notifications about any new mobile devices entering a previously specified emergency area to alert the user that, for
example, an emergency services vehicle has arrived at a location, or a civilian has entered the area and may be unaware of the emergency.

2. The technology will include the ability to receive notifications for any mobile devices exiting the defined emergency area. This could facilitate the creation of an evacuation list of people who are still remaining in the emergency area.

3. The technology will be able to locate specific mobile devices in both 2G and 3G networks, and overlay their position onto a map.

4. The technology will have the ability to provide sufficient privacy and authentication checking mechanisms to ensure mobile location security (The Victorian Department of Treasury and Finance 2009).

With regard to the location-based emergency services phase of NEWS, *the Telecommunications Amendment Integrated Public Number Database 2009 Bill* clarifies the *Telecommunications Act 1997* by explicitly allowing carriers and service providers supplying LBS to access listed public number information in the IPND, since the current Telecommunications Act does not contain express authority for use of information in the IPND for the purpose of providing LBS on a large scale (Gibbons 2009). The Bill seeks to explicitly permit access to IPND data for the purpose of providing location-based mobile phone emergency services and only limited to that information necessary to provide such services. The amendments also extend the existing secondary usage provisions of the Telecommunications Act to prohibit the use or disclosure of IPND data obtained for the purpose of providing the services, except for the purposes permitted under the Act. The prohibition against secondary usage applies to either the carrier or service provider, which initially requested the data and to any other party who may receive the information (The Australian Government: Department of Broadband Communications and the Digital Economy 2009).
2.8 Location-based mobile phone services for emergency management: Global cases

The following cases have been acquired from attainable news and media resources. As it will be noted later, the extent of location-based mobile phone services deployment for managing emergency differs from case to case. While in some cases LBS are utilised to manage all types of emergency events that may affect a whole country, others are limited to either a small geographic area (i.e. to province or jurisdiction) or to a specific type of emergency. Unfortunately, sufficient details were not always available for each case due to the lack of media coverage (since some of the cases were in the trial stage), because of the proprietary solutions LBS are built upon or because of the military/national security nature of some of these cases. In spite of the fact that more details generally means a better understanding of the case, the absence of some details should not introduce concerns about the validity of these cases since the main objective in presenting them is to provide a proof of concept and concrete examples that location-based services are successfully utilised to manage different and emergency event types and hazardous situations worldwide.

Nonetheless, one obvious point that should be stressed here is that the success of LBS utilisation in one country does not necessarily mean similar success in another country as there are many influencing factors. As shall be discussed in the following chapters, we need to determine the applicability and viability of these services, which include government support, legislative frameworks, telecommunications carriers’ participation and people’s acceptance of LBS within the Australian context.

2.8.1 Text messages to allay SARS fears in Hong Kong

On April 2003, Sunday, a mobile phone operator in Hong Kong, launched a location-based service that was capable of alerting its subscribers who happened to be in the vicinity of buildings where the deadly Severe Acute Respiratory Syndrome virus (SARS) had been reported. Those who opted in for the service had their mobile phones tracked continuously. The subscriber was informed via SMS which buildings, within a kilometre of his or her last known location, had SARS cases as declared by the Hong
Kong Department of Health. The subscriber also got updated information about the location of potential infected places the SARS patients were suspected to have visited (Lui 2003). Sunday Company is one of several mobile phone operators in Hong Kong; a highly competitive market with one of the highest mobile penetration rates in the world (The International Telecommunication Union 2003). Hong Kong was one of the most SARS affected countries in the world with more than 700 places were put under quarantine and around 1,425 SARS infections registered including 61 deaths. Worldwide, there were around 8422 cases that had been reported with SARS infection, with 916 deaths been recorded according to the World Health Organisation (2003).

2.8.2 California’s Contra Costa County emergency alerts

As part of its community warning system, the County of Contra Costa in California and in collaboration with Sprint, a US based mobile service provider, started to provide a free public safety emergency alert messaging service regarding impending and existing extreme events such as urban structure fires or wildfires. Sprint’s subscribers who happened to be in the County’s jurisdiction at the time of an emergency received a warning SMS if they were in the vicinity of a threatened area. However, in order to start receiving warning messages Sprint customers needed to opt first into the service via a dedicated website that was established by the County. Sprint utilised a proprietary solution from SquareLoop Company that enabled the location identification of the subscriber’s active mobile handset within the designated emergency area and then the delivery of the warning message to that handset (McGee 2008).

2.8.3 Natural disaster information system in India

With the aim of preventing loss of life in disasters such as the case in the 2004 Tsunami, a Bangalore-based company developed an alert system, which would disseminate warning messages to people in designated areas and in their local languages. The system, called Natural Disaster Information System (NDIS), is the result of a joint effort between Geneva Software Technologies and the Ministry of Science and Technology,
with a close partnership with the Indian Meteorological Department and Bharat Sanchar Nigam Limited Company.

The system is a multi-lingual cell broadcast service that is capable of sending text alerts in the event of an emergency through mobile handsets in over 100 languages including English and all regional languages of India. It can be configured to send text alerts followed by voice messages to mobile handsets and can be used also to send voice warnings to fixed landline telephones when necessary.

The system was basically designed to disseminate warnings in the case of a tsunami within 30 seconds of a weather satellite or an earthquake observatory giving an alert signal, but the system could also be used to warn for other types of emergencies such as cyclones or epidemics.

After generating a warning by the meteorological department alert system, the warning would be sent to the company’s server where it is converted by NDIS into a text message in two seconds. Within 19 seconds, the system translates the text into a predefined set of languages and converts the text into voice, if needed, using a Dynamic Voice Translation System (DVTS) component. Within only 30 seconds from receiving the meteorological department warning, the text message would be sent to its recipients or streamed as voice to handsets or fixed telephones.

The multi-lingual messaging software used by NDIS is based on a patented technology called VIVID. The software is compact enough to be stored on a subscriber identity module (SIM) card and compatible with almost all types of handsets used in India. The SIM software component is needed to present the message in the desired language based on its standard text messaging Unicode embedded technology. Users do not need to subscribe to the service but they need to equip their devices with a SIM card that is compatible with NDIS.

The system has also core LBS functionalities as it has the capability to track people during sudden events such as bomb blasts or those events that span over a long period of time such as epidemics (Geneva Software Technologies Ltd. 2006; The Statesman Newspaper 2006).
2.8.4 Early warning missile alert system in Israel

Israel is a country that is continuously threatened by rocket attacks. In its last two conflicts with Hezbollah; Lebanon and Hamas; Gaza, 90 percent of the Israeli casualties involved people who were hit by projectiles while being in open areas away from any building.

Individuals who seek shelter in designated safe buildings during rocket attacks are likely to avoid being wounded or killed. As a result, the Military Home Front Command of Israel has been working on warning civilians of rocket attacks by utilising mobile telecommunications technologies amongst others driven by the excellent mobile phone coverage in Israel with nine million active mobile phones for only seven million civilians. An early warning missile alert system is set to be ready in 2011 that is designed with rocket sensors capable of creating a virtual ellipse of the precise location of an impact zone and based upon the calculations all active mobile handsets within the affected zone will be given an early 10 minute warning to evacuate through their mobile handsets. The system is meant to be an addition to traditional warning systems such as the television, radio and sirens, not a replacement.

The alert will be received as a free service but the systems design requires the individual to sign up first to the service through a dedicated website and then to choose how he or she wants to receive the warning information. The alert can be obtained by logging onto the website, via email or pushed to the subscriber’s mobile handset in one or a combination of four possible forms: text message, audio alert, a handset vibration or light flash, which will be especially useful for people with hearing or vision impairment. At some stage, the system will be able to deliver the alert with a map of the affected area.

The system is the result of an agreement between Nixle, a San Francisco based company and Safe Cities Solutions Israel, a Homeland Security company specialising in security design and planning for governments worldwide. The system utilises Nixle’s proprietary technology and its secure text-messaging platform to disseminate geotargeted information from the Israeli government to the general public. The platform is mainly based on cell broadcast technology and will be able to send around 500 alerts per second from each single server used in the system.
Cell broadcast technology is already supported by the three main mobile companies and almost all mobile handsets currently operating in Israel. However, the Command is working with the Israeli Ministry of Communications to restrict the importation of mobile handsets to only those devices that support cell broadcasting. With the rate in which most Israelis upgrade their mobile handsets, a two-year waiting time is necessary for each individual to have a compatible handset with the technology. The waiting time will be spent in testing the system extensively with the first test held successfully in May 2009 in a nationwide exercise. The time is also needed to work on the system’s regulatory aspects that would shape the collaboration between the three mobile phone companies, and also guide the partnership between the Command and the Ministry of Communications on one side, and between the private mobile telecommunications companies on the other side (Lappin 2009a, 2009b; Nixle Media 2009; Sneh 2009; World Tribune 2009).

2.8.5 Earthquake and tsunami early warning system in Japan

Japan is one of the most natural disaster-prone countries in the world with more than 10 percent of world’s magnitude 6, or greater, earthquakes recorded every year. Administered by the Japan Meteorological Agency (JMA), the country launched its Earthquake and Tsunami Warning System (ETWS) that disseminates warnings over television and radio. On November 2007, the NTT DoCoMo Company has started to simultaneously provide location-specific earthquake and tsunami warnings to its customers. The company supplies its own mobile handsets with specific configuration menus from which the user chooses to receive earthquake warnings and/or tsunami warnings based on the user’s geographic location at any given time. The user can also define the volume and duration of the dedicated alert tone.

The NTT DoCoMo system is based on cell broadcasting technologies and designed to send multiple Message Indicators (MIs), where each MI is assigned for a specific type of emergency or language. Every broadcast warning message has a serial number that can be repeated every two seconds for new handsets entering the affected area, without appearing on handsets which have received the message.
Led by NTT DoCoMo, the ETWS is currently being standardised in The 3rd Generation Partnership Project (3GPP), the main international telecommunications standards body, upon strong request from the Japanese Government. It is expected that once the standardisation has been concluded other tsunami and earthquake prone countries, mostly in Southeast Asia, may deploy the same service on their national mobile telecommunications networks (Coyle and Childs 2005; One2many Company 2009; Sanders 2009).

Finally, as there is scant documented literature in the investigation of cases where location-based mobile phone technologies have been used in the realm of emergency management, presenting the above cases served to provide evidence that the coordination of emergency management procedures with location-awareness activities can act as a life-sustaining tool when these technologies are utilised by governments.

2.9 Overview of Chapter Two

This chapter was devoted to providing background information for understanding emergency, emergency management and location-based services with specific reference when appropriate to Australia. Driven by the importance to define what constitutes an emergency in this study, it was sought first to find a relevant meaning within the Australian socially constructed context. A review of Australia’s arrangements and its all-hazards approach to emergency management was then given, and the main emergency committees and organisations, alerting and warning systems, methods and techniques currently used in the country were also outlined. These included the recently deployed national emergency warning system in Australia.

By presenting Australia’s arrangements and efforts in the area of emergency management, a rationale emerged to define mobile government and its location-enabled emergency service application, setting the scene to present and discuss location-based services and the services relation to emergencies and emergency management. Different aspects of location-based services were considered, including the comprehensive background of the use of services for emergency calling/messaging and public warning notification purposes in the mobile telecommunications networks. This data included
the main technologies that are available today to deliver the location-based mobile phone warning notification to the public; in particular, the short message service and cell broadcasting service. A comparison was also given between the characteristics of these two technologies in the domain of public warning.

Afterwards, a basic requirements analysis for a location-based mobile phone emergency system, as part of a larger public warning and alerting system, was provided based on pertinent studies and projects worldwide. The requirements covered different aspects of the system, including the design, deployment and implementation. The requirements also covered some of the fundamental characteristics that should be considered in providing the service/message.

An overview was then given about the future location-based mobile phone emergency warning component of the recently deployed NEWS in Australia, including the expected amendments on the *Telecommunications Act 1997*. These amendments are suggested by the government of Australia to re-regulate the access to the IPND for the national warning system and its “location-enabled” component to function successfully. Finally, several global cases were presented in which mobile alerts and location services have been trialled, implemented or suggested for implementation for emergency management purposes worldwide.

The following chapter is a critical review of issues in location-based services, discussed with a specific focus on emergencies and disasters as the usage context of the location services. The purpose of the review is to provide the proper knowledge base through which an investigation can be carried out with the stakeholders of the location-based mobile phone service in Australia about the possible national utilisation of the service for emergency management. The review also serves as the needed ground for examining the social acceptance or rejection of the service utilisation in Australia.
3 Issues in location-based service utilisation for emergency management, theory and model development

3.1 Introduction

Emergencies inflict massive social costs on individuals and communities as well as usually having a heavy impact on critical infrastructure. The location-based mobile phone service has the potential to play an important role before, during or after these extreme events by augmenting the situational awareness amongst the users of the service about their immediate surroundings, thus help to avoid further casualties or damages. Yet, to the extent that the benefits of location-based services could be realised solutions, there are numerous challenges which must be considered that may have the ability to delay, impede or acutely interfere with the service success (Jensen 2002; Tsalgatidou et al. 2003; Bennett and Crowe 2005; Küpper 2005; Perusco et al. 2006; Bernardos et al. 2007; Perusco and Michael 2007). This chapter is a review of some of the most exacting issues identified in relevant literature to location-based services. However, attention is devoted mainly to those pertinent issues related to the utilisation of the service within the government emergency management arrangements. The identified issues lay the main foundation for this research endeavour upon which an in-depth qualitative exploration is later carried out with the stakeholders of the service in Australia.

Identifying the issues of greatest importance to the possible utilisation of the service is also an indispensable precursor to the quantitative research. The quantitative research forms the basis for the examination of the attitudinal and behavioural implications of the location-based mobile phone emergency service in Australia and the social acceptance or rejection of the service, setting forth the identified issues in this chapter to be the determinants of this acceptance or rejection. Correspondingly, a comprehensive review
of the prominent theories and models in acceptance and adoption literature is carried out and presented to enable the development of a conceptual model and a set of research hypotheses that are argued to be quite capable of providing a theory-based recognition to the identified issues and, at the same time, offering a justified means to execute the examination.

3.2 Issues in location-based services research

3.2.1 The visibility of the emergency management application of the location-based mobile phone service

Individuals may not be aware of the possible utilisation of location-based mobile phone service for emergency management and, therefore, it could be argued that the direct advantages or disadvantages of such utilisation would not be visible to them (Pura 2005; Chang et al. 2007). An early explanation of this common phenomena came from Zajonc (1968) who defined it as the “mere exposure effect”. It is the case where a person does not know or has little knowledge about a phenomenon but by repeatedly exposing him or her to a related stimulus object, the repetition is capable of changing his or her beliefs towards the phenomenon either positively or negatively. Individuals who are not aware of the existence of the location-based service or, basically, do not know about the capabilities of the service in the domain of emergency management may not develop an appreciation, or even depreciation, towards the service unless they were properly and repeatedly being introduced (exposed) to the service application. In other words, people may not be able to accurately judge the advantages or disadvantages of LBS unless the service application in the domain of emergency management is visible to them.

It should be noted, however, that the exposure effect does not necessarily increase the perceived functionality of the service, but it could enhance or degrade individuals’ perceptions about its usefulness, thus influencing their acceptance or rejection of the service (Thong et al. 2004).
One of the key attributes of the Diffusion of Innovation (DOI) Theory by Rogers (1995) is observability, which is defined as “the degree to which the results of the an innovation are visible to others” (p. 16). Innovation itself is “an idea, practice, [technology, solution] or object that is perceived as new to an individual or another unit of adoption” (Rogers 1995, p. 135). Later, observability was segmented by Moore and Benbasat (1991) into two distinct constructs of demonstrability, which is defined as “the tangibility of the results of using an innovation” and visibility as “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 may not be new but it could be unknown for the people or even for governments. This probably is the case with the location-based services where the services have been around for several years, yet their general usage rates, specifically for emergency management, are still extremely limited worldwide (Frost and Sullivan research service 2007; O'Doherty et al. 2007).

3.2.2 The quality features of the location-based mobile phone emergency service

Service quality can be defined as “a global judgement, or attitude, relating to the superiority of the service” (Parasuraman et al. 1988, p. 16). The quality is, therefore, the result of a personal subjective understanding and evaluation of the merits of the service. Quality nonetheless has always been a difficult concept to recognise and capture (Garvin 1984). In our context for example, individuals may not always have comprehensive knowledge about the location-based service attributes or the service capabilities for emergency management and, therefore, individuals may rely on indirect or inaccurate measures to judge such attributes. Accordingly, there is a need to create verifiable direct measurements in order to present the subjective quality (perceived) in an objective way (determinable dimensions) when examining the impact of the quality of the service on people’s opinions about the service (Garvin 1984).

Liljander et al. (2002) have discerned the need to address the lack of research about people perceptions of the service quality when shifting from interpersonal service
interactions to self-service technologies including electronic services (e-services). In the absence of reliable and commonly accepted instruments to measure the quality of e-services, researchers have been compelled to use traditional scales like the Parasuraman et al. (1988) SERVQUAL model (Liljander et al. 2002). However, in these models the interpersonal character of the delivery has the main impact on determining the quality of the service and, therefore, such models cannot truly apply to the paradigm of e-services (Boshoff 2007).

Several studies suggested alternative instruments to measure the e-service quality. Examples include Kaynama and Black (2000), and Zeithaml et al. (2000; 2002). However, Boshoff (2007) strongly argued that most of these instruments have flaws since they were either too narrowly focused 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 the 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 the location-based service there is no existing consummate set of dimensions that can be employed to measure the impact of the service quality features on the individual opinion about the service utilisation for emergency management. Therefore, defining a dimensional measurable set for the location-based mobile phone emergency service would not be a straightforward task since there is almost no scholarly research regarding such impact. Another issue that should be mentioned is the criteria of selecting the most pertinent quality features of the location-based mobile phone service to emergency management as Zeithaml et al. (2002) have warned that many researchers usually proposed dimensions in an ad-hoc or anecdotal way.

Accordingly, the quality dimensions of the location-based mobile phone service that are expected to be quite relevant to the emergency situations were adapted from Liljander et al. (2002), which in turn are based on the original Parasuraman et al. (1988) SERVQUAL model but were revised to accurately reflect the quality measurements of the e-service. The dimensions of Liljander et al. (2002) service quality model include reliability, responsiveness, customisation, assurance/trust, and user interface. Since the location-based service is basically an e-service, then most of the aforementioned
dimensions are highly pertinent and can be utilised to the benefit of this research. In addition, as the above mentioned dimensions are highly adaptable to capture new media (Liljander et al. 2002), then it is expected that these dimensions would be capable of explaining the individual evaluation of the introduction of the relatively new medium (i.e. the location-based mobile phone service) into the domain of emergency management.

The interpretation of the reliability concept follows Kaynama and Black (2000), Zeithaml et al. (2000) and Yang et al. (2003) as the currency and accuracy of the product information. To be considered reliable, the location-based service need to be delivered with the best possible service information, in the best possible state and within the promised time frame (Liljander et al. 2002). This is highly relevant to emergency circumstances taking into account that users are usually on the move and often in time-critical situations, which demand current and accurate service (Kar et al. 2004).

Since it is reasonable to postulate that the success of the 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, and due to the fact that fast response to changing situations or to people’s emergent requests is considered as providing timely information to them, then timeliness is closely related to responsiveness (Lee 2005). Therefore, investigating the responsiveness of the location-based service would be relevant in this context. In general, examining the influence of currency, accuracy and responsiveness quality features on people’s opinions is expected to provide an insight into the extent to which the location-based mobile phone service is generally considered trustworthy to be utilised for emergency management.

Liljander et al. (2002) user interface and customisation dimensions are not explicitly investigated. User interface dimension comprises factors such as aesthetics, something that cannot 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. This can be done for and by the user. Since the location-based emergency service is customised based on the location of the recipient’s mobile handset and also on the type of
information is being sent to him or her, then customisation is already an intrinsic quality in the core features of the location-based mobile phone emergency service.

Therefore, the service quality dimensions that are expected to impact on the success of the location-based mobile phone emergency service, and accordingly are put to investigation 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 the 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).

### 3.2.3 Risks associated with using the location-based mobile phone emergency service

Risk of varying types exists on a daily basis in the human’s 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 people’s confidence in any technology that is used in these situations (Im et al. 2008). Accordingly, an individual’s decision to use the location-based mobile phone emergency service might be influenced by his or her intuition that the service could be disrupted since its underlying infrastructure may suffer heavily in the severe conditions that are usually associated with emergencies, especially, in large-scale disasters. A telling example is Hurricane Katrina, which caused serious disruptions throughout New Orleans, Louisiana, and rendered inoperable almost every public and private infrastructure in the city. See Figure 3.1. As a result, uncertainty about the intensity of emergencies coupled with their unforeseeable
contingencies may have long-term implications on one’s perception towards the use of all technologies including the location-based service in life-threatening situations.

Figure 3.1: The impact of Hurricane Katrina. Sources (Hurricane Katrina Info 2005; The Associated Press 2005)

Uncertainty is a salient element of risk. Two distinct types of uncertainty have been differentiated by Bensaou and Venkatraman (1996), and Pavlou (2003): Behavioural and environmental.

In the context of LBS, behavioural uncertainty arises when LBS 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 the difficult conditions of emergencies. Therefore, the individual decision to rely on the uncertain behaviour of others can be perceived as introducing a potential risk on the personal safety. Physical, psychological and social risk perceptions could all be envisaged here as personal risks (Jacoby and Kaplan 1972).
Second, the decision might hold an economic risk perception 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 inordinate information or use the collected information for other purposes 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 the extreme conditions the underlying infrastructure supporting the location-based mobile phone emergency service would be compromised as all other telecommunication models. 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, which might lead to a potential risk on the personal safety or the safety of important others, such as 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 mobile phone emergency service may suffer or not perform as it is intended or desired (Grewal et al. 1994; Featherman and Pavlou 2003). There may not be a perception of a direct personal risk on the individual’s own safety but the idea of a service failure, when it is mostly needed, could augment the concerns about the performance of the service and its resilience in emergencies. A third environmental risk could be perceived financially when there is the possibility of a monetary loss of the private properties or assets (Featherman and Pavlou 2003).

3.2.4 Trust in the location-based mobile phone emergency service

Trust has long been regarded as an important aspect of humans’ 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). In the
uncertain environments of the e-services, including location-based services (Kaasinen 2005; Lee 2005), uncertainty leads individuals to reason about the capabilities of the location-based mobile phone emergency service and its expected performance, which eventually brings them to either trust the service by willingly accepting to use it or distrust the service by simply rejecting to use it. In emergencies, individuals may consider the possible risks associated with the location-based mobile phone service before using the service. Therefore, individuals are likely to trust the service and engage in a risk taking relationship, if they perceive that the benefits of using the service surpass its risks. However, if high levels of risk are perceived then it is most likely that individuals do not have trust in the service and, therefore, will not engage in a risk-taking behaviour by using it (Mayer et al. 1995). Consequently, it could be posited here that trust in LBS is a pivotal determinant of accepting the utilisation of the service, specifically, in emergencies 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 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 the 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 (Horkoff et al. 2006). The ability to provide such 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 usefulness and the potential risks associated with its utilisation. Nonetheless, it should be noted here that the trust, per se, is a subjective interpretation of the actual trustworthiness of the service, given
limited knowledge of the actual usage of the location-based mobile phone service in the domain emergency management in the real world (Pavlou 2003).

### 3.2.5 Privacy concerns pertain to the location-based mobile phone emergency service

A widely 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, privacy mainly pertains to the locational information of the individual and the degree of control he or she exercises over that information. This definition of privacy harmonises with Froomkin’s interpretation of the information privacy as “the ability to control the acquisition or release of information about oneself” (p. 1464). Therefore, the location information is regarded as highly sensitive data that when collected over a period of time or combined with other personal information inferences about a person could be generally made. Indeed, Clarke and Wigan (2008) noted that knowing the past and present location 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 the government to create a suspicion, or by the private sector to conduct target marketing.

Marx (1999) perceived the location as one of the dimensions of the person’s identity. Location represents a context that can be used to identify a person where:

Identification can refer to a person’s address. This involves location and reachability, whether in actual or cyberspace (a telephone number, a mail or e-mail address, an account number). This need not involve knowing the actual identity or even a pseudonym. But it does involve the ability to locate and take various forms of action such as blocking, granting access, delivering or picking up, charging, penalising, rewarding or apprehending (p. 101).
Accordingly, privacy concerns may originate when the individual becomes uncomfortable with the perception of the constant collection of his or her personal location information, the idea of the information perennial availability to other parties and the belief that he or she has incomplete control over the collection, the extent, the duration, the timing or the amount of data being collected about him or her.

The traditional commercial use of the location-based service, where a high level of details about the service application is regularly available for the potential user, may not raise much of sensitivity towards privacy since the user’s explicit consent is a prerequisite for initiating the service in most of the cases. 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 the people’s perspectives towards the location-based service in general. It also has the potential to raise a debate on the 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 emergencies.

However, far from any extreme scenario, the good intention is generally assumed as governments usually communicate with the prospective user what data will be collected, how much data will be collected and when it will be collected. Still, the perceived privacy concerns are expected to be one of the main impediments of accepting the location-based service and, therefore, should be put to investigation (Xu et al. 2005; Junglas and Spitzmuller 2006), even when the service is suggested for utilisation for emergency purposes.
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 can be examined when investigating perceived privacy concerns pertaining to the location-based service as well (Junglas and Spitzmuller 2006). *Collection* is defined as the concern that extensive amounts of location information or other personal identifiable data would be collected when using the location-based mobile phone service during emergencies, while *unauthorised secondary use* is defined as the concern that the location-based mobile phone emergency service information is collected for emergency purposes but will ultimately be used for other purposes without explicit authorisation from the individual. *Errors in storage* describes the concern that the procedures taken against accidental or deliberate errors in storing the location information are inadequate, while *improper access* is the concern that the stored location information is accessed by parties who do not have the authority to do so.

3.2.5.1 Control of location information under the location-based mobile phone emergency solution

Perusco et al. (2006) noted that even advanced countries such as the United States and Australia do not yet have special regulations or legislation that can deal with disputes and issues originated from utilising the location-based service in different contexts. Given that, it could be argued that one of the possible barriers to utilising the location-based mobile phone service for emergency management on the national level is the lack of dedicated mechanisms that could protect and safeguard the personal location information of the individual under emergency situations or under emergency declarations. Therefore, the existence of safeguards that protect the privacy of the individual and provide assurance of control over his or her personal location information is perceived fundamental to the success of the location-based mobile phone emergency solution.

Xu and Teo (2004) proposed three distinct information control mechanisms in order to alleviate the privacy concerns in the context of location-based services. They are *technology self-based*, *institution-based via self-regulations* and *institution-based via*
Technology self-based assurance of control refers to the ability of the individual to exercise a direct control over his or her personal location information via the technical features of the handset device. For example, the individual can determine when to opt out from the service or be able to define the preferred accuracy level to which the service provider is allowed to determine his or her current location.

When the technology infrastructure is not supported or favoured the individual might consider other alternatives of control mechanisms. One option is the institution-based via self-regulations in which the mobile telecommunications industry forces and exercises a set of policies to assure the privacy of the individual in regard to the location information and LBS transactions (Xu and Teo 2004). The relationship between the individual and the service provider is governed through a set of stipulated obligations and established codes and principles of professional practices within the industry itself.

Another possible alternative is the institution-based via legislation. In this case, relevant government policies and explicit laws and regulations would exist within the legal system to ensure the proper access and use of the personal location information (Xu and Teo 2004). Power forces (e.g. law enforcement or government emergency services organisations) would act as control agents on behalf of the individual by exercising a proxy control over his or her location information (Xu and Teo 2004, 2005)

Investigating these three distinct forms of control mechanisms is expected to provide an insight into the dependability of the mechanisms before any of the three could be reasonably utilised within the national location-based emergency solution in Australia. The practical investigation of the information control mechanisms stems from the fact that numerous studies have identified privacy concerns as one of the main impediments of using technologies, including the location-based service technologies (Esrock and Ferre 1999; Hoffman et al. 1999; Hann et al. 2002; Ho and Kwok 2003; Bauer et al.
2005; Junglas and Spitzmuller 2005; Parasuraman et al. 2005; Scharl et al. 2005; Xu et al. 2005; Michael and Salter 2006; Perusco et al. 2006). However, it is noted that despite the fact information control mechanisms have the ability to significantly alleviate concerns about the location privacy the mechanisms have been scarcely investigated in relation to privacy and LBS research, more specifically, in LBS acceptance research. Therefore, because of the expected significance of the information control under the utilisation of the national location-based mobile phone emergency service the mechanisms are examined as part of the survey of this study.

3.3 People’s acceptance of location-based mobile phone services for emergency management

In the current age of “permanent emergency” (Parenti 2003, p. 2), perhaps now more than ever, location-based services emerge as promising applications that could help to add significant value to the all-hazards approach governments are advocating. Utilising location-based services for emergency management could allow individuals to make more informed decisions before, during or in the after-effects of emergencies, leading them potentially into a safer position or status. People are the key stakeholders who would directly gain from deploying LBS solutions in potential perils caused by humans or by nature. Yet people are also the ones who may directly be disadvantaged from such a deployment. Consider for instance a service failure when a group of people are in desperate need of safety information about impending extreme weather conditions while camping. Despite the large body of research that has been written about location-based services, the scarcity of theoretical and empirical studies that specifically investigate people’s acceptance of using these services in the realms of emergencies is noted. One might, however, rightly ponder on whether any individuals would ever forego these services in a time of emergency? Yet, despite the apparent benefits, location-based services have long raised numerous issues amongst users; from the quality of the service information being provided, to privacy concerns, up to legal liability of a service failure or information disclosure accidentally or deliberately (O’Connor and Godar 2003; Tilson et al. 2004; Perusco et al. 2006; Perusco and Michael 2007).
In a review of several unsuccessful technologies, Cantwell (2002) noted that one of the main reasons for the technology's inability to succeed is the consequential public concerns of its use. Cantwell concluded that disregarding or ignoring people’s concerns, specifically privacy concerns, was costly to some technologies no matter how promising they were. In the case of the location-based service, some of its underlying technologies should fundamentally allow governments to be able to determine the almost exact geographic coordinates of all active mobile handsets in a defined emergency area(s), or track the handsets in real time within specified threatened zone(s). It is quite true that emergencies do represent unique context where privacy is most likely to be one of our least concerns. In theory, the determination/tracking processes should not trigger any concerns when being specifically employed for emergency management, but the general perception of the uninterrupted availability of these processes being in the hand of the government during normal daily life situations in times and places that are beyond the emergency situation itself, has the potential to raise acute concerns about privacy. In his book about mobilisation, James Harkin voiced equal concern when he stated that

unless there are clear limits on how government can employ the information that it gleans from our mobile communications – and in the current climate of international terrorism, few governments are keen to impose limits on their own meddling – there may well be a backlash that will impede the development of the technology itself (2003, p. 50).

Location information is a particularly sensitive kind of personal information that can have intrusive consequences on an individual’s privacy if misused (The Australian Communications and Media Authority 2004). This kind of information can be collected, stored, aggregated and when correlated with other personal information a broad view of behavioural patterns or detailed portraits of individual habits can be created (Parenti 2003; Clarke and Wigan 2008). Green (2001) posited that location-based technologies might be used one day to hold individuals institutionally accountable for their day-to-day activities. In his work about location-based profiling, Leenes (2008) goes even further and describes two actual cases where location data was used in criminal investigations. Indeed, this profiling of individuals is what could make people uneasy about the service national utilisation, because of concerns about privacy in general as well as fears of being incorrectly labelled (Holtzman 2006).
But without discarding the fact that the location-based mobile phone emergency service has true potential to save lives, shutting down the flow of information from one’s mobile handset as a reaction to concerns seems unrealistic thinking in the “transparent society” of today (Brin 1998). Nonetheless, a totally transparent society where privacy is abolished during emergencies is not feasible because of the inherent value of privacy for both the individual and society (Schneier 2008). Moreover, privacy per se is indispensable in a community that recognises social freedom as good and where many people dislike exposure of their private actions not because they have acted irregularly but because their psychological nature requires privacy (Ben-Ze'ev 2003). Accordingly, there is a need to find a harmony between the individual right to privacy and the government obligation of exploiting location-based mobile phone emergency systems as the next essential evolution step towards the securitisation of today’s society.

Despite the importance of privacy, attention should not be drawn to its issues alone but also to other issues with arguably comparable, though different, impact on people’s decisions towards accepting or rejecting the utilisation of the location-based service for emergency management. Once these issues are identified, an empirical examination could then be carried out by directly eliciting people’s opinions about them. It is believed that, this heuristic approach of investigation can provide better understanding of the actual matters of concern and better grasp of the true determinants of acceptance from the perspective of the people who would use these services one day. In this sense, Dillon and Morris argued that:

While the findings on user acceptance as a psychological construct both shed light on the forces that determine individual behaviour and enable researchers to predict with some accuracy how users will respond to a given application, there is a need to address acceptance at the outset of technology development, prior to investing in development costs (1996, p. 21).

Indeed, Marcus (2002) believed that the success of a solution or a service is mainly due to the value of being widely accepted, besides it being implementable. Therefore, investigating the social acceptance of the location-based mobile phone emergency service as one of the objectives of this study is seen imperative for concluding the
viability of the service within the national emergency management arrangements of Australia. It is argued that the type of knowledge obtained from examining people’s acceptance can be reasonably considered by the Australian government towards the formation of more successful diffusion strategies for the location-based mobile phone emergency service, knowing what would be the concerns of the people from such a service when it is deployed on the national level.

3.4 Review of the theoretical frameworks and models of acceptance and adoption

A plenitude of studies on acceptance and adoption have been conducted in the past two decades driven by the fact that several socio-cognitive theories have advanced researchers with the needed theoretical understanding to predict acceptance, usage and adoption behaviours of different ISTs (Malhotra and Galletta 1999; Rawstorne 2005). Some of these theories and models have outlasted others while, at the same time, managing not to be superseded by more recent research since finding substantial empirical support from numerous researchers across various disciplines. Exploring these models and theories will provide the present work with the essential justifiable theoretical base on which it grounds its conceptual model of acceptance, and also offer a validated instrument to empirically recognise the issues influencing LBS acceptance.

3.4.1 The Diffusion of Innovation Theory

A well-known theory in acceptance and adoption literature is the Diffusion of Innovation Theory (DOI) of Rogers (1995). The theoretical perspective of DOI has been long utilised in information systems and technology research (Prescott 1995). As a general theory, its conceptual framework has been used to explain adoption at a global extent, while being applied at both individual and organisational levels of analysis (Dillon and Morris 1996). Innovation is basically “an idea, [technology, solution], practice, or object that is perceived as new to an individual or other unit of adoption”,

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while diffusion is “the process by which an innovation is communicated through certain channels over time among the members of a social system” (Rogers 1995).

DOI explains the manner in which an innovation moves; from its initial stage where an individual becomes aware of it and forms an idea of how it functions, through the persuasion stage where the individual forms a favourable or unfavourable attitude towards using it, then to the decision to adopt or reject the innovation, then into the stage of utilising the innovation, and finally into the confirmation stage where the individual evaluates the outcomes of the innovation and the decisions he or she made about it (Rogers 1995).

DOI determines the rate of adoption for each individual of the social system and discerns between different categories of adopters based on their personal innovativeness. The five categories of adopters are innovators, early adopters, early majority, late majority, and laggards. Innovators are the audacious pioneers who are the very first to adopt. Early adopters are the opinion leaders who perceive the new trends early and become within the first in their segments to adopt, evaluate and then communicate the innovation to others. Early majority are deliberate in their adoption decisions, but since they usually lack the leadership roles found in the early adopters they tend to wait for their evaluation before adopting, but without waiting long to be the last to change. Late majority are the indecisive and the sceptical people who prefer to wait until most others have adopted the innovation. Laggards are the last individuals to adopt, who always prefer to base their decisions on what has been done previously (Rogers 1995; Brown and Venkatesh 2003).

Rogers (1995) has defined a set of five factors that predict the likelihood and the rate of innovation adoption. They are:

1. Relative advantage: The degree to which innovation is perceived as being with a better value than the idea it supersedes. The value of the innovation is resolved upon several determinants that include economics, convenience, satisfaction, prestige, and fashion.
2. **Compatibility**: The extent to which adopting an innovation is perceived to be consistent with existing values, beliefs, lifestyle, social practices, norms, past experiences and the needs of the potential adopters.

3. **Complexity** refers to the degree to which innovation is perceived as easy to be used or learnt.

4. **Trialability** refers to the chance to examine an innovation before making the decision of accepting or rejecting it.

5. **Observability** is the degree to which an innovation’s gains are visible to others.

Rogers and others later identified further constructs, which were thought to be significant on the decision to adopt. For example, Tornatzky and Klein (1982) have proposed five new dimensions to Rogers’ original five after conducting a meta-analysis investigation of previous innovation research. The new factors are *cost*, *communicability*, *divisibility*, *profitability*, and *social approval*. Moore and Benbasat (1991) have also suggested *image* and *voluntariness of use* as two more distinctive factors to be added to the model. *Observability* was later segmented by Moore and Benbasat (1991) into two unique constructs of *demonstrability* and *visibility*.

DOI provides a well-grounded theoretical approach by which researchers can examine the influence and the uptake of innovations over time. It also offers discernment into individuals’ characteristics who will adopt an innovation at different phases. However, the theory does not offer an explicit understanding of acceptance as it fails to exactly predict how an individual accepts or rejects a new innovation (Dillon and Morris 1996). Therefore, researchers’ quest of identifying the factors that determine user acceptance and adoption behaviours of a new innovation have drawn the attention into the cognitive and social psychology and also into the sociology branches of research (Dillon and Morris 1996). As a result, a new theoretical work emerged based on the aforementioned fields of research. The Theory of Reasoned Action (TRA), which sprouted from social psychology, is a good example of this manifestation.
3.4.2 The Theory of Reasoned Action

The Theory of Reasoned Action (Fishbein and Ajzen 1975; Ajzen and Fishbein 1980) has become one of the main theoretical intention models that has proven its success in predicting acceptance and usage behaviours in various domains (Davis et al. 1989; Chen et al. 2002). A conceptual framework of TRA is depicted in Figure 3.2. According to TRA, an individual’s actual behaviour is determined by the intention to perform that behaviour, such intention is a joint function of the subjective norms and the individual’s attitude towards engaging in the specific behaviour. Attitude and subjective norms are based on and determined by both behavioural beliefs and normative beliefs (Dillon and Morris 1996).

According to TRA, intention is the cognitive exemplification of an individual’s inclination to perform a given behaviour, attitude is the individual’s positive or negative feelings towards performing a target behaviour, whereas a belief is the individual's subjective probability that performing a given behaviour will produce a certain outcome (Fishbein and Ajzen 1975; Ajzen 1991, 2005).

TRA posits that if an individual holds a favourable attitude towards a behaviour, then it is more likely that the intention would be translated into actions (Ajzen 2005). The theory also asserts that attitude is predominantly determined by rather a small number of
salient beliefs about the outcomes of performing the behaviour, weighted by individual’s evaluation of each outcome. As the evaluation of the next outcome keeps diminishing, the belief influence on attitude becomes less significant. Accordingly, only the first few probable beliefs have the governing role in shaping the attitude (Fishbein and Ajzen 1975). Subjective norm is “the person's perception that most people who are important to him or her think he or she should or should not perform the behaviour in question” (Fishbein and Ajzen 1975, p. 302). Subjective norm is determined by normative beliefs about the opinions of relevant others, weighted by individual’s subjective motivation to comply with such opinions (Fishbein and Ajzen 1975; Ajzen and Fishbein 1980).

TRA has proven to be an excellent predictive theory that performs well even when it is utilised in situations beyond the original boundary conditions specified for its model (Sheppard et al. 1988). It has received continuing empirical support having been successfully utilised in numerous studies in various disciplines (Thompson and Panayiotopoulos 1999; Sogani et al. 2005). Nonetheless, because TRA was introduced as a general theory that is “designed to explain virtually any human behavior” (Ajzen and Fishbein 1980, p. 4), the attitude construct is “general” in its nature and is not anchored to any predetermined set of beliefs, which compels the researchers to first identify the beliefs that might influence the individual’s attitude before starting investigate the behavioural intention itself (Dillon and Morris 1996).

3.4.3 The Theory of Planned Behaviour

The Theory of Planned Behaviour (TPB) (Ajzen 1985, 1991) has been proposed as an extension of TRA in order to treat the limitations of the original theory in predicting behaviour of individuals who have low volitional control. A person is said to have a volitional control if he or she can demonstrate a will to perform or not to perform a specific action (Ajzen 1991). According to TRA, most social behaviours are accomplished under volitional control and, hence, can be predicted by intentions alone (Ajzen and Fishbein 1980; Ajzen 2002a). TRA theorises that intention is predicted by investigating the joint influence of an individual’s attitude and relevant others. However, a weakness in the theory stems from the fact that not all intentions can be
explained only by attitudes and subjective norms (Rawstorne 2005). Consider, for example, an alcoholic who has the intention to quit drinking and has the support of his or her family to do so, but does not have the sufficient volitional control over his or her addiction. His or her addiction makes it extremely hard for him or her to regard the opinions of important others or even to exercise his or her own will over it. The prediction power of TRA is extremely poor in such cases where, in practice, many impediments limit an individual’s freedom to act. Such impediments could be unconscious habits, ability limitations, time constraints or environmental contingencies (Bagozzi et al. 1992). As a result, the Theory of Planned Behaviour proposed the concept of *perceived behavioural control* in an attempt to advance the prediction power of the original theory. The construct is subsumed as an antecedent of both behavioural intention and actual behaviour. See Figure 3.3.

*Perceived behavioural control* reflects user’s perceptions of the influence of internal and external constraints on behaviour (Ajzen 1985). The concept has been later anatomised into two components. The first is *facilitating conditions*, which represents “the availability of resources needed to engage in a behavior, such as time, money, or other specialised resources”, while the second is *self-efficacy*, which reflects “an individual’s self-confidence in his or her ability to perform a behavior” (Taylor and Todd 1995b, p. 150).

![Figure 3.3: The Theory of Planned Behaviour. Adopted from Rawstorne (2005).](image-url)
3.4.4 The Technology Acceptance Model

The Theory of Reasoned Action and the Theory of Planned Behaviour are general theories that have been applied to understand and predict a wide range of human behaviours such as voting (Fishbein and Ajzen 1980), family planning (Goodson 2002), dental hygiene behaviour (McCaul et al. 1988; Rise et al. 1998), church attendance (Giles and Cairns 1996), purchase behaviour (Cook et al. 2002), pedestrian road-crossing intention (Evans and Norman 1998), alcohol consumption behaviour (Conner et al. 1999) and seat-belt usage (Budd et al. 1984).

A special adaptation of TRA has been introduced by Davis (1986, 1989) in the form of a Technology Acceptance Model (TAM), illustrated in Figure 3.4, in order to:

Provide an explanation of the determinants of computer acceptance that is general, capable of explaining user behaviour across a broad range of end-user computing technologies and user populations, while at the same time being both parsimonious and theoretically justified (Davis et al. 1989, p. 985).

The model postulates that the actual usage or adoption is predicted by the behavioural intention to use the technology. The intention is determined by the individual’s attitude towards using the technology. Both the attitude and intention are postulated as the main predictors of acceptance. The attitude is presumed to act as a mediator of the relationship between the intention and the two key beliefs of the model: (i) perceived ease of use, which is the individual’s perception concerning the amount of effort required to use the technology, and (ii) perceived usefulness, individual’s perception concerning the degree to which using the technology will improve the overall job performance. The two internal beliefs are posited as the key drivers of acceptance (Davis et al. 1989; Pavlou 2003).

In addition to the indirect effect of the beliefs on the intention through the attitude, TAM posits a direct link between perceived usefulness and intention. The link is theorised to explain the behaviour of some individuals who intend to use the technology because it is useful even though they do not have a positive attitude towards using it.
(Venkatesh 2000). TAM also posits that *perceived usefulness* is influenced by the *perceived ease of use* since, other things being equal, the easier a technology is to use the more useful it will be perceived (Venkatesh 2000). The model also grants a basis for investigating the influence of external factors on its internal beliefs, attitude, and intention.

3.4.4.1 *The main differences between the Technology Acceptance Model and the Theory of Reasoned Action*

Although originally derived from TRA, TAM has considerable differences from its predecessor. For example, the *subjective norm* construct has been dropped from the model as it has not been found to be an influential predictor of the *behavioural intention* to use the technology (Davis et al. 1989). Davis et al. argued that, as the technology that is being investigated has a personal nature of use, it does not rely upon others’ use of the same technology and, therefore, usage is not likely to be driven by the *subjective norms*.

Another distinction is that in TRA a researcher has to identify first a relevant set of beliefs before studying a specific behaviour. As a result, that specific set of beliefs cannot be generalised to other studies or other phenomena of interest. In TAM, however, the internal set of beliefs are postulated a priori and can be used as general determinants of user acceptance of any type of Information Systems and Technology (Davis et al. 1989). In addition, beliefs in TRA have no direct impact on each other,
while TAM posits a direct influential path between its internal beliefs, in that the *perceived usefulness* is swayed by *perceived ease of use*. This proposition is based upon the argument that if a user is presented by two similar systems or technologies, then he or she would find the easier of the two to be more useful (Venkatesh 2000).

TAM postulates that the internal belief of *perceived usefulness* has an indirect influence on the *behavioural intention to use* that is mediated by the *attitude*. This adheres to TRA in that the *attitude* has to always mediate the relationship between all the beliefs and the *intention*. However, TAM runs opposed to TRA by stipulating a direct influential path between the *perceived usefulness* and the *behavioural intention* (Dillon and Morris 1996). The direct relation between *usefulness* and *intention* is based on the idea that people may form intentions to use the technology if they believe it will enhance their job performance regardless of their positive or negative attitudes towards the technology itself (Davis et al. 1989).

### 3.4.4.2 Variations of the Technology Acceptance Model

Several revisions of TAM have been proposed by its initiator and other researchers. For example, Davis et al. (1989) have conducted a longitudinal study and found that the *attitude* has negligibly mediated the impacts of *internal beliefs* on the *intention*. Their new proposition (i.e. TAM 2) excluded the *attitude* construct from the model and creates a direct influential path of the beliefs on the *intention to use*. Another revision was done by Venkatesh and Davis (2000) in an effort to enhance our understanding of technology acceptance and usage behaviour in both voluntary and mandatory environments. As depicted in Figure 3.5, Venkatesh and Davis also eliminated the *attitude* from their new model but they theoretically extended it with a set of social influence processes (*subjective norm, voluntariness, and image*) and cognitive instrumental processes (*job relevance, output quality, result demonstrability, and perceived ease of use*) in order to better expound the variance in *perceived usefulness* and *intention to use*. The model reproposed TRA’s *subjective norm* as a direct determinant of *intention to use*, but it is theorised to be moderated by *experience* and *voluntariness* variables (Venkatesh and Davis 2000).
3.4.5 The Unified Theory of Acceptance and Use of Technology

There were several attempts to develop new propositions of integrated models and unified theories geared towards a superior explanation of acceptance across different systems and technologies. Probably, the most comprehensive study of its kind has been accomplished by Venkatesh and his colleagues in 2003 (King and He 2006). Venkatesh et al. (2003) conducted a longitudinal study, in which they reviewed eight of the most distinguished models in acceptance literature. Their empirical investigation formulated a new model under the name of the Unified Theory of Acceptance and Use of Technology (UTAUT). See Figure 3.6. UTAUT is argued to provide a more powerful theoretical tool to assess the likelihood of technology acceptance mainly in organisational contexts (Venkatesh et al. 2003).

Venkatesh et al. (2003) thorough investigation covered the Diffusion of Innovation Theory by Rogers (1995); the Theory of Reasoned Action by Fishbein and Ajzen
Based on the empirical results of their study, Venkatesh et al. (2003) excluded the attitude construct from UTAUT model and theorised performance expectancy, effort expectancy, social influence, and facilitating conditions constructs as the central determinants of the intention and usage behaviours. The fundamental associations between the model’s internal constructs are moderated by gender, age, experience and voluntariness of use variables. Venkatesh et al. (2003) introduced these moderating variables to reflect “a refined view of how the determinants of intention and behaviour evolve over time”.

UTAUT model hypotheses have been validated across several industries and organisations, and demonstrated a considerable improvement in assessing the likelihood of technology acceptance compared to previous models (Venkatesh et al. 2003).
3.5 The technology acceptance model as the theoretical foundation of the conceptual model of this study

One of the objectives of this study is to identify the influencing factors that impact on an individual’s decision to either accept or reject LBS utilisation for emergency management purposes. Therefore, since the main concern here is to predict a human behaviour and due to the fact that LBS are basically a set of technologies this study applies the Technology Acceptance Model as a special adaptation of the Theory of Reasoned Action to predict LBS acceptance. This technology-specific adaptation of the theory allows this research to exploit the variables of the attitude and intention as the main predictors of LBS acceptance while theorising the internal beliefs of the perceived usefulness and perceived ease of use amongst the key drivers of LBS acceptance (Davis et al. 1989; Davis 1993; Pavlou 2003). Justification for utilising TAM based on its original base theory of TRA are summarised as the following:

1. TAM has dominated much of the technology acceptance research in recent years. In a review of the cumulative literature, the model has been proven to be one of the most admissible and robust theories in predicting the attitude and the behavioural intention towards accepting a new IST (Chen et al. 2002; Benbasat and Barki 2007). Several meta-analysis studies have provided sufficient validation of TAM to be highly credible (Ma and Liu 2004; King and He 2006; Shumaila et al. 2007). TAM has also received substantial empirical support, by means of replication, from numerous researchers (Adams et al. 1992; Davis 1993; Igbaria 1993; Taylor and Todd 1995b; Venkatesh and Morris 2000). Furthermore, several research studies on mobile data services including location-based services have successfully utilised TAM. Some of the examples include mobile internet (Lu et al. 2003a; Lu et al. 2003b; Cheong and Park 2005; Lu et al. 2005a; Pedersen 2005), mobile ticketing (Mallat et al. 2006), general mobile services (Nysveen et al. 2005; Kargin and Basoglu 2006; Lu et al. 2006; Sendecka 2006; Bina et al. 2007; Rao and Troshani 2007), mobile commerce (Yang 2005; Simon et al. 2006; Lee and Jun 2007), multimedia messaging services (Hsu et al. 2007), mobile broadcasting/multicasting services (Hogg et al. 2007), Wireless Application Protocol (WAP) services (Hung et al. 2003), mobile portals (Serenko and Bontis 2004), mobile auctions (Wang and
Barnes 2007), mobile wireless finance (Kleijn et al. 2004), and location-based services (Chang et al. 2006; Kargin and Basoglu 2006; Junglas 2007).

2. The newer variations of TAM and also UTAUT models have omitted the mediating role of the *attitude* between the *perceived usefulness* and the *behavioural intention to use* constructs, and only kept a direct suggested influential path between the *perceived usefulness* and *intention* in order to reflect the performance expectancy impact on users’ behaviour regardless of the individual’s affective reaction towards the phenomena of investigation (Davis et al. 1989). The *attitude* construct was omitted because Davis et al. (1989) found its impact on the *behavioural intention to use* to be minimal. Several other studies such as Thompson et al. (1991) and Taylor and Todd (1995a) also reported similar results. However, Glassberg et al. (2006) argued that these studies focused on the technology use in organisational and work environments, where usage trends are mostly defined in mandatory settings and, consequently, users’ views of the technology of interest were originated from a practical perspective for productivity improvement with the motivation for use being extrinsic and focused on the outcome. In another study by Davis (1993), he clearly emphasised that the external variables of TAM should always operate through the attitude construct since the “attitude towards the behaviour is an affective evaluation of the behaviour” (p. 477). In addition, the attitude-behavioural intention relationship is fundamental to TRA and to its related models such as TAM (Davis et al. 1989). Moreover, despite the fact that Davis et al. (1989) had omitted the *attitude* construct in their study but they admitted, nonetheless, that “more research [was] needed to identify the conditions under which attitudes mediated the belief-intention link” (p. 999). Furthermore, several empirical studies found a significant mediating role of the *attitude*. Some of the examples include Mathieson (1991), Hartwick and Barki (1994), Agarwal and Prasad (1999), Hu et al. (1999), Van der Heijden et al. (2001), Lin and Wu (2002), Van der Heijden (2003), Ahn et al. (2004), Yang and Yoo (2004), and Kurnia et al. (2006). Additionally, the function of the attitude as a significant determinant of the behavioural intention has been well documented in social psychology and TRA research (Ajzen 2002b; Dennis et al. 2004). Accordingly, the retention of the *attitude* construct as one of TAM’s endogenous constructs is expected to help in preserving the theoretical
integrity of the base theory (i.e. TRA) while at the same time enhancing the capability of this research to predict the social acceptance of the location-based emergency service (Davis 1993; Glassberg et al. 2006).

3. Other models of acceptance have not been chosen based upon the recommendations of several researchers. For example, Mathieson (1991) conducted a comparison between TAM and TPB in an empirical study and found that TAM slightly outperformed TPB in predicting the *behavioural intention to use*. Gardner and Amoroso (2004) also found that TAM performed well against other models and theories of acceptance and adoption, even better than its base theory of TRA. However, in a study conducted by Taylor and Todd (1995b), TBP provided a better explanation than TAM for the *behavioural intention to use*, but the researchers stated that measuring TPB constructs was complex and difficult to operationalise due to the fact that TPB requires a pilot study to first identify control variables, referent groups and relevant outcomes for each new setting or investigation, while the constructs of TAM are measured in the same way almost for every context, making it more practical and easier to apply than TPB (Mathieson 1991). Taylor and Todd (1995b) also compared TAM with the decomposed TPB, a variant of the original TBP with eight additional antecedent constructs. Their results indicated that TAM, with its 5 constructs, explained about 34 percent of the variance of usage while the decomposed TPB, with its 13 constructs, explained about 36 percent of the variance. A difference of only 2 percent indicates that TAM is more efficient option to utilise in this theoretical research. Finally, Mathieson (1991) found that TAM explained the *attitude* better than TPB. As a result, Mathieson (1991) has recommended TAM to be the model of choice when the *attitude* is specifically of a particular interest such as the case in this research endeavour.

4. Whilst UTAUT has emerged as a promising theory with a greater ability to explain acceptance (Venkatesh et al. 2003), it has not been successful in mustering empirical support around it. In addition, the significant moderating effects of *age, gender* and *experience* in Venkatesh’s et al. (2003) model have been vitiated by a more recent study by Burton-Jones and Hubona (2006). Moreover, UTAUT excluded the *attitude* construct, making it an inapplicable choice to fulfil the needs of this research.
Based on the aforementioned reasons, utilising TAM as the foundation of the conceptual model of this research is expected to yield a model that is capable of predicting the individual acceptance of the location-based mobile phone emergency service while, at the same time, providing a justifiable theoretical approach for extending and integrating new variables within the nomological structure of the base theory model of TRA.

TAM is an extremely useful theoretical model for predicting why people would use a specific technology or system, but the model has to be adapted with a broader set of constructs that are related to the technical issues or social change processes to increase its predictive power (Legris et al. 2003). Integrating TAM with additional constructs is a highly validated approach that has been exploited before by numerous researchers for studying people acceptance of different technologies, services or systems. An important point should be understood however, is that when a model is extended with a new set of constructs, the constructs have to be operationally consistent with the original constructs of the model (Ajzen and Fishbein 1980; Mathieson et al. 2001; Pavlou 2003). Therefore, as the theoretical utilisation of TAM originates from the fact that it is intended to be employed for technology-based acceptance research (Barnes 2002; Hosbond and Nielsen 2005) and given the distinctive nature of location-based services as technology-based electronic services, then all of the following new theorised constructs are highly relevant to the distinctive characteristics of the services while being at the same level of abstraction as TAM’s original variables, which means that they are all measuring general beliefs and perceptions without specifying technical details of any of the underlying technologies.

Beside the constructs of TAM, the research model integrates a set of constructs that are derived from the Diffusion of Innovation Theory (DOI) literature and the literature of service quality, trust, risk and privacy. However, the actual usage construct of TAM will not be investigated due to the fundamental fact that it cannot be statistically measured since the actual usage rates of location-based mobile phone services in the domain of emergency management are extremely low in Australia. Therefore, the construct will not be addressed or included in the research conceptual model.
3.6 The constructs of the research conceptual model

3.6.1 Visibility

The main contribution of the DOI theory to this study is the integration of its visibility construct in the proposed conceptual model. Visibility is defined here as the extent to which the actual use of the location-based mobile phone emergency service is observed as to its potential user. Following a line of reasoning in former studies by Karahanna et al. (1999) and Kurnia and Chien (2003), the individual perception of the usefulness of the location-based mobile phone emergency service is positively related to the degree to which the service are visible to him or her.

3.6.2 Perceived service quality

It could be posited that the individual perception of how useful the location-based mobile phone service is in emergencies would be highly influenced by the degree to which he or she perceives the service to be accurate, current and responsive. The research conceptual model follows the same rationale as TAM, which postulates the perceived ease of use as a direct determinant of the perceived usefulness. Perceived ease of use is defined as the degree to which the individual believes that using the location-based mobile phone emergency service would be free of physical and mental effort (Davis 1989). It is then justifiable to postulate that the service easiness is related to the technical service quality dimensions of the location-based mobile phone emergency service since the individual’s evaluation of the service easiness is highly associated with the convenient design of the service itself. This is perhaps why the service ease of use has been conceived by several researchers as one of the core dimensions of the 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 model as direct determinants of the perceived usefulness of the location-based mobile phone emergency service.
3.6.3 Perceived risk

As it is practically rational to believe that the individual would perceive different types of risk during an emergency situation, then it might be quite difficult to examine each risk facet as being separate to others since they can be inextricably intertwined. Therefore, following the theoretical reasoning of Pavlou (2003), the *perceived risk* will be investigated as a higher-order unidimensional concept that embraces the two aforementioned types of uncertainty.

A number of former studies have shown that people’s perceptions of inherent risks in the e-service can be a pivotal barrier to the acceptance of the service (Campbell and Goodstein 2001; Featherman and Fuller 2003; 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 environments, people feel more vulnerable to the risks since there are always concerns of 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 here as the individual belief of the potential loss and the adverse consequences of using the location-based mobile phone emergency service and the probability that these consequences may occur if the service is used. Bearing in mind the high uncertainty that is usually associated with emergency situations; this research argues that the *perceptions of risk* would have a highly negative impact on the individual’s perception of the *usefulness* of the location-based mobile phone emergency service.

3.6.4 Trust

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 people’s acceptance of location-based service since both 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 of the two has a different type of interrelationship with uncertainty. While uncertainty augments the risk perceptions of using the location-based mobile phone emergency service trust reduces the individual’s concerns regarding the possible negative consequences of using the service, thus alleviating the uncertainty around the service performance (Morgan and Hunt 1994; Nicolaou and McKnight 2006). Therefore, since the trust in the location-based service can lessen the uncertainty associated with the service, thus reducing the perceptions of risk, this research theorises that the perceived risk is negatively related to an individual trust in the service. This is in line with a large body of empirical research, which supports the influence of trust on the perceptions of risk (Gefen et al. 2003b). In addition, theorising trust as an antecedent of the risk perceptions “harmonises with psychological accounts of how trusting, as a leap of faith, provides a sense of assurance even when outcomes are unclear” (Nicolaou and McKnight 2006, p. 339). Furthermore, by reducing uncertainty, the trust is assumed to create a positive perspective regarding the usefulness of the service and provide expectations of an acceptable level of performance. Accordingly, trust is postulated to positively influence the perceived usefulness of the location-based mobile phone emergency service.

### 3.6.5 Perceived privacy concerns

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

Reductions in the 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, this study investigates the influence of two pertinent privacy concerns on an individual acceptance of the location-based mobile phone emergency service: *collection* and *unauthorised secondary use*.

The adopted working definitions for all the research constructs are summarised in Table 3.1.

Table 3-1: Summary of the theorised factors and their definitions

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description of the adopted working definition</th>
<th>Based upon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude</td>
<td>The individual positive or negative feelings towards using the location-based mobile phone emergency service.</td>
<td>Fishbein and Ajzen (1975)</td>
</tr>
<tr>
<td>Behavioural intention</td>
<td>The individual decision to engage or not to engage in using the location-based mobile phone emergency service.</td>
<td>Fishbein and Ajzen (1975)</td>
</tr>
<tr>
<td>Trust</td>
<td>The belief that allows a potential user of the location-based mobile phone emergency service to willingly become vulnerable to the use-case outcome of the service, having taken the characteristics of the service into consideration, irrespective of the ability to monitor or control the service or the service provider.</td>
<td>Mayer et al. (1995), McKnight and Chervany (2001)</td>
</tr>
<tr>
<td>Perceived risks</td>
<td>The individual belief of the potential loss and the adverse consequences of using the location-based mobile phone emergency service, and the probability that these consequences may occur if the service is used.</td>
<td>Pavlou and Gefen (2004), Heijden et al. (2005)</td>
</tr>
<tr>
<td>Factor</td>
<td>Description of the adopted working definition</td>
<td>Based upon</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------</td>
</tr>
<tr>
<td>Perceived usefulness</td>
<td>The individual perception that using the location-based mobile phone emergency service is useful.</td>
<td>Davis et al. (1989)</td>
</tr>
<tr>
<td>Perceived ease of use</td>
<td>The degree to which the prospective user expects the location-based mobile phone emergency service to be free of effort in terms of usage.</td>
<td>Davis et al. (1989)</td>
</tr>
<tr>
<td>Visibility</td>
<td>The extent to which the actual use of the location-based mobile phone emergency service is observed to its potential user.</td>
<td>Agarwal and Prasad (1997)</td>
</tr>
<tr>
<td>Perceived service quality</td>
<td>The individual global judgment relating to the superiority of the location-based mobile phone emergency service.</td>
<td>Parasuraman et al. (1988)</td>
</tr>
<tr>
<td>Perceived currency</td>
<td>The prospective user perception of receiving up-to-the-minute service information during emergencies.</td>
<td>Zeithaml et al. (2000), Yang et al. (2003)</td>
</tr>
<tr>
<td>Perceived accuracy</td>
<td>The prospective user perception about the conformity of the location-based mobile phone emergency service with its actual attributes of content, location and timing.</td>
<td>Zeithaml et al. (2000), Yang et al. (2003)</td>
</tr>
<tr>
<td>Perceived responsiveness</td>
<td>The prospective user perception of receiving a prompt information service in the case of an emergency.</td>
<td>Parasuraman et al. (1988), Liljander et al. (2002), Yang et al. (2003)</td>
</tr>
<tr>
<td>Perceived privacy concerns</td>
<td>The individual concerns regarding the level of control by others over his or her personal identifiable information.</td>
<td>Stone et al. (1983)</td>
</tr>
<tr>
<td>Collection</td>
<td>The concern that extensive amounts of location information or other personal identifiable data will be collected when using the location-based mobile phone emergency service.</td>
<td>Smith et al. (1996), Junglas and Spitzmuller (2005)</td>
</tr>
<tr>
<td>Unauthorised secondary use</td>
<td>The concern that the location-based mobile phone service information is collected for emergency purposes but will be used for other purposes without an explicit consent from the individual.</td>
<td>Smith et al. (1996), Junglas and Spitzmuller (2005)</td>
</tr>
</tbody>
</table>
3.7 Research hypotheses

To describe the manner in which the above mentioned factors are assumed to influence people’s decisions towards the location-based mobile phone emergency service a set of research hypotheses are posited. Each hypothesis describes a positive or a negative relationship between a dependent construct and an independent construct. Each construct reflects one of the identified issues and all the hypotheses imply prediction or correlation rather than causation. The prediction of an individual acceptance of the location-based mobile phone emergency service is made possible by examining the individual attitude towards using the service and his or her intention to use. The hypotheses are reflected in the conceptual model as arrowed lines that start from the influential construct and end in the dependent construct. The research model, its constructs and the hypotheses are all illustrated in Figure 3.7.

The research hypotheses supplement TAM’s original set (i.e. the first five hypotheses) with another thirteen. All of the new hypotheses are completely consistent with the structural formulation of TAM and do not violate the grounded theory of TRA. That is, all the hypothesised effects of the additional external constructs would only be exhibited on TAM’s internal variables of the attitude and intention through the full mediation of TAM’s internal beliefs; the perceived usefulness and perceived ease of use. Any other arrangement must be considered another model; certainly not TAM.

Stating the research hypotheses is particularly important here since it can provide a design guideline before data collection and data analysis begin. Table 3.2 provides a summary of the research hypotheses.
Figure 3.7: The conceptual model of the location-based mobile phone emergency service acceptance
<table>
<thead>
<tr>
<th>No.</th>
<th>Hypothesis</th>
<th>Relationship Between the Constructs</th>
<th>Direction of Relationship</th>
</tr>
</thead>
</table>
| 1   | Hypothesis 1 (H1) | The intention to use the location-based mobile phone emergency service is positively related with the attitude towards using the service. | +  
  
  Attitude \( \rightarrow \) Intention |
| 2   | Hypothesis 2 (H2) | The intention to use the location-based mobile phone emergency service is positively associated with the perceived usefulness of the service. | +  
  
  Perceived usefulness \( \rightarrow \) Intention |
| 3   | Hypothesis 3 (H3) | The attitude towards using the location-based mobile phone emergency service is positively associated with the perceived usefulness of the service. | +  
  
  Perceived usefulness \( \rightarrow \) Attitude |
| 4   | Hypothesis 4 (H4) | The attitude towards using the location-based mobile phone emergency service is positively associated with the perceived ease of use of the service. | +  
  
  Perceived ease of use \( \rightarrow \) Attitude |
| 5   | Hypothesis 5 (H5) | The perceived ease of use has a positive impact on the perceived usefulness of the location-based mobile phone emergency service. | +  
  
  Perceived ease of use \( \rightarrow \) Perceived usefulness |
| 6   | Hypothesis 6a (H6a) | There is a positive relationship between the perceived responsiveness of the location-based mobile phone emergency service and its perceived usefulness. | +  
  
  Perceived responsiveness \( \rightarrow \) Perceived usefulness |
| 7   | Hypothesis 6b (H6b) | There is a positive relationship between the perceived currency of the location-based mobile phone emergency service and its perceived usefulness. | +  
  
  Perceived currency \( \rightarrow \) Perceived usefulness |
<table>
<thead>
<tr>
<th>No.</th>
<th>Hypothesis</th>
<th>Relationship Between the Constructs</th>
<th>Direction of Relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Hypothesis 6c (H6c)</td>
<td>There is a positive relationship between the perceived accuracy of the location-based mobile phone emergency service and its perceived usefulness.</td>
<td>Perceived accuracy → Perceived usefulness</td>
</tr>
<tr>
<td>9</td>
<td>Hypothesis 7 (H7)</td>
<td>The perceived usefulness of the location-based mobile phone emergency service increases as the visibility of the service application increases in the context of use.</td>
<td>Visibility → Perceived usefulness</td>
</tr>
<tr>
<td>10</td>
<td>Hypothesis 8 (H8)</td>
<td>The risks perceived from using the location-based mobile phone emergency service have a negative influence on the perceived usefulness of the service.</td>
<td>Perceived risk → Perceived usefulness</td>
</tr>
<tr>
<td>11</td>
<td>Hypothesis 9 (H9)</td>
<td>Trust in the location-based mobile phone emergency service positively influences the perceived usefulness of the service.</td>
<td>Trust → Perceived usefulness</td>
</tr>
<tr>
<td>12</td>
<td>Hypothesis 10 (H10)</td>
<td>Trust in the location-based mobile phone emergency service negatively impacts the risks perceived from using the service.</td>
<td>Trust → Perceived risk</td>
</tr>
<tr>
<td>13</td>
<td>Hypothesis 11a (H11a)</td>
<td>Collection as a perceived privacy concern negatively impacts the perceived usefulness of the location-based mobile phone emergency service.</td>
<td>Collection → Perceived usefulness</td>
</tr>
<tr>
<td>14</td>
<td>Hypothesis 11b (H11b)</td>
<td>Unauthorised secondary use as a perceived privacy concern negatively impacts the perceived usefulness of the location-based mobile phone emergency service.</td>
<td>Unauthorised secondary use → Perceived usefulness</td>
</tr>
<tr>
<td>No.</td>
<td>Hypothesis</td>
<td>Relationship Between the Constructs</td>
<td>Direction of Relationship</td>
</tr>
<tr>
<td>-----</td>
<td>-------------------------</td>
<td>-----------------------------------------------------------------------------------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>15</td>
<td>Hypothesis 12a (H12a)</td>
<td>Collection as a perceived privacy concern has a negative impact on the trust in the location-based mobile phone emergency service.</td>
<td>Collection → Trust</td>
</tr>
<tr>
<td>16</td>
<td>Hypothesis 12b (H12b)</td>
<td>Unauthorised secondary use as a perceived privacy concern has a negative impact on the trust in the location-based mobile phone emergency service.</td>
<td>Unauthorised secondary use → Trust</td>
</tr>
<tr>
<td>17</td>
<td>Hypothesis 13a (H13a)</td>
<td>The risks perceived from using the location-based mobile phone emergency service are positively associated with the perceived privacy concern of the collection.</td>
<td>Collection → Perceived risk</td>
</tr>
<tr>
<td>18</td>
<td>Hypothesis 13b (H13b)</td>
<td>The risks perceived from using the location-based mobile phone emergency service are positively associated with the perceived privacy concern of the unauthorised secondary use.</td>
<td>Unauthorised secondary use → Perceived risk</td>
</tr>
</tbody>
</table>
3.8 Overview of Chapter Three

Several issues and matters of possible concern were discussed throughout this chapter. These particularly include those with an expected impact on the opinions of the people towards the potential utilisation of the location-based mobile phone service by the Australian Government for emergency management purposes. These issues included the potential for breaches in privacy, people’s trust in the government as the service controller and provider and in the service as a reliable means for emergency management, risks associated with using the service in emergency situations, the degree to which the functionality of the service is visible to the people and the quality considerations of the service during emergencies.

In order to confirm or refute the influence of these issues on the opinions of the general public and the manner in which they might impact, either positively or negatively, this research proposes measures of acceptability and a set of research hypotheses in a constructed conceptual model, where each measure in the conceptual model reflects one of the identified issues or concerns while each hypothesis predicts a relationship between one measure and another. These measures and hypotheses will be fully tested later in the study through a survey that will target the general public of Australia.

The conceptual model exploits the Theory of Reasoned Action as its theoretical foundation, applied in the form of a Technology Acceptance Model. Doing so, the renowned theories and models of acceptance and adoption in the literature were presented. This particular presentation provides background knowledge that serves to demonstrate the main ideas underpinning the investigation.

The next chapter outlines the structural research design of this study, presenting the common paradigms and classifications of Information Systems and Technology (IST) research through which the nature of this study is defined and classified in order to aid in the best-fit methodological choice for this research endeavour. The following chapter also provides an overview of the research strategy, the data collection methods and the analytical procedures that are employed to help in satisfying the research objectives of this study.
4 Research design, data collection and data analysis techniques

4.1 Introduction

The multi-stage research design of this study is presented in this chapter. An overview is given first to describe the design structure, which is fundamentally based upon the aim and objectives of the study. This is followed by a discussion about the main paradigms in information systems and technology (IST) research to help identify the underlying research paradigms of this study. The common classifications in IST research are then discussed in order to define the nature of this study under these classifications (Orlikowski and Baroudi 1991; Patton 2002; Perry and Rao 2007). A thorough description is then given about the research strategy, and the approach toward a mixed quantitative and qualitative use of methods that will aid in ensuring that the objectives of this study are adequately addressed. Under each approach, details about the employed data collection method and data analysis technique are also provided. Finally, the human research ethics considerations are outlined. These ethical considerations direct how the research endeavour was conducted and define the responsibilities of the researcher of this study at each and every stage during the research process.

4.2 Structure of the research design

The research design can be viewed as a structured set of rational and decision-making choices or guidelines employed for the purpose of generating valid and reliable research results (Cavana et al. 2001). It is a uniformed and focused plan for solving a research problem (Perry 1998). The structure of the research design is illustrated in Figure 4.1.
Different stages in the research design are explained and justified throughout this chapter.

Figure 4.1: The structure of the research design
4.3 Defining research paradigm

The research paradigm refers to a belief system or the underlying philosophical assumptions that determine the research approach and influence the choice of methodologies (Iivari 1991). Methodology refers to the steps, tools and methods that are chosen by the researcher and taken as part of the research design for the purpose of achieving the research goals (Iivari 1991).

The paradigm per se, is the framework that guides the researcher in his or her research endeavour (Guba and Lincoln 1994). In essence, the paradigm is a set of linkage assumptions that frames the researcher’s beliefs about the nature of reality (ontology), how knowledge about that reality is sought (epistemology), and the techniques that are chosen to seek that knowledge (methodology) (Perry and Rao 2007). The paradigm can be expressed implicitly or explicitly within the conducted research but it is in the researcher’s best interest to commit to its framework of assumptions for the sake of generating credible knowledge for others (Cavana et al. 2001). In IST disciplines, these assumptions play a critical role in guiding the design and development processes of the research (Hirschheim and Klein 1989). Iivari (1991) and Iivari et al. (1998) have proposed a framework that embraces the following four main paradigmatic assumptions:

1. **Ontology** refers to the properties or the structure of what is believed to exist.

2. **Epistemology** is concerned with knowledge and how that knowledge can be obtained.

3. **Methodology** is concerned with methods, tools or procedures that are used to acquire knowledge.

4. **Ethics** refers to the set of moral and scientific principles and values that define the researcher’s responsibility for the consequences of his or her research approach and its outcomes.

Traditionally, *positivist, post-positivist, interpretivist* and *critical* are the common paradigms that have usually been adopted in information systems and technology research (Orlikowski and Baroudi 1991; Klein and Myers 2001). Although these
paradigms are distinct, in practice the distinctions are not so clear where the results of one paradigm tend to get mixed or integrated with the results of other paradigms (Myers and Avison 2002; Neuman 2003). Therefore, combining several paradigms is a common practice within information systems and technology research (Klein and Myers 2001; Mingers 2001).

4.3.1 The adopted paradigms in this study

This study was not dominated by a single paradigm. As discussed in the following sections, the post-positivist and the interpretivist paradigms are selected to justify the aim of this study and attain all of its objectives. Nonetheless, a look is taken first into the different paradigms in information systems research in order to provide a justification for the selection.

4.3.2 The positivist paradigm

The advocates of this paradigm argue that positivism forms the basis of the natural and social worlds and assumes that a social reality such as a belief, an attitude or a behaviour is subject to universal laws that can be objectively discovered, measured and described by independent observers through the use of traditional rigorous scientific methods (Buttery and Buttery 1991; Orlikowski and Baroudi 1991). The researcher in this paradigm is an objective outsider and through the use of random sampling can predict the characteristics or behaviours of a given population (Schulze 2003). Therefore, positivist research is usually concerned with identifying formal propositions, testing hypotheses, quantifying measures of variables and deducing inferences about a phenomenon from a representative sample to the stated population (Orlikowski and Baroudi 1991; Klein and Myers 1999). Hence, the positivist paradigm in IST research has traditionally been closely related to the quantitative research methods using statistical modelling, with survey research being the most popular (Cecez-Kecmanovic 2001).
4.3.3 Post-positivism

Some of the underlying assumptions of the positivist paradigm have led IST researchers to question the efforts to force social science methods to conform to natural science expectations (Hirschheim 1992; VanderStoep and Johnston 2009). As a result, the positivist paradigm has been subject to a number of criticisms. For example, several researchers argue that the paradigm is unsuitable for IST research since it does not have an established and intrinsically related body of theory to draw from and often needs to co-opt a theory from a ‘reference discipline’ such as organisational behaviour, management accounting or computer science (Clarke 2000; Tootell 2007). In addition, the paradigm generally lacks the vision to intensely explain social reality since reality is a complex, composite and multi-dimensional phenomenon that is not easily or completely amenable to statistical deduction (Perry et al. 1997).

In response to a growing critique of the positivist paradigm, a post-positivism movement emerged as an answer to the problematic issues of the positivist paradigm (Guba and Lincoln 1994). Onwuegbuzie (2002) even denoted this emergence as the start of more radical paradigms such as interpretivism, constructivism and naturalism.

The post-positivism paradigm provides for many of the aspects of positivism but tries to relax the strict line attributed to the positivist approach (Neuman 2003). Researchers under this paradigm, although still assuming objective reality, postulate it as “approximate” that is apprehended only imperfectly and, therefore, open to several interpretations or explanations (Guba and Lincoln 1994). In the world of post-positivism, a researcher’s perception is neither right nor wrong; it is just different from other perceptions (VanderStoep and Johnston 2009). Post-positivists see themselves as data collection instruments that are inevitably influenced by the values of the researcher and his or her gender, personality, ethnicity, nationality, culture, religion, family and attitude (Onwuegbuzie 2002; VanderStoep and Johnston 2009). Accordingly, even when post-positivists strive for objectivity in relation to the phenomena they are investigating, they believe it is impossible for a researcher to be totally objective in his or her observation of the data (Hatch 2002).
Similar to positivists, post-positivists seek generalisation to explain human behaviour, but they persist on explaining how and why individual differences between humans occur (Schulze 2003). Researchers under this paradigm are usually interested in capturing different participants’ perspectives in rigorously disciplined ways. However, because all measurements are fallible, since each measure introduces its own types of errors, a combination of methodologies in the study of the same phenomenon across multiple measures or observations is usually needed in order to obtain more accurate understanding (Hatch 2002; Onwuegbuzie 2002; Trochim 2006). Post-positivism is a paradigm that stresses objectivity when combining multiple methods that represent multiple perspectives while, at the same time, concedes the probability of bias in the research itself (Guba and Lincoln 1994; Trochim 2006).

Qualitative methods are frequently employed under this paradigm with low inference, and systematic procedures dominate data analysis processes (Hatch 2002). Nonetheless, the post-positivist paradigm tends to put more emphasis on deductive logic in which research is influenced by relevant theory/hypotheses (Onwuegbuzie 2002). Hence, post-positivism is a term that is usually used today to represent practicing quantitative researchers rather than qualitative purists (Phillips and Burbules 2000; Johnson and Onwuegbuzie 2004).

4.3.4 The interpretive paradigm

The interpretive paradigm attempts to understand a phenomenon through examining its context and through understanding the meanings people assign to it (Orlikowski and Baroudi 1991; Klein and Myers 2001). Researchers in the interpretive paradigm assume that reality is socially constructed but it is subjective and based on shared meanings created by experiences (Myers and Avison 2002). Whereas positivists emphasise the similarities between the objects of the social world, interpretivists recognise also the differences between them (Babbie 1998). The researcher in this paradigm is mainly interested in investigating people’s different perspectives and their multiple interpretations of a phenomenon. As a result, this paradigm is highly suitable to
examine a situation where the phenomenon is influencing or influenced by many factors or when several actors are involved (Clarke 2000; Myers and Avison 2002).

The growing interest in interpretivism amongst IST researchers is due to continuous attempts to address complex issues related to the interaction between different information systems and social phenomena such as organisational practices or individual behaviours (Klein and Myers 2001). An interpretivist acknowledges that the problem, which he or she is researching, exists in a social context and that the most appropriate way of understanding it may not necessarily be through numbers and statistical tests (Babbie 1998). This could largely explicate the tendency of the interpretive researcher to rely on qualitative methods instead of quantitative since the former has the ability to achieve greater explanations and reach a better understanding of the social phenomena (Putney et al. 1999).

4.3.5 The critical paradigm

Critical research has the focus towards the uncovering of conflicts and contradictions within the social system (Orlikowski and Baroudi 1991). Information systems research may be categorised as critical if its main objective is seen as being one of social critique, “whereby the restrictive and alienating conditions of the status quo are brought to light” (Klein and Myers 1999, p. 69). The paradigm puts an emphasis on the change and seeks to emancipate people by helping “eliminate the causes of unwarranted alienation and domination and thereby enhancing the opportunities for realising human potential” (Klein and Myers 1999, p. 69). Consequently, this approach to research denies that a researcher can be objective. Walsham (2005) argues that since critical research tends to enquire about what is wrong with the world rather than what is right, then it is the personal motivation which drives the researcher to carry out such enquiry.

Critical theorists generally assume that people can consciously and deliberately act to change their economic and social conditions, but their actions are limited by social, cultural and political domination (Klein and Hirschheim 1993). Accordingly, social reality is historically constituted in a way that it is continuously produced and reproduced by people (Klein and Myers 1999).
Babbie (1998) argues that the critical paradigm recognises the contributions of both positivist and interpretive research since it acknowledges the need for causal theory-based objective observations as well as interpretive descriptions that is based on the inter-subjective understanding of reality.

4.3.6 Justification for the selection of research paradigms for this study

Hirschheim (1992) argued that information systems epistemology draws heavily from the social sciences because information systems are, fundamentally, social rather than technical systems. However, this view, which ignores the technology side of information systems research, is changing as more researchers today recognise that information systems involve also an unavoidable technical component (Parker et al. 1994; Burstein and Gregor 1999). Klein and Myers (1999) elucidated that gaining knowledge about reality can be achieved through exploring the shared meanings about the phenomenon of interest. In the context of this research, understanding the issues surrounding the utilisation of location-based mobile phone services for emergency management can be achieved through exploring the shared meanings the stakeholders of the services assign to the issues, including the technical issues pertaining to this utilisation. Accordingly, it is reasonable to argue that this study is predominantly of an interpretive nature.

While it is possible under the interpretive approach to explore diversity of opinion (Ragin 1989; Klein and Myers 1999), not all answers can be acquired under the interpretive approach alone since the paradigm is mainly of an exploratory inductive nature. In spite of Dreher’s (1994) argument that “interpretive studies have functions that range from exploratory identification of variables to the actual testing of hypotheses” (p. 294), it is strongly argued that a combination of paradigms would serve as the best option to accomplish all the objectives of this study. Accordingly, the post-positivist paradigm is adopted, in addition to the interpretive paradigm, since it is completely justifiable under the post-positivist paradigm to explain people’s acceptance of location-based services by using relevant theories of acceptance, to provide empirical
and logical evidence of the acceptance and to produce results that can be generalised to other contexts as well (Onwuegbuzie 2002; Schulze 2003).

Whereas it is quite reasonable to uncover differences in opinions amongst the stakeholders of location-based services, with regard to some aspects in the services utilisation for emergency management, this study cannot in practice consider itself to be of a critical social nature since it is neither concerned with providing a social critique nor dictating an emphasis on change for any of the uncovered conflicts or disagreements within the phenomenon being investigated.

4.4 Classifications of information systems research

According to Neuman (2007), a research study can be generally classified under one or more of three main different classifications; exploratory, descriptive and explanatory research, based on “what the researcher is trying to accomplish – explore a new topic, describe a social phenomenon or explain why something occur” (p. 15).

4.4.1 Classifications of this research study

As far as this study is concerned it is exploratory and explanatory in nature. An overview is taken into the different classifications in information systems research before justification about the nature of this study is given.

4.4.2 Explanatory research

Explanatory research involves a high level of control so that a theory’s predictions may be tested and explained (Babbie 2001; Neuman 2007). Research of an explanatory nature attempts to extend the theory to new issues or topics, link these issues with a general principle, elaborate the prediction of the theory and provide support or refutation to the prediction (Neuman 2007). The explanatory research attempts to clarify “why” things are the way they are, and “how” a relationship between two aspects of the phenomenon exists (Neuman 2003). Deductive methods of inquiry are predominantly
employed in explanatory research since these are a productive means in theory testing when the theory already exists and data can be collected to confirm or deny it (Neuman 2003). Accordingly, the quantitative research methods are the common methods that are usually employed within this type of research.

4.4.3 Exploratory research

In exploratory research, a study may seek to investigate a relatively new topic or issue(s) in order to reach a better understanding and provide a knowledge base about the issue(s) for further research (Babbie 2001). Neuman (2003) describes exploratory research as one approach that is aimed at formulating more structured knowledge over time with the ability to create precise questions which future research may better address. Usually, the exploratory study addresses the “what” question (e.g. what would be the issues pertaining to LBS utilisation for emergency management?), but the study of an exploratory nature rarely provides conclusive answers to such problems or issues (Neuman 2007). The exploratory research tends to heavily rely on inductive methods of inquiry and the use of the qualitative research approaches rather than wedding to a specific theory or research question (Neuman 2003).

4.4.4 Descriptive research

Descriptive research aims to deliver high details of a phenomenon and to provide a better explanation of its structure as accurately as possible (Babbie 2001). This type of research is usually concerned with the “who” and “how” questions. Studies under this type of research classification generally aim for theory building as opposed to theory testing which incorporates the testing of hypotheses (Neuman 2003).

4.4.5 Justification for the research classification of this study

This research study is of an exploratory nature since the researcher is mainly interested in reaching an understanding of the viability of location-based mobile phone services
within the national emergency management arrangements of Australia, and uncovering
the interrelated potential dynamics between the stakeholders of the services under the
utilisation of the services in the future.

However, due to the need to reach a better explanation of people’s acceptance or
rejection of the utilisation of location-based services for emergency management, this
research study posits itself to have an explanatory dimension as well since it is possible
under the scope of explanatory studies to confirm or refute people’s acceptance or
rejection of the services based on existing theories and models of acceptance.

By classifying the nature of this research as both explanatory and exploratory, the study
is believed to have two intertwined characters that are working in tandem rather than
being polarised opposites.

4.5 Quantitative and qualitative approaches

Besides classifying information systems research as exploratory, descriptive and
explanatory, information systems research is more commonly categorised under
quantitative and qualitative approaches (Neuman 2003; Creswell 2009). These two
research approaches have been referred to in the literature as research “paradigms”, both
having roots in the philosophical thinking of the 20th century (Creswell 2009).

Quantitative research has its origins in the natural sciences but its methods are now
widely accepted in the social sciences including information systems (Myers 1997). As
stated previously, quantitative research methods are traditionally related to the positivist
and post-positivist paradigms, with surveys being the most practised approach of data
gathering in IST research (Myers 1997; Cecez-Kecmanovic 2001).

Qualitative research has originated in the social sciences to enable researchers to study
social and cultural phenomena (Myers 1997). Some of the well-known qualitative
methods include case study research and action research, with interviews,
questionnaires, observation, texts, documents and researcher’s impressions and
reactions as the main data sources (Myers 1997). Qualitative research can be practised
under any research paradigm (e.g. post-positivist or interpretivist), depending on the nature of the study and the kind of information the researcher is seeking to obtain.

Creswell (2009) believes the nature of the research problem is important in defining the criteria for selecting the research approach. The quantitative approach is considered to be suitable when the research problem evolves from an existing body of literature on which a study can built upon, when variables are known and when relevant theories can be tested and verified (Creswell 2009). Alternatively, the qualitative approach is more suited to exploratory research when only a small body of knowledge exists on the topic of interest, when variables are largely unknown, when there is inadequate or simply a missing theory base and when the researcher’s focus is in the context that shapes the understanding of the phenomenon being investigated (Creswell 2009).

4.6 The design strategy of this research

In this research, there is a clear need to combine both the quantitative and qualitative approaches since the combination provides the ability to satisfy all the research objectives (Creswell et al. 2007; Hewson 2008). One way to combine approaches is by mixing the use of the quantitative and qualitative methods. Creswell (2009) classified six designs, of what he also referred to as strategies or models, to mix the use of the quantitative and qualitative methods. These strategies are categorised under two main groups: sequential designs and concurrent designs (Figures 4.2 and 4.3). The strategies differ in several terms and aspects:

1. Choices made concerning their implementation (i.e. whether data are collected concurrently or sequentially);

2. Priority (i.e. whether the qualitative or quantitative approach is given priority); and

3. Integration (i.e. the stage in the research process at which qualitative and quantitative data are integrated (Hewson 2008; Creswell 2009).

Amongst these strategies, the concurrent embedded strategy, as illustrated in Figure 4.3.2, is believed to be the most suited design for this study. The concurrent embedded
strategy is identified by the use of a single data collection phase, during which both the quantitative and qualitative data sets are collected simultaneously (Creswell 2009). The concurrent embedded strategy should provide this research with the advantages of both the quantitative and qualitative approaches to address all of the study objectives, which can only be accomplished by combining the strengths of the quantitative research as the secondary research approach (e.g. surveys with large sample sizes and generalisability) with the strengths of the qualitative research (e.g. contextual details and in-depth description through the semi-structured interviews) (Patton 2002; Clark et al. 2008). The quantitative and qualitative data sets in this study are resided side-by-side in order to provide an overall compound assessment or understanding of the research problem (Creswell 2009).

There are a number of challenges associated with this type of design. For instance, the researcher should have a clear reason for the use of the secondary method and sufficient support for how the supplementary data is used within the larger study (Clark et al. 2008). In addition, the strategy requires a considerable amount of effort to adequately study the topic of interest through the use of separate methods (Clark et al. 2008). Furthermore, given the methods might be treated unequal in their priority, the approach may result in unequal evidence which could be regarded by some researchers as a disadvantage when interpreting the research outcomes (Creswell 2009). Thus, it must be clarified here, that the quantitative data is mainly used to examine the social acceptance or rejection of the location-based mobile phone emergency service, and also to explain the determinants of this acceptance or rejection, addressing part of the objectives of this study which cannot be satisfied by a sole qualitative approach. The findings of the quantitative approach used in this study are employed to supplement the findings of the qualitative approach which are all concerned in the identification of the issues pertaining to location-based emergency services, including understanding the social acceptance or rejection of the service towards assessing the viability of the service within the national emergency management arrangements of Australia. In addition, although some priority is given to the qualitative approach over the quantitative approach, the inequality does not in any way affect the validity of the research outcomes since the output of each research method has undergone rigorous procedures to validate the accuracy of the obtained data and test the reliability of the achieved results.
Figure 4.2: Sequential Designs. Adopted from Creswell (2009).

Figure 4.3: Concurrent Designs. Adopted from Creswell (2009).
4.7 Data collection methods

The decision for selecting a specific data collection method in this study is mainly driven by the nature of this research and embraces Patton’s (2002) pragmatic approach that seeks appropriateness of the method as the primary criterion of its selection. Such selection is built upon the fit of the method to the purpose of this study, the research objective the method it is trying to provide data for, and the availability of the resources for carrying out that method (Todd 1979; Sekaran 1992; Patton 2002).

Under the post-positivist paradigm a survey as the predominantly quantitative research method is employed. Surveys are feasible to the researcher and an effective way to reach and target the population of interest (i.e. the prospective users of the location-based mobile phone emergency service from the general public of Australia) (Biemer and Lyberg 2003). By surveying the public, this study endeavours to predict the social acceptance or rejection of the service and also to confirm or refute the impact of the theorised research constructs, described in the previous Chapter.

Under the interpretive paradigm in-depth semi-structured interviews are the main qualitative research method, in addition to the open-ended qualitative question in the survey. These methods are utilised to understand the meanings the stakeholders of the location-based mobile phone service assign to the service in relation to its application and potential utilisation for emergency management purposes in Australia. These methods help to explore the perspectives of the stakeholders regarding the matters of concern and potential impediments to the nationwide utilisation of the service. The interviews also help to shed light in understanding the anticipated role of each party involved in the utilisation and the expected mutual relationships between these parties in the location-based mobile phone emergency service chain of activities.

Table 4.1 provides a description of the setting of this research study, including the research approaches, objectives, research timing, data collection and communication methods and data analysis techniques used to obtain the results.
Table 4-1: The settings of this research endeavour

<table>
<thead>
<tr>
<th>Research approach</th>
<th>Objectives of the research approach</th>
<th>Research timing</th>
<th>Data collection method</th>
<th>Communication method</th>
<th>Data analysis technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantitative</td>
<td>1. Examine the Australian individual attitude towards using the location-based mobile phone emergency service and his or her behavioural intention to use the service in case of an emergency. 2. Examine the social acceptance or rejection of the service. 3. Identify the determinants of the social acceptance or rejection.</td>
<td>1- Pilot survey: Conducted in November 2008. 2- Survey: Conducted between March 1, 2009 - April 28, 2009.</td>
<td>1. Survey.</td>
<td>1. Traditional mail survey. 2. Face-to-face surveys.</td>
<td>1. SPSS v.15 statistical package (IBM Corporation 2010). 2. SmartPLS v.2.0 M3 software (Ringle et al. 2005).</td>
</tr>
<tr>
<td>Qualitative</td>
<td>1. Investigate the issues related to the potential nationwide utilisation of location-based services, as articulated by the stakeholders of the service. 2. Identify the barriers to the nationwide utilisation of the location-based service and offer recommendations towards setting realistic objectives and expectations for the service in Australia. 3. Understand the roles, accountability and responsibilities of the main parties involved in the utilisation of the service and the mutual relationships between these parties in the service chain of activities during emergencies and disasters.</td>
<td>November 25, 2008 – October 22, 2009.</td>
<td>1. Semi-Structured interviews. 2. Open-ended question in the survey.</td>
<td>1. Face-to-face interviewing. 2. Telephony interviewing.</td>
<td>1. A non-automated content analysis technique based on Miles and Huberman’s (1994) interactive model of qualitative data analysis. 2. Leximancer v.2.25 tool (Leximancer Company 2010).</td>
</tr>
</tbody>
</table>
4.8 The survey of this study

4.8.1 Survey preparation

The survey was prepared based on the objectives of this research. The survey went through several steps of refinement before it was released to the general public. Challenging issues, such as wording, the sequencing of questions and response time had to be considered first. Principles of good design approach advocated by Cavana et al. (2001) were adopted to minimise measurement errors as much as possible. The principles or guidelines are related to the content, wording and structure of the statements and can be summarised as follows:

1. Every statement was designed with brief content germane to the question of what data was collected for, avoiding at the same time the double-barrelled or compounded questions as much as possible.

2. Good care was taken to ensure that each word in the statement had only one meaning. No double negatives and no leading or biased words or phrases were used. Abbreviations or incomplete sentences were avoided when possible.

3. Attention was taken to ensure that each statement had a clear structure. Accordingly, only two types of structured questions were used in the whole survey: a five-point Likert rating scale and a three-choice ranking scale.

4. To minimise the measurement errors in the design, the instrument was pre-tested via a pilot study and adjusted accordingly.

The survey can be found in Appendix II.

4.8.2 The cover letter and introduction of the survey

At the beginning of the survey, a cover letter is presented explaining the purpose of the study. The letter emphasises the confidentiality of the obtained information and the privacy of the participants of the survey. Details about the researcher, the researcher’s
supervisors and his university were also included. In addition, an indication about the ethics approval by the Human Research Ethics Committee, at the University of Wollongong, was stated in the cover letter.

Following the cover letter, a simple informative introduction is presented to the survey participants in order to give the reader a principal understanding about location-based services and their various applications, including their possible application in the domain of emergency management. The cover letter and the introduction can be found in Appendix II, section A.

4.8.3 The focused vignettes of the survey

As one of the main goals of this research endeavour was to explore the social acceptance of the location-based mobile phone emergency service, utilising scenarios as part of the survey was considered highly suitable in exploration and discovery. Indeed, Martin (2004) and Presser et al. (2004) stated that the use of scenarios in the survey is specifically appropriate when there is a need to:

1. Explore how people think about a conceptual domain;

2. Test whether respondents’ interpretations of concepts are consistent with those that are intended; and

3. Analyse the dimensionality of the survey concepts.

The use of scenarios in the survey of this study is expected to be very useful, especially when the general understanding of the location-based service utilisation for emergency management is still relatively limited (Benbasat et al. 1987), or when the interrelated dynamics between the public, as the main stakeholder of the service, and other stakeholders, including government emergency agencies and the telecommunications carriers, could be a major determinant in the success of the service national utilisation (Bunn et al. 2002; Michael and Tootell 2005).

Scenarios have been long used by scholars to study attitudes, beliefs and perceptions (Finch 1987; Wilks 2004). Their use as a methodological tool involves the construction
of a descriptive sketch about a specific topic and then presenting it to the survey participants (Schoenberg and Ravdal 2000). A scenario is delineated as “a focused description of a series of [life] events…that normally is limited to a brief time span, to one or a few key actors, to a bounded space, or to all three” (Miles and Huberman 1994, p. 81). The main objective of using scenarios in this research is to help the survey participants to frame and enhance their understanding of the phenomenon being investigated (Carroll 2000; Munoz et al. 2003). Usually, scenarios do not contain technical details, such as how the wireless mobile networks enable different LBS functionalities (Carroll 2000). Rather, scenarios contain short descriptions of specific situations with reference to what is thought to influence a respondent’s possible reaction to those situations (Alexander and Becker 1978).

Scenarios can be expressed as specific vignettes that capture facets of how LBS might fit into different emergency management activities (Munoz et al. 2003). Vignettes are “brief stories that describe hypothetical characters or situations to which a respondent is asked to react” (Martin 2004, p. 2). The written word is the most common form of the vignette, although it can be presented in a variety of other forms, such as video, pictures, or cartoon animations (Wilks 2004).

Because the scenarios depict hypothetical situations that are beyond the idiosyncrasies of the respondent’s actual life, they offer a less personally threatening way to stimulate judgments and explore sensitive issues like emergencies (Finch 1987; Schoenberg and Ravdal 2000). Through the use of vignettes, participants are encouraged to project how they think individuals in general would react in a given situation when the location-based service is utilised in emergency situations. With such an indirect form of questioning, respondents are expected to provide their real responses since they would not perceive that they are personally or directly evinced in the given situation (Fisher 1993; Parboteeah 2005). Through the use of vignettes, the survey participants are encouraged to project their true perceptions about LBS while, at the same time, involve them in creating a meaning related to the use of the service in emergency situations (Schoenberg and Ravdal 2000). This is very important to establish amongst the participants before starting to obtain informed responses from them, especially when the utilisation of the location-based services in the realm of emergency management is still in its nascent stages worldwide. By using vignettes to create a knowledgeable meaning
about LBS amongst large numbers of participants, the approach provides the efficiency of the quantitative approach with a wealth of information that is closer to qualitative research (Finch 1987).

However, similar to any other research method, vignettes have shortcomings as well. For example, the use of the hypothetical situation might be criticised for not being realistic. Nonetheless, the merits of the vignette as a valid research method have been well documented in the literature (Finch 1987; Martin 2004; Morrison et al. 2004; Presser et al. 2004). Furthermore, their use can maximise precision by allowing the researcher to operationalise some of the research constructs; something that may not be achievable or possible under the available circumstances (Parboteeah 2005).

The vignettes in the survey of this study cover specific topics related to emergencies such as an impending natural disaster, an extreme weather condition, a situation where a person is particularly in need of urgent medical assistance and a national security issue. In total, four vignettes were designed for the survey. Two of them are formed to present LBS in a favourable light, while the other two vignettes were created to draw out the potential pitfalls of the services and their underlying technologies. See Appendix II, Section C. Given the vignettes in the survey depict different emergency situations in which LBS solutions could be possibly utilised, the vignettes represent a main source of knowledge to understand the issues and options generally related to location-based mobile phone utilisation. Accordingly, each participant is provided with all four vignettes, representing the potential positive effects and the potential negative effects of the use of the service in emergencies.

Exposing a participant to only one side of the effects might have the potential to skew his or her responses in a way that could undermine the validity of the survey results. Therefore, presenting all the vignettes to all the participants is expected to prevent the unfair prompting of a certain way of thinking and help to achieve higher objectivity in the study by controlling the undue influence and avoiding inherent bias in the survey questions.
4.8.4 The questionnaire of the survey

A self-administrated questionnaire is used to collect the data from the participants. The first question in the questionnaire helps the researcher to gain a basic understanding of the LBS usage trends amongst the surveyed population. In particular, what types of location-based services are used most amongst the respondents? See Appendix II, Section B.

Following the general question, respondents are introduced to the vignettes of the survey. For the scenarios of these vignettes, see Appendix II, Section C.

The participants are then presented with the three information control mechanisms and are asked to rank in order, from the most effective to the least effective, of the ability of these mechanisms to assure the locational privacy and grant the individual with control over his or her personal location information under the utilisation of the location-based mobile phone emergency service. The three mechanisms, found in Appendix II, Section D, reflect the assurance of control mechanisms discussed earlier in Section 3.2.5.1.

The next section of the questionnaire comprises separate sets of statements; each set reflects one of the constructs of the research conceptual model. The statements form the main body of data for the quantitative analysis. The sets are found in Appendix II, Section E.

The participants of the survey are then asked to rank how important it is to utilise the location-based mobile phone warning system by the government in 16 different emergency event types (i.e. government to citizen offerings of the location-based emergency service). For each emergency type, the participants are asked to rank from “not really important” to “extremely important” for the government to provide the people with a warning notification to their mobile handsets in the case of an event of that particular type of emergency. The 16 emergency event types are divided into two separate sets and categorised as human-caused and nature-caused. The types were congregated based on the Disasters Database that is provided to the public by EMA (Emergency Management Australia 2008). An adequate consideration was taken to include only the known or frequent types of emergencies or hazards in Australia.
Mentioning hazards like volcanoes, for example, would not be adequate since there are no occurrences of volcanic activities in Australia’s written history.

A third complementary set of emergency event types is also presented to the participants of the survey, but this particular set reflects the typical LBS offerings in personal/private emergency situations where a person invokes the service for him/herself or for an important other(s) when he or she or the important other(s) is in desperate need of immediate help and that help can be provided based on the current location information of the mobile handset of the needy. For the complete list of the emergency event types see Appendix II, Section F.

An important point that should be discussed here is that although it is reasonable to argue that any location-based mobile phone emergency solution should be flexible enough to allow support for all current and future types of emergencies and not to be designed to support specific types of emergencies requiring notification (The 3rd Generation Partnership Project 2008; The Victorian Department of Treasury and Finance 2009), the reality is different. One of the main issues that may arise from such a design is that providing warning notifications for all types of emergencies including minor events (i.e. high-probability events but with low-consequences) have the potential to dilute responses to warnings (Mileti and Sorensen 1990). A case in point is the example of several commercial public alerting projects in the United States where individuals started to opt out as a consequence of being continuously bombarded by minor notifications (Kidd et al. 2008; Martin 2008). Therefore, a need arises to investigate how the general public of Australia would rank the importance of utilising the location-based mobile phone service in various emergency event types, which might help the government and the designers of current and future solutions to narrow down their selections of the emergency types to only those with extremely high significance to people. Nevertheless, some could reasonably argue that one particular emergency event type, which is significant to some people, might mean nothing to others and therefore it is improper to rank different types of emergencies according to their importance (e.g. a tsunami for the people who live near the shoreline versus the people who live in an inland province). Still, the rankings would give a focus and a better acknowledgment of the emergency types that truly represent major concerns to the public in general and, at the same time, would offer an objective and validated criterion that could be considered
in the design of the solution to elicit the desired level of public response to the potential warning notifications (Kidd et al. 2008).

Following the ranking list of the emergency event types, the respondents of the survey are asked to answer a set of demographic and socio-economic questions. See Appendix II, Section G. The analysis of the demographic questions is foreseen to provide this study with a general descriptive profile and summaries about the sample population.

### 4.8.5 Development of the measurement scales for the survey questionnaire

A five-point Likert rating scale is used throughout the questionnaire. The selection of the Likert scale is made due to the fact that it is the most relevant for measuring attitudinal patterns or exploring theories of attitudes (Oppenheim 1992). According to Lissitz and Green (1975), reliability of the scale increases with the increments of the number of choices up to five in a scale, but levels off beyond. Therefore, the selection of the five-point scale was made after considering the need to reduce the response burden on the survey participants while obtaining comparable scores to other higher scale formats, such as the seven-point or the ten-point scales (Dawes 2008).

The Likert scale is an interval rating scale, showing responses that vary from a strong affirmation to a strong refutation with a mid-point indicating a neutral response. Each response on the scale is considered equal in attitude or value loading to the others. For each of the survey statements, the participants are asked to rate from “Strongly disagree” to “Strongly agree”. The rating scale is repeated with every statement to ensure easy referencing. One concern, however, is the participant’s possible tendency to use one of the two ends of the rating scale for all of the answers he or she is giving. When the researcher ends with such a case, the reply is simply discarded from further analysis.

To increase construct measurement reliability, most of the items in this study, which have been tested and validated in former studies, are adapted to reflect the specific context of this research (i.e. the utilisation of the location-based mobile phone service
for emergency management). 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, the *perceived usefulness* and *perceived ease of use*, are adapted based on the original scales of Davis (1989). The *attitude* measurement items are adopted from two studies by Agarwal and Prasad (1999) and Van der Heijden et al. (2001). The *intention to use* items are measured using scales adopted from Junglas and Spitzmuller (2005). The *Trust* measurements are adopted from Mayer et al. (1995) and Junglas and Spitzmuller (2005). Pavlou and Gefen (2004) *perceived risk* items are adopted to the benefit of this research. The items of the *visibility* construct are adopted from a study by Karahanna et al. (1999). The items of the *perceived privacy concerns* are adopted from Smith et al. (1996) and Junglas and Spitzmuller (2005). The statements of the *perceived service quality features* were not directly available but have been operationalised 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. Table 4.3 summarises the constructs of this research, the respective items of each construct and the statement of each item.

Table 4-2: The research constructs and their items

<table>
<thead>
<tr>
<th>No.</th>
<th>Construct name</th>
<th>Item No.</th>
<th>Item code</th>
<th>Statement</th>
<th>Adapted from</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Attitude</td>
<td>1</td>
<td>ATT1</td>
<td>I like the idea of using location-based services for hazardous and emergency situations.</td>
<td>Agarwal and Prasad (1999), Van der Heijden et al. (2001)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>ATT2</td>
<td>I consider using location-based services for emergencies a good idea.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>ATT3</td>
<td>In general, the idea of using location-based services for emergency management might be beneficial to my family and me.</td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>Construct name</td>
<td>Item No.</td>
<td>Item code</td>
<td>Statement</td>
<td>Adapted from</td>
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<td>--------------------------------------------------------------------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>2</td>
<td>Intention</td>
<td>1</td>
<td>INT1</td>
<td>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.</td>
<td>Johnny and Spitzmuller (2005)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>INT2</td>
<td>If my mobile phone company offers me free location-based services I will make use of the offer.</td>
<td>Johnny and Spitzmuller (2005)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>INT3</td>
<td>If LBS-enabled mobile phones become available I intend to buy one within the next three months.</td>
<td>Johnny and Spitzmuller (2005)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>INT4</td>
<td>If location-based services are widely used by my friends, I will start using them within the next three months.</td>
<td>Johnny and Spitzmuller (2005)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>INT5</td>
<td>In general, if the government offer location-based services for emergency management I intend to make use of the services.</td>
<td>Johnny and Spitzmuller (2005)</td>
</tr>
<tr>
<td>3</td>
<td>Trust</td>
<td>1</td>
<td>TRUST1</td>
<td>I trust the government use of LBS for managing hazardous and emergency situations.</td>
<td>Mayer et al. (1995), Junglas and Spitzmuller (2005)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>TRUST2</td>
<td>I think location-based services are trusted applications that can deliver warning notifications during emergencies.</td>
<td>Mayer et al. (1995), Junglas and Spitzmuller (2005)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>TRUST3</td>
<td>In my opinion, location-based services are mature mobile phone services that can be trusted for emergency management.</td>
<td>Mayer et al. (1995), Junglas and Spitzmuller (2005)</td>
</tr>
<tr>
<td>4</td>
<td>Perceived risk</td>
<td>1</td>
<td>PRSK1</td>
<td>There is a considerable risk involved in using location-based services for emergencies.</td>
<td>Pavlou and Gefen (2004)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>PRSK2</td>
<td>My decision to use location-based services for managing emergencies would be risky.</td>
<td>Pavlou and Gefen (2004)</td>
</tr>
<tr>
<td>No.</td>
<td>Construct name</td>
<td>Item No.</td>
<td>Item code</td>
<td>Statement</td>
<td>Adapted from</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>PRSK3</td>
<td>There is too much uncertainty associated with using location-based services for managing hazardous and emergency situations.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Perceived usefulness</td>
<td>1</td>
<td>PU1</td>
<td>The government use of location-based services for emergency management can save lives.</td>
<td>Davis (1989)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>PU2</td>
<td>Using location-based services in emergencies would be invaluable.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>PU3</td>
<td>Using location-based services for managing emergencies can guarantee my safety and well-being.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>PU4</td>
<td>Overall, I find location-based services to be useful for hazardous and emergency situations.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Perceived ease of use</td>
<td>1</td>
<td>PEOU1</td>
<td>Learning how to use location-based services would be easy for me.</td>
<td>Davis (1989)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>PEOU2</td>
<td>I think my interaction with location-based services would be clear and understandable when they are used for emergencies.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>PEOU3</td>
<td>I would find it easy to get location-based services to do what I want them to do.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>PEOU4</td>
<td>In general, I think I would find location-based services easy to use.</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Visibility</td>
<td>1</td>
<td>VIS1</td>
<td>At my work, school or amongst my friends, I can see location-based services being used.</td>
<td>Karahanna et al. (1999)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>VIS2</td>
<td>I have seen others using location-based services on their mobile phones.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>VIS3</td>
<td>It is easy for me to foresee others using location services in public.</td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>Construct name</td>
<td>Item No.</td>
<td>Item code</td>
<td>Statement</td>
<td>Adapted from</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>VIS4</td>
<td>I have seen location-based services being used before.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Perceived currency</td>
<td>1</td>
<td>PCUR1</td>
<td>I would expect the message content delivered to my phone to have up-to-the-minute information during hazardous or emergency situations.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>PCUR2</td>
<td>I would be concerned if the information provided to me was not up-to-date during emergencies.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>PCUR3</td>
<td>I think location-based services should always have the latest information in order to be reliable.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Perceived accuracy</td>
<td>1</td>
<td>PACC1</td>
<td>I would expect the message of the location-based service delivered to me to be always accurate when being used for emergencies.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>PACC2</td>
<td>I do mind if there are some errors in location information provided to me.</td>
<td>Not available but have been operationalised based on the recommendations of Churchill (1979)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>PACC3</td>
<td>I would find it unacceptable to receive inaccurate information when using location services during an emergency.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>PACC4</td>
<td>Overall, location-based services are reliable to be used for emergency management only when they are accurate.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Perceived responsiveness</td>
<td>1</td>
<td>PRES1</td>
<td>I would expect location-based services to be timely when being used for emergencies.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>PRES2</td>
<td>If I used location-based services, I would always expect a prompt response during hazardous situations.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>PRES3</td>
<td>I do mind if there is a delay in response to a location service query I have made during an emergency situation.</td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>Construct name</td>
<td>Item No.</td>
<td>Item code</td>
<td>Statement</td>
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<td>----------------------------------------------------</td>
</tr>
<tr>
<td>11</td>
<td>Collection</td>
<td>1</td>
<td>PPCOL1</td>
<td>Overall, location-based services should offer safety information in a timely manner when they are used for emergency management.</td>
<td>Smith et al. (1996), Junglas and Spitzmuller (2005)</td>
</tr>
<tr>
<td>11</td>
<td>Collection</td>
<td>2</td>
<td>PPCOL2</td>
<td>It would bother me if my location information is always collected by the location-based service provider during emergencies.</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Collection</td>
<td>3</td>
<td>PPCOL3</td>
<td>It would bother me if my location information is always collected by the location-based service provider during emergencies.</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Collection</td>
<td>4</td>
<td>PPCOL4</td>
<td>It would bother me if my location information is always collected by the location-based service provider during emergencies.</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Unauthorised secondary use</td>
<td>1</td>
<td>PPUSU1</td>
<td>I am not comfortable with the idea that the service provider will collect too much location data about me during emergency situations.</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Unauthorised secondary use</td>
<td>2</td>
<td>PPUSU2</td>
<td>I am not comfortable with the idea that the service provider will collect too much location data about me during emergency situations.</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Unauthorised secondary use</td>
<td>3</td>
<td>PPUSU3</td>
<td>I am not comfortable with the idea that the service provider will collect too much location data about me during emergency situations.</td>
<td></td>
</tr>
</tbody>
</table>

4.8.6 The open-ended question of the survey

The survey, which is designed in predominantly for quantitative analysis, also includes an open-ended question in order to solicit responses from the participants about the
utilisation of the location-based mobile phone service for emergency management in Australia. See Appendix II, Section H. The primary goal of the open-ended question technique was to identify and understand the issues pertaining to the utilisation as being perceived by the general public. The technique is an adequate approach of investigation when there is a need to start with broader exploration of a little-known phenomenon (Marshall and Rossman 1999), such as the topic this study is endeavouring to investigate. The comments included broad personal opinions, remarks, concerns and real life experiences that participants were willing to share.

4.8.7 The communication method of the survey

The survey can be communicated and collected in a number of ways, including face-to-face, traditional mail, mail panels, telephone, email and web (de Vaus 2002; Malhotra and Birks 2003; Churchill and Iacobucci 2004). According to Malhotra and Birks (2003), none of the survey methods can be regarded superior in all research situations, nor it can be claimed to be the best on all criteria. Therefore, the selection of the survey method should be justified upon several considerations that include the goals of the survey, the characteristics of the participants and resources constraints, such as cost and time (Malhotra and Birks 2003). Other considerations should also be taken into account. Table 4.2, provides an overview of these considerations.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Traditional mail</th>
<th>Telephone</th>
<th>Mail panels</th>
<th>E-mail</th>
<th>Web</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexibility of data collection</td>
<td>Low</td>
<td>Moderate to high</td>
<td>Low</td>
<td>Low</td>
<td>Moderate to high</td>
</tr>
<tr>
<td>Diversity of questions</td>
<td>Moderate</td>
<td>Low</td>
<td>Moderate</td>
<td>Moderate to high</td>
<td>Moderate to high</td>
</tr>
<tr>
<td>Use of physical stimuli</td>
<td>Moderate</td>
<td>Low</td>
<td>Moderate</td>
<td>Low</td>
<td>Moderate</td>
</tr>
<tr>
<td>Sample control</td>
<td>Low</td>
<td>Moderate to high</td>
<td>Moderate to high</td>
<td>Low</td>
<td>Low to moderate</td>
</tr>
</tbody>
</table>
After careful consideration, the traditional mail survey method was eventually favoured as the communication mode for this study. This is despite some of the issues that are generally associated with this approach; mainly the low response rate, which is an issue several researchers have noted before (Yu and Cooper 1983; Galpin 1987; Fowler 2001; Forza 2002; Zikmund and Babin 2007). In addition, from a research design perspective, the mail survey method requires substantial physical effort to collate, pack and deliver the survey, and also considerable time waiting for the replies to return, ultimately affecting the speed of the data collection. Nonetheless, the selection of the traditional mail survey was made upon two strong reasons:
1. According to Zikmund and Babin (2007), the mail survey method is the most resilient mode to the social desirability effects, compared to any other survey administration method. The social desirability is a tendency for respondents to reply in a way they think it is more socially appropriate, rather than giving their honest opinions, which could add serious bias to the survey responses (Cook and Campbell 1979; de Vaus 2002). By using the survey in this research, the researcher would rely entirely on the honesty and the accuracy of the participants’ responses to assess part of the objectives of this study (Marshall and Rossman 1999). Therefore, it was of an extreme importance to this research study to avoid the social desirability effects as much as possible.

2. The traditional mail approach is generally associated with high perceptions of anonymity with respondents, something that may not be completely assured or guaranteed by other methods of data collection since these methods tend to disclose some fractions of personal information, such as the telephone number, email address or IP address, which may cause possible infringements in privacy (Forza 2002; Michaelidou and Dibb 2006; Zikmund and Babin 2007).

4.8.8 The quantitative analysis techniques of the survey

For the purpose of generating descriptive statistics and summaries about the surveyed population, the well-known SPSS v.15 (IBM Corporation 2010) statistical package was used. The package was also employed to obtain the Friedman Test results for different ranking categories and Pearson’s Chi-square Test results for comparisons of frequencies for testing associations between the demographic characteristics of the survey respondent and various emergency event types. The Friedman Test is a non-parametric test alternative to the one-way repeated measures analysis of variance for multiple related samples from the same population used to assess whether or not there are differences amongst the mean ranks of the category ratings. Pearson’s Chi-square Test is used to explore the relationship between two categorical variables, each can have two or more categories (Pallant 2005). SPSS was also used to generate Cronbach’s alpha coefficients needed to assess the reliability of the measurements in the pilot survey.
A critical issue involved in testing the research model is the use of appropriate modelling and statistical methods to analyse its quantitative data (Barclay et al. 1995). Accordingly, a special consideration was taken to utilise the technique that could handle the complexity of the research model while, at the same time, provide the study with all the analytical interpretations that are usually reported in similar studies in the literature. The Structural Equation Modelling (SEM) technique, specifically, the Partial Least Squares (PLS) method, using SmartPLS 2.0 M3 software (Ringle et al. 2005), was chosen to test the components of the research model and its hypotheses. PLS is a second-generation multivariate analysis approach that is widely used in information systems and technology research (Barclay et al. 1995; Gefen and Straub 2005; Petter et al. 2007). Unlike the conventional multiple regression analysis, PLS is argued to suite the models that contain many variables as it has the ability to simultaneously perform factor analysis and hypotheses tests in the same analysis to the entire constructs of the model, presenting PLS as an appropriate choice to handle complex structural models (Fornell and Bookstein 1982; Garthwaite 1994; Gefen et al. 2000). PLS also has minimal demand on data distribution and sample size (Wold 1987; Barclay et al. 1995; Chin 1998a). In addition, PLS has been recommended when the study includes model testing and when the research is of an exploratory or predictive nature (Fornell and Bookstein 1982; Chin 1998b; Gefen et al. 2000).

Accordingly, given the complexity of this research conceptual model and the nature of this study, where the relationships between the theorised constructs and LBS acceptance in the realm of emergencies have been scantily examined before, PLS is presented as the most suitable technique for testing the study’s conceptual model and the research hypotheses.

4.8.9 The validation processes of the survey

Validating and testing the survey are quite essential processes in empirical research (Straub 1989). A step-by-step approach has been taken to ensure the validity and reliability of the survey based mainly on the recommendations of Straub (1989) and Moore and Benbasat (1991). The following sections describe the steps taken in this investigation.
4.8.9.1 Survey testing via face validity

Face validity was conducted to show whether or not the instrument would measure the constructs which it is supposed to measure, and whether or not it uses the appropriate language at the appropriate level (McCroskey 1992; Fink 2002). According to Sekaran (1992), face validity can be regarded as a primary index of content validity. People who have adequate experience in IST research can be solicited to advise on whether the scale items have face validity or not (Straub et al. 2005). Therefore, the content of the instrument was pretested by two IST academics for suggestions, comments and recommendations. It was then given to a panel of post-graduate students from the School of Information Systems and Technology (SISAT), at the University of Wollongong, to whom English is not their first language. The returned remarks were used to achieve a higher degree of clarity, both in the concepts and the consequent wording.

4.8.9.2 Survey testing via observational study

An observational study was then conducted with two persons, who had minimal to no knowledge of LBS. The observational study was done in order to calculate the approximate time needed to complete the survey and note any issues. The two volunteers who agreed to take part in the study were asked to complete the survey and note any difficulties in its questions. Their times were recorded and the average of 22.5 minutes was used as the base for the estimated time each respondent needs to complete all of the survey’s sections (20-25 minutes was actually stipulated as the time needed to complete the survey). The comments of the two participants were also used to refine the survey design.
4.8.9.3 Survey testing via piloting

Information systems literature places great emphasis on the importance of the pilot survey as part of the survey testing and scale development methodology (Baker 1999; Teijlingen and Hundley 2001). Essentially, the pilot survey is an experimental study which aims to collect data from a small set of subjects to discover any defects or flaws in the research instrument so as to be avoided in the main survey (Baker 1999; Zikmund and Babin 2007).

Six hundred pilot surveys were randomly distributed by hand, in November 2008, to households 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 in the survey. Another week was additionally given to allow for late respondents. This pilot survey was conducted prior to the Victorian Bushfires in February 2009.

Only 35 replies were returned, yielding an extremely low response rate of 5.8%. Two incomplete replies were further excluded, leaving only 33 usable surveys for the analysis. Although it is a desirable goal to obtain a high response rate in order 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 survey main objective is to serve as an initial test of the survey and does not, in any way, attempt to generalise its results to a new population. Therefore, the generalisability of the findings and the non-response bias effect are not issues here (Hunt 1990; Morgan and Hunt 1994). Moreover, there is much discussion in the literature 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. Anderson and Gerbing posited the consistency of this small sample size with the general agreement between researchers that the number of subjects 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, and dependant on the goal of the study.

Nevertheless, the principal concern when assessing the effect of the low response rate on the validity of the survey is when taking into account the nonresponse bias (Cummings et al. 2001; Fowler 2001). This bias stems from the possibility that only the population who are interested in the topic of the pilot survey would provide their responses back (Fowler 2001). However, if the non-respondents characteristics are systematically similar to those of the respondents, then the nonresponse bias is not an issue and 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 4.4, where for example, 7 respondents had a secondary education while 7 had a post-graduate degree (representing the low-level educated and the well-educated population) then it can be argued that non-respondents did not differ significantly from the survey’s respondents, suggesting that the nonresponse bias was not present, and therefore, the low response rate is not an issue here. Thus, the pilot survey of this study, for which no systematic differences between respondents and non-respondents exist, is considered valid for the analysis.
Table 4-4: The education level of the respondents of the pilot survey

<table>
<thead>
<tr>
<th>Education level</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Still at secondary school or tertiary institutions</td>
<td>1</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Secondary education</td>
<td>7</td>
<td>21.2</td>
<td>21.2</td>
<td>24.2</td>
</tr>
<tr>
<td>Certificate level including skilled vocational</td>
<td>5</td>
<td>15.2</td>
<td>15.2</td>
<td>39.4</td>
</tr>
<tr>
<td>Advance diploma or diploma level</td>
<td>5</td>
<td>15.2</td>
<td>15.2</td>
<td>54.5</td>
</tr>
<tr>
<td>Bachelor degree</td>
<td>4</td>
<td>12.1</td>
<td>12.1</td>
<td>66.7</td>
</tr>
<tr>
<td>Graduate diploma or graduate certificate level</td>
<td>4</td>
<td>12.1</td>
<td>12.1</td>
<td>78.8</td>
</tr>
<tr>
<td>Postgraduate degree</td>
<td>7</td>
<td>21.2</td>
<td>21.2</td>
<td>100.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>33</strong></td>
<td><strong>100.0</strong></td>
<td><strong>100.0</strong></td>
<td></td>
</tr>
</tbody>
</table>

A point that should, however, be strongly stressed here is that 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 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).

Of the 33 pilot survey replies, 17 were female (51.5%) and 16 (48.5%) were male. Australian citizens consisted most of the respondents (54.5%), followed by Europeans (24.2%) then Asians (9.1%). From the sample, 87.9% percent of respondents were aged 35 or more, concentrating in three age groups; 35-44 years old (33.3%), 45-54 years old (39.4%) and 55 years and over (15.2%).
4.8.9.4 Testing the reliability of the questionnaire instrument

Another step in the survey development process was to evaluate the internal reliability of its items. Reliability expresses the extent to which the measures in the research instrument are free of random errors, thus yielding similar consistent results if repeated on the same population (Zikmund and Babin 2007). 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 the reliability of a multiple-item construct. Straub (1989) suggested an alpha value of 0.8 as the lowest accepted threshold. However, Nunnally and Bernstein (1994) stated that 0.6 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 analysis results, presented in Table 4.5, reveal acceptable values for nearly all measurements except perceived accuracy of 0.684. Accordingly, one highly complex item was excluded from the perceived accuracy construct (Nunnally and Bernstein 1994; Hair et al. 2006), and the revised construct was put again to another round of validation, after which a higher acceptable coefficient of 0.724 was yielded.

Table 4-5: Cronbach’s alpha reliability statistics

<table>
<thead>
<tr>
<th>Scale</th>
<th>Cronbach’s alpha stage 1</th>
<th>Number of Items</th>
<th>Cronbach’s alpha stage 2</th>
<th>Number of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude</td>
<td>.894</td>
<td>3</td>
<td>.894</td>
<td>3</td>
</tr>
<tr>
<td>Intention to use</td>
<td>.778</td>
<td>5</td>
<td>.778</td>
<td>5</td>
</tr>
<tr>
<td>Trust</td>
<td>.908</td>
<td>3</td>
<td>.908</td>
<td>3</td>
</tr>
<tr>
<td>Perceived risk</td>
<td>.928</td>
<td>3</td>
<td>.928</td>
<td>3</td>
</tr>
<tr>
<td>Perceived usefulness</td>
<td>.869</td>
<td>4</td>
<td>.869</td>
<td>4</td>
</tr>
<tr>
<td>Perceived ease of use</td>
<td>.951</td>
<td>4</td>
<td>.951</td>
<td>4</td>
</tr>
<tr>
<td>Visibility</td>
<td>.795</td>
<td>4</td>
<td>.795</td>
<td>4</td>
</tr>
<tr>
<td>Perceived service qualities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived currency</td>
<td>.913</td>
<td>3</td>
<td>.913</td>
<td>3</td>
</tr>
<tr>
<td>Perceived accuracy</td>
<td>.684</td>
<td>4</td>
<td>.724</td>
<td>3</td>
</tr>
<tr>
<td>Perceived responsiveness</td>
<td>.837</td>
<td>4</td>
<td>.837</td>
<td>4</td>
</tr>
</tbody>
</table>
Another reliability scale assessment, through the computation of composite reliability, was also conducted. 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 1998b). Moreover, Raykov (1997) showed that Cronbach’s alpha test may underestimate the reliability of the congeneric measures, leaving the researcher with lower-bound estimates of the true reliability scores. The SmartPLS 2.0 M3 software (Ringle et al. 2005) was used to calculate the composite reliability of each construct. As illustrated in Table 4.6, the analysis shows that all scores far exceed the 0.7 recommended threshold (Hair et al. 2006). Consequently, these results bring more confidence in the research model as they have demonstrated high internal consistency for the entire model constructs under the evaluation of two separate reliability tests.

Table 4-6: Composite reliability statistics

<table>
<thead>
<tr>
<th>Scale</th>
<th>Number of Items</th>
<th>Composite reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude</td>
<td>3</td>
<td>.935</td>
</tr>
<tr>
<td>Intention to use</td>
<td>5</td>
<td>.844</td>
</tr>
<tr>
<td>Trust</td>
<td>3</td>
<td>.942</td>
</tr>
<tr>
<td>Perceived risk</td>
<td>3</td>
<td>.954</td>
</tr>
<tr>
<td>Perceived usefulness</td>
<td>4</td>
<td>.911</td>
</tr>
<tr>
<td>Perceived ease of use</td>
<td>4</td>
<td>.964</td>
</tr>
<tr>
<td>Visibility</td>
<td>4</td>
<td>.859</td>
</tr>
<tr>
<td>Perceived service qualities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived currency</td>
<td>3</td>
<td>.944</td>
</tr>
<tr>
<td>Perceived accuracy</td>
<td>3</td>
<td>.842</td>
</tr>
<tr>
<td>Perceived responsiveness</td>
<td>4</td>
<td>.896</td>
</tr>
<tr>
<td>Perceived privacy concerns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collection</td>
<td>4</td>
<td>.888</td>
</tr>
<tr>
<td>Unauthorised secondary use</td>
<td>3</td>
<td>.898</td>
</tr>
</tbody>
</table>
4.8.10 The sample of the survey

The use of the traditional paper-based mail survey was favoured based on the reasons presented in Section 4.10. The survey responses were gathered after the Victorian Bushfires in February 2009 and over a two month period, between the 1st of March and the 28th of April 2009.

Around 1350 surveys were distributed. The survey was administrated in two different ways:

1. Copies of the survey were delivered randomly by hand to households in the States of New South Wales and Tasmania. Participants were asked to return their copies to the researcher, in a reply-paid envelope provided with the survey, before the 14th of April 2009. Another two weeks were additionally allotted to allow for late respondents.

2. Other copies of the survey were distributed to students at the University of Wollongong, New South Wales, Australia. Every student was asked to voluntary complete the survey and return it to the researcher.

Although students have been widely used as convenience sample respondents in TRA and TAM studies (King and He 2006), it has often been criticised for low external validity (Gordon et al. 1986), and for being a more suitable representation of “professional users” than of “general users” for the phenomena of investigation (King and He 2006). Nevertheless, several reasons have contributed to the decision of selecting students as part of the survey population in this study. Unlike many empirical information systems and technology studies, this research does not assume or necessitate any previous experience with the topic of interest (i.e. LBS technologies). Moreover, students could not be regarded here as a true representation of the professional users of LBS since, similar to any other spectrum of society, students would be amongst the first “general users” of LBS if the services were to be nationally utilised for emergency management purposes in Australia. Accordingly, the validity of the survey is expected not to be compromised by using this significant group of society as part of its sample population.
From around 1350 surveys distributed, 304 were returned, yielding an acceptable 22.52% response rate. However, after excluding all unusable partial responses, 290 surveys were left for the statistical analysis. Amongst the 304 surveys, 59 were returned with comments in their open-ended question.

4.8.11 Partial least squares method and response rate considerations

As previously stated, the partial least squares method was employed to analyse the quantitative data of the survey questionnaire. The technique, it is generally argued is capable of handling “small” sample sizes (Barclay et al. 1995). Nonetheless, the question considered was how small a sample size could be in order to provide the sufficient levels of statistical power in the analysis.

The tendency of some researchers being less concerned about the adequacy of sample sizes has been highly censured by several studies (Marcoulides and Saunders 2006; Marcoulides et al. 2009). Marcoulides and Saunders (2006) argued that researchers should obtain adequate sample sizes in order to ensure stable estimates of prediction accuracy and also to permit the detection of low value model coefficients. Therefore, to verify whether or not the obtained sample size of this study was adequate to conduct the quantitative analysis, a sufficient level of power equal to or greater than 80 percent was needed to be achieved by the research model, according to Cohen (1988) and Marcoulides and Saunders (2006). The power level of 80 percent with alpha levels of 0.05 have been widely accepted in information systems literature as the sufficient levels of power and confidence by which the researcher is able to reject the hypothesis that the factor correlation in the population is zero (Goodhue et al. 2006; Marcoulides and Saunders 2006).

With these desired levels of power and confidence, being the traditional values usually reported, it is typically reasonable to detect, at least, a medium correlation effect size $r$ value of 0.3 (Cohen 1988; Green 1991; Straub et al. 2004). Hair et al. (2006) stated that sample sizes of 200 or more should be enough to discern the suggested effect size of
0.3. Nevertheless, a power analysis was carried out using the G*Power 3 software (Faul et al. 2007), in which the one correlation test was performed with the following inputs:

1. Tails = two
2. Effect size $r = 0.3$
3. Significance level $\alpha = 0.05$
4. Desired power $(1-\beta) = 0.8$
5. Population correlation = 0

The results indicated that a sample size of at least 84 was sufficient to conduct the analysis, which clearly means that the 290 sample size obtained was quite adequate to carry out the partial least squares analysis in this study.

### 4.8.12 Treatment of the survey questionnaire missing data

The excluded surveys were those with more than 5 percent of missing data in their questionnaire (Churchill and Iacobucci 2004). For most of the remaining 290 surveys, they had on average less than 1 percent of missing data that were missing at random (MAR).

Several approaches have been recommended to deal with missing data of the questionnaire. This study employed the expectation-maximisation (EM) algorithm (Dempster et al. 1977), as suggested by McDonald and Ho (2002), under which multiple data sets are created through a two-step iterative process. In the estimation step, missing values are substituted with predicted scores created from a series of regression equations. In the maximisation step, maximum likelihood estimates are calculated as if the data were complete. The two steps are repeated until convergence is achieved (i.e. until the matrices produced at subsequent steps become extremely similar to each other). By the end of the process, missing data is estimated, resulting in what looks like a complete data set (Enders 2001). This approach has the advantage of avoiding over-fitting, avoiding impossible matrices and producing realistic estimates of the missing data (McDonald and Ho 2002).
4.9 The interviews of this study

The use of qualitative methods, such as interviews, has been suggested for exploratory research when little is known about the area of study, when there is a need to identify unanticipated or new issues and when some research issues remain unanswerable by the quantitative methods (Marshall and Rossman 1999; Cecez-Kecmanovic 2001; Hennink 2008). Due to the fact that the researcher sought an in-depth exploration regarding location-based mobile phone utilisation for emergency management in Australia the interpretive research approach, carried out by the interviews, was the most appropriate method to perform the examination (Dawson 2007).

4.9.1 The semi-structured approach of the interviews

The semi-structured approach was selected to conduct the interviews driven by its ability to elicit the interviewee’s “framework of meanings” and expand on areas which the researcher felt were important to probe further, when the situation dictated (Carter and Henderson 2005; Greeff 2005). The semi-structured approach allowed the researcher to ask follow-up questions for clarification as the interview progressed.

4.9.2 The interview protocol

Under the semi-structured approach, an interview protocol was developed based on the objectives of the study. The protocol was mainly designed to help guide and steer the interview process. The protocol embraced the same concepts the research model addressed, such as trust and privacy concerns, but it also extended its reach to other areas where the quantitative approach was limiting. Basically, the interview protocol provided the researcher with a set of pre-defined procedures of what to do in each interview. The protocol also contained additional sub-questions and provided cues to be used, when necessary, to expand further on issues related to the question being discussed. The interview protocol can be found at Appendix III, Section B.
4.9.3 The participants of the interviews

The main criterion for approaching a potential interviewee was the relevance of his or her area of academic and scientific knowledge, professional experience or societal activities to this study. In brief, the interviewees were considered experts in their field and widely respected for their unique contribution to the industry at large. Several government departments and organisations pertinent to emergency management were also approached. The assumption made by the researcher in selecting the interviewees was that each interviewee possessed a wealth of knowledge and expertise to elaborate on the questions at hand. The intention was to end up with a good cross selection of diverse profiles that mainly span over government, society, industry and academia. Eventually, the researcher completed nine interviews, either face-to-face or via a telephone connection. The nine interviews are believed to be quite sufficient and representative for this research endeavour. The personal details of the participants were removed to allow for anonymity in responses but wherever possible company and organisational names remained. However, as an acknowledgment to all of the interviewees’ valuable responses, a summary of the nine interviewees and their background is presented in Table 4.7.
### Table 4-7: Descriptive list of the interviewees

<table>
<thead>
<tr>
<th>Interviewee (State or Territory)</th>
<th>Interviewee profile</th>
<th>Interviewee pseudonym</th>
<th>Interview date</th>
<th>Interview duration (Minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The Department of Justice – Office of the Emergency Services Commissioner (The State of Victoria)</td>
<td>Vic-Gov</td>
<td>November 25, 2008</td>
<td>56</td>
</tr>
<tr>
<td></td>
<td>The Office provides leadership in emergency management for Victoria, with specific responsibility for ensuring the delivery of efficient, equitable and integrated emergency services. It also undertakes complex and sensitive investigations or inquiries into the activities of the agencies, or the State's emergency management arrangements. In addition, the office provides advice on any issue in relation to emergency management, and act as principal advisor to the Minister for Police and Emergency Services and the Department of Justice Executive on policy and strategic issues relating to the emergency management arrangements. The Office also establishes and monitors performance standards for the prescribed emergency service agencies and reporting to the Minister on the performance against the required standards. Moreover, the Office oversees more effective utilisation of the common resources of the emergency services and encouraging and facilitating cooperation between all agencies before, during and after an emergency (Office of the Emergency Services Commissioner 2008).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Independent expert (The State of New South Wales)</td>
<td>Expert A</td>
<td>July 13, 2009</td>
<td>62</td>
</tr>
<tr>
<td></td>
<td>Has more than 40 years of experience over several domains including academia, coordinating and teaching subjects in emergency management and practical emergency management as an emergency service officer with the State emergency Services in Tasmania. He worked in several projects and short-term training programs with the Australian Government helping local government officials in the Philippines on disaster management responsibilities. Currently, he is delivering emergency management education at tertiary levels, looking at how emergency management is progressed in Australia and what has been done overseas. He is also looking at recovery in communities and linking that through to how best make communities responsible for themselves and examining preparedness and needs of small rural communities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interviewee (State or Territory)</td>
<td>Interviewee profile</td>
<td>Interviewee pseudonym</td>
<td>Interview date</td>
<td>Interview duration (Minutes)</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>------------------------</td>
<td>----------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>3 State Emergency Services (The State of New South Wales) *</td>
<td>An emergency and rescue service dedicated to assisting the community in times of peril. It is made up almost entirely of volunteers, with 226 units located throughout the state of New South Wales (NSW) alone. While its major responsibilities are for flood and storm operations, the Service also provides general rescue efforts in the rural parts of the state including road accident rescue, vertical rescue, bush search and rescue, evidence searches (both metropolitan and rural) and other forms of specialist rescue that may be required due to local threats. The Service's trained rescuers also support the full-time emergency services during major disasters. In addition, the SES assists other emergency services when they are performing major operations. These services include the NSW Police Force, the NSW Rural Fire Service, the NSW Fire Brigades and the Ambulance Service of NSW (The NSW State Emergency Service 2008)</td>
<td>SES</td>
<td>August 4, 2009</td>
<td>83</td>
</tr>
<tr>
<td>4 A representative from Whispir Company (The State of Victoria) *</td>
<td>An Australian company provides a high availability messaging platform that enables the instant and automatic invocation of communications across web, email, SMS and voice channels, from any location including from a mobile handset. Whispir now services more than 50 other companies across all core sectors, delivering business critical communications for crisis management, emergency and incident management, field operations, corporate communications and IT disaster recovery throughout Australia, New Zealand, Asia, Europe and North America (Whispir Company 2009).</td>
<td>Whispir-Rep</td>
<td>August 12, 2009</td>
<td>50</td>
</tr>
<tr>
<td>5 Independent expert (The Australian Capital Territory)</td>
<td>A well-known expert who has a professional background working as an advisor on large-scale systems for the Australian Government including the formulation of national internet ICT polices. He is also a renowned worldwide IT consultant who is working on numerous issues</td>
<td>Expert B</td>
<td>August 28, 2009</td>
<td>38</td>
</tr>
<tr>
<td>Interviewee (State or Territory)</td>
<td>Interviewee profile</td>
<td>Interviewee pseudonym</td>
<td>Interview date</td>
<td>Interview duration (Minutes)</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>---------------------------------------------------------------------------------------</td>
<td>-----------------------</td>
<td>------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>6 Independent expert (The State of New South Wales)</td>
<td>Has an engineering career with more than 30 years of experience, mainly working in networking and telecommunications sectors. His work has contributed to the development of Service Creation Environments for Intelligent Networks (IN) with British Telecom Research Laboratories, and later with Telstra. He also worked on several worldwide projects developing a wide range of solutions with a focus on wireless IN services and the development of various cellular location systems for emergency and commercial services. In addition, he was amongst the scientists who were responsible for shaping, initiating and launching E-911 in the United States.</td>
<td>Expert C</td>
<td>September 23, 2009</td>
<td>55</td>
</tr>
<tr>
<td>7 Independent expert (The State of Queensland)</td>
<td>His current work involves the development of new innovative technologies. He has an extensive experience in Research and Development of internet, web, and mobile technologies, and the standardisation of technologies at the international and national levels. He has led several R&amp;D teams into new technologies and developed advanced prototype demonstrators. He also has collaboration with many world leading organisations including Nokia, SUN and Adobe. His research ideas have lead to several commercial products including the ODRL that has been adopted by the mobile sector standards body and is now prevalent in most mobile handsets worldwide. He also has research interests in emergency messaging standards, new technologies and applications for emergency messaging and national emergency warning systems.</td>
<td>Expert D</td>
<td>September 29, 2009</td>
<td>27</td>
</tr>
<tr>
<td>8 Independent expert (The State Queensland)</td>
<td>A consultant who works for a large law firm in Australia. He is a communications specialist with more than 25 years of experience in technology, regulatory and business strategy in telecommunications and broadcasting. He has been involved with a number of significant commercial and regulatory transactions in the telecommunications sector in Australia and globally and has provided regulatory/strategic advice in both broadcasting and telecommunications. His practice includes providing advice to Telstra, Bell Canada, the GSM Association, State and Federal Government and international organisations such as the World</td>
<td>Expert E</td>
<td>October 14, 2009</td>
<td>49</td>
</tr>
<tr>
<td>Interviewee (State or Territory)</td>
<td>Interviewee profile</td>
<td>Interviewee pseudonym</td>
<td>Interview date</td>
<td>Interview duration (Minutes)</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>---------------------</td>
<td>-----------------------</td>
<td>----------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>9 A representative from Redcoal Company (The State of New South Wales)</td>
<td>Bank. He has several publications on technology strategy with particular interest in the next generation telecommunications network implementation.</td>
<td>Redcoal-Rep</td>
<td>October 22, 2009</td>
<td>28</td>
</tr>
</tbody>
</table>

*Views obtained here are those of the representatives and are not necessarily expressing those of their respective offices, departments or companies.*
4.9.4 The interview process

Each participant was initially approached and invited to participate via a telephone call or an email. A preamble of the purpose of the study was given or sent to him or her. When an approval was obtained, a list of the interview questions, along with a cover letter explaining in more detail the objectives of the study were emailed or faxed to him or her. The letter also included a statement that guaranteed the confidentiality of the interviewee’s personal information and an indication of this study adherence to the ethical guidelines of conducting research as approved by the University of Wollongong.

On the day of the interview, each participant was asked to sign a consent form signifying his or her acceptance to conduct the interview, if the interview was conducted face-to-face. Alternatively, he or she was asked to send a scanned copy by email or to fax the consent form if the interview was done over the telephone.

While each interview was projected to last for 60 minutes, as indicated in the interview’s invitation, the interviews ranged between 18 - 83 minutes in length. Voice recording techniques were used during each interview along with the usual technique of note taking. Each participant was asked whether or not he or she permitted for the interview to be recorded. At the beginning of each interview, the researcher made sure that his contact information was given to the interviewee. The transcript and a copy of the recorded interview were sent back to each interviewee who had registered his or her interest to receive them as a reference or for further comments and modifications. Participants were assured that they had the choice to modify the transcript or even void their permission to use the interview material at any stage of the research process. The interview consent form, the interview protocol and its set of questions can be found at Appendix III.

4.9.5 The qualitative analysis strategy

Qualitative analysis refers to the process that requires the identification of recurring ideas, patterns of beliefs and salient themes from collected data and the attempt to demonstrate support for them (Miles and Huberman 1994). Patton (2002) defines qualitative analysis as the challenging process of transforming data into findings, but
more importantly, making sense of it. Patton (2002) argues that while the transformation process involves “reducing the volume of raw information, sifting trivia from significance, identifying significant patterns and constructing a framework for communicating the essence of what the data reveal” (p. 432), there are no shared ground rules for determining what is significant and what is not and no way exists to perfectly replicate the researcher’s analytical thought processes. Hence there is no straightforward test that can be applied to determine the reliability and validity of the findings. Nonetheless, Patton (2002) gives his advice to every researcher who wishes to conduct a qualitative analysis to “do your very best with your full intellect to fairly represent the data and communicate what the data reveal given the purpose of the study” (p. 433).

Similarly, Marshall and Rossman (1999) regard qualitative analysis as the process of bringing structure and meaning to the mass of the collected data and, accordingly, postulate that the best approach to analyse the data is “reading, reading, and reading once more through the data, forcing the researcher to become familiar with those data in intimate ways. People, events, and quotes sift constantly through the researcher’s mind” (p. 153). Nevertheless, in order to guide the qualitative analysis effort of this study the research strategy was to perform content analysis on the incorporated units of analysis (i.e. data from the interviews and the open-ended question in the survey) by following the Miles and Huberman (1994) interactive model of analysis. In Miles and Huberman’s model, the qualitative analysis is an iterative step that consists of a set of activities, including data collection, data reduction, data display and conclusion drawing. See Figure 4.4. The following sections explain each of these activities as it was conducted in the investigation.
4.9.5.1 Data preparation

The textual data of the interviews went through preparation processes to make it ready for the analysis. The audio-recorded interviews were transcribed verbatim and each transcription was kept in a separate word document for easy reference. The hand-written interview notes, which were taken by the researcher himself in each interview, were used as an additional source of guidance and information. All transcriptions were then re-read and checked for additional accuracy.

In a similar fashion, all the comments from the survey open-ended question were typed, aggregated and then kept in one document, as all comments represented the perspective of a single distinct stakeholder of location-based services (i.e. the prospective user of the LBS).

While great care was taken to maintain the integrity of all responses, preliminary coding procedures including preparatory data reduction processes were quite necessary to be performed in order to transform the data into a usable status (Miles and Huberman 1994). This included shedding specific information, including the personal identifiable information of the interviewee and the appreciation and greeting sections of each interview.
4.9.5.2 Data reduction

Miles and Huberman (1994) believe that data reduction processes occur continually throughout the analysis and, therefore, it is part of the analysis itself and cannot be separated from it. As stated before, initial data coding in this study, including preliminary data reduction processes were performed to prepare the data for the analysis. In the following stages of the analysis, reduction happened through segmenting and summarising the data into concepts of information. Developing concepts is regarded a way of data reduction (Punch 2005). In later stages of the analysis, reduction occurred under the associated activities of the analysis model. That is, throughout displaying correlated concepts into more focused central themes and throughout drawing and verifying findings from the emerging themes.

4.9.5.3 Data display

Miles and Huberman (1994) consider displaying data as one of the major avenues to valid qualitative analysis. This activity is concerned with organising, compressing and assembling information into a more readable format from the data’s voluminous, bulky and dispersed original state (Punch 2005). Therefore, data display is found at all stages of the analysis.

Data display defines which stage of the analysis has been reached and provides the basis for the next stage (Punch 2005). The qualitative data can be displayed in different forms such as charts, diagrams or concept maps. Nonetheless, any form of data display is regarded valid as long as it is meaningful and appropriately moves the analysis forward (Punch 2005). In this study, diagrams and concepts maps are the main forms that are used to illustrate and display the qualitative data.

4.9.5.4 Drawing and verifying conclusions

The aim of this stage is to generate a meaningful and coherent picture of the data (Punch 2005). Basically, data reduction and displaying are performed to assist the drawing and
verifications of conclusions from the collected data (Miles and Huberman 1994). While drawing conclusions logically follows the reduction and displaying of the data. Miles and Huberman (1994) noted that conclusions take place, more or less, concurrently with other stages in the content analysis. Punch (2005) also posited that conclusions could be discerned early in the analysis, although they are vague and not truly developed.

Drawing conclusions is typically regarded the most difficult stage to perform amongst all the stages of the analysis since it involves developing propositions, verifying these propositions, drawing conclusions and confirming the obtained findings (Miles and Huberman 1994; Punch 2005).

4.9.5.5 The content analysis approach used in this study

Following Miles and Huberman’s (1994) model, the textual data of the interviews and the survey open-ended question were repeatedly explored, as suggested by Marshall and Rossman (1999), to summarise the data into a more focused form by noting regularities, patterns, explanations, relationships and propositions in the explored text.

All interview transcripts were carefully read to get a sense of the text as a whole and to get more familiar with the content. A list of key words or codes was also noted in the text was written down while reading. Afterwards the researcher started to read through thoroughly one interview at a time to extract all its concepts in detail. A textual unit (e.g. a sentence or paragraph) was extracted from the textual data of the interview only if evidence of a key word related to a concept was found in it. The identified key words from the first reading were added to the keyword list and used to extract the concepts from the following interview. Following the extraction process, a concept from one interview was synthesised with other concepts from the other interviews under one category if a pattern emerged or an explanation pertaining to a similar phenomena appeared between the concepts. All categories were read again to ensure their internal consistency and that they were actually distinct from one another (Marshall and Rossman 1999). Further grouping of comparable categories into a more focused state formed the emergent themes of this study.
The above mentioned non-automated content analysis approach of coding the textual data was eventually favoured over the complete automated analysis approach, using one of the available software packages to the researcher, such as NVivo (QSR International 2010) or Leximancer (Leximancer Company 2010). This is despite there being some arguments in the literature that using an automated approach of coding would improve the overall reliability in the content analysis since potential errors in coding, due to inaccurate human judgement and fatigue, can be largely avoided (Alexa and Zueil 2000; Scott and Smith 2005). In addition, some researchers argued that using the non-automated approach of coding may have the potential to introduce an unintentional degree of bias that is unlikely to exist using the automated methods of analysis alone (Tootell 2007).

However, a main issue in using the automated content analysis techniques is the validity of the findings, as it is quite difficult for an automated content analysis software to fully comprehend the broader meaning of the text and to recognise the communicative intent of the specific word usage with relation to its context (Gebauer et al. 2008). In addition, under the automated approaches of coding, a sentence (or group of sentences) is tagged as containing a concept only if the accumulated evidence (the sum of the weights of the key words found) is above a set threshold (Smith 2003). An inadvertent result because of this is that a low-profile concept, which is merely presented in the text, would be more likely to be left unnoticed by the researcher since no focus is given on the concept in the automated output of the analysis. Accordingly, it is strongly argued that by using the non-automated approach of coding the textual data of this study a high level of validity in the analysis results can be achieved with an extended reach for all the possible concepts and their related meanings since the non-automated coding technique relies on the human understanding of the text being analysed.

Still, in order to provide a level of validation for the non-automated analysis technique and to have more confidence in the reliability of the analysis results, the transcribed interviews and the digitised comments from the open-ended question in the survey were parsed together through an automated content analysis tool called Leximancer (Leximancer Company 2010). Leximancer was capable of determining the core themes in the textual data, which helped to ensure that they matched the main themes found by
the investigator himself. The themes also provide additional insight into the issues that were explored in the narrative thematically.

However, several interactive manual interventions were necessary to perform within Leximancer to: (i) clean the auto-generated thesaurus list of words (e.g. singular vs. plural, merging synonyms or like terms, and the merging together of words into short phrases like “location-based services”); (ii) delete irrelevant terms that may have been used frequently but in essence detracted from the main essence of the study (e.g. “should”, “think”); (iii) add words to the visual concept map from the auto-generated thesaurus that were considered significant in meaning by the researchers but may not have featured in the most highly ranked concepts; and (iv) consider at which level of granularity to view the concept map to best understand the inner forces at play between the major actors in the network.

4.10 Ethical considerations of this research

Ethics is one of the important constituents of information systems research (Davison 2005). In essence, every researcher is obliged to define his or her actions and responsibilities at any given stage during the research process by means of ethical principles and reasoning (Davison 2005; Creswell 2009). Kimmel (1988) believes that researchers should be aware of the moral issues implicit in their work and of the need to meet their obligations with complete respect to those involved in the research. Nonetheless, Kimmel (1988) acknowledges that ethical issues can be extremely complex and subtle, which frequently place the researcher in moral predicaments that appear, sometimes, quite unresolvable.

Given that information systems research involves collecting data from people and about people (Punch 2005), the ethical issues often require researchers to strike a delicate balance between the requirements of a given research methodology, placed on them as scientists in pursuit of truth, and their subjects’ rights and values potentially impacted by the research (Kimmel 1988). As such, the underlying guiding research principle is to proceed both ethically and without impacting on the validity of the research endeavour insofar as it is possible to do so (Kimmel 1988).
However, the researcher’s problems can multiply when these principles come to be applied, when they move “from the general to the particular, from the abstract to the concrete” (Cohen et al. 2005, p. 75). One possible solution is for the researcher to adhere to and adopt an established code of professional practice that is capable of defining the researcher’s responsibilities and clarifying the boundaries of what is accepted as a conduct and what is not (Cohen et al. 2005). As a result, to fulfil the specific ethical requirements of this research, the study made sure that it completely adhered to and complied with the ethics and professional conduct guidelines provided by the University of Wollongong before starting the data collection process. Accordingly, the researcher sought formal approval from the Human Research Ethics Committee (HREC) at the University to pursue his research.

A human ethics application was submitted that included the ethical considerations this researcher would adhere to. These embraced the privacy and confidentiality of participants’ identities and personal information, protection of any given responses from misrepresentation or exploitation, storage and access procedures to participants’ collected data and the exact means through which data will be disposed once a decision was made to do so. The application also included comprehensive details about the purpose and nature of the research, duration of the study and the research design.

An indication of the ethics application approval accompanied the identification details of the researcher and the purpose of the study in every survey and within each interviewee cover letter.

4.10.1 Ethical considerations for the survey

The traditional mail survey approach was purposefully used, as stated earlier, to achieve the highest possible degree of anonymity. Survey participants were informed that the completion of the survey is done anonymously as no personal identifiable information of any kind was requested. The participants were made aware that the information provided during the study would remain absolutely confidential and would not be accessed except by the researcher himself. Participants were also informed at the beginning of the survey that they were free not to contribute to the research and could
withdraw at any time by simply discarding the survey and not sending the response back in the reply-paid envelope provided.

4.10.2 Ethical considerations for the interviews

Every interviewee was informed that he or she had the complete choice to withdraw his or her interview from the research at any time. Each participant was given a consent form to indicate his or her knowledge of the nature of the study and the potential risks that might be associated with conducting interviews in general. No interview was recorded without prior explicit approval from the interviewee. Participants were assured that all their personal identifiable information would be totally removed prior to the subsequent analysis and only a pseudonym or a code would be used to identify either the establishment or the interviewee’s area of expertise.

4.11 Overview of Chapter Four

The research design of this study was discussed in this chapter. Towards an optimal design, there was a need first to present the common paradigms and classifications in information systems literature in order to identify the underlying research paradigms and classification of this study. This identification was important to be done before a research strategy could be followed. A discussion was then given for the reasons behind choosing the concurrent embedded strategy to guide the research endeavour. The discussion included comprehensive details about the quantitative and qualitative data collection methods that are employed under the strategy. In addition, an overview of the data analysis techniques which are employed under each method was also provided.

Under the qualitative approach, the design of the interview protocol and the reasons for choosing the semi-structured approach for conducting the interviews were fully explained. The reader was also introduced to the iterative sequence of processes that are carried out to analyse the qualitative data, which is discussed in more detail in Chapter 6 when the qualitative content data analysis is presented.
Under the quantitative approach, the design steps of the survey and its different sections were fully discussed. In addition, the steps taken to test the survey were presented. These included, face validity, observational study and pilot survey. The analysis results of the pilot survey were outlined. The results show high reliability and internal consistency scores for the entire research constructs that are reflected in the survey, which brought high confidence in the research model and provided credence of the instrument’s dependability for the main survey.

Due to the fact that ethics are an integral important component in information systems studies, the ethical considerations of this research were delineated in accordance with the ethics and professional conduct guidelines provided by the researcher’s university. These considerations defined the responsibilities of the researcher at any given stage during his research process by means of ethical principles and reasoning.

In the next chapter the analysis results of the research conceptual model, its constructs and research hypotheses are presented. Doing so, the statistical tests that were employed to obtain meaningful descriptive statistics about the sample population and to empirically validate the collected data of the survey are discussed. This validation of data is highly important to perform in order to verify that the proposed conceptual model, which is a reflection to the issues pertaining to location-based mobile phone service utilisation for emergency management, is indeed a reasonable representation of reality.
5 A synthesis of the quantitative findings and discussion

5.1 Introduction

The purpose of this chapter is to present the quantitative findings of the analysis of the survey data and then to provide an in depth discussion related to the research. First descriptive statistics of the survey sample population is provided and summaries of the usage trends of location-based services amongst the population at the time when the survey was conducted between the 1st of March and the 28th of April 2009 are then presented. The presentation of the findings extends to include the rankings of three distinct information control mechanisms that can be feasibly utilised in the location-based mobile phone emergency system to grant the user of the mobile handset control over his or her personal location information. The results of the analysis also include the rankings of the importance of utilising the location-based mobile phone service in various emergency event types. Subsequently, the analysis results of the survey questionnaire in relation to the research conceptual model and its hypotheses are fully detailed. A comprehensive discussion of these quantitative findings follows afterwards.

5.2 The descriptive analysis of the survey population

The data of the survey subjects was summarised and reported in aggregated form to maintain anonymity and confidentiality of all respondents. Out of the 290 replies of 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.

People who had described themselves as Australians consisted 36.6% (N=106) of the whole sample population, followed by Asians with 28.6% (N=83), Middle Easterners with 9.3% (N=27) and then Europeans with 7.9% (N=23). One important point that should be noted here is that the definition of ethnicity is based on the principle of self-assessed identification with an ethnic group and not on the documented nationality of the person being, for example, Australian (Treliving 2001). Therefore, in this survey a person who identified themselves as being Asian may in actual fact be an Australian national but have provided an answer of not being from an Australian ethnicity because it could be perceived as belonging to a different ethnicity group than his or her ancestors (Khoo and Lucas 2004).

The demographic and socio-economic characteristics of the sample population are illustrated in Table 5.1. For complete details, see Appendix IV, Section A.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>110</td>
<td>37.9</td>
</tr>
<tr>
<td>Male</td>
<td>180</td>
<td>62.1</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-25</td>
<td>125</td>
<td>43.1</td>
</tr>
<tr>
<td>26-34</td>
<td>63</td>
<td>21.7</td>
</tr>
<tr>
<td>35-44</td>
<td>54</td>
<td>18.6</td>
</tr>
<tr>
<td>45-54</td>
<td>36</td>
<td>12.4</td>
</tr>
<tr>
<td>55-64</td>
<td>10</td>
<td>3.4</td>
</tr>
<tr>
<td>65 or above</td>
<td>2</td>
<td>0.7</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Still at secondary school or tertiary institutions</td>
<td>7</td>
<td>2.4</td>
</tr>
<tr>
<td>Secondary education</td>
<td>48</td>
<td>16.6</td>
</tr>
<tr>
<td>Certificate level including skilled vocational</td>
<td>20</td>
<td>6.9</td>
</tr>
<tr>
<td>Advance diploma or diploma level</td>
<td>27</td>
<td>9.3</td>
</tr>
<tr>
<td>Bachelor degree</td>
<td>120</td>
<td>41.4</td>
</tr>
<tr>
<td>Graduate diploma or graduate certificate level</td>
<td>19</td>
<td>6.6</td>
</tr>
<tr>
<td>Postgraduate degree</td>
<td>49</td>
<td>16.9</td>
</tr>
<tr>
<td>Characteristics</td>
<td>Frequency</td>
<td>Percentage (%)</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>-----------</td>
<td>----------------</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australian</td>
<td>106</td>
<td>36.6</td>
</tr>
<tr>
<td>Aboriginal, Torres Strait or Pacific</td>
<td>7</td>
<td>2.4</td>
</tr>
<tr>
<td>Islander</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Zealander</td>
<td>12</td>
<td>4.1</td>
</tr>
<tr>
<td>African</td>
<td>12</td>
<td>4.1</td>
</tr>
<tr>
<td>European</td>
<td>23</td>
<td>7.9</td>
</tr>
<tr>
<td>Middle Eastern</td>
<td>27</td>
<td>9.3</td>
</tr>
<tr>
<td>Asian</td>
<td>83</td>
<td>28.6</td>
</tr>
<tr>
<td>Indian Sub-continent</td>
<td>11</td>
<td>3.8</td>
</tr>
<tr>
<td>North American</td>
<td>3</td>
<td>1.0</td>
</tr>
<tr>
<td>Latin American</td>
<td>3</td>
<td>1.0</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Annual gross income</strong></td>
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<tr>
<td>Under $19,999</td>
<td>83</td>
<td>28.6</td>
</tr>
<tr>
<td>$20,000 – $39,999</td>
<td>69</td>
<td>23.8</td>
</tr>
<tr>
<td>$40,000 – $59,999</td>
<td>54</td>
<td>18.6</td>
</tr>
<tr>
<td>$60,000 – $79,999</td>
<td>34</td>
<td>11.7</td>
</tr>
<tr>
<td>$80,000 – $99,999</td>
<td>22</td>
<td>7.6</td>
</tr>
<tr>
<td>$100,000 – $119,999</td>
<td>4</td>
<td>1.4</td>
</tr>
<tr>
<td>$120,000 or more</td>
<td>21</td>
<td>7.2</td>
</tr>
<tr>
<td>Missing</td>
<td>3</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Occupation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manager or administrator</td>
<td>29</td>
<td>10.0</td>
</tr>
<tr>
<td>Professional</td>
<td>45</td>
<td>15.5</td>
</tr>
<tr>
<td>Clerical, sales and service person</td>
<td>41</td>
<td>14.1</td>
</tr>
<tr>
<td>Associate professional (technical and</td>
<td>16</td>
<td>5.5</td>
</tr>
<tr>
<td>admin support)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant/machinery operator or transport</td>
<td>6</td>
<td>2.1</td>
</tr>
<tr>
<td>driver</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labourer or related work</td>
<td>15</td>
<td>5.2</td>
</tr>
<tr>
<td>Home duties</td>
<td>8</td>
<td>2.8</td>
</tr>
<tr>
<td>Tertiary student</td>
<td>112</td>
<td>38.6</td>
</tr>
<tr>
<td>Other</td>
<td>18</td>
<td>6.2</td>
</tr>
</tbody>
</table>

### 5.3 The usage trends of the location-based service in Australia amongst the sample population

As illustrated in Table 5.2, 290 responses were obtained from the question “Have you used any type of LBS before?” Of the respondents 37.2% (N=108) said they had used at
least one LBS offering before, 37.9% (N=110) said they had not used LBS ever, 24.5% (N=71) said they did not know whether or not they had used LBS before, while one respondent had not answered this question.

Table 5-2: Have you used any type of LBS before?

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid Yes</td>
<td>108</td>
<td>37.2</td>
<td>37.4</td>
<td>37.4</td>
</tr>
<tr>
<td>No</td>
<td>110</td>
<td>37.9</td>
<td>38.1</td>
<td>75.4</td>
</tr>
<tr>
<td>Don’t know</td>
<td>71</td>
<td>24.5</td>
<td>24.6</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>289</td>
<td>99.7</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Missing System</td>
<td>1</td>
<td>.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>290</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The most widely used service amongst the survey respondents was for navigation or turn-by-turn driving directions (e.g. TomTom, Navteq, Navman, Uniden) as 93 people said they had used it previously. This service was followed by requesting information about a nearest point of interest (e.g. restaurant, ATM, cinema, etc.) service with 60 people saying they had used it previously. Receiving information about traffic conditions or weather updates had been used by 41 people. Surprisingly, the least commonly used service was that of an LBS-enabled emergency service such as “locating a child, an elderly relative, or any missing person” which had only been used by two persons. Appendix IV, Section B, summarises the frequency tables of LBS usage amongst the surveyed population.

5.4 The rankings of the information control mechanisms

The participants of the survey were asked to rank in order, from 1 (the most effective) to 3 (the least effective), how they perceived the ability of three different mechanisms in providing effective control over the location information and in protecting the personal privacy of users of the service. A transformation of the data was necessary to be carried
out before the analysis to force the statistical package to treat (1) as the highest weight while treating (3) as the least weight amongst the three selections. The Friedman Test was then applied to assess whether or not there were any differences amongst the mean ranks of the three mechanism ratings (Pallant 2005). Only 288 responses were returned on this question. The results of the analysis suggested that the differences in the mean rank between the three information control mechanisms were statistically significant with asymptotic significance (Asymp. Sig.) of $p < 0.001$. The mechanism with a higher mean rank value had a higher rating than the mechanism with a lower mean rank. Accordingly, the government policies, laws and regulations information control mechanism had the highest rating amongst the three mechanisms with a mean rank of (2.22), while the mobile telecommunication industry’s privacy policies stood with the lowest rating amongst the mechanisms with a mean rank of (1.77). Table 5.3 illustrates the results.

<table>
<thead>
<tr>
<th>The Mechanism</th>
<th>Mean Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Government policies, laws and regulations</td>
<td>2.22</td>
</tr>
<tr>
<td>2 Technical features of the mobile phone</td>
<td>2.02</td>
</tr>
<tr>
<td>3 Privacy policies and LBS code of practice</td>
<td>1.77</td>
</tr>
<tr>
<td>N</td>
<td>288</td>
</tr>
<tr>
<td>Asymp. Sig.</td>
<td>.000</td>
</tr>
</tbody>
</table>

5.5 The rankings of the importance of the location-based service utilisation in various emergency event types

The survey participants were asked to rank how important it was to utilise the location-based mobile phone emergency service in various hazardous and emergency event types, categorised into human-caused, natural-caused and other types of emergencies. The weight of (1) was indicated as least important, while (3) was defined as most important for each type given. The Friedman Test was applied separately on the three
different categories to test for the significant differences in the mean ranks of importance of the comparable types of emergencies within each category (Pallant 2005).

5.5.1 Human-caused events

For this category, only 283 responses were received. The results denoted significant differences between the mean ranks of all human-made emergency event types \( (p < 0.001) \). See Table 5.4.

<table>
<thead>
<tr>
<th>Emergency Type</th>
<th>Mean Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terrorism act</td>
<td>6.24</td>
</tr>
<tr>
<td>Urban fire</td>
<td>5.63</td>
</tr>
<tr>
<td>Toxic spill or chemical emission</td>
<td>5.60</td>
</tr>
<tr>
<td>Explosion</td>
<td>5.54</td>
</tr>
<tr>
<td>Major transportation incident</td>
<td>4.95</td>
</tr>
<tr>
<td>Civil disturbance (e.g. riot)</td>
<td>4.55</td>
</tr>
<tr>
<td>Mining or industry incident</td>
<td>4.31</td>
</tr>
<tr>
<td>Pollution</td>
<td>4.19</td>
</tr>
<tr>
<td>Blackout or main power failure</td>
<td>3.99</td>
</tr>
</tbody>
</table>

\[N = 283 \]
\[\text{Asymp. Sig.} = .000\]

5.5.2 Natural events

For this category, related to natural hazards and disasters, only 286 responses were received. The differences in the mean ranks between the various types in this category were statistically significant with \( (p < 0.001) \). Bushfires and flash floods were ranked the highest amongst the others with mean ranks of 4.47 and 4.23 respectively. See Table 5.5.
Table 5-5: The importance of utilising LBS in natural hazards and disasters

<table>
<thead>
<tr>
<th>Emergency Type</th>
<th>Mean Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Bushfires</td>
<td>4.47</td>
</tr>
<tr>
<td>2 Flash floods</td>
<td>4.23</td>
</tr>
<tr>
<td>3 Tsunami or tidal waves</td>
<td>4.19</td>
</tr>
<tr>
<td>4 Severe weather conditions (e.g. storm surge, land gale, hail, cyclone, hurricane, torrential rain, etc.)</td>
<td>3.92</td>
</tr>
<tr>
<td>5 Earthquake</td>
<td>3.84</td>
</tr>
<tr>
<td>6 Epidemic or disease outbreak (e.g. SARS, Salmonella, Avian flu, West Nile virus, etc.)</td>
<td>3.84</td>
</tr>
<tr>
<td>7 Landslide or mudslide</td>
<td>3.51</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>N</th>
<th>286</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asymp. Sig.</td>
<td>.000</td>
</tr>
</tbody>
</table>

5.5.3 Other types of emergency events

For this category of “other types of emergency events” only 287 responses were received. Emergency event types in this category represented the typical location-based service offerings. A typical offering is where an individual invokes the service for him- or herself, or on the behalf of important others, when there is a desperate need of immediate help, and that help can be provided based on the person’s current location. The analysis suggested significant differences in the mean ranks of these distinctive types of services ($p < 0.001$). See Table 5.6.

Table 5-6: The importance of utilising LBS in other types of emergencies

<table>
<thead>
<tr>
<th>Emergency Type</th>
<th>Mean Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 To be automatically located after calling 000</td>
<td>2.83</td>
</tr>
<tr>
<td>2 Finding the location of a missing person</td>
<td>2.58</td>
</tr>
<tr>
<td>3 Finding the nearest point of help</td>
<td>2.51</td>
</tr>
<tr>
<td>4 To be automatically located by a roadside assistance company</td>
<td>2.08</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>N</th>
<th>287</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asymp. Sig.</td>
<td>.000</td>
</tr>
</tbody>
</table>
5.6 The partial least squares analysis results in relation to the research conceptual model

The research conceptual model comprises a set of endogenous dependent constructs that were predicted by one or more other constructs and a set of exogenous independent constructs that were not predicted by any other constructs of the same model. The endogenous constructs were the behavioural intention to use, attitude towards using, perceived usefulness, perceived risks and trust. The exogenous constructs included the perceived ease of use, collection as a perceived privacy concern, unauthorised secondary use as a perceived privacy concern, visibility, perceived currency, perceived accuracy and perceived responsiveness. The model has 43 observed measures (indicators or items) all related to their respective constructs in a reflective mode as they were all viewed as effects and not as the cause of their respective constructs (Chin 1998a; Petter et al. 2007).

The SmartPLS 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 (the outer model) and the assessment of the structural model (the inner model) (Barclay et al. 1995). The measurement model defines how well each set of the combined observed items relates to its respective construct. The measurement model was evaluated first to ensure that the items were indeed reliable and valid before trying to draw any conclusions regarding the relationships between their constructs in the structural model (Barclay et al. 1995; Gefen et al. 2000). Therefore, following Barclay’s et al. (1995) procedure, the first stage was to assess the reliability, convergent validity and discriminant validity of each construct in the measurement model. The second stage was to test the research hypotheses by estimating the path coefficients and $R^2$ between the constructs of the structural model.
5.6.1 The measurement model

5.6.1.1 Assessing the reliability of the measures and constructs

Reliability was assessed by employing two separate tests: the individual item reliability test and the composite reliability test. First, the reliability of each individual item (or indicator) was assessed by evaluating its loading on its respective construct (Barclay et al. 1995; Chin 1998b; Hair et al. 2006). Barclay et al. (1995) recommended to accept only items with a loading of 0.707 or more. However, Hair et al. (2006) and Udeh (2008) suggested that items with a factor loading of 0.5 or more are significant enough and could be retained. As shown in Table 5.7, all loadings were found to be greater than 0.5, suggesting that all items could be retained while, at the same time, exhibiting a high degree of item reliability across the measurement model.

Table 5-7: Measurement and factor loadings for each construct *

<table>
<thead>
<tr>
<th>No</th>
<th>The construct</th>
<th>No</th>
<th>Item code</th>
<th>Statement</th>
<th>Factor loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Attitude</td>
<td>1</td>
<td>ATT1</td>
<td>I like the idea of using location-based services for hazardous and emergency situations.</td>
<td>0.888</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>ATT2</td>
<td>I consider using location-based services for emergencies a good idea.</td>
<td>0.906</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>ATT3</td>
<td>In general, the idea of using location-based services for emergency management might be beneficial to my family and me.</td>
<td>0.864</td>
</tr>
<tr>
<td>2</td>
<td>Intention</td>
<td>1</td>
<td>INT1</td>
<td>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.</td>
<td>0.775</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>INT2</td>
<td>If my mobile phone company offers me free location-based services I will make use of the offer.</td>
<td>0.811</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>INT3</td>
<td>If LBS-enabled mobile phones become available I intend to buy one within the next three months.</td>
<td>0.836</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>INT4</td>
<td>If location-based services are widely used by my friends, I will start using them within the next three months.</td>
<td>0.802</td>
</tr>
<tr>
<td>No</td>
<td>The construct</td>
<td>No</td>
<td>Item code</td>
<td>Statement</td>
<td>Factor loading</td>
</tr>
<tr>
<td>----</td>
<td>---------------</td>
<td>----</td>
<td>-----------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>5</td>
<td>INT5</td>
<td>5</td>
<td>1</td>
<td>In general, if the government offer location-based services for emergency management I intend to make use of the services.</td>
<td>0.843</td>
</tr>
<tr>
<td>1</td>
<td>TRUST1</td>
<td>1</td>
<td>1</td>
<td>I trust the government use of LBS for managing hazardous and emergency situations.</td>
<td>0.861</td>
</tr>
<tr>
<td>2</td>
<td>TRUST2</td>
<td>1</td>
<td>2</td>
<td>I think location-based services are trusted applications that can deliver warning notifications during emergencies.</td>
<td>0.893</td>
</tr>
<tr>
<td>3</td>
<td>TRUST3</td>
<td>1</td>
<td>3</td>
<td>In my opinion, location-based services are mature mobile phone services that can be trusted for emergency management.</td>
<td>0.878</td>
</tr>
<tr>
<td>1</td>
<td>PRSK1</td>
<td>1</td>
<td>1</td>
<td>There is a considerable risk involved in using location-based services for emergencies.</td>
<td>0.863</td>
</tr>
<tr>
<td>2</td>
<td>PRSK2</td>
<td>1</td>
<td>2</td>
<td>My decision to use location-based services for managing emergencies would be risky.</td>
<td>0.908</td>
</tr>
<tr>
<td>3</td>
<td>PRSK3</td>
<td>1</td>
<td>3</td>
<td>There is too much uncertainty associated with using location-based services for managing hazardous and emergency situations.</td>
<td>0.913</td>
</tr>
<tr>
<td>1</td>
<td>PU1</td>
<td>5</td>
<td>1</td>
<td>The government use of location-based services for emergency management can save lives.</td>
<td>0.769</td>
</tr>
<tr>
<td>2</td>
<td>PU2</td>
<td>5</td>
<td>2</td>
<td>Using location-based services in emergencies would be invaluable.</td>
<td>0.597</td>
</tr>
<tr>
<td>3</td>
<td>PU3</td>
<td>5</td>
<td>3</td>
<td>Using location-based services for managing emergencies can guarantee my safety and well-being.</td>
<td>0.838</td>
</tr>
<tr>
<td>4</td>
<td>PU4</td>
<td>5</td>
<td>4</td>
<td>Overall, I find location-based services to be useful for hazardous and emergency situations.</td>
<td>0.812</td>
</tr>
<tr>
<td>1</td>
<td>PEOU1</td>
<td>6</td>
<td>1</td>
<td>Learning how to use location-based services would be easy for me.</td>
<td>0.905</td>
</tr>
<tr>
<td>2</td>
<td>PEOU2</td>
<td>6</td>
<td>2</td>
<td>I think my interaction with location-based services would be clear and understandable when they are used for emergencies.</td>
<td>0.894</td>
</tr>
<tr>
<td>3</td>
<td>PEOU3</td>
<td>6</td>
<td>3</td>
<td>I would find it easy to get location-based services to do what I want them to do.</td>
<td>0.881</td>
</tr>
<tr>
<td>4</td>
<td>PEOU4</td>
<td>6</td>
<td>4</td>
<td>In general, I think I would find location-based services easy to use.</td>
<td>0.920</td>
</tr>
<tr>
<td>1</td>
<td>VIS1</td>
<td>7</td>
<td>1</td>
<td>At my work, school or amongst my friends, I can see location-based services being used.</td>
<td>0.906</td>
</tr>
<tr>
<td>2</td>
<td>VIS2</td>
<td>7</td>
<td>2</td>
<td>I have seen others using location-based services on their mobile phones.</td>
<td>0.855</td>
</tr>
<tr>
<td>3</td>
<td>VIS3</td>
<td>7</td>
<td>3</td>
<td>It is easy for me to foresee others using location services in public.</td>
<td>0.819</td>
</tr>
<tr>
<td>4</td>
<td>VIS4</td>
<td>7</td>
<td>4</td>
<td>I have seen location-based services being used before.</td>
<td>0.815</td>
</tr>
<tr>
<td>1</td>
<td>PCUR1</td>
<td>8</td>
<td>1</td>
<td>I would expect the message content delivered to my phone to have up-to-the-minute information during hazardous or emergency situations.</td>
<td>0.886</td>
</tr>
<tr>
<td>No</td>
<td>The construct</td>
<td>No</td>
<td>Item code</td>
<td>Statement</td>
<td>Factor loading</td>
</tr>
<tr>
<td>----</td>
<td>---------------</td>
<td>----</td>
<td>-----------</td>
<td>---------------------------------------------------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>PCUR2</td>
<td>I would be concerned if the information provided to me was not up-to-date during emergencies.</td>
<td>0.813</td>
</tr>
<tr>
<td>9</td>
<td>Perceived accuracy</td>
<td>3</td>
<td>PCUR3</td>
<td>I think location-based services should always have the latest information in order to be reliable.</td>
<td>0.861</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>PACC1</td>
<td>I would expect the message of the location-based service delivered to me to be always accurate when being used for emergencies.</td>
<td>0.796</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>PACC2</td>
<td>I would find it unacceptable to receive inaccurate information when using location services during an emergency.</td>
<td>0.684</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>PACC3</td>
<td>Overall, location-based services are reliable to be used for emergency management only when they are accurate.</td>
<td>0.894</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>PRES1</td>
<td>I would expect location-based services to be timely when being used for emergencies.</td>
<td>0.779</td>
</tr>
<tr>
<td>10</td>
<td>Perceived responsiveness</td>
<td>2</td>
<td>PRES2</td>
<td>If I used location-based services, I would always expect a prompt response during hazardous situations.</td>
<td>0.868</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>PRES3</td>
<td>I do mind if there is a delay in response to a location service query I have made during an emergency situation.</td>
<td>0.662</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>PRES4</td>
<td>Overall, location-based services should offer safety information in a timely manner when they are used for emergency management.</td>
<td>0.833</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>PPCOL1</td>
<td>It would bother me if my location information is always collected by the location-based service provider during emergencies.</td>
<td>0.892</td>
</tr>
<tr>
<td>11</td>
<td>Collection</td>
<td>2</td>
<td>PPCOL2</td>
<td>I am concerned that the service provider will collect too much location data about me during emergency situations.</td>
<td>0.912</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>PPCOL3</td>
<td>I am not comfortable with the idea that the service provider is able to collect location information about me at any time in emergencies.</td>
<td>0.831</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>PPCOL4</td>
<td>I would rather not provide my location information to the service provider even in emergency situations.</td>
<td>0.675</td>
</tr>
<tr>
<td></td>
<td>Unauthorised secondary use</td>
<td>1</td>
<td>PPUSU1</td>
<td>The service provider should never disclose my location information even during emergency situations.</td>
<td>0.920</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>2</td>
<td>PPUSU2</td>
<td>In emergencies, the service provider should never use my location information for any other purposes unless it has been authorised by me.</td>
<td>0.942</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>PPUSU3</td>
<td>The service provider should not share my location information with 3rd parties without my consent during emergencies.</td>
<td>0.827</td>
</tr>
</tbody>
</table>

* All constructs are measured using a five-point Likert rating scale (Strongly disagree – Strongly agree). The number of respondents is 290 (N=290).
The second reliability test was the composite reliability which was calculated for each construct in the conceptual model. This reliability test is highly 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 1998b). As illustrated in Table 5.8, all scores far exceeded Hair et al. (2006) recommended threshold of 0.7 indicating a good composite reliability for all the constructs of the model. Cronbach’s alpha reliability statistics are also reported in the same table and reveal acceptable values for all of the measurements since they surpass the 0.7 threshold recommended by Agarwal and Karahanna (2000).

<table>
<thead>
<tr>
<th>The construct</th>
<th>Composite reliability</th>
<th>Cronbach’s alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy</td>
<td>0.837</td>
<td>0.722</td>
</tr>
<tr>
<td>Attitude</td>
<td>0.916</td>
<td>0.864</td>
</tr>
<tr>
<td>Collection</td>
<td>0.899</td>
<td>0.855</td>
</tr>
<tr>
<td>Currency</td>
<td>0.890</td>
<td>0.818</td>
</tr>
<tr>
<td>Ease of use</td>
<td>0.944</td>
<td>0.922</td>
</tr>
<tr>
<td>Intention</td>
<td>0.907</td>
<td>0.874</td>
</tr>
<tr>
<td>Responsiveness</td>
<td>0.867</td>
<td>0.794</td>
</tr>
<tr>
<td>Risk</td>
<td>0.923</td>
<td>0.876</td>
</tr>
<tr>
<td>Trust</td>
<td>0.909</td>
<td>0.850</td>
</tr>
<tr>
<td>Unauthorised secondary use</td>
<td>0.925</td>
<td>0.887</td>
</tr>
<tr>
<td>Usefulness</td>
<td>0.843</td>
<td>0.756</td>
</tr>
<tr>
<td>Visibility</td>
<td>0.912</td>
<td>0.882</td>
</tr>
</tbody>
</table>

### 5.6.1.2 Assessing the convergent validity and discriminant validity

Convergent validity is usually assessed as evidence that a set of grouped items converge or correlate with each other when representing a specific construct, particularly when compared to the convergence of items that are relevant to other constructs (Straub et al. 2004). As argued by Fornell and Larcker (1981), convergent validity is achieved if the Average Variance Extracted (AVE) value explained in the items by their respective construct is greater than the variance unexplained (i.e. if AVE is more than 0.5). Table
5.9 shows that all AVEs exceed the value of 0.5, indicating a high convergent validity for all the constructs of the model.

Table 5-9: The AVE statistics

<table>
<thead>
<tr>
<th>The construct</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy</td>
<td>0.634</td>
</tr>
<tr>
<td>Attitude</td>
<td>0.785</td>
</tr>
<tr>
<td>Collection</td>
<td>0.693</td>
</tr>
<tr>
<td>Currency</td>
<td>0.729</td>
</tr>
<tr>
<td>Ease of use</td>
<td>0.811</td>
</tr>
<tr>
<td>Intention</td>
<td>0.662</td>
</tr>
<tr>
<td>Responsiveness</td>
<td>0.623</td>
</tr>
<tr>
<td>Risk</td>
<td>0.801</td>
</tr>
<tr>
<td>Trust</td>
<td>0.770</td>
</tr>
<tr>
<td>Unauthorised secondary use</td>
<td>0.806</td>
</tr>
<tr>
<td>Usefulness</td>
<td>0.578</td>
</tr>
<tr>
<td>Visibility</td>
<td>0.722</td>
</tr>
</tbody>
</table>

Discriminant validity indicates the extent to which a set of measurement items are posited to reflect a specific construct and that set differs from those that are not believed to make up the construct (Straub et al. 2004). Basically, it indicates the degree to which a given construct is different from other constructs (Barclay et al. 1995). Discriminant validity is established when two conditions are met (Fornell and Larcker 1981; Chin 1998b; Hair et al. 2006). First, as shown in Table 5.10, the square root of the AVE on the diagonal of the correlation matrix should always be greater than all off-diagonal (inter-construct) correlations. Second, as presented in Table 5.11, the indicators should load more highly on their respective construct than on any other construct, with all correlations being significant at \( p \leq 0.05 \) level at least. As can be seen from Table 5.10 and Table 5.11, discriminant validity is supported since all the constructs of the research model are indeed measuring different concepts and all correlations are significant at \( p <0.001 \) levels. Accordingly, all of the measures and constructs in the measurement model show satisfactory reliability and validity scores.
### Table 5-10: Latent Variable Correlations

<table>
<thead>
<tr>
<th></th>
<th>Accuracy</th>
<th>Attitude</th>
<th>Collection</th>
<th>Currency</th>
<th>Ease of use</th>
<th>Intention</th>
<th>Responsiveness</th>
<th>Risk</th>
<th>Trust</th>
<th>Unauthorised secondary use</th>
<th>Usefulness</th>
<th>Visibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attitude</td>
<td>0.40357</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collection</td>
<td>0.098927</td>
<td>-0.07171</td>
<td>0.832466</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Currency</td>
<td>0.666224</td>
<td>0.417567</td>
<td>0.032819</td>
<td>0.853814</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ease of use</td>
<td>0.391212</td>
<td>0.310881</td>
<td>-0.071833</td>
<td>0.359985</td>
<td>0.900555</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intention</td>
<td>0.346678</td>
<td>0.466779</td>
<td>-0.075061</td>
<td>0.290526</td>
<td>0.413542</td>
<td>0.813633</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Responsiveness</td>
<td>0.719893</td>
<td>0.425726</td>
<td>0.093703</td>
<td>0.703045</td>
<td>0.343983</td>
<td>0.333275</td>
<td>0.789303</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk</td>
<td>-0.119578</td>
<td>-0.23082</td>
<td>0.206021</td>
<td>-0.111408</td>
<td>-0.075573</td>
<td>-0.18575</td>
<td>-0.06795</td>
<td>0.89499</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trust</td>
<td>0.374921</td>
<td>0.469395</td>
<td>-0.180234</td>
<td>0.31566</td>
<td>0.385381</td>
<td>0.5295</td>
<td>0.346135</td>
<td>-0.36016</td>
<td>0.8775</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unauthorised secondary use</td>
<td>0.134771</td>
<td>-0.01741</td>
<td>0.626453</td>
<td>0.111863</td>
<td>0.051952</td>
<td>-0.013786</td>
<td>0.149196</td>
<td>0.147166</td>
<td>-0.11766</td>
<td>0.897775</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Usefulness</td>
<td>0.442378</td>
<td>0.50728</td>
<td>-0.034341</td>
<td>0.423154</td>
<td>0.510396</td>
<td>0.566835</td>
<td>0.421835</td>
<td>-0.23194</td>
<td>0.544599</td>
<td>0.02953</td>
<td>0.760263</td>
<td></td>
</tr>
<tr>
<td>Visibility</td>
<td>0.177441</td>
<td>0.126404</td>
<td>-0.307382</td>
<td>0.290118</td>
<td>0.278549</td>
<td>0.091102</td>
<td>0.162327</td>
<td>0.04478</td>
<td>0.040363</td>
<td>-0.187029</td>
<td>0.187822</td>
<td>0.84971</td>
</tr>
</tbody>
</table>

Bold numbers on the diagonal are the square root of the variance shared between each construct and its measures (square root of the average variance extracted). Off-diagonals are the correlations among the constructs.
Table 5-11: The cross loadings of the constructs and their items

*** denotes significance at 0.001 level.

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5.6.2 The structural model

The general aim of the structural model is to give an explanation of the theorised relationships (i.e. hypotheses) amongst the constructs. The research hypotheses were assessed by examining the path coefficients and their significance levels, and also by reporting the $R^2$ of each endogenous construct in the model (Barclay et al. 1995). The path coefficient in the PLS analysis is similar, in interpretation, to the traditional regression standardised beta coefficient $\beta$ in expressing the relative strength of the statistical relationship between a dependent construct and independent construct, while $R^2$ represents the percentage of variance of the dependent construct that is explained by its respective independent constructs and it signifies the predictive power capability of the research model (Fornell and Larcker 1981; Barclay et al. 1995). However, as PLS approach makes minimal distributional assumptions of normality and sample sizes (Gefen et al. 2000) a nonparametric re-sampling procedure such as bootstrapping, as suggested by Chin (1998b), is needed to obtain estimates of significance (i.e. $t$ statistics values) for the path coefficients. Chin (1998b) recommended bootstrapping with 500 resamples.

Table 5.12 presents the path coefficients, $t$-statistics, and the significance levels ($p$ values) of the research hypotheses. Each $p$-value is derived based on the corresponding $t$-value statistical tables provided by Blaikie (2003). Figure 5.1 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.
Table 5-12: The PLS path coefficients, *t*-statistics and levels of significance

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Path</th>
<th>Path coefficient</th>
<th><em>t</em>-statistic</th>
<th>Significant at</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>Attitude $\rightarrow$ Intention</td>
<td>0.241</td>
<td>4.044</td>
<td>0.001</td>
</tr>
<tr>
<td>H2</td>
<td>Perceived usefulness $\rightarrow$ Intention</td>
<td>0.444</td>
<td>9.052</td>
<td>0.001</td>
</tr>
<tr>
<td>H3</td>
<td>Perceived usefulness $\rightarrow$ Attitude</td>
<td>0.471</td>
<td>6.787</td>
<td>0.001</td>
</tr>
<tr>
<td>H4</td>
<td>Perceived ease of use $\rightarrow$ Attitude</td>
<td>0.070</td>
<td>1.175</td>
<td>n.s.</td>
</tr>
<tr>
<td>H5</td>
<td>Perceived ease of use $\rightarrow$ Perceived usefulness</td>
<td>0.273</td>
<td>5.654</td>
<td>0.001</td>
</tr>
<tr>
<td>H6a</td>
<td>Perceived responsiveness $\rightarrow$ Perceived usefulness</td>
<td>0.079</td>
<td>1.049</td>
<td>n.s.</td>
</tr>
<tr>
<td>H6b</td>
<td>Perceived currency $\rightarrow$ Perceived usefulness</td>
<td>0.085</td>
<td>1.251</td>
<td>n.s.</td>
</tr>
<tr>
<td>H6c</td>
<td>Perceived accuracy $\rightarrow$ Perceived usefulness</td>
<td>0.063</td>
<td>0.898</td>
<td>n.s.</td>
</tr>
<tr>
<td>H7</td>
<td>Visibility $\rightarrow$ Perceived usefulness</td>
<td>0.075</td>
<td>1.520</td>
<td>n.s.</td>
</tr>
<tr>
<td>H8</td>
<td>Perceived risk $\rightarrow$ Perceived usefulness</td>
<td>-0.084</td>
<td>1.850</td>
<td>n.s.</td>
</tr>
<tr>
<td>H9</td>
<td>Trust $\rightarrow$ Perceived usefulness</td>
<td>0.341</td>
<td>5.773</td>
<td>0.001</td>
</tr>
<tr>
<td>H10</td>
<td>Trust $\rightarrow$ Perceived risk</td>
<td>-0.334</td>
<td>5.166</td>
<td>0.001</td>
</tr>
<tr>
<td>H11a</td>
<td>Collection $\rightarrow$ Perceived usefulness</td>
<td>0.063</td>
<td>1.029</td>
<td>n.s.</td>
</tr>
<tr>
<td>H11b</td>
<td>Unauthorised secondary use $\rightarrow$ Perceived usefulness</td>
<td>0.013</td>
<td>0.226</td>
<td>n.s.</td>
</tr>
<tr>
<td>H12a</td>
<td>Collection $\rightarrow$ Trust</td>
<td>-0.175</td>
<td>2.203</td>
<td>0.05</td>
</tr>
<tr>
<td>H12b</td>
<td>Unauthorised secondary use $\rightarrow$ Trust</td>
<td>-0.007</td>
<td>0.091</td>
<td>n.s.</td>
</tr>
<tr>
<td>H13a</td>
<td>Collection $\rightarrow$ Perceived risk</td>
<td>0.129</td>
<td>1.858</td>
<td>n.s.</td>
</tr>
<tr>
<td>H13b</td>
<td>Unauthorised secondary use $\rightarrow$ Perceived risk</td>
<td>0.027</td>
<td>0.349</td>
<td>n.s.</td>
</tr>
</tbody>
</table>

n.s. denotes non-significance

5.6.2.1 Hypothesis testing

As shown in Figure 5.1, the attitude towards using the location-based mobile phone emergency service (b = 0.241, *p* < 0.001) was a significant predictor of the behavioural intention to use the service, thus supporting H1. The perceived usefulness (b = 0.444, *p* < 0.001) was also an influential predictor of the intention, thus validating H2. Both the
attitude and perceived usefulness demonstrated a good prediction power of the intention with $R^2$ at 0.365, indicating an explanation level at 36.5 percent of the variance of the behavioural intention to use the service in the future.

The perceived usefulness ($b = 0.471$, $p < 0.001$) was a highly significant predictor of the attitude, thus validating H3. However, H4 was not supported since the perceived ease of use did not have any significant influence on the attitude. On the contrary, the effect of the perceived ease of use ($b = 0.273$, $p < 0.001$) on the perceived usefulness was significant, thus validating H5.

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

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

Regarding hypotheses H6a, H6b, H6c, H7, H8, H11a, H11b, H12b, H13a, H13b, all were not statistically supported, and therefore, should be rejected. Table 5.13 summarises the hypothesised relationships and illustrates which hypotheses are supported by the results of the structural model.
Table 5-13: Test of the hypotheses based on the results of the structural model

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Hypothesised relationship</th>
<th>Hypothesis supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>Attitude → Intention</td>
<td>Yes</td>
</tr>
<tr>
<td>H2</td>
<td>Perceived usefulness → Intention</td>
<td>Yes</td>
</tr>
<tr>
<td>H3</td>
<td>Perceived usefulness → Attitude</td>
<td>Yes</td>
</tr>
<tr>
<td>H4</td>
<td>Perceived ease of use → Attitude</td>
<td>No</td>
</tr>
<tr>
<td>H5</td>
<td>Perceived ease of use → Perceived usefulness</td>
<td>Yes</td>
</tr>
<tr>
<td>H6a</td>
<td>Perceived responsiveness → Perceived usefulness</td>
<td>No</td>
</tr>
<tr>
<td>H6b</td>
<td>Perceived currency → Perceived usefulness</td>
<td>No</td>
</tr>
<tr>
<td>H6c</td>
<td>Perceived accuracy → Perceived usefulness</td>
<td>No</td>
</tr>
<tr>
<td>H7</td>
<td>Visibility → Perceived usefulness</td>
<td>No</td>
</tr>
<tr>
<td>H8</td>
<td>Perceived risk → Perceived usefulness</td>
<td>No</td>
</tr>
<tr>
<td>H9</td>
<td>Trust → Perceived usefulness</td>
<td>Yes</td>
</tr>
<tr>
<td>H10</td>
<td>Trust → Perceived risk</td>
<td>Yes</td>
</tr>
<tr>
<td>Hypothesis</td>
<td>Hypothesised relationship</td>
<td>Hypothesis supported</td>
</tr>
<tr>
<td>------------</td>
<td>--------------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>H11a</td>
<td>Collection → Perceived usefulness</td>
<td>No</td>
</tr>
<tr>
<td>H11b</td>
<td>Unauthorised secondary use → Perceived usefulness</td>
<td>No</td>
</tr>
<tr>
<td>H12a</td>
<td>Collection → Trust</td>
<td>Yes</td>
</tr>
<tr>
<td>H12b</td>
<td>Unauthorised secondary use → Trust</td>
<td>No</td>
</tr>
<tr>
<td>H13a</td>
<td>Collection → Perceived risk</td>
<td>No</td>
</tr>
</tbody>
</table>

5.7 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); an indication that reflects how well the constructs of the model are approximate representations of real world issues. A good fit between the conceptual model of this research and the collected data would provide a firm ground upon which the findings can be defended and generalised. But, 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 (i) construct reliability (internal consistency) being above 0.7 for all of 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 has been illustrated earlier in Table 5.8, all the reliability scores from two separate tests far exceeded the 0.7 thresholds, indicating high internal consistency for the entire model’s constructs. The $R^2$ of the attitude and intention constructs, which are postulated as the predictors of the individual acceptance of the location-based mobile phone emergency service, were above 25 percent, a highly acceptable prediction level in social science research (Arlinghaus and Griffith 1995; Beck et al. 2006; Gaur and Gaur 2006). Although that 10 out of the 17 path coefficients were insignificant (as depicted in Figure 5.1 and Table 5.13), and even the path between the collection as a privacy concern and the perceived usefulness (0.063), and between the unauthorised secondary use as a privacy concern and the perceived usefulness (0.013) were in the opposite direction of that predicted (i.e. positive impact instead of negative influence), the path coefficients to the main predictors of the service acceptance (i.e. attitude and intention) evinced extremely high significant levels at $p < 0.001$, with all coefficients to be above the 0.2
threshold marked by Chin (1998b) implying meaningful relationship. Accordingly, the goodness-of-fit of this research model is established since the analysis of the two components of the PLS model, the measurement model and the structural model, have shown good results in almost all of the statistical tests performed.

5.8 Discussion of the quantitative findings

5.8.1 The rankings of the information control mechanisms

The respondents of the survey perceived that government legislation is the most effective mechanism for safeguarding and protecting the privacy of the individual and controlling his or her personal information under the national utilisation of the location-based mobile phone emergency service. The privacy policies and the service code of practice within the mobile phone industry were perceived as the least effective information control mechanism amongst the three, with a mean rank of 1.77, compared to a mean rank of 2.22 for the government legislation and 2.02 mean rank for the ability to control the location information with the technical features of the mobile handset.

It is true that there is a traditional, unique relationship between people and government in the context of an emergency (Quarantelli 1986) in which people have always looked to their government to keep them safe and to provide them with aid and assistance in the case of an emergency. The Australian people under the utilisation of the location-based emergency service, expect in a similar fashion the forces in power (i.e. government emergency agencies) to act within their traditional roles and responsibilities usually defined by legislation. In brief, this would allow the government to exercise control over every citizen’s location information in an emergency situation, so that the optimal goal of safety is achieved. Relevant legislation to the location-based mobile phone emergency service has been perceived by the respondents of the survey as part of the traditional image of the mutual relationship between the government and its constituents in an emergency situation. This is completely different from the nature of the relationship that traditionally governs the interaction between the mobile phone
company and the mobile phone user, which is usually stipulated on a monetary value in exchange of the service that is provided to the user.

In addition, the government through current legislation can protect the citizen from any illegal or damaging behaviour, such as the unauthorised access to personal location information. On the other hand, the code of practice and privacy policies do not provide similar meaningful protection since these policies are not usually bounded to agreed standards or legal requirements and can be changed at the company level at any time (Cain 2002; Chandra 2003; Haduri 2003; Baron 2005). In contrast to mere privacy policies, amendments to legislation require a parliamentary vote before changes can be legally enacted.

5.8.2 The importance of utilising the location-based mobile phone service in various emergency event types

5.8.2.1 The utilisation of the service in human-caused emergency events

Despite the fact that terrorism attacks are very rare in Australia (Templeman and Bergin 2008), the quantitative findings revealed that the respondents of the survey have ranked terrorism acts as the highest human-made emergency (mean = 6.24) for which the government should utilise the location-based mobile phone emergency service. This particular outcome is most likely to be the result of the continuous interest of the Australian media in worldwide terrorism attacks. It could also be due to the high impact of several major terrorism attacks that took place overseas but were targeted at the Australian people. One such example included the 2002 Bali bombings that left 88 Australians dead. This finding could also be explained by, or explain, the cumulated investments of the Australian Federal government on counter-terrorism programs, including public campaigns, which have exceeded Aus$10 billion since September 11, 2001 attacks, compared to only Aus$500 million in managing the potential consequences of a large-scale natural disaster occurring in Australia (Templeman and Bergin 2008). It is true that people do fear terrorism more than natural disasters (Kay 2006). Indeed, unlike any other event, terrorism acts are transnational phenomena that have the power to attract the public attention anywhere (Inglis 2002).
The respondents of the survey have ranked the urban fires, with a mean rank of 5.63, as the second most important risk in which they preferred the location-based emergency system to be utilised by the government. This particular result can only provide an indication of the extent of impact left by the deadly Victorian Bushfires, in February 2009, and of the serious consequences of fires on people’s lives being either urban or wild as discussed in the following section.

5.8.2.2 The utilisation of the service in natural emergency events and disasters

The annual frequencies of bushfires, flash floods and extreme weather conditions, particularly cyclones in Australia, may provide an adequate answer of why these specific events had been rated amongst the top four in their category, with mean ranks of 4.47, 4.23 and 3.92 respectively. In addition, Australia suffered its worst natural disaster, since the 1918 world-wide influenza (Spanish Flu strain) pandemic (Emergency Management Australia 2008), when severe bushfires claimed the lives of 173 Australians in the State of Victoria in February 2009. This tragic disaster clearly explains why bushfires had the highest mean rank (mean = 10.94) amongst all types of natural hazards and disasters, even when compared with all other emergency types as depicted in Table 5.14.
Table 5-14: The importance of utilising LBS in natural and man-made emergency event types

<table>
<thead>
<tr>
<th>Emergency Type</th>
<th>Mean Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Bushfires</td>
<td>10.94</td>
</tr>
<tr>
<td>2 Flash floods</td>
<td>10.36</td>
</tr>
<tr>
<td>3 Tsunami or tidal waves</td>
<td>10.30</td>
</tr>
<tr>
<td>4 Severe weather conditions</td>
<td>9.71</td>
</tr>
<tr>
<td>5 Terrorism act</td>
<td>9.65</td>
</tr>
<tr>
<td>6 Earthquake</td>
<td>9.49</td>
</tr>
<tr>
<td>7 Epidemic or disease outbreak</td>
<td>9.48</td>
</tr>
<tr>
<td>8 Landslide or mudslide</td>
<td>8.86</td>
</tr>
<tr>
<td>9 Urban fire</td>
<td>8.51</td>
</tr>
<tr>
<td>10 Toxic spill or chemical emission</td>
<td>8.43</td>
</tr>
<tr>
<td>11 Explosion</td>
<td>8.36</td>
</tr>
<tr>
<td>12 Major transportation incident</td>
<td>7.23</td>
</tr>
<tr>
<td>14 Civil disturbance</td>
<td>6.62</td>
</tr>
<tr>
<td>15 Pollution</td>
<td>6.07</td>
</tr>
<tr>
<td>16 Blackout or main power failure</td>
<td>5.76</td>
</tr>
</tbody>
</table>

N          283
Asymp. Sig. .000

5.8.2.3 The utilisation of the service in other types of emergency events

The importance of the location-based mobile phone emergency service utilisation in personal safety situations (i.e. to be automatically located after making an emergency call) was ranked higher than the important other safety end emergency services (i.e. finding the location of a missing child or an elderly relative or someone with a mental illness). Although there is no straightforward explanation of the mean ranks order here, the results could simply mean that most of the respondents of the survey had not been exposed to a situation where they needed to find a missing child or an elderly relative. Anyway, the respondent generally favoured the utilisation of the location-based service in a personal emergency situation over any other emergency context concerning others.
5.8.3 The relationship between the demographic characteristics of the survey participant and his or her response to a specific emergency events type

Comparisons of frequencies for testing associations between each demographic characteristic of the survey participant and his or her specific response to a given emergency event type was carried out with Pearson’s Chi-square Test. This test showed whether or not the demographic characteristic of the participant influences his or her response of how important it is for the government to utilise the location-based emergency service in a specific emergency event type. Only $P$ values of 0.05 or less with the assumption of a “minimum expected cell frequency” of 5 were considered significant enough to be reported (Weinberg and Abramowitz 2002; Pallant 2005). The only significant relationship between a demographic characteristic and a specific emergency event type was the association between the gender of the respondent and terrorism acts, as illustrated in Table 5.15.

<table>
<thead>
<tr>
<th>Demographic characteristic</th>
<th>The situation</th>
<th>Pearson Chi-Square value</th>
<th>$P$-value</th>
<th>Minimum expected cell frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Terrorism act</td>
<td>9.403</td>
<td>0.009</td>
<td>9.87</td>
</tr>
</tbody>
</table>

Although the Chi-Square Test yielded a significant difference between males and females ($p < 0.05$) the test does not have the ability to indicate which group is likely to be more susceptible to terrorism. Nonetheless, recent research on gender differences in response to terrorism seemed to preoccupy and disproportionately concern women over men as:

Women consistently reported higher levels of perceived threat, personal vulnerability, and anxiety in response to terrorism than did men, a gender difference that occurred in reaction to violent threats more generally (Huddy et al. 2007, p. 2).
This particular finding also lends empirical support to several previous studies where significant gender differences were found with regard to the respondent attitude towards terror acts. See for examples, Keinan et al. (2003), Goodwin et al. (2005), Fordham (2006), and Christelis and Georgarakos (2009).

5.8.4 The attitudinal and behavioural issues pertain to the location-based mobile phone emergency service

One of the objectives of this research was the need to examine the attitudinal and behavioural implications of the possible nationwide utilisation of the location-based mobile phone emergency service in Australia in order to have a preliminary understanding of the opinion of the Australian individual about the service and a futuristic insight into his or her decision towards using the service, if there is a need to in the case of an emergency. These objectives were most likely to be achieved through examining the individual attitude towards using the service and his or her behavioural intention to use it (Davis et al. 1989; Davis 1993).

This study through its research model was eventually able to explain 26.1 percent of the attitude, and 36.5 percent of the variance of the intention. These levels of explanation are considered highly acceptable, especially when the explanation is concerned with a human behaviour (Arlinghaus and Griffith 1995; Gaur and Gaur 2006) such as the case in this study. According to these levels of explanation, it is quite reasonable to say that Australians hold a highly positive attitude towards using the location-based emergency service once it is utilised by the Australian government and intends to use the service, if there is a need to use it, in case of an emergency in the future.

The findings indicate a significant relationship between the individual attitude towards using the service and his or her intention to use it. Despite that attitude was somewhat weaker as a determinant of the behavioural intention \( (b = 0.241, \ p < 0.001) \) than the perceived usefulness of the service \( (b = 0.444, \ p < 0.001) \), the findings are quite consistent with Taylor and Todd’s (1995a) study in which they found the perceived usefulness to be the strongest predictor of behavioural intention of the individuals who have never experienced the technology or service before. Still, given the significant attitude-intention relationship found in this study, an extremely important implication is
presented in that the common Australian individual who has never used a location-based emergency service before is strongly inclined towards a personal decision for using the service once the service has been deployed by the Australian government. The relationship also implies a unique significance since it shows how the citizen of Australia positively evaluates and feels about the expected national initiative of the government to utilise the location-enabled components within its mobile government emergency portfolio. The strong relationship between the attitude and intention is also evidence that the attitude construct has an important mediating role that cannot be overlooked between the effects of the individual’s salient beliefs about the location-based emergency service (i.e. the perceived usefulness of the service and its perceived ease of use) and his or her behavioural intention to use the service once it is utilised in Australia.

5.8.5 The social acceptance of the location-based mobile phone emergency service

In technology acceptance and adoption literature, the individual attitude towards using a technology or a service and the behavioural intention to use are postulated as the main predictors of the person’s acceptance of that service or technology (Davis et al. 1989; Davis 1993; Pavlou 2003). According to the findings of this research, it is strongly argued that the people of Australia are more likely to accept, than to reject, the government utilisation of the location-based mobile phone emergency service based on the positive general attitudes and intentions that are held by Australians towards using the service. Nevertheless, this social acceptance of the service is expected to be moulded by several determinants that are discussed in the following sections.
5.8.6 The determinants of the social acceptance of the location-based mobile phone emergency service

5.8.6.1 The usefulness of the location-based emergency service

The perceived usefulness of the location-based mobile phone emergency service was the key driver behind the individual’s positive attitude towards using the service, and also his or her behavioural intention towards using the service. Australians believe that the service can actually meet their exigent needs in situations related to emergencies, where there are truly genuine benefits in utilising the service for emergency management that outweigh any concerns associated with it. The service was perceived to be highly useful despite (i) the risks that are perceived to be associated with the utilisation of this electronic service, (ii) the probability of the excessive collection of personal location information under the utilisation of the service and for purposes beyond emergencies, and (iii) the probability of the unauthorised secondary use of the collected information. The findings about the usefulness of location-based services completely support the few studies that have been conducted before within the acceptance research of location-based services, such as Chang et al. (2006) and Junglas and Spitzmuller (2006), in which the significant role of the usefulness has been identified as a key driver of the individual attitude and intention towards the service despite of potential concerns of the privacy of location information. In all cases, the high perception of the usefulness of the location-based mobile phone emergency service that is held by Australians came as no surprise in this study since the principal goal for utilising this service is to convey safety information or warning notification to the people when and where they need it most.

Reflecting on the arguments of this study, the antecedents of the perceived usefulness of the location-based mobile phone emergency service were: the perceived quality features of the service, the individual trust in the service, the social risks perceived as associated with using the service, the privacy concerns perceived with the utilisation of the service, the visibility of the service application to Australians and the perceived service ease of use. These antecedents were collectively successful in explaining more than 45 percent of the usefulness variance of the location-based emergency service. This high level of explanation in the service usefulness variance, standing at 45.4%, does provide
reasonable indicators into the issues that can be brought into focus if there is ever a pressing need to improve the public perception of the usefulness of the location-based emergency service, thus positively enhancing the overall social acceptance of the service.

5.8.6.2 The location-based mobile phone emergency service ease of use

The findings of this study have evinced the weak evidence for the existence of any direct effect of the perceived ease of use of the mobile phone location-based emergency service on the individual attitude towards using the service. Nonetheless, the findings did verify the highly influential impact of the perceived ease of use of the service on its perceived usefulness, suggesting that the individual is willing in general to accept the location-based mobile phone service regardless of how easy or difficult it is to use in the context of an emergency. This relationship between the usefulness of the service and how easy it is to use provides a strong indication that the individual would perceive the service to be more useful if it was easier to use, thus positively influencing his or her personal stance towards the service utilisation. Accordingly, there is reasonable ground to suggest that the perceived ease of use of the service has an indirect influence on the individual attitude and his or her intention towards the emergency service through the mediating role of the perceived usefulness of the service. Generally, the findings provide strong direction for designers of location-based mobile phone emergency service to contrive service offerings with easy-to-use design interfaces, making the service as intuitive as possible to use during emergencies, and comprehensible to everyone, including the young, the elderly and the non-technologically inclined people.

5.8.6.3 The visibility of the location-based mobile phone service application for emergency management

In general, the visibility of the location-based mobile phone service can provide the opportunity for the non-user to observe and judge the application of the service in its usage context, providing an effective source for the individual to evaluate the usefulness of the service (Karahanna et al. 1999). However, the visibility of the location-based mobile phone service application for emergency management to Australians was not
found to be statistically significant in determining his or her perceived usefulness of the service. A rational explanation is that location-based services are not yet widely utilised for emergency management in Australia and, therefore, the individual cannot easily observe the application of the services in the context of emergencies. In addition, Australians may rely more on his or her personal experience with the electronic service than relying on observing its use by others. Consequently, the individual may rely on his or her own source of evaluative information to judge the usefulness of the location-based mobile phone emergency service (Karahanna et al. 1999). Nonetheless, a highly intuitive rationale is that the specific usage context of emergencies, for which the location-based mobile phone service is considered for utilisation, eliminates the importance of observing the application of the service by the individual in order to judge its usefulness for emergency management since, in essence, any service or technology that is put into use for such purposes is perceived useful by its very nature regardless of how visible its application is to the potential user.

5.8.6.4 The quality features of the location-based mobile phone emergency service

Investigating the quality features of the location-based mobile phone emergency service emanated from the need to understand the accepted degree of the service quality the prospective user anticipated in the service when it is utilised for emergency management, given the fact that limited knowledge about the actual service quality dimensions of the service are available to Australians today. However, the findings demonstrate the insignificant role of the perceived quality features of the location-based mobile phone emergency service in shaping the individual perception of the usefulness of the service. It is speculated however that the findings reflect Australians uncertainty of the performance impact of the location-based service, in terms of accuracy, currency and responsiveness, on the usefulness of the service for emergency management purposes, which can only be grounded on the fact that the service has not yet been implementation in Australia. Still, even with the insignificant impact of the perceived service quality features on the perceived usefulness of the service in statistical terms, the service quality features did actually emerge as one of the important issues pertaining to the possible nationwide utilisation of the service for emergency management in
Australia, as it is discussed in detail in the qualitative findings presented in the following Chapter.

5.8.6.5 The risks associated with using the location-based mobile phone emergency service

The social risks perceived from using the location-based mobile phone service for emergency management had an extremely weak impact on the perceived usefulness of the service. One explanation for this insignificant impact is that Australians may perceive location-based services to be a part of the well-established mobile telecommunications network in the country, thus being mature enough to permit the useful delivery of safety information or warning notifications during emergency situations. Taking this into consideration, the risks associated with the use of the location-based mobile phone emergency service are actually part of the risks implicating the entire cellular network and not necessarily impacting this particular service alone.

5.8.6.6 Privacy concerns pertain to the utilisation of the location-based mobile phone emergency service

The perceived privacy concerns, including the excessive collection of personal location information and the unauthorised secondary use of that information, were both poised to play determining roles in (i) diminishing the individual trust in the location-based mobile phone emergency service, (ii) augmenting the risks perceived from using the service, and (iii) negatively impacting the perceived usefulness of the service. However, the findings indicate that only the collection, as a perceived privacy concern, has a significant negative impact on trust while all other effects are statistically insignificant to be reported.

It was particularly of interest to find that unauthorised secondary use was without any effect on the trust as collection did. One rational 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 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, contributing to a degree of personal attribution towards distrust the location-based emergency service more than any other privacy concern.

The findings also reveal that the two privacy concerns, collection and unauthorised secondary use, did not have any significant influence in augmenting the social risks as perceived from using the location-based mobile phone service for emergency management, which indicates that there is some threshold level that must be reached in the privacy hierarchy of effects before such risks are perceived (Drennan et al. 2006). Nonetheless, people did perceive the privacy concerns to be important even in the emergency situations reflected as has been stated earlier in the significant negative impact of the collection on trust. However, the negative impact of the privacy concerns was not enough to keep people away from engaging in a risk taking relationship when they perceived the benefits of the location-based emergency service to surpass the perceived risks, which make sense of why the privacy perceptions of the excessive collection of the location information and the unauthorised secondary use of the information had positive impacts on the individual perception of the usefulness of the service in contrast to the direction of the expected prediction. Although the impact of the collection and unauthorised secondary use on the service usefulness was insignificant in statistical terms, but its positive effect implies that Australians 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 Australians may perceive the outcome of the extensive collection of their locational data and the secondary use of the data in emergency situations to be in their favour when these activities are practised by the government. The findings also suggest that the context of emergencies is quite sufficient to produce an adverse impact on some of the “traditional” aspects of information privacy concerns.

5.8.6.7 Trust in the location-based mobile phone emergency service

The definition of trust in location-based emergency services encompasses the individual trust in the government agency controlling and providing the service and his or her trust in the technology and underlying infrastructure through which the service is provided
(Carter and Bélanger 2005). In situations related to emergencies where uncertainty is always present, the lack of trust in the location-based mobile phone emergency service may constitute a real barrier for the government towards the successful utilisation of the service. Indeed, the findings of this research show the highly significant role of trust as the most influential determinant of the individual perception of the usefulness of the service, suggesting that uncertainty reduction is a key component in the social acceptance of the service (Pavlou 2003) that deserves on-going attention from the government. The findings about the significant role trust plays highly corroborates several previous studies about the need to investigate trust in location-based services research (Basole and Chao 2004; Kaasinen 2005; Junglas and Spitzmuller 2006; Rao and Troshani 2007). The findings also echoed that of Pavlou’s (2003) work, Carter and Bélanger (2005) and Lu et al. (2005b) about trust issues in researching technology acceptance in the contexts of electronic commerce, electronic government and wireless internet services respectively. Though differences in the research context, it seems that trust is an important issue in any environment where data communication activities are present.

The findings of this study also demonstrate the pronounced role of trust in ameliorating the social risks as perceived from using the location-based mobile phone emergency service, thus breaking down these barriers to the usefulness of the service. When the individual has trust in the location-based emergency service there is much less risk perceived when interacting with the service, thus anticipating the service to be even more useful. These particular findings suggest that beside the significant direct influence of the trust on the usefulness of the service, trust also indirectly influences the usefulness of the service through the perceived risks. This validates the earlier conceptualisation of the trust-risk relationship in the research conceptual model of this study, mentioned in Section 3.6.4, in which the directionality of the relationship flows from trust to the perceived risks. The trust-to-risk directionality accurately describes the effects of this relationship and confirms the need to treat the two constructs separately and not to combine them into one construct, as suggested by Mayer et al. (1995), since their shared antecedents have displayed different effects on each of them (Junglas and Spitzmuller 2006).
People’s trust in the location-based mobile phone emergency service increases the benefits they perceive they would gain from utilising the service knowing that the government as the service controller is capable, trustworthy and behaving in a manner which people expect them to (Gefen et al. 2003a). It is only when people can form a trusting belief that the location-based emergency service is capable of performing the expected functions and that the government as the service provider and controller, acts with the people’s best interest in mind, that the service is considered useful enough to be utilised for emergency management. Finally, when a service, such as the location-based services is utilised to act as a life-sustaining tool, issues pertaining to privacy are proven to be less important and wholly overshadowed by issues related to trust. Only very few people would opt not to disclose their real-time physical location information in the name of privacy, especially if it meant that they could survive a natural disaster. What is of a greater concern to the success of an emergency service offering however 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 the service.

5.9 Overview of Chapter Five

This chapter presented and discussed the quantitative analysis results of a survey conducted with the general public of Australia to examine the issues and matters of concern in relation to the possible nationwide utilisation of the location-based mobile phone emergency service as part of the national emergency warning system in the country.

Details of the descriptive statistics of the survey sample population were presented first, followed by presenting summaries about the general usage trends of location-based services amongst the sample population at the time when the survey was administered. The presentation also included the analysis results of the rankings of the three information control mechanisms and the rankings of the importance of utilising the location-based emergency service in various emergency event types. A detailed presentation was then provided for the results of the partial least squares analysis on the
two components of the research model: the measurement model and the structural model.

Subsequently, an extensive discussion of the findings was initiated, detailing first the findings of the attitudinal and behavioural implications of the national utilisation of the service, which indicate the positive attitude of Australians towards using the service and his or her intention towards using the service in the case of an emergency. The behavioural findings provided a strong ground to then suggest the social acceptance of the location-based mobile phone service as an admissible addition to the Australian government emergency management arrangements. A discussion is then held regarding the determinants of this acceptance in which the role of trust has been recognised as being the most influential factor in driving people’s perceptions of the usefulness of the location-based emergency service, overshadowing whatever concerns people have about the privacy of their location information and ameliorating, at the same time, the risks perceived as associated with utilising the service for emergency situations.

The following chapter is a synthesis and analysis of the qualitative findings of this study in relation to the research investigation of the issues pertaining to the potential national utilisation of the location-based mobile phone service for emergency management in Australia, as articulated by the key stakeholders of the services. The chapter represents the effort of an extensive, in-depth exploration of the textual data of the semi-structured interviews and the open-ended question in the survey. Several key issues are identified and thoroughly discussed, in addition to presenting and discussing the expected barriers to the national utilisation of the service and significant key recommendations towards realising the service in Australia.
6 A synthesis and discussion of the qualitative findings

6.1 Introduction

This chapter is a narrative discussion of the qualitative content analysis findings of the issues pertaining to the possible national utilisation of the location-based mobile phone service for emergency management in Australia, as perceived and articulated by the key stakeholders of the services. Following Miles and Huberman’s (1994) model of qualitative data analysis, an iterative in-depth exploration of the textual data of the interviews and the open-ended question in the survey was carried out to reduce the text into a more focused form by keeping note of any regularities, relationships or patterns and then displaying the extracted text as shared themes. Throughout this chapter, each theme (or section) reflects a specific issue under which relevant viewpoints or opinions are presented as direct quotations from the stakeholders for easy referencing and for discussion purposes. The output of the Leximancer tool on the same textual data is also presented in this chapter, mainly to have more confidence in the reliability of the results and to enrich the presentation of the findings by providing a meaningful concept map and “a bird’s eye view” of the textual data, a view that represents the main themes and concepts contained within the textual data (Smith 2005).

The findings of the analysis identify areas of congruence between the stakeholders in relation to a number of key issues, including Australia’s need to utilise the location-based mobile phone service within the country’s national emergency management arrangements, and the pressing requirement for a comprehensive legislative framework that is effectively capable of controlling and regulating the utilisation of the service. The analysis findings also reveal areas of dissonance between the stakeholders on other
issues of concern, notably on the design aspects of the location-based mobile phone emergency system and the privacy of the individual under the utilisation of the system.

Other issues of importance emerged in the analysis as well, including the government and telecommunication carrier potential liabilities under the system utilisation, the expected roles and responsibilities of the government and other stakeholders, and some of the social implications of the location-based government emergency services, such as people’s trust in the services and risks perceived as associated with using the services.

The narrative discussion of the qualitative analysis findings extends to elucidate the potential barriers to the national utilisation of the location-based mobile phone emergency service in Australia. These include the lack of national coordination towards location-based emergency solutions, financial issues, Australia’s small emergency management budgets, geographic distribution of the population in Australia and technology constraints and limitations. Finally, a critical discourse of recommendations and proposals from the stakeholders of the service are discussed to help inform the road ahead towards setting realistic objectives and expectations for the service in Australia.

6.2 Leximancer output

Figure 6.1 depicts the core themes in the textual data of the interviews and the open-ended question in the survey that were automatically identified by the Leximancer tool. These themes and their related concepts, in addition to the themes identified by the iterative content analysis approach, are fully explored in the discussion presented in the following sections.
6.3 *Australia’s need for the location-based emergency service*

Australia’s future need to utilise the location-based mobile phone service within its national emergency warning system fundamentally stems from the practical characteristics of the service, which complement other channels of safety information. As stipulated by Expert A, the broadcast media do a very good job of communicating emergency information to the public, but there is no guarantee that that information is received by individual persons, especially if they have no desire to keep informed at any given time period. Expert C pointed out that everybody does not listen to the radio. The

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Figure 6.1: Leximancer concept map showing important issues forthcoming from interviews and open-ended question in the survey. The larger the concept the greater its importance to the study.
Black Saturday Victorian Bushfires, more than any other single event in Australia’s modern history, can be used to illustrate the need for advanced communication services. As Expert A reflected, Australians questioned where the notifications were and why so many people had to die: “[t]he notifications were being [sent] out in the normal fashion by radio, television, but because people were outside, it [did] not necessarily mean that they tuned in to those radio stations, or the television…”. It took the deaths of 173 Australians during a tragic event for the government to consider more innovative ways to communicate with the community before, after and during an event. There is now an “expectation by the community to be informed [in a] timely [fashion], rather than in a haphazard way” (Expert A). One way forward is to make use of the mobile phone, available technology already in the hands of the majority of Australian adults, which can provide crucial emergency information dependent on where the mobile phone is located. While you cannot guarantee that people will receive time-critical information via their mobile phone (e.g. it may be turned off), at least authorities are making “use of available technology to reduce the likelihood of people not knowing and increasing the likelihood of them being informed” (Expert A).

Other interviewees also acknowledged the shortcomings of the current information warning channels in Australia and the need to utilise location-based public warning notifications. Expert D was categorical in his assessment: “I definitely think we do need location-based warnings. There is no doubt about that”. While making use of landline billing address details for emergency notifications was one possible way forward using the legacy Integrated Public Number Database (IPND), Expert D preferred a warning system that could detect people roaming and provide customised location-based information. Vic-Gov also noted that they ultimately wanted a system that could be deployed during the largest and most troubling types of emergencies. Three months prior to the Victorian Bushfires, a Vic-Gov representative contacted the researcher, desperately seeking to put in place a system that could be used to notify individuals anywhere they were during large-scale emergencies in order to save more lives. For Vic-Gov, traditional forms of media were passive. From their assessment of a range of technologies that were nationally consistent, Vic-Gov was convinced by the power of the mobile phone and especially its ubiquity, not requiring an individual to be anchored anywhere to receive the given information. Vic-Gov stated: “People have, invariably, got their mobile phones with them. Usually, they are turned on. And so, if that
individual with an active handset is within an area that has been affected by something there is a very high likelihood that we will get a message to them, informing them that we know that they are in the area and we can point them to other sources of information. So, they do not need to be anchored to anything. It is the closest [thing] to somebody’s eyes and ears”. For the State Emergency Services (SES) the location-based mobile phone service can be considered yet another telephony-based channel to get a message to the public. SES highlighted the potential of the mobile phone to get people’s attention, especially if a disaster was to hit late at night when people were asleep.

Written comments from the survey respondents also reflected the community’s expectation toward the introduction of the location-based mobile phone emergency service in Australia in the near future. For the greater part comments focused around the need to have the location of an emergency caller automatically identified and tracked. One respondent noted that when calling emergency services 15-30 seconds “are wasted in providing the patient/caller location/address. It would be a great time/life saver technique if LBS is properly implemented by service providers as the police, hospitals and car-service providers as NRMA”. Numerous respondents thought that implementing such capability would be a good idea, practical and very beneficial, given Australia’s history of natural disasters. Some were even prepared to subscribe to such a service for up-to-the-minute information. Beyond the obvious advantages of location-based notifications via mobile phones, there is one segment of the community that would particularly benefit from the introduction of such warning systems. Vic-Gov noted that such a system would be highly beneficial to the profoundly deaf and hearing impaired which affect one in six Australians: “[i]f these people were in an area where they had been affected, they would receive a text message… So, by default, I guess, we have addressed a section of the population who struggle to receive [comprehensible] notifications”. Expert A showed his disappointment at the lack of urgency shown by some stakeholders, especially government, when he said: “[i]t is about time we had these systems in place. We see money being wasted in a lot of areas that are not as important as providing safety to our communities. And for a long, long time, disaster management and all those type of activities have not been at the forefront of government action. They tend to wait until after something happens”. The Redcoal-Rep echoed similar sentiments when he noted that it generally takes a tragedy for a reaction to come from government, and only then when it is a vote winning issue.
6.4 Legislative ground for the location-based emergency system

The introduction of a comprehensive legislative framework which would regulate the utilisation of location-based mobile phone emergency services was a recurring theme which emerged from the expert interviews. In Australia at least, it was found that without a legislative framework in place the introduction of a location-enabled emergency system would be somewhat unlikely. The lag between the introduction of new enabling technology and the establishment of legislation to support that technology’s capabilities can be stifling to the development of any new product or process. SES identified the government as lagging behind in clearly providing protection around the governance and use of location-based emergency notifications to all Australians. The emphasis is on the deployment of “blanket coverage” technology which is where the government needs to get started on legislating, according to the SES. But, rather than the view that legislation comes first, and then the technology can be rolled out, in this particular mobile government application society is evolving hand-in-hand with the technology. “Location-based services can be protected by legislation and need to be protected by legislation… You have to evolve your legal framework along with the technological underpinnings of the society it involves” (Expert C).

One suggestion by Expert C was to draft legislation associated with the emergency warning system under Emergency Management Australia, via consultations through the Council of Australian Governments (COAG). “Whether it is an emergency warning system under a federal agency’s control or whether it is a social networking site under a commercial operator’s control, those entities, to the extent that they are governed by our jurisdiction’s legislation, should be constrained in terms of what they can do with that location information” (Expert C). And it is here that location-based emergency warnings differ from traditional carrier-based LBS solutions. In the government context, we are not referring to a subset of consumers who opt-in to using a paid subscriber service but to all people who may be in an affected zone, including citizens and non-citizens alike. Expert E also noted the importance of an agreement between the individual to whom location information applies and the provider of that application. The agreement should be protected by law and should clearly identify “what that location information can and cannot be used for”, ensuring that the location data “not be used for any other purpose”. 

The introduction of early warning systems by their very nature cannot be put in place without some kind of a legislative or regulatory imperative. For Expert E, the fact that location-based early warning systems would need to be deployed unilaterally—that is across the whole population—a liability risk would be incurred as part of any set of legislative regulations or responsibilities. The actual scope of risks and responsibilities would need to be defined but in this open-ended environmental context there would be an arbitrary amount of potential liability. “There has to be a fundamental foundation from a regulatory and a policy perspective before any of this can happen,” reaffirmed Expert E.

Numerous survey respondents also confirmed Australia’s need for a legal framework to support the possible utilisation of the location-based mobile phone emergency service, with clear rules and penalties to effectively control the utilisation. One respondent noted that there should be “strict guidelines and rules for how and when the [location] information should be used, and significant penalties for companies that break these rules as well as appropriate compensation for the affected people”. Another respondent wrote that strict laws should govern what information is kept, how it is kept and who has access to it. The idea of penalties for misuse of location information was also raised.

Respondents were divided on whether or not to introduce completely new legislation or amending existing legislation so that the immediate use of location-based mobile phone emergency services could begin. One respondent was concerned that quick “fixes” might open a door for potential gaps in the implementation of the amended legal framework in a way that could be employed by third parties for purposes other than emergencies. Another respondent was circumspect about the law in general: “[e]ven with policies or laws which are created, I am worried about quick laws being passed to authorities to allow them to use our data for surveillance without us wanting to”. This respondent was more concerned about the authorised use by external parties than unauthorised use.
6.5 The liability of the location-based emergency service providers

There can never be any absolute guarantee that an error will never occur when location-based mobile phone solutions are utilised under the national warning system in Australia. Different types of errors could originate such as, unintentional human mistakes and sudden faults in underlying technologies or infrastructure. However, several issues arise, especially if there is the likelihood of loss of life due to an error. Expert D maintains that there must be the ability to identify where the error occurred in order to take the appropriate action against an entity and that someone is held liable for that mistake, especially in the event that there is loss of life as a result of that error. Consider the complexity of the LBS value chain and the scenario whereby the Bureau of Meteorology sends out a cyclone watch message via a third party provider, who for some reason downgrades the message eventually misinforming the public. Thus, “defining the source of the error is a condition to defining the accountability of each party involved in these solutions” (Expert D).

6.5.1 Government accountability

It may be difficult to understand how a government can be held accountable for its actions (or inactions) but Royal Commissions in Australia are common, providing a platform for major governmental public inquiries into a given issue. For example, there was a 2009 Victorian Bushfires Royal Commission (VBRC) which handed down its final report on July 31, 2010. In the context of LBS for emergency services, the interviewees were not in agreement on who for instance would be held accountable if a person did not receive a warning message at a crucial time. The SES pondered on such a scenario: “[i]f I do not get that warning message that I have been promised that I am going to get on my mobile phone and my family or I am hurt as a result of that, my question to government is going to be: ‘Well you promised you were going to tell me and you have not and I have suffered this damage from it’. I would be heading down the road to one of those barristers and I reckon I would have a pretty good case”. Realistically, however, another interviewee noted that no technology or system is fool proof, and that given LBS solutions rely on technology, the government cannot be to blame for system errors which are squarely outside their control. There is nothing to say
that at any given point in time, something could go unintentionally wrong with the technology.

Expert A believed that the government should not be liable for any problems surrounding location-based services that negatively impact people, given that early warning systems are just one method among many available during disasters. But despite this, the government still needs to define, through an explicit legal framework, its exact responsibilities and obligations under location-based mobile phone emergency solutions. According to the SES: “[t]he government needs to have a look and make sure they have all the legal ends tied up to protect themselves so that whatever legislation they will bring in to place to cover this, it will provide appropriate protection for them to be able to provide the service”.

6.5.2 The telecommunications carrier accountability

Amongst the issues that should also be regarded in future legislation, or within amendments into existing Acts, is a reference to the possible inaccuracies in the delivered information disseminated by the telecommunications carriers to the people in the case of an emergency. Consider a scenario where a warning notifies the wrong group of people about a pending natural disaster, or provides the wrong list of directions on what to do (based on the location of a mobile), during and immediately after the emergency. Expert C advised that while it was good to have accuracy requirements, he believed it was a “very dangerous game to play to say that anybody has to be absolutely correct. And this is actually particularly true of location-based services with specific reference to things like the value of the location as determined… It is actually a statistical game and it is actually not possible to be one hundred percent correct”. A notable practical example to support this can be found in the United States Government E-911 initiative, as the interviewee added “for a handset-based location determination technology like GPS, the operator has to be within 50 meters, 67th percent. So, in other words, you have to be within 50 meters of accuracy at a two-thirds confidence. So, two out of three of those locations you provide you need to be correct within that 50 meters. And then they also said further that you need to be within 100 meters of accuracy at the 95th percentile. So, in other words, 19 out of 20 times you had to be correct within 100 meters. But, they quite reasonably said that 5 percent of the time, you may be well,
completely wrong. But, there are basically two levels of confidence that are specified as part of the regulation”.

Accordingly, what is needed in the Australian context is to set comparable accuracy requirements that practically define the responsibilities of the telecommunication carriers and/or the government when location-based services are utilised nationally for emergency management. It is the operators who need to be held responsible for achieving those levels of performance, not so much the Australian Government. Expert C said, “[y]ou can use that mechanism to ensure that the operators are applying all the due diligence that they should be doing, that their network is as optimised as effectively can be on any kind of reasonable cost analysis basis, but at the same time it means that you are not going to hold liable that operator for an individual event where in fact the location information was not correct with respect to that location determination. And with respect to the performance of location systems generally, I think you have to have that realistic underpinning within the requirements of the government legislation”.

Further consideration of the accuracy issue reveals that there needs to be a fine balance. The operator needs to be doing everything they can based on a given set of performance metrics without putting themselves in a liable situation so that any given individual at any given period can claim arbitrary large dollar amounts for damages (Expert C).

Service level agreements or defined contracts are the most logical and practical of options to define and regulate the relationship between the government and the telecommunications carriers. These contracts can also serve the purpose of defining the responsibilities when and if something goes wrong. Expert E complemented the views held by Expert C, looking at the dilemma surrounding the accuracy of location information as a contractual issue. He said that ultimately it had to do with the contract between the service provider and the acquirer of that service. The acquirer in this instance is the Government (at the State or Commonwealth level) and they would have agreed on a series of service levels pertaining to location-based services for the emergency context. This is distinctly a jointly developed government and business model. This is a very important observation, that mobile government applications by their very nature are not, and cannot be, models exclusively built by a single stakeholder, but rather a collaborative effort between stakeholders (Figure 6.2).
Expert E played out a possible scenario based on the contractual relationship. “If somebody sued the service provider [for inaccurate location information], the service provider would say: ‘Well, I do not have a contractual relationship with you. My contractual relationship is with the state, so go sue the state. And if the state has a problem, then they will join me in that action [as a party] anyway’”. As Expert E’s scenario further developed, an individual who had been adversely affected might then sue the state for damages and to the extent that the state attempts to file an action against the service provider, that action will be limited by the formal contractual agreement. In this instance there are legal limitations on being able to underwrite against loss of life- “your indemnity for loss of life and the warranty on loss of life would end up being incredibly specific” (Expert E). The agreement would most probably say something like- the responsibility for life lies with the contractor, not the service provider. Expert E role plays in the shoes of the service provider: “[w]e will, of course, look after a death that occurs, for example, in the installation of the equipment.
that is going to be used to provide the service but not as something that occurs as a consequence of the service not being available or not working the way that you expected, except to the extent that we said it will work that way”. It quickly becomes apparent from the interviews that not a single stakeholder type, especially Government, will commit to one hundred percent availability of such services.

6.6 Roles and responsibilities under the location-based emergency system

A national location-based emergency system is yet to be fully realised in Australia, although members of the Australian public can now receive emergency alerts on their mobile phones. Among the surveyed population, most respondents said that the government had a responsibility to control the legal and operational aspects of such systems. One respondent highlighted that it was a great idea (especially if it was instituted free of charge to the consumer), but that it must be controlled by government regulation in order to protect the personal information and privacy of the individual. Another respondent noted that such services should only exist if service providers had first obtained the explicit permission of a given government organisation. People generally found the idea of location-based services for emergency warnings to increase their personal security, but most also noted the importance of implementing “strict laws” to prevent excessive intrusion on personal privacy. One respondent said that “it would be necessary to create government agencies that monitor the transactions by service providers, and make sure that service providers act under strict laws and government supervision”.

Expert A argued that the responsibility of the location-based warning system should be added to the existing list of responsibilities that are executed by the disaster management committee in each State and Territory in Australia. “Each state already has a committee for disaster communications. That is part of their roles and responsibilities. I see this as being very simple, easily linked into that. It should not take any additional bureaucracy to be involved”. Expert C perceived the responsibility to be a multi-dimensional role that should be distributed according to the specific function each party is fulfilling under the utilisation of the location-based warning system. These parties include different government emergency services agencies, in addition to the
telecommunications carriers. Responsibility is distributed across agencies that are best equipped with maintaining different aspects. Expert C stipulated that network operators should be responsible for location determination systems, the ultimate reliability of the location information, and the performance and capacity of the location determination mechanisms. Network operators would also be responsible for the integrity of the location information itself, but how that location information is used must be the responsibility of the agency and not the network operator.

Expert D held the position that the responsibility of warning messages be assigned with the most relevant department pertaining to that emergency. Expert D identified that the government agency would then outsource the requirement to send the message to one of the mobile telecommunications carriers. What is important here to note, is that it is likely that authorisation for sending out specific warning messages still remains with the relevant authority, such as the Bureau of Meteorology for weather warnings, etc. Accordingly, a very important point is to clearly define the control authority, which is allowed to initiate the use of the location-based mobile phone warning system, assign the responsibility of the emergency situation to the proper government emergency agency(ies) and control the sending of the warning message to the public. The control authority should also aim to prevent the overlapping of jurisdictions between different government emergency service organisations over the responsibility of managing a specific emergency situation. Expert B provided an example from the VBRC when it was revealed that the Fire Authority wanted to issue warnings but they did not think they were authorised to do it, so they did not. Expert B identified an administrative problem rather than a technical one and noted: “I think that is what is missing and we need that worked out”.

At the time of the interviews, which government department would be granted the role of the control authority under the national location-based mobile phone emergency system was still unknown. The Victorian government official believed that it should, at least, exist at the jurisdiction level. “Who is going to run this thing? Who is going to own this thing? I do not have a clear answer for you because it is still a question that I keep asking. I think it should certainly rest on a jurisdiction level because the emergency management arrangements exist at that level” (Vic-Gov). But more importantly, a control authority at the federal level should also exist to ensure consistent
quality levels of the location-based mobile phone emergency services anywhere in Australia. “Every Australian citizen is entitled to receive a message if they are potentially in an emergency situation. Now, if I was travelling throughout the Northern Territory, Queensland or Western Australia, I would dearly hope that the quality of the service provided to me was equal to that which I received in any other State or Territory. So, from a federal perspective, there would need to be guidelines around what that meant… ensuring that [each state] was delivering that same quality of service countrywide” (Vic-Gov).

Expert C identified Emergency Management Australia (EMA), which belongs to the Attorney-General’s Department, as a good candidate for the role of the control authority over the location-based mobile phone emergency system on the national level in Australia. It was the opinion of a number of experts interviewed that a common approach and platform within a consolidated agency was required for the successful implementation of a national warning system, alerting people of diverse emergencies as they occurred. Among the responsibilities that the EMA might enjoy include: maintaining the reliability of the national emergency warning system platform, maintaining the privacy of any personalised location information gathered according to the Privacy Act, the structure and contents of distributed warnings, the management of the geographic boundaries and the integrity of the interfaces to the networks for getting the location information (Expert C).

6.7 People’s trust in the location-based emergency service

When Expert C was asked about the impact of trust on location-based services for emergency warnings, he replied “[u]sing the telecommunications network channels as a mechanism for warning people in emergency services is something I would trust to the extent of it being better to have it than to not have it”. It is perceived that most people who received an emergency alert from an emergency authority would consider it to be beneficial. Expert C explained further: “the information that I received by that alert I would trust to the extent that I trust emergency services to get it right, but that is not the technology’s problem, that is just the general perspective on how reliable and trustworthy public authorities are in any case”. Similarly, Expert B commented that
people trust firemen more than they trust politicians, so trust in a location-based emergency warning alert system for tsunamis, fires, earthquakes and so on, should be accepted by the general public, if not highly favoured.

A close examination of the responses by the expert panel implies that people’s trust in the location-based mobile phone emergency service would actually reflect their trust in the actual services, in addition to their trust in the authority that controls and provides the services. The Redcoal-Rep preferred to rephrase the question reflecting: “Will people trust it? I think the question should be will they trust it more than the existing modes of communication, which is the media? I would imagine, to a large extent.” However, building people’s trust in these advanced services may require educating the general public about the specific benefits of these services for emergency management and also on the limitations of the capabilities. For Vic-Gov awareness was very important where trust in services and the authorities who offered them was a concern. “Once we have educated them [the public] on the fact that this technology exists and that, potentially, at any time they could receive such a message, a large percentage of the public would trust the message they will be receiving”. In general, people’s trust in location-based services is a key element to the success of the services within the national arrangements of emergency management in Australia. One respondent commented that while the service was good, that her only concern was whether LBS would be a trusted product for emergencies. This respondent also drew a close tie between trust and privacy. Another respondent rightly commented that if LBS became a highly trusted service that could be used for emergencies, only then would it be possible to prevent many deaths and other losses.

6.8 Risks associated with using the location-based mobile phone emergency service

The risks associated with use of location-based services as emergency services were considered to be just like any other technology (Expert C). Nonetheless, one of the social risks that could be specifically associated with using location-based services is the possibility of not informing or instructing individuals properly in the case of an emergency. According to Vic-Gov the risk was not so much with the LBS technology but rather how people might react when receiving a message.
Another risk that is not related to the characteristics of location-based services but in the way they might be utilised within emergency management activities is to rely entirely on these services in emergencies. Expert D described the risks with an over-reliance on any one technology or communication channel. There are inherent risks with using just a mobile phone to keep updated on the latest emergency news, without some kind of backup secondary outlet like television so that information could be reconciled in more precarious situations. Expert D noted: “I suppose that would be the biggest risk if their sole information source was their mobile handset and were not getting any sort of secondary information from television or radio, then there would sort of be that risk because it is always useful and very important to have… secondary sources to make sure that they are consistent with each other”.

However, one of the experts argued that it is more important to think beyond the risks that are associated with LBS technical failures and to consider the risks associated with LBS in relation to the surrounding political environment in which these services are utilised by the governing forces in power. With regard to the social risk, Expert C claimed that LBS was just like any other technology, that it could be used for a variety of purposes: “[i]t is not the technology itself that is fundamental actually. The fundamental control that people have with respect to how much surveillance they are under, what controls they are under, to what extent their freedoms are constrained, is more fundamentally linked to the strength of their democracy than it is to any one or other technology that exists within their daily lives”. Accordingly, it is the political environment that can introduce concerns for people in the way location-based services might be utilised. Thus, Expert C was adamant about any social risk that could arise from LBS in emergency management: “[it] has more to do with the extent to which their society and the strength of their democracy protect them [the general public] than it does anything to do with the technology itself”.

In all the interviews with the expert panel it was found that any potential risk that may be associated with location-based services utilisation for emergency management in Australia will be far less than the risk of not introducing these services at all. The Redcoal-Rep spoke about the difference between perceived risk and actual risk. For him, the perceived risk from the public is that the LBS infrastructure might be used for other applications other than for emergencies, heralding a type of function creep. But in
terms of the actual risk, the Redcoal-Rep was circumspect in saying that “you need to consider the fact that any business technology may fail. That risk is common for any new service or even existing service that is in place”. The Redcoal-Rep also discussed the notion of relative risk, in this case, the risk of not implementing a nationwide emergency service. Quite often the perceived risk far outweighs the actual risk. Indeed, the risks of not introducing location-based services for emergency management in Australia have been manifested in the recent trend of the Australian Government which followed the tragic 2009 Victorian Bushfires in identifying the compelling need for utilising location-based mobile phone technologies for emergency management purposes on the national level (The Victorian Bushfires Royal Commission 2009; The Victorian Department of Treasury and Finance 2009).

6.9 Privacy issues pertain to the utilisation of the location-based mobile phone emergency service

Emergencies, as unique usage contexts of LBS, should be enough by their very nature to alleviate any concerns people could have about privacy and the way these services are utilised. That is, it is generally hard to believe why someone might wish to exploit others during a time of crisis. SES were very honest in their appraisal: “I think there are privacy issues, but it is probably in our best interest to waive those privacy concerns, and it is more about people keeping safe. And to keep people safe you need to be able to tell people they are in the path of danger, and I think that waives those privacy issues”. A similar sentiment was echoed by Expert E, “[m]y personal opinion is that there would be a general expectation that, perhaps, privacy should fall away when there is a threat, particularly when the individual is threatened”.

The position of Vic-Gov on the matter of privacy was quite straightforward: “[i]t is not something that we are going to use to even identify the name of the person necessarily. All we are interested in is that phone number within the emergency area at the time of the event”. For Vic-Gov it has more to do with making the individual more resilient and providing them with information which helps them to make informed decisions. If people can call triple zero in Australia without any expectation of privacy, then the privacy associated with this [LBS] should similarly not be an issue reasoned Vic-Gov. It
will be the same organisations which will handle the information, save for the potential for evidence to be used in exceptional circumstances like in a Coroners Court.

In the case of an emergency the essential identification of personal information, such as the mobile phone number, should never be perceived as a threat. This sort of identification might be the only approach for the government to provide location-based mobile phone emergency services to people, thus the needed safety information to counter or deal with that emergency. The only difference here is that in triple zero calls, an individual volunteers their personal information for safety purposes, while in an emergency warning setting the Government makes a judgement regarding the safety and well-being of their citizens. Vic-Gov again reiterates: “[t]he only aspect that we are interested in is the number. If there was another way we could send a notification to that handset whether to the IMEI [International Mobile Equipment Identity], or something like it, that would do us as well. It is whatever will allow us to get the message to that handset in the most efficient manner”. The Vic-Gov official insisted that this mode of identification for emergency purposes cannot be labelled as collection of personal information and, therefore no privacy concerns should be perceived. She said: “[i]t depends…on what your definition of collection is. I would prefer to talk about it as being purely identifying active handsets at a point in time because a particular event has occurred and we feel an obligation to notify those handsets that an event has occurred and there is the likelihood that they could be impacted by it. We are not collecting anything. We are identifying the handsets that were there at that point of time and that is the extent of it”. There needs to be a clear distinction between the possibilities of a breach in privacy in government applications like the national warning system, and those pertaining to commercial entities. In a commercial context it is expected that consumers might have grave reservations about LBS, even though carriers have been storing this information since the inception of their networks.

The identification process of individuals cannot trigger any privacy concerns since there is basically no breach to people’s privacy. Vic-Gov further explained that from the emergency management perspective, the Government will not have visibility of even who the individual is; they simply require a mechanism to notify a person that they may be in a potentially dangerous situation. Whether it is the handset ID or a handset phone number is irrelevant. Nonetheless, while the majority of people would most likely
overweigh the potential benefits of LBS over any associated concerns, the benefits alone may not stop some individuals from continuing to perceive the use of LBS as an invasion to their privacy even during emergencies. “There are people in the community that would actually find that an invasion of their privacy. Strange as it may seem, there are people like that out there, but I think the majority of people would not be too concerned about receiving a message if it was aimed at helping them to survive a threatening situation” said Expert A.

It is argued that privacy in today’s society has been augmented as an issue of concern due to the political climate that has been progressively characterised by the introduction of unprecedented security measures forcefully attempting to counter all identifiable human- and natural-caused security risks. These measures, such as the CCTV Ring of Steel initiatives in New York and London, and body scanners in many airports around the world were introduced by several governments, including the Australian, as indispensable to the general public’s safety. They are however perceived by many as the beginning of the “total surveillance society” (Garfinkel 2000; Rule 2007). As a result, new security initiatives such as the national location-based mobile phone emergency system, with the ability of its underlying technologies to locate and track mobile handsets almost everywhere, could easily trigger genuine concerns about privacy. For Expert E, things became a lot greyer once the extent of an emergency becomes drawn out, in a similar way to the issues surrounding Homeland Security in the United States. In this instance, the national security threat has lasted for eight years and is not about to go away any time soon, so privacy is curtailed for the public good. Now ask someone in the general community whether they would like to use such a warning system for a one off event like a Tsunami, versus some kind of terrorist threat and you might end up with some quite different results to what you expect. Expert E summarised his position as follows: “[s]o, would I mind if personally identifying information, which I have not given permission to use, was used by the police to warn me that there was a burglar in the street? Then no, I would not, and I do not think most people would. Would I mind if that information was used for something, which was generally for the good of police operations in Sydney? Yes, I would. I would be much more upset about it”.

Although there was an overwhelming appreciation for LBS utilisation as an additional useful emergency tool by the survey respondents, several comments heavily expressed,
the concerns people had about the privacy of the individual in Australia if and when LBS were utilised for emergency management, giving clear evidence that examining people’s acceptance in this study was indeed an opportunity to understand such concerns. One respondent wrote: “I am very concerned about the impact this technology would have against civil rights, including lack of privacy”. Numerous individuals were concerned about the misuse or abuse of individual location data: “[m]y concern is what happens if government abuses the use of LBS?” and again, “there must be limits on the access of the services”, and another “I would be concerned with the negative aspects that may arise, specifically if the data is misused”. Now in all of these instances, individuals did point out that they saw an emergency warning system facilitated through their mobile as a good, beneficial and positive idea that they would support, but individuals also were not devoid of thinking about the “what if” scenarios. One respondent listed his concerns as follows: “1. Loss of control over personal data, including location data. My privacy would be compromised. 2. The potential for my data to be misused by unauthorised individuals. 3. Anxiety relating to other parties knowing my location at any given time and making inaccurate assumptions about me/my family. Safety concerns are also relevant here”. On the latter point of personal safety, one respondent raised the issue of the potential for private information collected about geo-location to be distributed or shared amongst the third parties affiliations of telecommunications carriers. This issue was not just about sharing data but also that the data collected by the carrier could in no way be guaranteed in terms of integrity. The risk of unauthorised access of an individual’s location data would in fact be a breach to personal privacy, said another respondent.

Privacy issues associated with utilising location-based mobile phone emergency services were perceived as a problem and a real source of concern to the people who had responded to the survey, and who were likely to consider themselves amongst the prospective users of these government emergency services. This is despite people’s critical appraisal of the significant benefits of the services for emergency management purposes (Table 6.1).
Table 6-1: People’s perceptions of privacy: Representative responses

<table>
<thead>
<tr>
<th>ID</th>
<th>Representative privacy related comments from the survey response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I agree that there are many advantages in using LBS. But, I also note that my location information can easily be misused as well. Tough laws need to be passed prohibiting unauthorised use of personal information (location) without user’s consent/authorisation. But, even with the existence of tough laws, the possibility remains for others to use information about one’s location.</td>
</tr>
<tr>
<td>2</td>
<td>I like the idea that LBS should be used in case of emergencies. However, with recent events… that law enforcement here ignored the rights to privacy, the conflict of rights to privacy and the importance of security need to be addressed.</td>
</tr>
<tr>
<td>3</td>
<td>I would be concerned about my location information being used without my permission. If part of using LBS included my location information being used by third parties e.g. advertisers, I would not use it at all.</td>
</tr>
<tr>
<td>4</td>
<td>I strongly support the use of location-based services for emergency management as I believe that it could really help save lives. At the same time, I hope it is used only for these purposes so that people’s privacy could be retained.</td>
</tr>
<tr>
<td>5</td>
<td>I would like the telecommunications firms to use LBS but only for emergency situations… But, the problem these days is that our privacy is violated by these companies, and would you believe these companies would treat our privacy in full confidence? These days we all supervised by the government, security cameras on the streets, and even sometimes these reach our rooms and houses. Moreover, spy satellites can identify and get us even in our own places. Would you accept that LBS violates our freedom? These technologies are pretty nice but only if we use them right.</td>
</tr>
<tr>
<td>6</td>
<td>It is a good idea, but can be very intrusive and annoying if advertising companies get access to it.</td>
</tr>
<tr>
<td>7</td>
<td>LBS sounds like a good service for emergencies. However, if a person can be located constantly wherever they are this may cause concerns about being ethical to know where someone is 24/7. While many would use it for good, some may use it to benefit their own behaviour.</td>
</tr>
<tr>
<td>8</td>
<td>Whilst I can see the benefits of using LBS, I have major concerns over the fact that these mechanisms can be used to track my location. I understand that my mobile phone can easily give a rough location as this is just a by product of the technology of mobile phone towers. I do not want my exact location to be known 24x7. I believe the technology should exist where with 100% certainty the feature can be turned off.</td>
</tr>
<tr>
<td>9</td>
<td>Although I have a few concerns of being tracked by the service provider, if it does not impinge on rights of personal freedom too much, I think that it is valuable and definitely beneficial.</td>
</tr>
<tr>
<td>ID</td>
<td>Representative privacy related comments from the survey response</td>
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<tr>
<td>----</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>10</td>
<td>This is an interesting idea as long as it does not affect people’s privacy or personal life in any way.</td>
</tr>
<tr>
<td>11</td>
<td>LBS would be a great help in emergencies as long as it is not used to interfere with the privacy of people using it in daily activities.</td>
</tr>
<tr>
<td>12</td>
<td>Something like LBS would be exceptionally useful if the privacy concerns are looked at, then the advantages will outweigh the concerns.</td>
</tr>
<tr>
<td>13</td>
<td>For me, I am totally on board with the use of LBS for emergency management. The only concern that I have is the potential abuse of personal information. Organisations must handle personal information properly when no emergency exists.</td>
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</tbody>
</table>

Interestingly enough, one explanation of why people might perceive the use of location-based services as an invasion to their privacy, even during emergency situations, is given by an emergency management expert who believed that individuals who had never been in a serious emergency before would still outweigh his or her privacy over anything else. The expert from SES who works in emergency services has experienced situations where people can be caught up in danger very quickly. While he did not mind receiving an SMS if he was found to be in the area, to assist others out of harm’s way, he commented that a citizen, who had probably never seen a lot of these situations, might find himself/herself thinking that access to sensitive location data was an invasion of their privacy.

In addition to the lack of awareness about the seriousness of emergencies, and accordingly the possible benefits of LBS in such situations, people might also be unaware about the fact that providing mobile location information to the government in the case of an emergency is actually part of the service agreement package with all mobile service providers in Australia. Although these agreements only cover citizen-to-government (C2G) types of services, without any explicit mention to the government-to-citizen (G2C) service type. The possibility of provisioning such information is nonetheless consented by each person once he or she enters into a mobile phone service in Australia. Expert A reiterated the importance of this fact and emphasised that emergency warnings were an “information service” supported through service providers and definitely not a breach in privacy. It is a public service announcement and thus it
cannot be opt-in or opt-out, “it is there permanently and you just have to accept it as being part of your acceptance of a service provision” (Expert A).

In regard to privacy and location information, one of the key experts who has long worked with location-based technologies argued that the pervasiveness of mobile phones and the abundance of technologies and applications that successfully integrate location information as part of the regular service offerings have all helped to positively change the social attitude towards the use of the personal locational information. As the expert discerned, location information has become a “common topic” amongst the general public that does not raise high sensitivity today as it used to about a decade ago. According to Expert C, much of this has to do with time. At the turn of the millennium when 911 happened there was a lot of talk about new location-based applications like friend finders, child finders, local information, navigation and the reaction of the people was “‘Oh, I don’t like the sound of that’. There were the big brother implications. There were the surveillance implications. There were the government control implications… [but] come forward ten years and the last few years in particular, and the proliferation of personal navigation devices, there is an increasing amount of comfort with things like GPS and knowing where you are”. Indeed the introduction of “free” services like Google Maps (e.g. StreetView and Latitude) has somewhat desensitised users on the one hand, and educated them on the potential application on the other hand. For Expert C, location-based emergency services are a “social service” that he could not believe would be a controversial or contentious issue with the general public, and definitely not an election winning issue.

Expert C stressed the need to acknowledge the technical and physical limitations of the current telecommunications networks and positioning technologies in Australia, as these limitations would ultimately provide a rationale for the public to eliminate any misconceptions about possible infringements in privacy. It is worth quoting him in full: “[f]or a system like an authority to citizen warning service, there is that implication associated with the whole concept that you have to know where everybody is, and that actually… is a significant technical challenge, practical challenge. A network operator cannot actually know moment to moment where everybody is. The actual determination and specific geographic location in a mobile network context requires resources, requires network signalling resources, it requires device resources if the device is
contributing to the location determination. To be continually doing it moment by moment, to know where everything is actually is not a practical proposition. It is not a practical proposition with today’s technology. It is not even a practical proposition with foreseeable technologies because you have got to acknowledge that you are actually going to be consuming resources, and if it is moment by moment at arbitrarily small intervals that you are going to be consuming resources, it is something approaching infinity”. While Expert C raises some very important points to do with the feasibility of tracking citizenry moment by moment, the granularity of tracking still remains a relevant discussion point. Most people would agree that you do not require such fine granularity to understand the location profile of an individual. And as humans are creatures of habit, predictions are usually accurate to an established margin of error.

What is perhaps irrational, beyond the technical feasibility of tracking and monitoring citizenry is why a government would actually wish to track everyone anyway. The Vic-Gov representative dismissed the idea completely: “…the things not going to be on all day long just monitoring who is moving in and out of a network all around the country”. She concurred with Expert C regarding the load such a scenario would have on a carrier’s network. She also believed that a carrier would not want the government probing and monitoring to that extent. Expert E also pointed out that no carrier would want to risk damage to its brand or reputation by using the available locational information potentially for purposes other than emergencies. “The carriers themselves are terribly concerned to make sure that they do not abuse… personally identifying information… in a way that could result in almost any criticism” (Expert E). Expert B emphasises that the community will accept that some of their normal rights will be limited or waived in the event of a state of emergency. In this instance, people might not only accept, but expect to be ordered around for their own good and survival.

Nevertheless, there is still a need to clearly reflect the potential invasion of privacy in future government legislative amendments. The Whispir-Rep asserted: “I would like to see a recipient controlled system. That is the most respectful and appropriate way to engage communications. But that might not be practical. If there is a political will to or a desire to communicate to every handset, then all you are talking about is overriding people’s preferences and sending them a message regardless… There are privacy issues to be dealt with. I am not saying that it is a reason not to provide a service but certainly
the legislation needs to be changed to send a message to those people whether or not they have asked for them. My understanding of the legislative framework is that it needs to be changed to this use case”. Finally, as there shall always be concerns from some individuals and associations about infringements in privacy, even if the intended purpose of location-based mobile phone service utilisation is for emergency management, the government of Australia can genuinely help to alleviate such concerns through communicating a set of guarantees about the use, collection and storage of the location information under location-based mobile phone emergency solutions. As the Redcoal-Rep insisted, a large part of it had to do with how the government communicates the need for such services in case of emergencies. Expert D puts it all in perspective by saying that there are always going to be privacy issues concerning the general public. “You have always got to have a sector of the community who will be concerned about whether that information is somehow leaked out or made available or used for other purposes. So, the community would have to be assured that the collection of location [information] would only be for the specific purpose of warning you of a quite threatening emergency. And even in that case, any information collected by the agencies about your current location would then, somehow, be de-identified if the information needs to be stored”. A summary of trust, privacy and risk-related matters between stakeholders can be found in Figure 6.3. It should be noted that the union between two stakeholders indicates the dominant matter at hand. For example, the dominant theme found in the analysis between “government” and “customers” is “Trust”.
6.10 The location-based emergency service quality dimensions

Survey respondents from the general public did identify factors related to accuracy, currency and responsiveness of location-based mobile phone emergency services. Most prominent in their remarks was the need for acceptable quality levels. A recurring theme amongst respondents was that for such a warning system to work, the information provided by the service must be accurate and timely and reliable. In this manner it would lead to personal safety but otherwise fail. Respondents did not expect a service that was always accurate as they did not consider technology to be perfect per se, but they did emphasise the need for only a very small margin of error. 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”. A number of respondents distinctly discussed “quality” and others “product reliability” but emphasised that without quality and reliability the LBS warning service would be useless. Other conditions the general public identified included that the service should be heavily regulated, controlled, optional and free to use. Some respondents were also very concerned about how personal information might be misused but when it came to safety were concerned...
about the possibility that incorrect information would be dispersed or late data arrival would only add to the confusion during an emergency. People also highlighted the pitfalls of late data arrival via SMS which if not timely could cause panic and chaos amongst the general community which would be even more hazardous during an emergency situation.

6.11 Opt in and opt out system design issues

In regard to the opt in/opt out design aspects, a number of interviewees agreed that every person in Australia should receive the warning message without having the opt-in option built into the location-based mobile phone warning system. In addition, most viewpoints concurred that the system should not have an opt-out option. In other words, each individual in Australia is obliged to receive the warning notification if they are located in a defined emergency area (see Figure 6.2). The role of the government is to provide societal securitisation to protect citizens and non-residents from harm. As the SES representative pointed out, “[i]f you make it an opt-in system does that mean you let all those who opt-out just die? There is something inherently unethical about such a systems design. Expert B emphasises that during an emergency there is no opt-out, “[i]t is compulsory to receive the warning message”.

Implementing an opt-out feature in a national emergency warning system complicates the network design. Expert E plainly concurred with other interviewees, “I cannot see that working”. Opting-out is fraught with a number of concerns. For instance, what if two people share the same phone, and one wishes to opt-in and the other opt-out? Taking the possibility further Expert E developed the scenario: “[i]f one opts-out and the other dies because they did not get an emergency warning because of the opt-out, I would not like to be representing, for our firm, the people who are sued because of that”. Thus opting-out just does not make sense. The official from the Victorian Government also shared a similar opinion: “[i]f they opt-out and they did not receive the message and then the unfortunate event occurred where they lost their life, it would not be well received within the Coroners Court as to why they did not get the message and why we could not have, when provided everybody else, with a means of
maintaining their safety”. For Vic-Gov the national warning system should neither be opt-in nor opt-out.

However, the following are some interesting points of view on why there is a need to enable the opt-in and opt-out options in the location-based mobile phone warning system. Expert C in particular voiced his bewilderment at why the Government placed such constraints on the solution, without allowing people to opt-in or opt-out, instead automatically applying the solution to everyone. Expert C correctly identified the usefulness of opting-in to emergency warnings, because one might have an interest in a given area despite not actually being there during a disaster, and want to be kept informed about the latest developments. For Expert D, the facility to opt-out should be an option, independent of why someone does not wish to receive messages that might aid their survival. He noted that there are five levels of threats, and that one could build a warning system that was dependent on the severity of the warning. Level four and five warnings, for instance, may not provide an opt-out feature due to the severity of the emergency, simply if one is in that geo-location then they will receive a warning message. But for lower level warnings that do not have an impact on one’s life, an opt-out option should be offered.

“Some people will be interested in certain things for different reasons. I think it should be recipient driven because you cannot make too many assumptions about the communications people want to receive”, said the Whispir-Rep. There are some complex use-cases surrounding the deployment of such warning systems but providing people with the choice is very important and not difficult. The Whispir-Rep considered that such a choice could be made by providing an interface whereby people could manage and maintain their own profile. For instance, what happens to people who have several mobile phones for different reasons, should all their phones ring at the same time to let them know a single message has arrived in their inbox.

The perspective of the survey respondents who specifically wrote comments pertaining to the issue of an opt in/opt out system design as a means to maintain the individual privacy and as a mechanism to control the use of the service under the utilisation of the location-based mobile phone warning system is somewhat divided in opinion. One respondent wrote: “[t]his service should be regulated by the government and made compulsory in all phones and the choice would be to the individual to use or not”.

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Another wrote: “LBS should be an opt-in service. In regard to emergencies, in a triple zero call, the first question should be ‘can we access your location information?’ Some people might be deterred from calling for help in an OD [Over Dose] situation if they do not want authorities knowing where the OD happened (someone’s house)”.

A number of respondents stipulated an opt-in service to ensure they had more control of their own privacy. The ability to switch off the LBS functionality to protect privacy was prevalent in numerous responses. “Obviously, people are going to be concerned about data being used inappropriately, so measures to put users’ minds at ease would be the biggest thing”, wrote one individual. Some respondents had clear concerns about the possibility they would be constantly tracked in the name of “emergencies”. There seemed to be a constant struggle in individuals who wrote about the usefulness of LBS in emergency situations, only to follow up with a statement that was seemingly contradictory. Most people wanted to use LBS only at a time that was necessary during an emergency but definitely not when engaged in personal errands. Others were still suspicious over where their personal location data might end up, such as in the case of targeted advertising campaigns. “I would stop using LBS the moment information was used for targeted advertising, even if it meant not having the service available in an emergency. I would also not use the LBS if it had no government “anti terrorism” opt out option. I do not need be told the “threat level” of any area I visit, nor do I want to know about riots, etc. as the decision is mine to make without government influence”.

6.12 Potential barriers in the national utilisation of the location-based service for emergency management

6.12.1 Lack of national coordination

Had it not been for interstate disagreements, Australia would have already had a realised national location-based mobile phone warning system (Bita and Sainsbury 2009a), some believe even as far back as 2006. Expert B discusses the problem as a lack of national coordination. A possible reason for this lack of coordination could be the lack of viable attractive business propositions of location-based mobile phone solutions through which
emergency services can be successfully utilised on the national level in Australia. Expert B blamed the professionals involved who failed to come up with viable proposals for a national emergency warning system, and not due to a lack of political will. “I think it is partly that emergency experts need to get together with the technology computer experts and work out what to do because I cannot imagine the politicians are going to say: ‘No, we do not want a reliable integrated emergency warning system’. I think the problem is politicians will naturally react at short term. That is normal for them. So, you have to know how to cope with that when you are proposing something to them”. However, the lack of an inclusive national coordination to emergency management between the different States and Territories of Australia can possibly still be manifested in the decision of the government of Western Australia to keep its StateAlert emergency system instead of adopting the recently deployed national emergency warning system (NEWS). Under the COAG agreement, each state or territory retains full autonomy about the warning system it chooses to implement (The Australian Government: Attorney General’s Department 2009). This provides an impetus for the future need of an extensive collaboration between the government of Western Australia and other governments of Australia to resolve certain issues related to systems integration, regulations and legislative jurisdictions.

### 6.12.2 Lack of a common approach for emergency warning in Australia

Another potential barrier in the plight towards the realisation of a national location-based mobile phone emergency solution in Australia is the lack of a common approach for the warning notification between different emergency organisations in the same State or Territory. This is despite the fact that comparable government emergency organisations from different states or territories in Australia have developed equivalent warning notification arrangements to the general public in the case of a specific emergency event (The Australian Government: Department of Transport and Regional Services 2004). This issue has also been noted by Expert B in the perceived need to get the relevant emergency authorities to agree on a common approach for emergency alerts before even talking technology. “[I]f you magically built a system to send everybody a message tomorrow, we still would not be able to send them messages because we do not
have a coordinated decision-making process as to what message you should send”. This just further demonstrates that it is not merely a technology problem.

6.12.3 Financial issues and telecommunications costs

Some of the financial implications of utilising location-based mobile phone services within the national emergency warning system were identified by expert interviewees and survey respondents alike. Expert A said that the cost of such a system was a “huge impediment” to progress. The two options to overcome the cost barrier included waiting until things got cheaper to build, or waiting until the pressure from the public was so great that cost no longer was a factor because it was overtaken by need. “I think lots of people will have considered it but they probably were reluctant on the cost of it and how often it will be used”, commented Expert D. If we ponder that an early warning system of this nature will rarely be utilised yet has to be available 24/7, it is a hard sell. Indeed, several comments from the survey respondents actually raised people’s concern about the financial burden of these services once they are utilised. Some respondents were concerned that the service would be fee/tariff-based and that only those who could afford it could opt-in which would raise significant equity issues. “As long as there is no extra cost to users, it is alright”, noted one individual. And another said categorically, “[i]t should be cheap or free”. Nonetheless, all interviewees basically agreed that the responsibility lay with the federal, state and territory governments in financing location-based mobile phone emergency solutions under the national emergency warning system. Vic-Gov said, “[e]very Australian citizen has the right to be advised if they are likely to be life threatened… it probably rests at both a Commonwealth and a Jurisdiction level, the funding of such a solution”. A complementary remark by a citizen was that the additional cost should be borne/ supplied by government and that part of the Goods and Services Tax (GST) should be allotted to the scheme.

One of the interviewees suggested that part of the financial burden could be carried by the telecommunications carriers and mobile service providers in Australia as a condition of their operating licence. Expert B pondered, “I think it has to be directly government funded and partly industry funded. So, for example, in the case of television and radio broadcasting, the radio and television broadcasters pay the cost themselves already. They do not charge the government a fee when they issue an emergency broadcast. It is
a condition of their licence and I think similarly with telephones you would do the same thing”. However, the Victorian Government official who was interviewed entirely dismissed the idea of the participation of the private sector in financing such systems: “[w]hen you dial triple zero you do not get an ad while on hold waiting a call-taker. It has never been our intention that a system like this would be ever financed through any kind of advertising or support or a sponsorship”.

In all cases, the cost of funding these systems must be clearly justified to the public. Expert A reflected, “[i]t costs a lot of money to put these things into process and a government has to justify to the people and also to the opposition why that money has to be expended. And with the economic situation at the moment I think they are under more pressure to cut costs and when they look at the impact of a disaster it is only when we get impacts like the Black Saturday disaster, where a lot of people died in very small communities in our heartland, that we start to take notice”. Finally, the cost factor should never stand as a barrier in the face of realising location-based warning systems in Australia, although realistically there would be some kind of return on investment (ROI) figure that would need to be calculated somewhere. The Vic-Gov representative was not naïve about this, stating that it would potentially depend on a cost per message figure. But she also said, “[it] would break my heart that somebody might hover over that “cent button” thinking there is enough money in the budget to save those lives”.

### 6.12.4 Australia’s small emergency management budgets prevent the use of new technologies such as location-based services

Australia does not invest much in technology to counter the effects of natural events compared to the country’s investments on counter-terrorism technologies and programs. This is despite the fact that terrorism attacks are very rare in Australia (Templeman and Bergin 2008). Australia’s Federal Government cumulative investments on counter-terrorism programs, including public campaigns, has exceeded Aus$10 billion since the September 11, 2001 attacks, compared to only Aus$500 million in managing the potential consequences of a large-scale natural disaster occurring in Australia (Templeman and Bergin 2008). Expert A argued that such small budgets have prevented Australia from exploiting or investing heavily in technology, including location-based technologies, specifically in countering natural emergency events. As he argued, the
main reason for keeping these budgets small is Australia’s great reliance on voluntary manpower during these types of emergencies. Expert A said: “…although we follow best practice [in emergency management]… the use of technology has been a little bit overlooked or not been as embraced as it could have been”. Expert A points to the fact that Australia has a great reliance upon volunteerism. So, to an extent we are already dealing with emergency services that are heavily restricted by budget constraints. To start discussing the potential for a technology-based system that would require a significant outlay to begin with and then to operate and maintain is probably being exorbitant.

6.12.5 The geographic population distribution in Australia prevent effective location-based mobile phone emergency service

The use of location-based mobile phone services implies the government’s commitment and need to adequately reach and effectively target all mobile handsets within a defined emergency area of all carriers in Australia (The Victorian Department of Treasury and Finance 2009). However, covering all of Australia with functioning mobile phone services would require massive investment in networking and underlying infrastructure, something that is not economically viable or practically feasible today or even in the near future, despite the notion of universal service obligation (USO) being so pronounced in Australia. For one respondent the vision of Australian-wide coverage was good but the reality was that the reception of signals was unreliable in some non-urban locales, and that things would remain the same until some major spending occurred. Expert A believed that this type of technology worked well in cities but for those who lived in smaller regional and rural communities the technology was not always reliable, thus the service would be with no much value for them. He said, there was the potential for individuals to miss out on timely and valuable data. Expert A identified an issue of equity, when some members in the community would receive a timely message, and others would not. For looming emergencies that could be predicted 24-48 hours prior to enactment, timeliness was not such a great issue, but for those that needed more imminent warning, messaging to those greatest at risk was a problem. “We have a responsibility to all the communities and we should provide that equally. So, I think focusing on people that live in the urban areas because there are more of them is
not actually doing what is best for the communities as a whole. And we should not go that way because we then start separating rural and urban. It becomes an equity issue as well and everyone is equally threatened by hazards in a place where hazards exist” (Expert A). To date the focus has been on providing communication services to Australia’s coastal strip but there is now a need to offer all Australians the same access to services.

6.12.6 Technology constraints and limitations

As one of its core obligations towards people, the Australian Government needs to seek a technology that is accessible by all mobile handsets in the case of an emergency. Constraints may be forced on location-based mobile phone emergency solutions if no such technology exists. The Redcoal-Rep advised: “[w]hatever service is developed, it has to be accessible by everyone. There is no point in having an emergency alert system that sends out emails when not everyone has an email address”. Unfortunately, none of the currently available technologies can fulfil the prime requirement of reaching every handset in the event of an emergency. In addition, the very few technologies that are accessible by most handsets working today do not represent an attractive solution to the Australian Government due to their coarse coverage definition and inaccuracies. These issues were clearly reflected in the comments of the official from the Victorian Government who specified the State’s thorough but unsuccessful efforts researching a technology that can be effectively utilised in location-based emergency systems on mobile handsets. The main issue is the existence of a mix of mobile technologies in Australia, and that 3G technology is not as straightforward as 2G. “I am not quite sure whether anything might even pop its head up, still on the 3G network that looks something like cell broadcast, but we will still have issues with the very large reach cells that are in more regional and remote locations. I do not have a good answer yet on how we would narrow that down when using something like cell broadcast. Where these things have been deployed elsewhere in the world, they are all based on cell broadcast. It is still a bit unknown even how well received or accepted they are” (Vic-Gov). So the geo-demographics of a given country have a great deal of impact on the success of location-based emergency solutions. A summary of the barriers that held back the Australian government’s introduction of the national emergency warning
system are depicted in Figure 6.4, juxtaposed against the mechanisms that supported their ultimate deployment.

Figure 6.4: Toward the successful deployment of a national location-based emergency warning system

### 6.13 Recommendations and road ahead

#### 6.13.1 Towards a solution that evolves

Viable location-based emergency solutions should be capable of evolving over time by adapting to new technologies while not entirely relying on one specific technology. Expert C said it was imperative to look for a scalable and evolvable technical solution that would cater needs well into the future, at least ten years. For example, a focus on

1. Evolvable technical solution
2. Resilient solution
3. Avoid ad-hoc systems design approach
4. Effective content and messaging guidelines ease of comprehension
5. Trialing the location-based emergency system
6. Use early warning system when major need to do so
7. Acknowledge the limits of location-based services
8. Wide partnership and responsibility for emergency systems with non-government organizations
9. Educate people about use of emergency system
10. Collaboration between carriers and service providers
11. A solution that carriers can also gain from

1. Lack of national coordination
2. Lack of common approach to emergency warning
3. Financial issues
4. Small emergency management budgets
5. Geographic population distribution fit
6. Technology constraints and limitations
using SMS as a key or only warning channel would be concerning as it is an old technology. Expert C explained further, that while SMS had a high penetration, it was in the words of Peter Drucker: *The future that has already happened*. SMS is a switch circuit, public switch telephone network technology, and not a broadband internet technology. Expert C predicted the disappearance of SMS in the future. “If you look at LTE [Long Term Evolution] which is the next generation of 3G or 4G networks from the standards, they do not even support circuit service. There is no SMS in LTE. There is no SMS in WiMAX [Worldwide Interoperability for Microwave Access]. There is certainly no SMS in DSL [Digital Subscriber Line] or cable connectivity. And yet, they are all telecommunications and network channels by which, if you are making a plan to have a national system for alerting people about emergency situations, they are the kinds of technologies that you should actually have at the forefront of your mind, to know how you are going to address that” (Expert C). In summary Expert C warned against going down a “blind alley” or “dead end” with SMS, and called any investment into it as “sunk capital”.

Other concerns about a SMS solution have also been voiced by other interviewees, specifically the scalability of its underlying technologies for mass public warning purposes. This concern was, particularly, expressed in response to recent trials in Australia in which several State governments used SMS to disseminate safety information to the people. Expert B was clear that neither the fixed landline solution nor the SMS solution was workable or would scale. Expert D supported this opinion, “[t]hey need a system that is definitely scalable from sending ten messages a minute to 100,000 messages in seconds or whatever. The scalability is a major issue”. In addition to SMS, concerns about cell broadcasting technologies have also been expressed since these technologies do not represent an attractive option for emergency management purposes. Expert B admitted to liking cell broadcast technology in mobile phones but added that it was not well supported by carrier or handset manufacturers. Expert D acknowledged that while cell broadcast was a feature that some ninety percent of mobile phones had set to default, that some handsets would have it turned off, leading to major issues after an emergency. One advantage of SMS over cell broadcast is that SMS was usually carrier independent, but from a performance point of view it is quite smart to get the cell tower to broadcast a message to all mobile phones in range (Expert D). However, most people are not familiar with cell broadcast or have not knowingly used it...
before, so “[f]rom a public acceptance point of view there would need to be some form of public awareness campaign because you do not just simply want someone right now to simply receive all these cell broadcasts and not knowing where they are from and what they all really mean” (Expert D).

Similar concerns about the cell broadcasting technology have also been shared by the Victorian Government official. She stated, “we have pretty much discounted it as the means by which we would move forward, because it is too coarse and it is too broad in its reach. And we are very specific, as good emergency management practices would say that you only notify the individuals that are within the area of the likely impact”. In Australia, going down the path of cell broadcasting for emergency warnings would probably mean that people who should not be contacted for a given warning are, due to the large cell size. As a result, you might have people who are completely disconnected to a warning, preparing as if they would be impacted, only to find the message is entirely irrelevant to them. This could have the effect of desensitising the individuals from future warning alerts, like the boy who cried wolf. Such a message, depending on the directions given by the authorities, bring people closer together to an epicentre of a problem, rather than keeping people who are not connected with the emergency out of the affected zone. As an example, the Vic-Gov official spoke of a certain cell within Australia that had up to 18 kilometres of reach. She then went on to provide a scenario of an emergency that only needed to notify persons within a one kilometre radius from where the centroid of the cell was located. It quickly became apparent in this scenario that by using cell broadcast, there would have been “over-notifications” and the target segment of persons affected “over saturated”. Who knows what the effects of advising people 17 kilometres away from the epicentre of the problem would be, beyond the obvious issue that people would begin to feel that warnings were just irrelevant or unreliable to them in the future.

While there is a need to build a solution that evolves over time, by embracing newer technologies, a careful consideration should nonetheless be given to enable backward compatibility, allowing the solution to reach every handset still in service, including legacy devices. While evolvability is a key, as Expert A put it, “technology is always changing”. What is important is that the chosen technology is “equitable to everyone… So, the service has to be at the lowest common denominator rather than the highest. It
has got to be able to go out to the person who has the oldest machine rather than the latest.” One must not be at a disadvantage because of the device they use, and people with smart phones should not be in an exclusive club any more deserved of receiving warning messages than anyone else.

6.13.2 Creating a resilient solution

There is a need to build a solution that can withstand the severe effects of extreme events and be resilient enough to be ‘self-healing’ if disrupted for any reason. Expert D considered technical issues which would need to be resolved if mobile services were used near hazards like fires. Fires might, for instance, affect the actual channels of communication, and as a result reduce the ability to get messages out to the people who need them most. According to Expert D, these issues have yet to be resolved, despite their seeming simplicity. There is also the fundamental problem of extreme conditions that would render cell towers inoperable which are all part of the deployment issues that need to be considered when rolling out a national emergency service based on mobiles. “Even in a flood or a cyclone, if all your cell towers get blown over or lose power then your messages going out to location-based devices are going to be affected” (Expert D). Carriers in Australia, in cooperation with government authorities, have demonstrated that networks can be quite resilient even under the worst conditions (e.g. Cyclone Larry) and are particularly prepared to get business customers back up and running after a disaster within 24 hours wherever possible. One survey respondent said that “fail-safe” technological systems need to be introduced as far as that is possible”. So, from a deployment point of view the chosen system needs allow for the rapid set up of mobile phone towers to get the message out to people.

6.13.3 Avoid the ad-hoc system design approach

There is a need to avoid the ad-hoc uncoordinated approach in designing location-based emergency solutions. Expert B was clear that if the government, the emergency agencies and the IT professional did not design the national warning system properly, that “lives [would] be lost and they [would] be held legally and criminally liable as a
result”. Expert B was worried by this haphazard approach, examples of which emerged from the Victorian Bushfires Royal Commission.

6.13.4 Effective warning content and messaging guidelines

The content of the location-based warning message has to be crafted with great care, lest individuals receiving the message misinterpret warnings and directions. It cannot be complex. Expert A spent some time discussing the issues around mobile communications from the Government. He said the information sent out to the public had to be accurate and well intended, effective, correct at the time of delivery and from the very beginning well thought out and structured. There need to be clear guidelines that in the event of a problem in communications or interpretation that the next time a message is sent out the authorities get it right, so that the public do not become complacent or lose faith in the medium. The public need to understand that every personalised message they receive is urgent and is not just being sent out as a matter of course. It must not be treated as just another piece of junk mail. It has to be both professional and appropriate.

In addition, the dissemination of location-based mobile phone warning notification should adhere to well-defined protocols to assure the correctness of the message content and its intended destination. Misinformation or even disinformation would just add to the woes of an emergency response. Expert A insisted that there must be strict protocols for the dissemination of information and they must be adhered to, just like the processes that are presently in place with communicating emergencies to inform the media who then in turn inform the general public through traditional channels. “Currently, we have processes in place for informing the media, and it goes through a series of checks, certain people are only allowed to inform the media of things. They have special training in media management, they provide media releases, they are written in a certain way, they are vetted and then it goes out and it is put out” (Expert A). However, if we liken the correspondence on mobile phones to that more attuned to email communications, rather than television or radio, we begin to see the risks more clearly. “When it is instantaneous, you tap something on a computer screen and it is gone. You cannot retract it. So, the protocols have to be in place to ensure that only the right information goes out” (Expert A).
Moreover, the content of the message must be carefully chosen to match the exact intended purpose of the warning. And this, all within the context of a warning which needs to be sent out not hurriedly but in a timely fashion. A warning that does not arrive on time to avert disaster, is not a warning at all. And yet, despite the urgency “[t]here needs to be some hard thought and consideration to the content of the message depending on what the event is” (Vic-Gov). Some events will be easier to determine content for than others while other events might require multiple messages to be sent in succession as the nature of the disaster unfolds hour by hour. In the latter instance a “close-out message” would be advisable as you do not wish to have people waiting in anticipation and with some level of anxiety over next steps. Vic-Gov provided the following example of a chemical spill situation. “[T]he initial message maybe to inform the people who have been potentially affected by that chemical spill to go indoors, shut their door, turn off their air-conditioning. So, we have given them the message to keep them safe, depending on how long the impact of that chemical spill remains for. We need to also keep those people updated, I believe, and that might be an hour later, two hours later. We certainly also need to provide those people with a close-out message to tell them that it is now safe to open their door and open their windows” (Vic-Gov).

But, in addition to the content of the warning message the way the message is conveyed, being in text or voice, should be carefully considered, taking into account the timing of the emergency event. Vic-Gov demonstrated their advanced understanding on the topic when they pondered on the time-of-day issue. “If the event is occurring at night particularly, or in the very early hours of the morning a text message may not wake somebody up. And we are also pretty certain that there is a technology which will allow us to over the air, kind of, send an update to particular handsets before the messages got sent, and that could be an over the air distinctive type of siren, or it could be something more like a ringing of the phone and then deliver a text message”. It was also noted that unified messaging would be at play. A message sent between midnight and 4.30 a.m. would be in the form of a voice message, but otherwise text-based.

Finally, with the right technological advances the message designers should consider at some stage the rich ethnic diversity of Australia and the need to provide an option for the message recipient to choose the language of the location-based mobile phone warning message like most other electronic government services currently available to
the public in Australia today. These issues are already within the interest of the Australian Government. While Vic-Gov was only considering the message content to be in English, they were open to the idea of way down the track to send the message in a translated form. Vic-Gov said this would be the only case in point for an add-on opt-in channel feature.

6.13.5 Trailing location-based emergency systems

Conducting trials and exercises on the chosen location-based mobile phone warning system before the national implementation is a point that has been explicitly expressed by SES representatives, who are on the frontline of emergencies almost on a daily basis. Trials and exercises should, however be dealt with great care so as not to cause any adverse outcomes on the public (e.g. panic or false alarms). The SES could not underscore this enough: “[y]ou have got to practice this sort of stuff and you have got to be very careful of the wolf business”.

6.13.6 Use the location-based warning system for major events only

The location-based mobile phone warning system should only be used in case of a large-scale emergency or imminent disaster. As the SES pointed out: “[a]m I going to go and wake up a million people at 2 am in the morning to tell them there is a thunder storm coming through?”. Expert A agreed with SES when he said: “[i]t cannot be something that is used on a daily basis for minor things, because we will end up causing grief to ourselves. It should only be used in situations that are deemed, where it is the only means of getting information out quickly”. For Expert A, other existing channels of communication could be used in situations where information did not have to go out immediately, such as in news reports on television and radio, etc. What you do not want is a system in place that people actually complain about as opposed to appreciate.

An optimum level of notifications needs to be achieved, as the frequency of receiving a notification may be a determining factor of the system’s usefulness by the general public. This issue has been recorded before in other emergency warning systems, as the representative of the State Emergency Services explained in more detail. “They [the
Government] put these big signs on top of big sticks and they test them every day. And so, if the dam goes over the siren goes and after a couple of years the people got so sick of the thing going off. They go up and cut the wires. They did not want to know and it was becoming painful. That is a reality. That is another part of it; people’s perception. Do I want to be warned? People do not want to know about disasters, until they go wrong, and this is precisely what happened in Victoria” (SES). The Whispir-Rep reiterated the comments of the SES: “[t]he introduction of these technologies should be managed carefully so as not to lose face with the public”. The Whispir-Rep recounted that shortly after the Victorian Bushfires, every person in Victoria and Tasmania were sent messages by their carrier which “broke all the rules in terms of communication management”. Such messages actually have the propensity to harm mobile government communications. By their very nature they are disregarded by people because they are not real: “[s]o, the whole idea of this is the context of the boy who cried wolf too many times. What we want to see is fewer communications sent but those communications sent are targeted, well structured communications that people would be anticipating” (Whispir-Rep).

6.13.7 Acknowledge the limitations of location-based services

Just like any solution on the market, location-based mobile phone emergency solutions also have their limitations that need to be acknowledged by all parties from the outset. The first reality is that no matter how hard the government tries, they are never going to get 100 percent coverage because people will have their phones turned off. “So, it is really important to understand the operational context in terms of what you are trying to achieve and what is a realistic outcome” (Whispir-Rep). At a more practical level, the SES emphasise the limitations of human comprehension, despite the brevity of the message, content can be misinterpreted. “Based on work we have done we know factoring in evacuations you need to provide time for message assimilation. I think when you are looking at a telephony-based warning system or an SMS one, some of the limitations is that you can only have a very small message. It is more about how to get somebody’s attention to then go and do something else, to go and get more information” (SES). The short message sent to the mobile phone can be likened to a siren. If nothing else, the siren gets your attention, so that you can listen to the radio, turn on the
television, or pay closer attention to the directions given by in-person emergency services staff in the vicinity of the emergency. It is certainly not straightforward and at times utterly complex when you are trying to tell people what to do or not to do based on their given circumstances. According to the SES there would be a specific notification sequence so that evacuation routes are not congested, causing even greater problems in surrounding areas. This would be extremely difficult to implement using a SMS system.

In addition, some extreme events could impose a challenge that cannot be met or is basically beyond the capabilities of LBS solutions due to the speed or high level of unpredictability of these events. This fact would require careful consideration from the government to plan for only a narrow selection of emergency event types that can be effectively managed under location-based mobile phone emergency solutions. Therefore, an early assessment of location-based mobile phone capabilities for Australia’s specific requirements and characteristics is highly necessary before the implementation of the services. For this reason, the system should be designed to deliver what is actually possible within the current capabilities of the extant technologies of location-based services. Plainly, as spoken by Expert B, “[w]e should avoid trying to build more than is technically possible at the moment, and we should limit the expectations of the community, because the information we can give via the warning system is going to be limited in its accuracy and timeliness. We have to limit the expectations people will get. They are not going to get much information. They are not going to get very precise information in most cases”.

6.13.8 Build a wide partnership and share responsibility of location-based emergency systems with non-government organisations

Toward a comprehensive national approach for location-based mobile phone emergency systems, there is a need to involve not only all levels of government in Australia but also to effectively acquire the participation of every voluntary and non-government organisation (NGO) in Australia that has a close relation, one way or another, to emergencies. For Expert A, there needs to be an inclusive participation from all areas of government. Government agencies are ultimately responsible for communities. And if a
Government notifies people to “evacuate”, there needs to be some explanation of the best method of evacuation. Not everyone who receives a message to evacuate is physically mobile. And what you do not want is a state of panic and to be flooded with calls coming back questioning directions. Some members of the community will need assistance in acting on directions. Expert A suggests that early warning systems are actually a “partnership between the system being put in place and the types of activities required for those notifications to be planned for and more effectively carried out. You may end up having to use local service groups, volunteer organisations to assist in doing some of the actions that are required, for example, the evacuation or the management or the leading of people to safe areas”. It will most certainly be a partnership between government agencies, local community groups and welfare and support groups that are called upon in normal emergency management practices. These are the groups that will especially have to embrace location-based mobile phone emergency notifications as they continue to provide their services on a voluntary basis. Expert D also identified a consultative stakeholder group that was as wide a group as possible to ensure acceptance. Expert D reflected, “I think that it is very critical that you incorporate as much consultation with a wide group as possible, because it is relatively fragmented in terms of the different federal, state and local levels, all have their own sort of emergency management groups and strategies, and it is always quite important that everyone be involved in any type of new system being developed or evolving. Otherwise, your acceptance level will be very low. If you do not do that, then you will find people saying: ‘Well, we were not involved in that consultation so we are not going to accept whatever the outcome is of that consultation’” (Expert D).

6.13.9 Educate the people of Australia about emergencies and emergency solutions

All levels of government in Australia need to start preparing the public on how to cope and how to deal with the potential threats of human- and nature-made emergencies and disasters, towards creating resilient communities that are capable of withstanding these extreme events until further professional assistance from different government emergency organisations arrives. Building resilient communities would greatly assist the objectives of the national emergency warning system in Australia including the
future LBS component of the system, where these systems could truly be utilised as initial safety information channels. The SES contend that psychology should play a vital role independent of the technology used. They provide a plausible scenario that hits home the importance of having a community ready. “[Imagine] you have got people standing up there at the doors at Bondi [a well-known beach in Sydney] and the word says ‘There has been a 9.7 earthquake, just north of New Zealand and you have got exactly 45 minutes, you have got 2.5 meters of water coming up Sydney Harbour’. You know what is going to happen? Absolute panic. All of the plans we have in place of orderly evacuation routes, of you go here, you go there, it is not going to happen”.

How best to avoid such panic is to work on building resilient communities. In a severe event, the SES or other emergency services personnel will probably not be able to reach individuals given the amount of infrastructure that has been damaged. During this time, individuals, families, business owners, need to work together to overcome hardship. This has very little to do with location-based services per se and more to do with social networking. In fact, what might eventuate is that support groups begin to post messages online to help people share vital information and provide feedback to government authorities of the situation on the ground, if a disaster is to continue for some time. While the SES acknowledged there might be some problem with the cultural mix in Australia, education was a key to breaking the barriers when it came to people in the community helping one another. “What we need to be moving to is to that preparedness mitigating mindset, where we are educating our children and our communities how to prepare for a natural disaster. You have got to take it back to the beginning. The preventive side of things. You have got to stop people being in situations and then of course if they are going to be in those situations prepare them for what needs to be done” (SES).

Part of this public preparation should be spent towards educating the people on what to do when they receive the location-based warning message on their mobile handsets. The Whispir-Rep agreed with SES that the challenges of introducing such a warning system were not going to be technical, as so much as cultural and how best to educate people on how to respond the messages they are receiving. “So, it [location based mobile emergency warning system] needs to be going hand-in-hand with an education program and people need to be made aware of that they may from time to time receive those
messages. So, I think those hurdles need to be addressed as part of the solution”. While the preparation could target the vast majority of people in Australia, there will be still some people that need the help of the local government service groups or volunteer organisations. The Whispir-Rep gives two scenarios- the aged person who is a little deaf and is sent a tsunami alert on their mobile phone, and the bus loaded with Japanese tourists. “What are those two communities of people going to do in those circumstances and how do you manage the fall out of just broadcasting these types of communications?”

Fortunately, educating the public is a concern that is already on the agenda of the Australian Government. Vic-Gov confirmed that they had always planned to deploy this type of technology with a substantial education campaign. “It is not simply education to the public, it is education within the various emergency service agencies. It is education through all layers of other interested parties as well” (Vic-Gov). These would include, among others, principals or authority figures of schools who have hundreds of children under their care on a daily basis. Education would be necessary wherever there was a large concentrated gathering of people. Vic-Gov followed up by providing the following examples: major places of interest, building managers, shopping centre managers but added that she was unsure whether she had yet considered all the layers and levels that would go into a substantial education campaign.

6.13.10 Real collaboration between the telecommunications carriers mobile and service providers

Realising location-based mobile phone emergency services on the national level in Australia requires the effective collaboration between all the telecommunications carriers of Australia, not just the incumbent operator. The Redcoal-Rep imagined a better collaboration between the major carriers was needed, and noted that this relationship would be significant if the service was to be successful. Indeed, there is a need not just for carriers and service providers to better collaborate but for the business side to be more in tune with the government mandate(s). In the context of emergency services, one cannot solely talk about an innovative business model but about the jointly developed government and business model that is required to get such a service off the ground.
6.13.11 A solution the telecommunications carriers can also gain from

The participation of the mobile telecommunications carriers in Australia is central in location-based emergency systems. The Whispir-Rep stated categorically, “[n]othing is going to happen without the support of the carriers”. This was also expressed by the Victorian Government official: “[t]o collect the data, we need the cooperation of the carriers”. The carriers are able to provide a fundamental piece of the puzzle in that they know the make-up of their infrastructure better than anyone else, and they can provide details of their assets, their sites, their cells and even their customers, if required. Vic-Gov noted the need for this data would be to purely know to whom they should send out the message to the active handsets that have been identified.

There has been some contention over whether or not a carrier should charge for such a service during an emergency to the general public but the overwhelming consensus in Australia’s case, is that the cost should be borne by the government. This does not mean that the carrier does not receive any revenue. On the contrary, by the mere fact they are sending a message to a handset, the revenue must go back to them (Vic-Gov). Accordingly, utilising the carrier networks to provide location-based mobile phone emergency services strongly imposes the cost factor as one of the possible determinants of their participation. The Whispir-Rep is clear that the government must engage the carriers with respect to emergency service messaging of this nature, as such a system would place a heavy load on the infrastructure of any mobile network provider. In addition, more infrastructure would be required to enable the government the capability to speak to everyone’s mobile handset in a given area. Unless carriers receive some type of subsidy or have an interest in the solution or outcome, they would be unlikely to make such a significant outlay for little in return.

6.14 Overview of Chapter Six

This chapter presented the qualitative content analysis findings on the issues surrounding the potential national utilisation of the location-based mobile phone emergency service in Australia, as articulated by the stakeholders of the service. The
findings of the analysis showed Australia’s need for the application of location-based mobile phone service within the country’s national emergency management arrangements as well as the need to regulate and control the service under a well-defined legal framework. Several disagreements between the stakeholders were recorded in the findings over some of the issues pertaining to the utilisation of the service within the national emergency warning system of Australia, specifically in relation to some of the design aspects of the location-based emergency system, the privacy of location information under the system implementation and the administrative structure needed to deploy the services. Other issues of importance were also revealed. These included the government and telecommunications carrier potential liabilities under the utilisation of the national location-based mobile phone emergency system, the expected responsibilities and roles of the government and other stakeholders in the utilisation, and some of the social implications of the location-based emergency services, such as people’s trust in the services and in the government, and the risks perceived as associated by utilising the services. Potential barriers to the national utilisation of the service and recommendations towards setting realistic objectives for the service in Australia were also presented and discussed.

The following chapter concludes this study by presenting the main findings of this research, assessing whether or not location-based mobile phone emergency services are viable in the Australian landscape. The implications and contributions of this study to the body of practical knowledge and scholarly literature are identified, the limitations of this study are outlined and, finally, prospective directions for further research opportunities are provided.
7 Conclusions, limitations and future work

7.1 Introduction

This Chapter puts forward the conclusion of this research investigation assessing the viability of the location-based mobile phone emergency service within the national emergency management arrangements of Australia. The implications and contributions of this study for practical, research and theory are presented, limitations of this research work are outlined, further research opportunities arising from this research investigation are shared and, finally, a concluding statement is given.

7.2 The viability of the location-based mobile phone service within the national emergency warning system of Australia

This research investigation was carried out to establish whether the viability of the national location-based mobile phone emergency service in Australia could be objectively ascertained. The viability of the service reflects the extent to which the service is capable of existing and developing, and whether or not the Australian environment is ready for the service application within its national emergency management arrangements. That is, the extent to which Australia is ready– within social, technical, administrative and regulatory aspects– to accept, support and diffuse the service nationally. The quantitative and qualitative findings of this research provided a set of key dimensions or measures upon which the service viability could be assessed. This assessment was then used to reach a compound understanding and overall evaluation of the current environment of the service in Australia. Drawing from the findings of this study, the dimensions included the social readiness to the service, the value the service created to the people of Australia, the allocation of the appropriate financial resources for the service utilisation and the technical feasibility of the service technology. But, drawing comprehensively further from the findings, the extended set of the viability dimensions are presented in Table 7.1.
<table>
<thead>
<tr>
<th>No.</th>
<th>Dimension</th>
<th>Current state</th>
<th>Main findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The attitudinal and behavioural implications of the service</td>
<td>Confirmed</td>
<td>It is reasonable to suggest that Australians holds a highly positive attitude towards using location-based emergency service and intends to use the service, if there is a need to use it, in the case of an emergency in the future.</td>
</tr>
<tr>
<td>2</td>
<td>The social acceptance of the service</td>
<td>Confirmed</td>
<td>Australians are more likely to accept the service than to reject it.</td>
</tr>
<tr>
<td>3</td>
<td>The social readiness for the service</td>
<td>Not ready</td>
<td>There is evidence to indicate the lack of social awareness of location-based mobile emergency services. There is a lack of concerted and focussed educational campaigns to enhance Australian’s experience in managing the location-based mobile phone warning notification.</td>
</tr>
<tr>
<td>4</td>
<td>The service value to all Australians</td>
<td>Unconfirmed</td>
<td>The value of the service may not be confirmed nationally due to the geographic distribution of the Australian population and to the unreliable reach of the mobile phone networks in rural areas.</td>
</tr>
<tr>
<td>5</td>
<td>The service legalisation</td>
<td>Pending</td>
<td>The Australian federal government introduced into Parliament <em>The Telecommunications Amendment (Integrated Public Number Database) 2009 Bill</em> that proposed changes to the <em>Telecommunications Act 1997</em> to enable the provision of location-based mobile phone emergency services.</td>
</tr>
<tr>
<td>6</td>
<td>Financing and carrier compensation</td>
<td>Approved: Government financing</td>
<td>Share responsibility of the Australian Government, Council of Australian Governments and the State and Territory governments in financing location-based mobile phone emergency solution.</td>
</tr>
<tr>
<td>No.</td>
<td>Dimension</td>
<td>Current state</td>
<td>Main findings</td>
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</tr>
<tr>
<td>7</td>
<td>The service technology</td>
<td>Not ready</td>
<td>No evidence to indicate there is currently a feasible technology capable of delivering accurate and timely warning notification to each and every active mobile handset based on the physical location of the handset in the area of an emergency and across all mobile phone networks anywhere in Australia.</td>
</tr>
<tr>
<td>8</td>
<td>The service national coordination</td>
<td>Unconfirmed</td>
<td>The national agreement on the service did not provide the much-needed evidence to inform the national coordination for the service.</td>
</tr>
<tr>
<td>9</td>
<td>A national approach for the service</td>
<td>Undetermined</td>
<td>There is a lack of a common approach for the warning notification between different emergency organisations in the same State or Territory in Australia.</td>
</tr>
<tr>
<td>10</td>
<td>The participation of all telecommunications carriers</td>
<td>Partially determined</td>
<td>Apart from Telstra, the incumbent provider of NEWS, the engagement of all mobile telecommunications carriers with the government and with each other in Australia is still to be fully determined.</td>
</tr>
<tr>
<td>11</td>
<td>The participation of the non-government organisations</td>
<td>Undetermined</td>
<td>The engagement of the main NGOs in Australia is yet to be determined.</td>
</tr>
</tbody>
</table>
As shown in Table 7.1, most of the dimensions of the service viability are yet to be
determined, which unfortunately does not suggest a successful utilisation for the service
within the national emergency management arrangements of Australia, at least not in
the near future. The lack of pertinent legal frameworks in the Federal and State
legislative bodies and the current technology constraints, especially the underlying
course positioning techniques of location-based services are presently the principal
barriers to a viable national location-based mobile phone emergency service in
Australia. Other dimensions of the service viability are dependent to a great extent on
the existence of defined legislation and an end-to-end technology solution, and then on
the government decision to create the right settings and a control body to transform the
idea of the service into a tangible value to the people of Australia and other
stakeholders. Nevertheless, a viable location-based mobile phone emergency service
needs a runway to develop and mature so as to be put into a successful national practice,
which suggests a new perspective from which the service viability can be meaningfully
assessed.

But first, there is the need to address an important question here of what would happen
if nothing were to be done today by the Australian government in experimenting with
the available location-based technologies, once the amendments to the legislation to
enable the provision of the location-based emergency service are ready. It is a stark
reminder that the national emergency warning system (NEWS) was instituted only after
the tragic Black Saturday Victorian Bushfires of February 2009, as a response to the
victims who lost their lives due to a lack of timely information. It would be extremely
difficult to comprehend another comparable peacetime disaster of the same magnitude
as a result of waiting for a perfect technology to come about. Determining the viability
of the location-based mobile phone emergency service based on the current
 technological limitations is a great risk in terms of Australia’s future. Accordingly, there
is a need to think beyond the immediate barriers to identify what can be done, even
imperfectly, with the technologies available today in order to have the adequate
knowledge and a depth of expertise when future effective technologies emerge. This
provides a basis for several implications for policy and practice.
7.3 Research implications for practical knowledge

It is hoped that the type of knowledge obtained in this study would contribute to the body of practice towards the formation of more informed deployment and diffusion strategies for the national location-based mobile phone emergency service in Australia. It is also hoped that the outcomes of the research will be fruitful, channelling Australian government strategy for emergency services in the right direction. The following points are some of the main implications for the body of practical knowledge.

7.3.1 A strategic experimentation with the location-based mobile phone emergency system

With the current capability to utilise existing alternatives to a non-existent optimal technology, strategic experimentation with the location-based mobile phone emergency system today should be conducted, especially for early public warning. This is a highly critical element in securing Australia against diverse hazards into the future. Once the right technology for the system becomes available, such experimentation would provide a systematic approach by which it would be possible to unlock the potential values of the system, resolve uncertainties about the system’s underlying operational processes, guide the alignment of interests across the stakeholders of the system, reinforce the Australian individual ownership of the services of the system and create informed utilisation options of the future services of the system (Ciriello et al. 2005; Davila et al. 2007; Flamholtz and Kannan-Narasimhan 2007).

Although this strategic experimentation implies heavy investments in temporary solutions, it can be nonetheless effective in mapping out the roles and responsibilities of the Australian government and the telecommunications carriers in advance, which would aid in building the response capabilities of the system, bringing emergency preparedness planning to life, and enhancing the operational processes and testing the knowledge of vulnerable populations (International Federation of Red Cross and Red Crescent Societies 2009).
Building such a resource base of practical knowledge would greatly aid in creating much-needed public awareness for the future implementation of the system. As it is highly argued that the real challenge of introducing such a location-based emergency system are not going to be technical as so much as educational and cultural, and how best to prepare the Australian people to respond to the warning message(s) they are receiving. “People are more likely to pay attention to warnings if they have been educated about the risks in advance and know what actions to take” (International Federation of Red Cross and Red Crescent Societies 2009, p. 31). Accordingly, gaining the right knowledge about the location-based mobile phone emergency system today would facilitate the overcoming of most of the challenges to permit a viable system tomorrow. In addition, the fact that the introduction of the national location-based mobile phone emergency system into Australia is more likely to be resolved through a government-mandated scheme, the Australian government should demonstrate that this introduction is in the best interest of Australians. A strategic experimentation with the system today can provide both proof of the viability of the system’s services and of the existence of demand for them, and also clear evidence that the utilisation of this type of service has no detrimental social repercussions on the privacy of Australians.

The strategic experimentation with the system would help to avoid the ad-hoc uncoordinated approach in designing future location-based emergency system since gaining practical knowledge by experimentation today implies a certain amount of preparedness for the future, and what is essential for today’s system must also be viable for the system of the future (Bossel 1987). It is quite true that systems improve through practice, and the future system can be planned based on the “current” architecture and design implementation (Sandborn and Myers 2008). Conducting exercises on the imperfect but achievable design of the location-based mobile phone emergency system today would help to reach and produce the desired version of the system. Through exercises also, it is possible to coordinate the operational processes of the system for the longer term in a way that can prevent the components of the future system being eroded over time. It would be extremely difficult to create such a system and then maintain it for events that may occur very infrequently (International Federation of Red Cross and Red Crescent Societies 2009).
The reasonable evidence established by this study of the social acceptance of location-based mobile phone emergency services in Australia provides the Australian government with another reason to consider the current location-based technologies as viable candidates for an experimental but narrower nationwide version of the location-based mobile phone system for early public warning. It is true that around 85 percent of the Australian population live in towns and cities within 50 kilometres of the coast (Australia.gov.au Website 2010). Cities are usually covered with an excellent array of mobile network cells (Jokinen 2009), which greatly enhance the accuracy levels of the employed network-based mobile phone positioning techniques. The location-based mobile phone emergency system can be experimented in a contracted version all around Australia to provide people with warning notifications based on their physical location within the boundaries of towns and cities and their wards. Although this sort of experimentation would definitely provoke serious equity issues within the Australian society, the high societal value the system could create for the vast majority of the Australian population in augmenting their situational awareness of their immediate surroundings in the case of grave emergency, should go beyond the discursive arguments of inequity. Public policy must acknowledge the fact that for the future of most Australians, it is highly important to have a contracted or experimental version of the location-based mobile phone emergency system today, than not to have a system at all. Ultimately, utilising this type of system is meant only to complement the traditional emergency notification mediums, such as the television and radio, and not to replace any of them in any way.

7.3.2 A strategic collaboration with other countries

Acquiring knowledge about the location-based mobile phone emergency system implies the need for guidance in the area of “how to”. A key component of success in this area is openness to experience and interact with the outside world (Davila et al. 2007). A higher level of collaboration that extends beyond the boundaries of Australia and incorporates the exchange of experience with other countries might be required as well. The Australian government could shorten and significantly eliminate several obstacles on the way to a viable location-based mobile phone emergency system by sharing with
and learning from the experience of other countries, such as The Netherlands or South Korea. Although these two particular countries are quite different from Australia in terms of having smaller geographic areas and a relatively condensed population distribution with effective cellular network coverage, both of these countries have been nonetheless trialling emergency management location technologies on a national level for years (Ho 2006; Jagtman 2010a). Surely, all countries share a comparable perspective of the seriousness of emergencies and disasters, and location-based mobile phone emergency services can emerge as a future venue for a new cross-national collaboration between countries regardless of whatever conflicts in ideologies or interests.

7.3.3 The regulation of location-based emergency services in Australia

The findings of this study showed that the population of the survey had ranked government regulations and legislation as the most effective mechanism capable of controlling personal location information under the nationwide utilisation of the location-based mobile phone emergency services. One significant implication of this result is that the Australian public have the adequate level of trust in the Australian government to unreservedly support the government recent efforts looking into introducing location-based emergency components within NEWS. For example, the government requires public support for the introduction of amendments to the *Telecommunications Act 1997* to legislatively regulate and control the collection and use of location information under the utilisation of NEWS. One of the main insights coming from this study is predominantly practical providing a series of recommendations towards ultimately regulating the location-based mobile phone emergency system under a governmental legislative structuring. Nevertheless, while the Australian government would most certainly follow a transparent approach in regulating such a system, the extremely complex interplay that was revealed in this study between different government agencies, telecommunications carriers, non-government organisations and the Australian public under the nationwide utilisation of the system is an evident reasoning for the imperative need of a joint-effort regulatory approach that is
capable of providing a consensus on all related issues and matters of concern, mainly specifying how and to what extent the system can be used in Australia.

Another point that should be mentioned is that any related regulation would most certainly reflect the specific nature and the distinctive characteristics of location-based mobile phone emergency services that will be provided under the national emergency warning system in Australia, but as it has been emphasised in this study the services should be designed under a technology-neutral architecture (TNA) to promote the principles of system compatibility and system evolvability and, therefore, a strong implication arises in that the regulation of the services should also be a technology-neutral regulation (TNR) that is independent from the underlying technologies of the services to further promote the quality of research and development for both the domains of emergency management and commercial applications.

7.4 Contributions to the scholarly research

This study adds to the scholarly literature in a relatively new area for which there has been little research in investigating the public offerings of location-based services in the domain of emergency management. Although there have been several documented studies about the technical feasibility aspects of utilising location-based services as an advanced mobile government location-enabled application 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 service 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 scholarly literature in which this study makes a significant contribution.

This study is also one of the first to present a methodological approach for examining the importance of utilising the location-based mobile phone service in various emergency event types, presenting both the importance rankings of the service utilisation as perceived by the general public and the perspectives of the main stakeholders of the service in confirming the need to utilise the service for major events only. As some investigators may still argue that it is entirely wrong to compare two
different types of emergencies to each other, this type of investigation provides the opportunity to focus on the emergency types that are of real concern to people in general and offer a valid and objective approach for scholarly researchers seeking to utilise a similar approach in future studies in regard to the utilisation of other new technologies and applications in the domain of emergency management. In addition, although it is quite true that the importance of different types of emergencies would most likely differ from one country to another, the research method that was applied in this study to quantitatively rank the importance of utilising the location-based emergency service in various emergency event types, could still correctly serve as a valid basis for other researchers in their respective markets. It should be noted that the underlying statistical tests are totally applicable to the service, irrespective of its underlying context of analysis.

7.5 Contributions to the theories and models of acceptance

The findings of this study contributes 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, grounded upon the significant role of the attitude in influencing the behavioural intention towards using the location-based emergency service, thus enhancing the overall ability to predict the social acceptance of the service. These findings completely validate and are in line with several social psychology studies in which the role of the attitude as an important determinant of the behavioural intention has been exceedingly emphasised (Ajzen 2002b; Dennis et al. 2004). The retention of the attitude as one of the endogenous constructs within the nomological structure of the Technology Acceptance Model in this study gives also additional momentum to the arguments that call to preserve the theoretical integrity of the Model and, consequently, the Model’s base theory of the Theory of Reasoned Action.

This study also provides a strong signal for the importance in examining the attitude of the individual in acceptance research, especially when studying the social acceptance of new government initiatives and services.
Although the research conceptual model of this study was exploited to predict the individual acceptance of the location-based mobile phone service in the context of emergencies, the model is viewed nonetheless as a generic model. This generic model can credibly serve as a candidate model in other studies to predict people’s acceptance of location-based services in other usage contexts, application, scenarios or settings, since all of the theorised factors of the model are highly relevant to the intrinsic characteristics of location-based services. Examples would include law enforcement applications of location-based services, such as surveillance implications of location-based services, location-based evidence capture and social issues pertaining to the application of the services for arrest support, traffic violations or riot control.

An issue that has been largely overlooked in the acceptance literature of location-based services is the quality features of these services, and the degree to which the perceptions of the service quality impact on the acceptance of the services. One of the main contributions of this study is the introduction of a highly justifiable theoretical foundation for investigating the perceived quality features of location-based services in the context of emergencies. However, given the general lack of dedicated measurements for the quality features of location-based service in the literature, it is argued that the service quality scales that were developed in this study, including accuracy, currency and responsiveness, could be adapted in further research and conceptual acceptance models about location-based services, not only in the context of emergencies but reasonably in other usage contexts and settings as well.

7.6 The limitations of this study

A number of limitations in this study should be clearly stated. To any extent possible, all steps were taken to minimise or mitigate the effects of these limitations.

One of the early concerns was the number of surveys that had been returned in the pilot survey. From around 600 mail-outs randomly distributed, only 35 replies were obtained. Despite the comprehensive discussion that was given about the validity and adequacy of this response rate for the specific purposes of the pilot survey, a higher number of
responses would have nevertheless excluded all possible bias in the results and would have enabled a more in-depth analysis of the data.

The response rate of the survey of this study was proven to be statistically adequate with 290 responses. Nonetheless, a desirable goal was to obtain a higher response rate than the one acquired to have additional confidence in the generalisability of the findings (Emory and Cooper 1991; Saunders et al. 2007). 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 (Granello and Wheaton 2004).

The lack of access to some stakeholders like vital emergency management strategy makers in the Federal government meant that some valuable perspectives were unavailable. However, State counterparts did participate. As every possible attempt was made to acquire the participation of each stakeholder, it should be highlighted that no informant refused to participate in the study. Rather all the stakeholders approached who could not participate provided an explicit reason for being unable to take part. In all cases, the researcher expressed his gratitude for their kind attention. Namely, the researcher sought the participation of Emergency Management Australia and its newly established Emergency Warning System (EWS) Taskforce – the National Security Resilience Policy Division of the Attorney General's Department which has been assigned to ensure the realisation of the national emergency warning system in Australia. However, both agencies had apologised on the basis that the information provided by them may unjustifiably impinge on the integrity of the “Request for Information (RFI) to the market” that was released at the time by the Federal government looking at the capability of the Australian telecommunications carriers to meet the long term requirements of a national emergency alerting and warning system utilising location-based technologies for emergency purposes (The Victorian Department of Treasury and Finance 2009). The EWS Taskforce specifically indicated in their reply that

"For reasons of probity, as the Commonwealth is a participant in the RFI process, it would not be appropriate for the Commonwealth to respond to [the] survey at this time. As the outcomes of the RFI will inform..."
future decisions by governments on the adoption of such a capability, it would not be prudent for members of the Taskforce to participate through responding to the survey questions when there is not yet an established position on the capability across Commonwealth and State and Territory Governments (Emergency Warning System Taskforce National Security Resilience Policy Division Attorney-General's Department 2009).

The researcher also sought the participation of Communications Alliance Ltd., the most influential association in the Australian communications industry (Communications Alliance Ltd. 2009a). However, they apologised based on the premise that the Alliance was a representation of many stakeholders and could not be voiced as one. They stated

After reviewing the questions, I can inform you it is inappropriate for Communications Alliance personnel to take part in an interview. This is because the membership of Communications Alliance has diverse views on location-based services and emergencies and I believe I would be unable to represent them accurately (Communications Alliance Ltd. 2009b).

### 7.7 Prospective directions for further research

Several opportunities for further empirical research emerge from this study, but the most appealing to pursue amongst them in the near future is to again approach emergency management decision and strategy makers from the Australian Federal government, especially Emergency Management Australia, to gather their opinion and interpretation on the research results. This could only be done once the outcomes of the RFI were ready since it would be possible at that time for different Australian government agencies to have their say on the national utilisation of the location-based mobile phone emergency service in Australia. In all cases, the perspectives of these important stakeholders have to be taken into account whether a decision is made to consider or not to consider the location-enabled components in the NEWS. Since it is strongly argued that such a decision would be primarily based on the technological
readiness of the Australian telecommunications industry, it is highly reasonable to presume that it would be a matter of time until a location-based technology is considered for utilisation for all emergency purposes in Australia.

Given the fact that this study is cross-sectional in its design another follow-up longitudinal study would enrich our knowledge about the determinants of the social acceptance of the location-based emergency service. Further work could be carried out to examine the opinions of the Australian public once the service has been nationally implemented and deployed for some time. Such a study could be set to investigate, in the long term, how and why the determinants of acceptance change or reshape after the adoption and diffusion of the service, and whether or not the relationships between these determinants are consistent over time. This type of work reflects Karahanna et al. (1999) arguments 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 his or her decision to accept or reject the location-based emergency service, and his or her beliefs in the post-adoption phase (actual adoption), which is marked by the actual usage or take-up of the service.

Demographic and socio-economic factors could also form a reasonable basis for further research about location-based emergency services. Currently, it can only be guest what the impact of these factors is on individual acceptance of the service. But further research in this area might reflect how the determinants of the attitude, behavioural intention and acceptance evolve over time (Venkatesh et al. 2003), and whether or not there are any differences that are associated with the person’s demographics, such as gender, profession or educational level, and the acceptance behaviour towards the service. In this domain also, a question of possible differences between the ethnicities in Australia in regard to the identified research issues were not raised in the study except, as presented in Section 5.8.3, when a question of whether or not the ethnicity of the participant of the survey had an influence on how he or she had ranked the importance of utilising the location-based mobile phone emergency system by the government in different emergency event types. It would be a reasonable future research opportunity to investigate the location-based emergency service from the perspective of ethnicity as it would provide additional insight relative to the impact of the cultural aspects on the social acceptance of location-based emergency 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 individual acceptance of location-based services. Although this research showed that the usage context of emergencies was quite sufficient to produce a positive impact on these concerns, although it was not significant in statistical terms, a future cross-sectional comparative research taking into account several usage contexts is needed to ascertain the role of the context of usage on people’s perceptions of the location information privacy concerns.

Finally, as this study was designed to investigate the viability of the location-based mobile phone emergency service within the national emergency management arrangement of Australia, future comparative cross-national studies between Australia and other countries would also be quite compelling carried out on the same issues identified in this work. It is strongly held by this present researcher that the findings of such studies would highly enrich the international body of knowledge through helping us to define shared sets of concerns and issues surrounding the utilisation of the location-based emergency service. This will, at the same time, shed light in understanding the role of culture and other aspects, such as the role and influence of government administration, in creating disparities in the factors determining the acceptance or the success of such a service.

7.8 Concluding statement

Disasters and large scale emergencies, that have the potential to disrupt the orderly manner of the civil society, are considered national security challenges today (Buzan et al. 1998). 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. This will be critical element in securing the future of Australians against such challenges. 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. Today’s national security scope has grown to encapsulate such socially constructed emergency applications. However, the possible deployment of location-based emergency services is not altogether favourable as few Australian individuals see the introduction of laws mandating access to certain types of personal information to only aid in the gradual relinquishing of the individual right to privacy. Beyond unauthorised access and the disclosure of citizen location details is the public perception that authorities will be able to perform selective tracking after legitimately deploying a year long emergency declaration. With limited effort from the Australian government to raise the public awareness about the anticipated location-based emergency services most of the concerns, although they may merely be as a result of misconceptions, have the power to impact negatively on the practised emergency response measures and devalue the purpose of the services in the eyes of the public.

Nevertheless, although the responsibility for the implementation and follow-up of the national emergency warning system and its proposed location-enabled mobile phone emergency component is primarily placed on the Australia government, the system cannot by its very nature be a sole responsibility of the Government alone (International Federation of Red Cross and Red Crescent Societies 2009). As was clearly evident from this study, despite the government likely mandated application of the anticipated location-based emergency system, the system comes with major implications and the road towards a successful system in Australia will require a greater interplay to address such implications between the key stakeholders, including the telecommunications carriers and supporting value chain members and the general public who are the ultimate users of such a system.

Another layer of partnership and responsibility should also be formed with the Australian scientific and academic communities to ensure a continuous and supportive research environment for the fostering of this system which will no doubt emerge over time. Fortunately, this has been expressed in the final report of the Victorian Bushfire Royal Commission, which was released to the public on July, 31 2010, in which it was stated under Recommendation 65: Research and Evaluation that the Australian government would:
Establish a national centre for bushfire research in collaboration with other Australian jurisdictions to support pure, applied and long-term research in the physical, biological and social sciences relevant to bushfires and to promote continuing research and scholarship in related disciplines (The Victorian Bushfires Royal Commission 2010, p. 3).

Therefore, it is strongly believed that the time for the main stakeholders of location-based mobile phone emergency services to interact is now, as the Australian government moves from basic mobile phone emergency services based on the billing address of the mobile phone subscriber into more sophisticated, fully-fledged and ubiquitous location-enabled emergency services based on the almost exact physical location of the mobile phone, once the right technology is made available. It is true that, “timely, preventive response to disaster risk requires effective early warning systems that are technically sound, politically viable and communally acceptable” (International Federation of Red Cross and Red Crescent Societies 2009). This study made every possible effort to shorten the distance between the key stakeholders and bring all the major implications of the location-based mobile phone emergency service insight in the aim of determining the current and future viability of the service within the national emergency management arrangements of Australia.
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Appendix I: Information sheet for the participant of the survey

University of Wollongong

Dear Sir/Madam,

Thank you for showing an interest in this research project. Please read this information sheet carefully before deciding whether or not you wish to participate. Participation is voluntary.

Purpose: We are writing to ask for your assistance in a study on a set of cellular mobile phone services called location-based services. Specifically, this study investigates the use of these mobile services for emergency management in Australia. The study is being conducted by a doctoral candidate, Mr. Anas Aloudat, who is supervised by Dr. Katina Michael, at the School of Information Systems and Technology, at the University of Wollongong.

Description: This survey will ask you about several aspects of location-based services such as the usefulness of these services and the potential risk of using them for emergencies or hazardous situations. The attached questionnaire should be completed by one household member of 18 years of age or older. The survey will take around 20-25 minutes to complete. We also ask you to disclose some basic demographic characteristics about yourself, such as age, gender, and educational level. All information here is gathered for statistical purposes only.

Confidential: The research data gathered from this project will be published in a form that does not identify you in any way. Please email Mr. Anas Aloudat at aa279@uow.edu.au or Dr. Katina Michael at katina@uow.edu.au if you would like to receive a copy of the overall findings at the conclusion of the study. Please be assured that your responses will be treated in strict confidence. Your anonymity will be protected and your answers will not be shown to any other participants or organisations.

Complaints: If you have any concerns regarding this study, please do not hesitate to contact the Ethics Officer, Human Research Ethics Committee, Office of Research, at the University of Wollongong, telephone: 02 4221 4457.

We would like to take this opportunity to express our appreciation for your cooperation in completing and returning this questionnaire within 3 weeks and before the 14th of April 2009.

The success of this survey depends on your participation and candid responses. Once again, thank you very much for your valuable contribution to this research.

Anas Aloudat
PhD Candidate

Katina Michael
Associate Professor
PhD Supervisor

School of Information Systems and Technology, at the University of Wollongong
With LBS provided to your mobile phone, your telecommunications carrier will be able to report your location information to authorities such as the police or ambulance services in case of an emergency. When you call 000, your current location will automatically be detected and passed on.

With LBS provided to mobile phones, emergency service organisations in collaboration with the telecommunications carriers will be able to send warning notifications to all the mobiles phones regarding a potential hazard (e.g. an industrial incident, a flood, a severe storm, or a bushfire) if such hazard is in the immediate proximity of these mobile phones.

With LBS provided to your mobile phone, government emergency agencies in collaboration with the telecommunications carriers will be able to send a warning message to your mobile phone regarding an emergency (e.g. a major traffic incident, a land gale, or
Appendix II, Section B: General knowledge questions about location-based services

The questions in this section ask you about how familiar you are with location-based services (LBS). Please cross X in the appropriate box.

1. Have you used any type of LBS before? □ Yes □ No □ Don’t know

   *If yes, then please continue to questions 2, otherwise please continue to the next page.*

2. What types of LBS have you used? (Please cross X wherever appropriate)

   □ Requesting information about a nearest point of interest e.g. restaurant, ATM, cinema, etc.
   □ Friend Finder (finding the current location of a friend).
   □ Locating a child, an elderly relative, or any missing persons.
   □ Receiving advertising notifications from nearby shopping centres (e.g. discounts).
   □ Receiving information about traffic conditions or weather updates.
   □ Navigation or turn by turn driving directions e.g. TomTom, Navteq, Navman, Uniden, etc.
   □ Fleet tracking/Fleet management.
   □ Customer Relationship Management (e.g. parcel delivery).
   □ Other (Please explain) .................................................................
       ...........................................................................................................
Appendix II, Section C: The vignettes of the research survey

Hypothetical scenarios about the use of location-based emergency services

The informative scenarios below are **made up** examples to demonstrate how LBS can be used in emergencies. Please read all the scenarios before starting to answer the questions in the following sections.

<table>
<thead>
<tr>
<th>Scenario 1: Needing Emergency Help</th>
</tr>
</thead>
<tbody>
<tr>
<td>This afternoon, Jane has decided to take a new route to her home. However, a heavy fog started to form, making visibility almost impossible. Jane kept driving, but suddenly she hit a roadside tree. Jane is fine. She only had minor injuries. She needs help but she does not know where she is exactly. Jane knows that by calling 000, her telecommunications carrier (e.g. Telstra, Optus or Three) can report her location information to an emergency dispatch centre (with an accuracy between 50 and 150 meters). The centre can then inform the ambulance services or the police who can reach her location.</td>
</tr>
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<table>
<thead>
<tr>
<th>Scenario 2: Early Personal alert</th>
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<tr>
<td>Despite the sudden heavy downpour of rain, Clark and Jessica decided to keep driving to Bellambi. They are now on Princes Highway near Russell Vale. Jessica has a subscription with the early alert messaging service with her telecommunications carrier (e.g. Telstra, Optus or Three). When they came in the vicinity of Bellambi, Jessica’s mobile received SMS warning her that the torrential downpour has brought flash floods and the roads in that area might be affected.</td>
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<thead>
<tr>
<th>Scenario 3: Suspected Terrorist</th>
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<tr>
<td>Matilda lives in a neighbourhood where a suspected terrorist is alleged to reside. Government intelligence agencies in collaboration with telecommunications carriers (e.g. Telstra, Optus or Three) will gather detailed mobile transaction data (including location information) of every person in that area for a period of 7 days (with accuracy of 500 meters), without acquiring the consent or approval of anyone.</td>
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<tr>
<th>Scenario 4: Early Public Warning</th>
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<tr>
<td>Stephanie and her family are currently at North Wollongong beach. There is a potential for a Tsunami, which can make an impact on the shoreline within 90 minutes. The government relevant agencies in collaboration with the telecommunications carriers (e.g. Telstra, Optus and Three) located all mobile phones in North Wollongong and the surrounding areas and then disseminated a warning notification to these mobile phones without acquiring any kind of approval or consent from the recipients.</td>
</tr>
</tbody>
</table>
### Appendix II, Section D: Information control mechanisms

How *your* location information can be controlled

Please rank the following methods in their ability to assure your location privacy and grant you control over your own location data once the location-based services are used by the government for emergency management?

Please rank them in order of preference from 1 (the most effective) to 3 (the least effective)

<table>
<thead>
<tr>
<th>Method</th>
<th>Rank</th>
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<tbody>
<tr>
<td>• By introducing <strong>technical features</strong> in the mobile phone in order to switch on/off LBS functionalities or to be able for you to adjust the accuracy level to which the telecommunications carrier is allowed to track your mobile device.</td>
<td>1</td>
</tr>
<tr>
<td>• By establishing an “LBS code of practice” within the telecommunications industry and introducing clear <strong>privacy policies</strong> to regulate the relationship between you and the carriers (e.g. Telstra or Optus) in order to assure the privacy of your location information.</td>
<td>2</td>
</tr>
<tr>
<td>• By introducing <strong>government policies, laws and regulations</strong> within the legal system to guarantee the proper disclosure and use of the personal location information.</td>
<td>3</td>
</tr>
</tbody>
</table>
### Appendix II, Section E: The main questionnaire of the survey

Your general views on location-based services

On a scale of 1 to 5, please cross X in the appropriate box to indicate how strongly you disagree or agree with each statement. Please answer all the questions in this section.

<table>
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<tr>
<th></th>
<th>Strongly Disagree</th>
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<tr>
<td>1.</td>
<td>I like the idea of using location-based services for hazardous and emergency situations.</td>
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<td>[ ]</td>
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<tr>
<td>2.</td>
<td>I consider using location-based services for emergencies a good idea.</td>
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<td>[ ]</td>
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<tr>
<td>3.</td>
<td>In general, the idea of using location-based services for emergency management might be beneficial to my family and me.</td>
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<tr>
<td>1.</td>
<td>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.</td>
<td>[ ]</td>
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<td>2.</td>
<td>If my mobile phone company offers me free location-based services I will make use of the offer.</td>
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<tr>
<td>3.</td>
<td>If LBS-enabled mobile phones become available I intend to buy one within the next three months.</td>
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<td>4.</td>
<td>If location-based services are widely used by my friends, I will start using them within the next three months.</td>
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<td>5.</td>
<td>In general, if the government offer location-based services for emergency management I intend to make use of the services.</td>
<td>[ ]</td>
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</tbody>
</table>
1. I trust the government use of LBS for managing hazardous and emergency situations.  
2. I think location-based services are trusted applications that can deliver warning notifications during emergencies.  
3. In my opinion, location-based services are mature mobile phone services that can be trusted for emergency management.  

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<tr>
<th>Strongly Disagree</th>
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</table>

1. There is a considerable risk involved in using location-based services for emergencies.  
2. My decision to use location-based services for managing emergencies would be risky.  
3. There is too much uncertainty associated with using location-based services for managing hazardous and emergency situations.  

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<th>Strongly Disagree</th>
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</table>

1. The government use of location-based services for emergency management can save lives.  
2. Using location-based services in emergencies would be invaluable.  
3. Using location-based services for managing emergencies can guarantee my safety and well-being.  
4. Overall, I find location-based services to be useful for hazardous and emergency situations.  

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<th>Strongly Disagree</th>
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</table>

1. Learning how to use location-based services would be easy for me.  
2. I think my interaction with location-based services would be clear and understandable when they are used for emergencies.  
3. I would find it easy to get location-based services to do what I want them to do.  
4. In general, I think I would find location-based services easy to use.  

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<th>Strongly Disagree</th>
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1. At my work, school or amongst my friends, I can see location-based services being used.  
2. I have seen others using location-based services on their mobile phones.  
3. It is easy for me to foresee others using location services in public.  
4. I have seen location-based services being used before.

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<th>Strongly Disagree</th>
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<th>Somewhat Agree</th>
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</table>

1. I would expect the message content delivered to my phone to have up-to-the-minute information during hazardous or emergency situations.  
2. I would be concerned if the information provided to me was not up-to-date during emergencies.  
3. I think location-based services should always have the latest information in order to be reliable.

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<th>Strongly Disagree</th>
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</table>

1. I would expect the message of the location-based service delivered to me to be always accurate when being used for emergencies.  
2. I would find it unacceptable to receive inaccurate information when using location services during an emergency.  
3. Overall, location-based services are reliable to be used for emergency management only when they are accurate.

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<tr>
<th>Strongly Disagree</th>
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</table>

1. I would expect location-based services to be timely when being used for emergencies.
2. If I used location-based services, I would always expect a prompt response during hazardous situations.  

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
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3. I do mind if there is a delay in response to a location service query I have made during an emergency situation.  

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<th>Strongly Disagree</th>
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<tbody>
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</tr>
</tbody>
</table>

4. Overall, location-based services should offer safety information in a timely manner when they are used for emergency management.  

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

| (1) | (2) | (3) | (4) | (5) |

1. It would bother me if my location information is always collected by the location-based service provider during emergencies.  

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

2. I am concerned that the service provider will collect too much location data about me during emergency situations.  

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

3. I am not comfortable with the idea that the service provider is able to collect location information about me at any time in emergencies.  

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

4. I would rather not provide my location information to the service provider even in emergency situations.  

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

| (1) | (2) | (3) | (4) | (5) |

1. The service provider should never disclose my location information even during emergency situations.  

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

2. In emergencies, the service provider should never use my location information for any other purposes unless it has been authorised by me.  

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

3. The service provider should not share my location information with 3rd parties without my consent during emergencies.  

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

| (1) | (2) | (3) | (4) | (5) |
**Appendix II, Section F: The importance of using location-based services in different emergency situations**

Please rank the importance of using location-based services by the government to provide you with a warning notification based on your mobile location in the case of one of the following hazardous and emergency situations. Please cross X in the most appropriate box, (1) the least important to (3) the most important.

<table>
<thead>
<tr>
<th>The situation</th>
<th>To be provided by LBS?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not really Important</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
</tr>
</tbody>
</table>

**Human-caused hazards and emergencies**

1. Toxic spill or chemical emission
2. Urban fire
3. Explosion
4. Blackout or main power failure
5. Major transportation incident e.g. road closure, traffic collision
6. Terrorism act
7. Mining or industry incident
8. Civil disturbance (e.g. riot)
9. Pollution (e.g. air pollution, water pollution, smog, etc.)

**Natural hazards and disasters**

1. Severe weather conditions e.g. storm surge, land gale, hail, cyclone, hurricane, torrential rain, etc.
2. Earthquake
3. Flash floods
4. Bushfires
5. Tsunami or tidal waves
6. Landslide or mudslide
7. Epidemic or disease outbreak e.g. SARS, Salmonella, Avian flu, etc.

**Other types of emergencies**

1. Finding the location of a missing child or an elderly relative or someone with a mental illness
2. Finding the nearest point of help e.g. hospital, police station, etc.
3. To be automatically located after making an emergency call e.g. after calling 000
4. To be automatically located by a roadside assistance company (e.g. NRMA)
## Appendix II, Section G: The demographic questions

The following questions are ONLY gathered for statistical purposes and your responses will remain confidential. Please cross X in the most appropriate box.

<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. To which age group do you belong?</td>
<td>18 - 25 Years, 26 – 34 Years, 35 – 44 Years, 45 – 54 Years, 55 - 64, 65 or above</td>
</tr>
<tr>
<td>2. Your gender?</td>
<td>Male, Female</td>
</tr>
<tr>
<td>3. Your highest level of education?</td>
<td>Still at secondary school or tertiary institutions, Secondary education, Certificate level including skilled vocational, Advance diploma or diploma level, Bachelor degree, Graduate diploma or graduate certificate level, Postgraduate degree, Other (Please specify)</td>
</tr>
<tr>
<td>4. Ethnicity background?</td>
<td>Australian, Aboriginal, Torres Strait or Pacific Islander, New Zealander, African, European, Asian, Indian Sub-continent, North American, Latin-American, Other (Please specify)</td>
</tr>
<tr>
<td>5. Your annual gross household income (before tax)?</td>
<td>Under $19,999, $20,000 – $39,999, $40,000 – $59,999, $60,000 – $79,999, $80,000 – $99,999, $100,000 – $119,999, $120,000 or more</td>
</tr>
<tr>
<td>6. Occupation (or previous one if you have retired)?</td>
<td>Manager or administrator, Labourer or related work, Professional, Home duties, Clerical, sales and service person, Tertiary student, Associate professional (technical &amp; admin support), Other (Please specify), Plant/machinery operator or transport driver</td>
</tr>
</tbody>
</table>
Appendix II, Section H: The open-ended question in the survey

We would like to hear your comments or views about the use of location-based services for emergency management. For instance, do you have any concerns? Would you like to discuss benefits? Your comments will help us convey the right message to government agencies and telecommunications carriers. Please feel free to comment on ANY aspect of the survey and to attach additional pages if you require the space.

_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________

Would you like to participate in future research on location-based services?

☐ Yes ☐ No

If yes, then please provide us with your contact details:

_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________

We would be grateful if you checked all sections of the questionnaire to ensure they have been completed to your satisfaction.

Your contribution to this research is highly appreciated.

Thank you very much

Please kindly return this questionnaire in the reply paid envelope provided.
Appendix III, Section A: The interviewee consent form

University of Wollongong

I have been given information about the research project "Investigating Location-Based Services Utilisation for Emergency Management in Australia" and discussed the research project with Mr. Anas Aloudat who is conducting this research in fulfilment of the requirements for the degree of Doctor of Philosophy in Information Systems and Technology, under the supervision of Dr. Katina Michael, at the School of Information Systems and Technology, the University of Wollongong.

I have been advised that the potential risk associated with this research is minimal, and limited to the duration of this interview.

I understand that my participation in this research is voluntary, and I am free to refuse to participate and withdraw from the research at any time.

I am aware that this interview will take about one hour of my time. I am also aware that the interview will be audio taped with my permission.

I am aware that if I have any enquiries about the research, I can contact Mr. Anas Aloudat at aa279@uow.edu.au or Dr. Katina Michael at katina@uow.edu.au.

If I have any concerns or complaints regarding the way the research is being or has been conducted, I can contact the Ethics Officer, Human Research Ethics Committee, Office of Research, at the University of Wollongong on 02 4221 4457.

I understand that the data collected from my participation will be used for the purpose of a PhD thesis and may be published in a form that does not identify me in any way, and I consent for it to be used in that manner.

Signed       Date
.................................................................       ....../....../......

Name (please print)
.................................................................
### Appendix III, Section B: The Interview protocol

1. **[Indication of appreciation of participation and initial introduction]** 5 minutes

   First I would like to thank you for agreeing to conduct this interview. I have previously sent you the questions so please feel free to answer all or some of them. The interview should take around 60 minutes. On completion you can opt to:

   1. Receive a copy of the interview transcription.
   2. Read and edit the transcription.
   3. Receive a copy of the final results.

   As we go through the questions, please feel free to ask me to clarify anything. In addition, if you feel there are any other issues you would rather be talking about, please take the opportunity to do so.

   *[Ask the interviewee to sign the consent form]*

   A. Do you mind if I record our conversation?

   *[Start recording if yes]*

   B. Do you have any questions for me before we begin?

   C. I would like to start today by learning something about you. Please tell me a little bit about yourself?

   *[A gesture of esteem. Response should be encouraged]*

   *[Probe to expand on the interviewee’s education, working experience, responsibilities, etc]*

2. **[The opportunity of using LBS for EM in Australia]** 20 minutes

   Ok, let us first talk about the possibility of using location-based services (and its subset the location services) for emergency management in Australia. Several countries such as South Korea and the Netherlands have already started to utilise the cellular mobile phone location-based services to provide people in designated areas with early warnings and up-to-the-minute information regarding impending events. Such information can take the form of a map, directions, or a text message.

   1) Do you believe we currently have a similar solution here in Australia?

   2) How do you think the dissemination of early alerts or warnings to people in one particular
geographic area is managed in Australia?

3) Do you believe LBS solutions could coexist with the current informative channels such as the internet, TV, and the radio for the purpose of disseminating critical information to people who need it, before, during or after a particular extreme event?

    [Why? Why not?]

4) Do you believe there is a need for using location-based services for emergency management in Australia?

    [Why? Why not?]

5) Have you or would you consider the possibility of using LBS for EM?

    [If yes, then why it has never been eventuated?
    If no, then why?]

6) What do you think would be the most important factors to consider before coming into a decision to use, or even not to use, the LBS solutions for emergency management?

    [If not mentioned, probe for the following:
    Cost. Suitability. Market trends. Scalability. Private vs. public/private initiatives. Functionality and service qualities e.g. accuracy, currency, responsiveness, etc.]

7) Do you believe people would trust the use of these services during hazardous and emergency situations?

    [Why? Why not?]

8) In general, what benefits do you perceive from using such technologies, specifically, in Australia?

    [How could these solutions be useful to Australians?]

9) Can you think of any risks associated with the use of these services for managing emergencies?

10) What hurdles do you believe must be overcome before bringing LBS solutions into widespread use?

11) What would be your recommendations or suggestions towards the realisation of nationwide LBS solutions for EM in Australia in the future?

    [What should be done so that Australians see LBS actively being utilised during emergencies?]
3. [Defining the roles of LBS stakeholders in the context of EM] 25 minutes

Now, let’s talk about the LBS value chain. The chain includes several parties such as the government, the mobile phone vendors, the telecommunications carriers, the mobile phone services providers, the location providers, the content providers and, of course, the end-users.

12) Who do you think are the key actors who could translate the idea of using LBS for public warning into a feasible solution?

13) In such solutions, who do you think should be responsible of providing the services to the public?

[Probe to expand on:
1. Who should provide the information to the people?
2. Which department/authority should be entitled with the duty?]

14) Where would you place the relationship between you and the key players in the context of using LBS for emergency management?

15) Who do you think should be responsible of financing these solutions?

[Probe to get more details on:
1. Who should pay for warning or alert messages during emergencies? The government? The subscribers?
2. Who should pay for licensing arrangements and service level agreements (SLAs)?
3. What if there is a ready proprietary solution?]

16) Who do you think should be responsible of operating and maintaining these solutions?

17) How do you see the role of the state and federal governments with regard to supporting these technologies and solutions to come into fruition?

18) In your opinion, what would be the impediments, if any, to the government’s decision for adopting location-based services for emergency management?

[If not mentioned, probe for the following:
1. Lack of the political will.
2. No legislation to mandate the involvement of the private sector (i.e. telecommunications carriers) in the case of emergencies.
3. No standard regulations are established to control similar solutions.
4. No explicit legislations to solve any disputes that may arise from using these]
technologies.

5. No dedicated governmental department that is specifically assigned to deploy, maintain and manage these solutions]

19) What can be done to clear such impediments?

20) In your opinion, how do you see the role of the telecommunications carriers with regard to supporting these technologies and solutions to come into fruition?

21) What would be the impediments, if any, to the companies’ decision for adopting the location-based services for emergency management?

[If not mentioned, probe for the following:

1. Lack of attractive business models. Cost-benefit analysis is not in favour of these solutions.

2. No dedicated government authority that is capable of coordinating the work with these companies]

22) Do you think it is important to ask the people regarding the use of LBS solutions for emergencies before a possible deployment of the services in the future?

[Why? Why not?]

[If not mentioned, probe for the following:

1. To know whether the people would accept or not accept the use of these services for EM.

2. To conclude the factors that would influence their decisions.

3. To clearly define any concerns the people have regarding the use of these services for emergencies]

23) Is there a need to create awareness amongst Australians about the benefits of using location-based services and their technologies in emergencies?

[Why? Why not?]

[How can that be done?]

4. [Control of information and privacy concerns] 10 minutes

Let us talk now about some of issues in relation to LBS. The LBS solution for EM depends, essentially, on the ability of pertinent government agencies working in concert with the telecommunications carriers/mobile services provides to determine and/or track the almost exact geographic location of all active cellular mobile phones and then provide the services/information to them. The information is provided if the active mobile phone is
currently in the targeted area or if it enters, leaves or comes in the vicinity of that area.

24) In emergencies, do you believe the solution provider has the right to collect any personal location information without a prior consent from the mobile phone user?

[If not mentioned, probe for the following:

1. subscribers vs. nonsubscribers

25) What mechanisms do you think could be introduced to protect the individual’s privacy and his or her personal location information?

[Probe to expand on assurance of control mechanisms:

1- LBS privacy policies.
2- Dedicated state and federal legislations that clearly define when, what and how location information is determined, collected and stored.
3- The technical features of the mobile phones]

26) In your opinion, what could be the justifications of providing information to an individual regarding an impending danger without first ensuring a prior explicit consent from him or her?

[If not mentioned, probe to expand on the following:

1- Ethical arguments:
   a. The government has an ethical obligation to protect the safety of everyone.
   b. It could be in the person’s best interest to be informed about the impending hazard.
   c. The hazard affects other people’s lives, not just those who are in the hazard zone e.g. friends, family, etc

2- Practical arguments:
   a. The nature of information provided makes the prior consent unnecessary.
   b. Providing this information will raise more awareness about the impending threat, thus giving the change to the individual to come into more informed decisions. ]

27) Could it, in any way, be considered an invasion to the individual’s privacy and his or her personal identifiable locational information?

[If not mentioned, probe to expand on the following:]
1. Considering it as an invasion undermines the purpose to saving lives.

2. Considering it as invasion undermines the commitmen of the government to provide vital information to its citizens by using all available and possible means.

28) Do you believe the solution provider is liable for any legal action if such act happened?

[Why? Why not?]

[What if such legal action was taken?]

29) Could you see a space for any government legislation(s) that regulate the disputes in the case of disclosing personal details - either accidentally or deliberately- if these services were nationally utilised for emergency management in the future?

30) Do you believe the solution provider should be accountable for any inadvertent or accidental errors in the delivered information?

[Probe to expand on the following:

1. What type of errors could not be acceptable?
2. What about inaccurate or outdated information?
3. What about the delay in receiving the services?]

5. [Restating appreciation and concluding the interview] 5 minutes

I do thank you for your time. Your contribution to this research is highly appreciated.

A. Is there any last comment you wish to add, or do you believe there is any issue or aspect that we haven’t touched or covered properly?

B. Do you wish to receive a transcript of this interview?

[If yes, then:

1. Ask if the interviewee prefers to receive it by email or as a hardcopy by post.

2. Get the preferred contact details]

C. Do you wish to receive a copy of the final results

[As above]

[Assure the interviewee that he or she has the complete choice to edit the transcript and void his/her permission to use the interview material at any stage towards the end of the thesis]
Appendix IV, Section A: The demographic profile of the participants of the survey

Descriptive Statistics

<table>
<thead>
<tr>
<th>Statistic</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Variance</th>
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</thead>
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<td></td>
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<td>Std. Error</td>
<td>Statistic</td>
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Frequencies

Age

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<td>35-44</td>
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<td>45-54</td>
<td>36</td>
<td>12.4</td>
<td>95.9</td>
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<td>55-64</td>
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<td></td>
<td>65 or above</td>
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<tr>
<td>Total</td>
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### Gender

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
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<td>Total</td>
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### Education

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<th>Valid Percent</th>
<th>Cumulative Percent</th>
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<tr>
<td>Valid</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Still at school</td>
<td>7</td>
<td>2.4</td>
<td>2.4</td>
<td>2.4</td>
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<tr>
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<td>16.6</td>
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</tr>
<tr>
<td>Certificate level including skilled vocational</td>
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<td>6.9</td>
<td>6.9</td>
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<tr>
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<td>9.3</td>
<td>9.3</td>
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<td>Bachelor degree</td>
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<td>41.4</td>
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<td>Graduate diploma or graduate certificate level</td>
<td>19</td>
<td>6.6</td>
<td>6.6</td>
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### Ethnicity

<table>
<thead>
<tr>
<th></th>
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<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
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</thead>
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<td>9.3</td>
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<td>Asian</td>
<td>83</td>
<td>28.6</td>
<td>28.6</td>
<td>93.1</td>
</tr>
<tr>
<td>Indian Sub-continent</td>
<td>11</td>
<td>3.8</td>
<td>3.8</td>
<td>96.9</td>
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<td>1.0</td>
<td>97.9</td>
</tr>
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<td>99.0</td>
</tr>
<tr>
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<tr>
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<td>290</td>
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</tbody>
</table>

### Annual gross income

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
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<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid Under $19,999</td>
<td>83</td>
<td>28.6</td>
<td>28.9</td>
<td>28.9</td>
</tr>
<tr>
<td>$20,000 – $39,999</td>
<td>69</td>
<td>23.8</td>
<td>24.0</td>
<td>53.0</td>
</tr>
<tr>
<td>$40,000 – $59,999</td>
<td>54</td>
<td>18.6</td>
<td>18.8</td>
<td>71.8</td>
</tr>
<tr>
<td>$60,000 – $79,999</td>
<td>34</td>
<td>11.7</td>
<td>11.8</td>
<td>83.6</td>
</tr>
<tr>
<td>$80,000 – $99,999</td>
<td>22</td>
<td>7.6</td>
<td>7.7</td>
<td>91.3</td>
</tr>
<tr>
<td>Salary Range</td>
<td>Frequency</td>
<td>Percent</td>
<td>Valid Percent</td>
<td>Cumulative Percent</td>
</tr>
<tr>
<td>----------------------</td>
<td>-----------</td>
<td>---------</td>
<td>---------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>$100,000 – $119,999</td>
<td>4</td>
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<td>1.4</td>
<td>92.7</td>
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<td>$120,000 or more</td>
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<td>7.3</td>
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<td><strong>100.0</strong></td>
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</tr>
<tr>
<td>Missing System</td>
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<td></td>
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<td><strong>Total</strong></td>
<td><strong>290</strong></td>
<td><strong>100.0</strong></td>
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</tbody>
</table>

### Occupation

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<tr>
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<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid Manager or administrator</td>
<td>29</td>
<td>10.0</td>
<td>10.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Professional</td>
<td>45</td>
<td>15.5</td>
<td>15.5</td>
<td>25.5</td>
</tr>
<tr>
<td>Clerical, sales and service person</td>
<td>41</td>
<td>14.1</td>
<td>14.1</td>
<td>39.7</td>
</tr>
<tr>
<td>Associate professional (technical &amp; admin support)</td>
<td>16</td>
<td>5.5</td>
<td>5.5</td>
<td>45.2</td>
</tr>
<tr>
<td>Plant/machinery operator or transport driver</td>
<td>6</td>
<td>2.1</td>
<td>2.1</td>
<td>47.2</td>
</tr>
<tr>
<td>Labourer or related work</td>
<td>15</td>
<td>5.2</td>
<td>5.2</td>
<td>52.4</td>
</tr>
<tr>
<td>Home duties</td>
<td>8</td>
<td>2.8</td>
<td>2.8</td>
<td>55.2</td>
</tr>
<tr>
<td>Student</td>
<td>112</td>
<td>38.6</td>
<td>38.6</td>
<td>93.8</td>
</tr>
<tr>
<td>Other</td>
<td>18</td>
<td>6.2</td>
<td>6.2</td>
<td>100.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>290</strong></td>
<td><strong>100.0</strong></td>
<td></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>
Gender * Age Crosstabulation

Count

<table>
<thead>
<tr>
<th>Gender</th>
<th>Age</th>
<th>18-25</th>
<th>26-34</th>
<th>35-44</th>
<th>45-54</th>
<th>55-64</th>
<th>65 or above</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>89</td>
<td>35</td>
<td>32</td>
<td>20</td>
<td>3</td>
<td>1</td>
<td>180</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>36</td>
<td>28</td>
<td>22</td>
<td>16</td>
<td>7</td>
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<td></td>
</tr>
<tr>
<td>Total</td>
<td>125</td>
<td>63</td>
<td>54</td>
<td>36</td>
<td>10</td>
<td>2</td>
<td>290</td>
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</tbody>
</table>

Bar Chart
Appendix IV, Section B: The general knowledge questions about location-based services

Each of the following tables represents a specific location-based service and its usage/non-usage frequencies:

1- Requesting information about a nearest point of interest

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>60</td>
<td>20.7</td>
<td>20.7</td>
<td>20.7</td>
</tr>
<tr>
<td>No</td>
<td>230</td>
<td>79.3</td>
<td>79.3</td>
<td>100.0</td>
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<tr>
<td>Total</td>
<td>290</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

2- Friend Finder

<table>
<thead>
<tr>
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<th>Percent</th>
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<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>13</td>
<td>4.5</td>
<td>4.5</td>
<td>4.5</td>
</tr>
<tr>
<td>No</td>
<td>276</td>
<td>95.2</td>
<td>95.2</td>
<td>99.7</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>.3</td>
<td>.3</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>290</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>
### 3- Locating a child, an elderly relative, or any missing person

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>Yes</td>
<td>2</td>
<td>.7</td>
<td>.7</td>
</tr>
<tr>
<td></td>
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<td>288</td>
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<td>99.3</td>
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<tr>
<td>Total</td>
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<td>100.0</td>
</tr>
</tbody>
</table>

### 4- Receiving advertising notifications

<table>
<thead>
<tr>
<th></th>
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<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
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<td>25</td>
<td>8.6</td>
<td>8.6</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>265</td>
<td>91.4</td>
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</tr>
<tr>
<td>Total</td>
<td></td>
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<td>100.0</td>
<td>100.0</td>
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</table>

### 5- Receiving information about traffic conditions or weather updates

<table>
<thead>
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<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
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<tr>
<td>Valid</td>
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<td>41</td>
<td>14.1</td>
<td>14.1</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>249</td>
<td>85.9</td>
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<tr>
<td>Total</td>
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</table>
6- Turn by turn driving directions

<table>
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<th>Percent</th>
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<th>Cumulative Percent</th>
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</thead>
<tbody>
<tr>
<td>Valid</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>93</td>
<td>32.1</td>
<td>32.2</td>
<td>32.2</td>
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<tr>
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<td>67.6</td>
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</tr>
<tr>
<td>Total</td>
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<td>99.7</td>
<td>100.0</td>
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</tr>
<tr>
<td>Missing</td>
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<td></td>
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</tr>
<tr>
<td>System</td>
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<td>.3</td>
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<tr>
<td>Total</td>
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7- Fleet tracking/Fleet management

<table>
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<th>Percent</th>
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<th>Cumulative Percent</th>
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<td>96.9</td>
<td>96.9</td>
<td>100.0</td>
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<tr>
<td>Total</td>
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</table>

8- Customer Relationship Management

<table>
<thead>
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<th>Percent</th>
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<th>Cumulative Percent</th>
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<td></td>
</tr>
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<td>5.9</td>
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