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An approach to studying location-based Services regulation in Australia

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Keywords

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Abstract

Location-based Services (LBS) afford a means of positioning, tracing and tracking individuals and objects, for purposes such as emergency management, employee monitoring, and consumer convenience. This paper reviews the present LBS setting and expected developments in this space, with a particular focus on the implications for Australian research and regulatory efforts. The origins of LBS in the mobile-commerce field are explored, incorporating an appraisal of the underlying positioning technology, the stakeholders in the LBS value chain, and the regulatory environment in which these services are employed. There is an evident disparity between the implementation of LBS technologies and the introduction of suitable regulatory provisions, substantiated through limited consideration of the social and ethical implications and the practical safeguards required to govern LBS usage. This paper provides an approach for studying LBS regulation in general, and highlights the need for an interdisciplinary and comprehensive approach to fulfil the established gap in LBS literature and research. It also alludes to the importance of such an approach in the Australian context, and identifies research progress to date.

Keywords: literature, location-based services, regulation, Australia

1. Introduction

Location-based services (LBS), and related technologies, utilise the location of an entity to provide a relevant, value-added solution to the user. LBS solutions and technologies are being deployed globally, and specifically within Australia, without the necessary regulatory provisions in place. Therefore, a significant gap exists between technology deployment and the appropriate regulatory safeguards to govern their usage. The primary objective of this paper is to provide a review of relevant LBS scholarship, allowing for an appreciation of the complex dimensions associated with research into the regulatory environment pertaining to location-based services. The paper will present the necessary background information relating to the nature of the technology, and present a number of research gaps for future consideration.

2. Background

Location-based Services (LBS) afford a means of positioning, tracing and tracking individuals and objects, for purposes such as emergency management, employee monitoring, and consumer convenience. A common definition of LBS is difficult to articulate, given the multiple means associated with determining the location of an entity (discussed further in section 2). Where satellite positioning systems are utilised, location based services refer to the applications and tools that combine geographic coordinates with services, thereby providing value-added solutions to users [1-3]. However, this definition does not account for mobile network-dependent LBS that make use of signals in a cellular network to ascertain location information.

Although a common definition of LBS is not broadly acknowledged [4], the label adopted throughout this paper is "any applications that offer information, communication, or a transaction that satisfies the specific needs of a user in a particular place" [5: p. 269], in order to incorporate both the satellite and network-dependent cellular alternatives. Example location-based services include in-car navigation systems, mobile social networking tools, mapping services, and GPS data logging devices, all of which serve a particular need based on knowledge of location data.

LBS literature typically offers useful systems of categorising applications based on various criteria in an attempt to offer insights into the industry and technology. A common classification distinguishes between pull and push services, each of which implies different technological considerations. For instance, push solutions require the coordinates of the individual to be provided continuously in real-time, whereas pull services involve the individual providing updates on a selective basis when required [1, 6]. Additional classifications of LBS include person-oriented versus device-oriented, network-based versus handset-based solutions, reactive versus proactive, and also the market segment to which the LBS application is targeted [1, 4]. This allows scholars to offer novel ways of understanding the components and

characteristics of a particular LBS application. For instance, [1] introduces an LBS application taxonomy, in which the author maps the associations between person-oriented/device-oriented applications and push/pull services to offer a myriad or matrix of LBS categories. For example, tracking solutions are device-oriented, and can be implemented as either a push service involving automatic alerts sent to the user, or a pull service where the user must request information in the tracking scenario.

Regardless of the classification system employed, location-based services exhibit their potential in countless situations, which generally fall within the government, business and consumer domains. The uses of LBS encompass: (a) emergency management and government applications, including the exploitation of mobile devices for the provision of timely information by government/other agencies, and also user-initiated distress calls in emergency situations [3, 7], (b) business solutions, whereby location-based services are used for purposes such as vehicle tracking/fleet management, employee monitoring and location of field staff, in addition to product tracking [3, 4, 8] , (c) consumer applications, such as navigation services to ascertain geographic details or directions, and information services that offer users location-specific content [3], and (d) other applications, which are industry-specific, such as health, tourism and policing.

Additional applications are being introduced at a substantial pace depending on customer needs, and the creation of innovative offerings that combine existing solutions with a location component or feature. Examples of the latter are mobile social networking/friend locator solutions such as Google Latitude [9] and Vodafone Pocketlife [10]. These LBS applications incorporate traditional online social networking software with location capabilities, delivered on a mobile handset. With the introduction of novel applications, the positive and driving factors behind LBS usage are evident, and are promoted by industry representatives and covered in the literature. For instance, motivations for LBS deployment may include efficiency and cost management in a corporate setting, and benefits such as convenience, time/money savings and general interest in the consumer scenario [6]. Despite the advertised and demonstrated benefits, there is increased recognition of the ensuing social implications of LBS implementation and adoption. Additionally, the need for reconceptualising the location-based services industry as a comprehensive unit, with multiple stakeholders and numerous dimensions, clearly emerges throughout the survey of existing literature. This re-conceptualisation can be achieved through an understanding of the origins of LBS technologies, the manner in which solutions are delivered to customers via the LBS value chain/net, and a review of the social implications resulting from the introduction of LBS within a particular social context. Provided below is a discussion of these elements.

2.1. Mobile commerce origins

Research into location-based services (LBS) requires a fundamental understanding of the origins of the technology and the manner in which it came into being, prior to addressing its dimensions. The birth of LBS can be linked to the mobile commerce (m-commerce) domain, which is defined as one the following: engaging in a transaction using a wireless, internet-enabled device [11]; and/or exploiting wireless telecommunications systems and devices to engage in activities irrespective of location and generally within the business systems context [8]. Importantly, m-commerce is characterised by the study of wireless and portable mobile technologies, thereby providing “mobility (of participation)” and “portability (of technology)” [8: p. 3]. Consequently, this allows LBS technology and related applications to thrive and assume a predominant role in the m-commerce domain, due to the centrality of the geographic (or location) facet.

2.2. Key technologies that have influenced the development of LBS

While multiple techniques or technologies can be employed in determining the location of a target (refer to section 2.3), the introduction of LBS can be largely accredited to two major developments. This includes advancements in wireless communications (cellular), including internet connectivity and mobile technology [8], and the use of satellite positioning systems, specifically the introduction of GPS into the commercial sphere [1, 12]. It is important at this point to note a current development in satellite positioning technology, Galileo, which will inevitably impact on the LBS field. The Galileo system is a joint initiative managed by the European Commission and the European Space Agency [13], and is intended as "Europe's initiative for a state-of-the-art global satellite navigation system, providing a highly accurate, guaranteed global positioning service under civilian control" [14].

Figure 1 parallels the wireless cellular communications and satellite positioning systems timelines, which have influenced the development of LBS technologies.

The diagram, constructed using the works of [1, 8, 12] and official documentation from the European Space Agency [13, 15], demonstrates that the inception of mobile LBS is a natural progression enabled by the convergence of various concepts (and technologies). Specifically, this refers to the assimilation of mobility

(wireless communications and mobile technologies), location (GPS and mobile positioning techniques) and services (m-commerce strategies and applications). It further highlights that the development and operation of Galileo is expected to provide improvements to existing positioning techniques, providing higher levels of accuracy, connectivity and real-time location data, which will have significant implications for emergency management and other LBS application areas. An overview of current positioning techniques is provided in the following section.

	Wireless Communications (cellular)	Satellite Positioning Technologies	
		GPS (US)	Galileo
1970s	Prior to 1970 & during this time, wireless comms only practised in certain settings (government & military) Quality lacking	Used by US Department of Defense, for military & emergency purposes	
1980s	1st Gen analogue networks (voice) Used in BIS domain Birth of wireless phone & telecomm companies, Nokia, Ericsson, Motorola	Open to industry for commercial use Selective availability, where accuracy can be downgraded	
1990s	2nd Gen digital networks (voice & limited data) SMS & Internet browsing using WAP GSM network introduced Late 90s-early 2000: 2.5 Gen network (2G + enhanced data capabilities), GPRS introduced, improved data transmission & 'always on connectivity'	GPS encouraged interest from mobile network operators	
2000s	3rd Gen broadband network (voice & multimedia) Integrated business & social dimensions of user	Selective availability removed	Development & validation phase, improved positioning & accuracy promised Experimental satellite launched in 2005
Current	Other improvements: broadband speeds, security, miniaturisation, location integration UTMS introduced in Japan (2001) & US/Europe (2002)	GPS widely used in LBS applications	Deployment phase between 2008 to 2010 27 operational satellites & 3 reserves planned
2010+			Operations phase

Figure 1.Wireless communications, GPS and Galileo timelines

2.3. Location and positioning infrastructures

In a comprehensive account of location-based services, [4] discusses the fundamentals of LBS, from introductory definitions through to various means of categorising the technology. A particularly important aspect of the author's work is a review of positioning infrastructures, where the distinction between satellite, cellular and indoor positioning techniques is articulated [4], enabling an understanding of the underlying network or technology on which LBS are built. Essentially, the location of an entity can be derived via mobile-network independent technologies that require the device to contain an embedded passive GPS receiver; mobile network-dependent approaches which rely on active mobile device signals in a cellular network; or alternatively short-range, indoor technologies such as Bluetooth, Wireless Local Area Networks and Radio Frequency Identification [3, 4, 16], the latter of which is beyond the scope of this research. Each positioning technique is associated with a particular level of accuracy, coverage and technology, signifying that the core positioning technique and network will determine the environment in which a specific LBS solution operates, and the type of collaboration required in the delivery of the service. That is, the provision of an LBS solution calls for a joint effort between various stakeholders in the LBS value chain or net, given the varying classifications and models that LBS solutions adhere to, discussed below.

3. Location-based service value chain/net

Satisfying user needs through the provision of a location-based service requires a complex set of interactions amongst a series of stakeholders. This is traditionally represented as a value chain, which refers to "a map of the entire set of competencies, investments, and activities required to produce, deliver, maintain, and reap the proceeds from a product or service" [17: p. 122]. While the value chain representation is common in the literature and industry [18, 19], [20] argue that a value 'net' is preferable, given that mobile business services (and in fact LBS in general) are non-sequential in nature as the term chain suggests, but are rather a mesh of three distinct value chains fused together, specifically the service development, service provisioning and devices value chains.

Furthermore, the LBS value chain or net is unique in that various models can be implemented based on the type of LBS solution being delivered and that a single stakeholder is unable to provide a complete offering to

customers, resulting in a situation in which partnership is crucial [17]. That is, LBS provisioning is an "interorganizational matter" [4: p. 10], requiring the cooperation of multiple actors such as individuals, companies and organisations. This paper will use the term value chain and net interchangeably to encompass both concepts (chain and net) in referring to the stakeholder groups that provide LBS in Australia, while recognising the complexity of interactions between the players.

3.1. LBS stakeholders

[17] track the evolution of the mobile commerce value chain, commencing with the actors required for first-generation cellular voice services and second-generation digital voice and data, through to next-generation wireless internet services. The latter, specifically, identifies five stakeholder groups involved in the provision of m-commerce services, which include content and application providers, portal and access providers, wireless network operators, support services, and delivery platforms and applications, while the mobile customer or end user is listed as a peripheral component at the completion of the process. While this listing is inclusive, [4] also identifies developers and researchers, standardisation committees, government entities and other indirect stakeholder groups as LBS actors, maintaining that such stakeholders fulfil a non-operational role as they are not concerned with the technical dimensions of LBS delivery.

In the interest of a comprehensive approach, this paper offers a consolidated, diagrammatic representation that incorporates both non-operational and operational/technical actors (see Figure 2). Furthermore, the generic value chain model is specific to LBS as opposed to m-commerce, combining various studies in the identification of stakeholders [4, 17-19].

Perceiving LBS with respect to the constituent stakeholders within the industry enables an appreciation of the level of partnership required to deliver a solution, while also alluding to the complexity of stakeholder interests which must be accounted for in developing and implementing location-based services. This paper argues that an accurate study of LBS within a specific social context (Australia, in this instance) requires research into the manner in which stakeholders interact.

This claim is aligned with and based on the principles of socio-technical theory (and related approaches), a theoretical approach which encourages that the social and technical components within a given system are granted equal consideration. In a seminal study describing the importance of social analyses in the technology realm, [34: p. 62] declares the need to deviate from the "technical determinist" orientation in researching new technologies. Rather, a more inclusive approach is promoted, in which all elements surrounding a technology are appreciated, as opposed to adopting the view that technological developments will solely drive social change.

The need for inclusivity is reiterated by [35: p. 273], claiming that "all stable ensembles are bound together as much by the technical as by the social", and as such should be treated as a single ensemble consisting of "intimate social and technical links". An early conceptualisation of a socio-technical system [see 36: p. 25] demonstrates the need to consider the interactions between a number of constructs in the social and technical units, including structure, people, technology and tasks.

A key focus of this paper, therefore, is to apply the above knowledge to the Australian context in order to comprehensively focus on the ensuing social implications of LBS development and implementation, by considering the socio-technical factors that are present and the stakeholders concerned. A first step in such as application is the conceptualisation of location-based services as a socio-technical ensemble, which is the focus of future research, and beyond the scope of this paper.

4. LBS landscape in Australia: the broad social implications

A major challenge in considering the social and ethical implications of emerging technologies such as location-based services is the exchange between the constructive and the potentially damaging consequences that the technology facilitates. For instance and with specific reference to wireless technologies in a business setting, [8] maintain that such systems facilitate monitoring and surveillance which can be applied in conflicting scenarios; namely, positive situations where monitoring can improve effectiveness or provide employee protection in various instances (although this view has been frequently contested), and negative uses where the excessive monitoring may compromise privacy or lead to extreme situations such as stalking. Accordingly, the dual and opposing uses of a single LBS solution become problematic and situation-dependent, and indeed increasingly difficult to objectively examine.

While the literature surveyed previously has chiefly examined the potential of the technology in terms of innovation and background information, the progress of certain technologies, possible application areas and the LBS value chain/net, an alternative stream of literature calls for research into the social implications associated with LBS development and deployment. These studies

specifically incorporate the less desirable aspects which are often overlooked, specifically the broad social, ethical

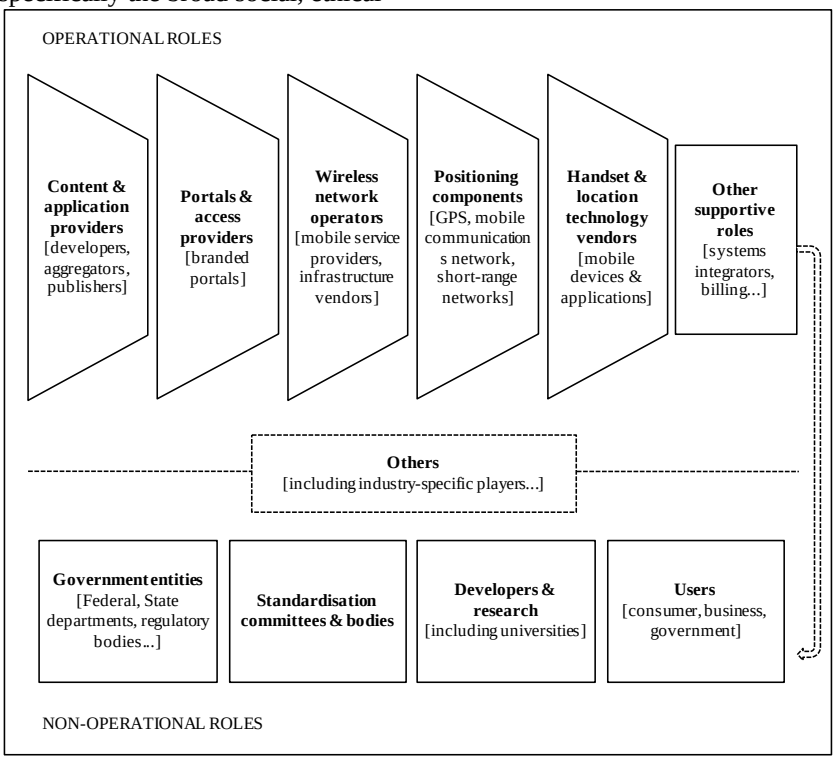

Figure 2. LBS value chain/net

and legal challenges, which exist in the external context or environment surrounding the LBS value chain/net.

4.1. Social and ethical consequences

Studies addressing the social implications of emerging technologies generally reflect on the ethical dilemmas resulting from the implementation of the technology within a given social context. While numerous approaches to ethics exist, all are inextricably linked to ideas of morality, and an ability to distinguish good conduct from bad. Ethics can be considered as: (a) "the study of morals in human conduct and the construction of principles and rules that ensure moral behaviour" [8: p. 465], and (b) "a set of rules, or a decision procedure, or both, intended to provide the conditions under which the greatest number of human beings can succeed in 'flourishing', where 'flourishing' is defined as living a fully human life" [21: p. 248].

Two prominent ethical dilemmas in the LBS domain are the risk of privacy breaches, and the possibility of increased monitoring leading to unwarranted surveillance by institutions and individuals.

According to [21], privacy is often considered the most intricate issue challenging LBS adoption, as it requires organisations to understand what a breach in privacy entails prior to embracing a responsive role. Additionally,

privacy protection and trust must be assured for the successful adoption of mobile location services, as information will be transmitted between multiple players in the value chain [3]. However, this is a delicate issue as an accurate understanding of the term privacy is difficult to articulate, due to the fact that the term is liberally and subjectively applied, and that the boundaries constituting privacy protection are unclear. For the purpose of this research, privacy refers to "the interest that individuals have in sustaining a 'personal space', free from interference by other people and organisations" [22], a definition recognised by the Australian Privacy Foundation, and aligned with the enduring definition of the 'right to be left alone' [23]. According to Privacy International, the term privacy comprises a number of aspects, including information privacy, bodily privacy, privacy of communications and territorial privacy [24], all of which are relevant in LBS discussions.

Several studies examine privacy from theoretical, practical and technical perspectives with respect to LBS, and specifically location data. Generally, the literature is fixed on addressing the trade-off between convenience and privacy protection. For instance, in a field study of mobile guide services, [25: p. 45] supports the need for

resolving such a trade-off, arguing that “effortless use” often results in lower levels of user control and therefore privacy. Additionally, there are studies which suggest that privacy issues are closely linked to notions of trust and perceived risk in the minds of users [26], thereby affecting a user’s decision to engage with LBS providers and technologies. In a business setting, [27] also reports on trust-related issues emerging from excessive monitoring, establishing that employee monitoring may contribute to deterioration in professional work relationships between employer and employee. Furthermore, control, trust, privacy and security are deemed important and interrelated issues in LBS research, as privacy protection requires security to be maintained, which in turn results in enhanced levels of control, leading to decreased levels of trust [28]. It is commonly acknowledged in LBS privacy literature that resolutions in this space will seek consensus between issues of privacy, security, control, risk and trust, all of which must be technologically supported.

Alternative research suggests technological solutions to address the LBS privacy challenge, mainly concerned with either degrading the ability to pinpoint location, or alternatively masking the identity of the user. For example, [29] explore the concerns associated with protecting personal information and privacy in using location-based technologies, through the development of a system which provides individuals with control over how they disseminate location information. The authors claim that individuals must possess such control and be notified of requests to access information in order to maintain privacy. Similarly, other authors present models that anonymise user identity through the use of pseudonyms [30], architectures and algorithms that decrease location resolution [31], and systems that introduce ideas of obfuscation [32].

This paper recognises the need for both technological solutions, in addition to commitment and adequate assessment/consideration at the social level. Specifically, the current study corresponds with work which stipulates that the privacy debate involves contemplation of privacy policies, regulatory frameworks and technical approaches such as obfuscation and maintaining anonymity [32]. That is, privacy-related technical solutions must also be allied with supportive public policy and socially acceptable regulatory structures.

A preliminary step in seeking a solution to the privacy dilemma is to clearly identify and assess the privacy-invasive elements of LBS in the Australian context. A possible technique that can be employed to identify risks and implications, and consequently possible mitigation strategies, is a Privacy Impact Assessment (PIA). [37] defines a PIA as "a process whereby the potential impacts and implications of proposals that involve potential privacy-invasiveness are surfaced and examined". The tool is effectively a "risk management" technique that involves addressing both positive and negative impacts of a project or proposal, however, with a greater focus on the later [38: p. 4-5]. PIAs could prove valuable to the current research, as location-based services present unique considerations, given their reliance on knowing the location of the target.

That is, the difficulty in maintaining location privacy is amplified due to fact that location-based services, by nature, rely on knowledge of the user’s location and preferences [8]. Therefore, it is likely that there will always be a trade-off ranging in severity. Namely, one end of the privacy continuum will demand that stringent privacy mechanisms be implemented, while the opposing end will support and justify increased surveillance practices.

In terms of surveillance systems, [8: p. 474] maintain that “Surveillance and monitoring are not in themselves either good or bad activities. What makes the difference is how they are used”. While studies of surveillance (and related practices and assemblages) are beyond the scope of this paper, there are important concepts to be extracted from the above perspective. Specifically, that intentions and motivation play a crucial role in defining the acceptability of certain activities. Defining what constitutes ‘acceptable’ behaviour and usage of LBS requires legal and/or regulatory frameworks to be introduced, in order to govern the use of LBS across a range of scenarios.

4.2. Legal and regulatory implications

Issues of law, regulation and policy development are of great importance in the study of mobile location services [3]. Furthermore, the merits and limitations of legislation and industry self-regulation must be considered in this instance. They are particularly significant in discussions pertaining to the limiting nature of legislative action. For example, [21] argue that industry self-regulation is preferable to legislation, eliminating the need for restrictive laws that hamper progress within the industry as was the case in the telemarketing arena. The relevance of legal, policy and regulatory issues is further substantiated in a study of the geographic information science discipline, which covers the legal and policy implications related to spatial data exchange. In particular, the author states that policy issues are just as significant as technological considerations, and that the law and policies are often required to alter to accommodate advances in technology, specifically in the context of GPS devices that contain ‘tracking’ capabilities [12].

Based on this premise, future research in this space must incorporate the concepts of policy development and perhaps industry self-regulation, to promote minimal restrictions and an advantageous outcome for stakeholders in the LBS value chain, at both the operational and non-operational layers and within a wider social context. The need for inclusive LBS policies is apparent given the lack of an overarching policy in Australia, which appropriately covers spatial/location information, excluding the concept of the national spatial data policy which was introduced following a natural disaster [12]. Formulating policies in this realm is a difficult endeavour, given the multitude of stakeholders, and the varying types of LBS applications that must be incorporated.

In considering policy and regulatory movements, there is the need to discuss the importance of 'evidence-based policy-making', which is a current challenge in the government domain. According to [33], evidence-based policy-making involves the introduction of systems and techniques that incorporate evidence into all stages of the policy development process, with the intention of being “receptive” to all types of evidence and data (p. 16), in an attempt to avoid the “policy-based evidence” situation (p. 8). Engaging in this form of policy development requires a suitable methodology to be adopted, the characteristics of which include: testing a theory or proposition which clearly demonstrates how the policy will serve general public interest; considering "what would happen in the absence of any action"; investigating both direct and indirect effects; and providing a measurable and replicable model for use by others (a complete list of characteristics is available in [33], p. 8).

Prior to commencing evidence-based policy-development, however, it is crucial to establish the background and review the current legal/regulatory environment pertaining to location-based services in Australia. Specifically, there is the need to evaluate existing legislation and policies, in order to be well informed and contribute constructively to the public policy debate.

An initial investigation into the present environment within Australia has shown the need to examine the relevance and applicability of various legislations with respect to location data. Notably these include the Privacy Act, Surveillance Devices Act, Telecommunications Act/Telecommunications (Interception and Access) Act, and the ASIO Legislation Amendment Act/Anti Terrorism Act.

Existing Acts in Australia must be reviewed within a broader socio-technical framework in order to: (i) enable an understanding of their relevance and limitations in the Australian context with respect to LBS, (ii) allow other social, environmental and technical issues to be addressed in parallel, and factored into the research, and (iii) incorporate the interests of all stakeholders throughout the process.

The preliminary review of the LBS landscape in Australia has recognised that the social, ethical and legal issues (examined above) are crucial factors for the purpose of LBS research in the Australian context. While such factor have been introduced in many studies, it is apparent that they are generally examined in isolation or void of adequate detail, particularly in relation to interactions between various entities and stakeholders, in addition to the supportive mechanisms required to govern the development, deployment and usage of LBS.

5. Discussion

A majority of studies concerning LBS review the technology in terms of its origins in the mobile commerce domain, the underlying technologies and infrastructure, the m-commerce/LBS value chains, ways in which LBS can be categorised, and the application of the technology in various areas including navigation, tourism, health, and emergency management, particularly in the consumer, business and government domains. Furthermore, the growth of LBS technology is examined from a strategic, business perspective, or alternatively from a development/innovation viewpoint. While scholars introduce the technical, legal, ethical and social implications of LBS, a comprehensive review of the interactions between all elements, specifically in the Australian context, is lacking, particularly in a practical sense. Importantly, the social, technical and environment contexts are under-researched, specifically with respect to ethics (socio-ethics) and regulation. In order to address such limitations, future research must account for an interdisciplinary and comprehensive approach, which amalgamates various areas of study, which have a bearing on LBS regulation in Australia. The dimensions for such research are offered in Figure 3.

While the identified issues and concerns apply internationally, the current research seeks to address the challenges in the Australian context. The Australian case will be unique in terms of factors such as the public policy setting, the existing legal/regulatory environment, the manner in which the technology is adopted by users, and the ensuing social consequences that will emerge. The suggested dimensions allow for a number of research objectives to be formulated, namely to assess the usability of LBS in Australia; to examine and describe the socio-ethical implications; to evaluate LBS stakeholder relationships; and to review existing telecommunications/ related laws. While valid for the Australian context, these objectives can also be applied internationally or in alternative settings.

Provided below is an overview of future research direction, and progress to date.

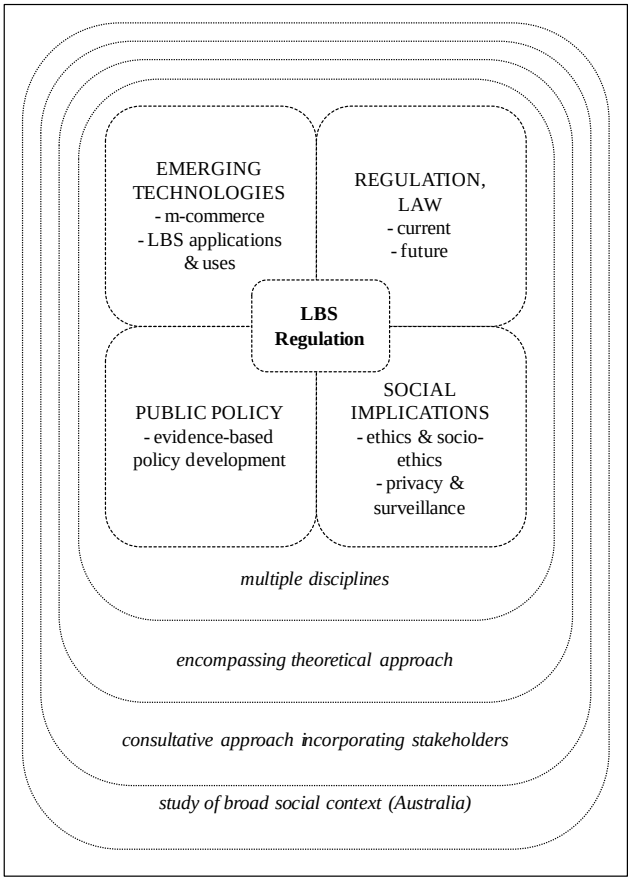

Figure 3. Suggested research dimensions

5.1. Future research direction

In considering future research direction, and establishing a framework for such research, it is important to reflect on the practical and theoretical contributions that such studies will present.

At the practical industry level, there is a tendency "to concentrate on the technicalities of introducing the technology at the expense of the social aspects" [8: p. 463]. The result is an incomplete or unbalanced account of location-based services within a particular social context, effectively ignoring the social dimensions and the external factors, and the need for actionable and pragmatic solutions. This paper calls for an inclusive approach in which the social and the technical systems command equal consideration, as does the environment or external context in which location-based services operate, effectively resulting in balanced depiction of the industry and participation of relevant stakeholders.

At the theoretical level, the review of existing research also demonstrates that a comprehensive view or conceptualisation of the LBS industry and its interactions is yet to be presented or developed, particularly in the Australian context. For instance, the value chain literature principally approaches LBS research from a strategic angle, offering models and direction for the creation of successful mobile commerce value chains [17, 20], while attempting to understand the technology using tools such as value chain analysis [17]. Such approaches, while positive in business and economic terms (as they call for an appreciation of the various forms that LBS solutions may take), are purely intended for strategic use, and are therefore not directly applicable to the research. Other bodies of literature focus on theoretical aspects in isolation, typically discussing LBS adoption models and criteria [5], describing and categorising application areas, or introducing the legal aspects independent of the contextual and peripheral considerations.

In order to attempt to reconceptualise existing views and address the practical, theoretical and literature gaps, the following areas must be examined: stakeholders in the LBS value chain to encourage an appreciation of LBS stakeholder dynamics; the legal, regulatory and public policy environment to promote a practical outcome; and the social implications that have been alluded to in previous studies, but have been poorly addressed in terms of practical solutions, and an inclusive approach to ensure all factors have been incorporated into the study. Further research is presently being conducted to provide the theoretical underpinnings for understanding the regulatory environment in Australia with respect to LBS, based on the established limitations in the LBS industry and scholarship.

5.2. Research progress to date

Preliminary studies are being conducted in order to fulfil the identified research objectives/gaps, and enable an appreciation of LBS stakeholder dynamics in Australia. This is being executed through various means: (a) the collection of GPS data logs and accompanying diary entries of LBS users, to identify socio-ethical challenges and user attitudes; and (b) a consultative interview process that aims to address the social and ethical implications of LBS as perceived by stakeholders, while also evaluating existing regulatory provisions and their adequacy.

It is anticipated that the research results will contribute to a better understanding of the present regulatory environment in Australia, and provide direction for the introduction of mechanisms that will serve the interests of all stakeholder groups.

6. Conclusion

This paper has provided a review of location-based services, identifying present literature and public policy gaps, and future research approaches and direction. An apparent limitation exists with respect to conceptualising the LBS industry as an interconnected network of interactions or a unit in which all stakeholder interests are respected. The suggested comprehensive perspective is particularly relevant in studies focussing on LBS regulation in a specific social context, such as Australia, as it highlights the importance of focussing on the social, technical and environmental contexts in parallel.

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