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A Human Factors Perspective On Volunteered Geographic Information

by

Christopher J. Parker

A Doctoral Thesis
Submitted in partial fulfilment of the requirements for the award of

Doctor of Philosophy of Loughborough University

(July 2012)

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Abstract

This thesis takes a multidisciplinary approach to understanding the unique abilities of Volunteered Geographic Information (VGI) to enhance the utility of online mashups in ways not achievable with Professional Geographic Information (PGI). The key issues currently limiting the use of successful of VGI are the concern for quality, accuracy and value of the information, as well as the polarisation and bias of views within the user community. This thesis reviews different theoretical approaches in Human Factors, Geography, Information Science and Computer Science to help understand the notion of user judgements relative to VGI within an online environment (Chapter 2). Research methods relevant to a human factors investigation are also discussed (Chapter 3).

(Chapter 5) The scoping study established the fundamental insights into the terminology and nature of VGI and PGI, a range of users were engaged through a series of qualitative interviews. This led the development of a framework on VGI (Chapter 4), and comparative description of users in relation to one another through a value framework (Chapter 5). Study Two produced qualitative multi-methods investigation into how users perceive VGI and PGI in use (Chapter 6), demonstrating similarities and the unique ability for VGI to provide utility to consumers. Chapter Seven and Study Three brought insight into the specific abilities for VGI to enhance the user judgement of online information within an information relevance context (Chapter 7 and 8).

In understanding the outcomes of these studies, this thesis discusses how users perceive VGI as different from PGI in terms of its benefit to consumers from a user centred design perspective (Chapter 9). In particular, the degree to which user concerns are valid, the limitation of VGI in application and its potential strengths in enriching the user experiences of consumers engaged within an information search. In conclusion, specific contributions and avenues for further work are highlighted (Chapter 10).

KEYWORDS: VGI, Human Factors, Neogeography, Computer Science, Information Science
List of Publications


Harding, J., Sharples, S., Haklay, M., Burnett, G., Dadashi, Y., Forrest, D., Maguire, M., Parker, C.J. & Ratcliff, L. 2009, "Usable geographic information – what does it mean to users?", Proceedings of the AGI GeoCommunity '09 Conference, AGI GeoCommunity,


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This PhD was funded by *Ideas In Transit*, a five-year project that applied user innovation to the transport challenges faced by individuals and society. It was a unique collaboration between government, commercial and academic interests in the UK thought leaders and their networks. The overall project aimed to promote the understanding, awareness and development of user innovations relevant to transport.

I would also like to thank the staff and friends within Loughborough University who have supported me and kept me going over the three years, in particular Alison Burrows, Camilo Muñoz and Tracy Ross. Special mention has to go to Nick Smith, without whom I would never have managed to conquer the statistics within this thesis.

This thesis is dedicated to my mother, who sadly passed away during the research period. Through her life she was inspirational, and without whom this work would never have been possible.

Susan Joy Parker
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The following definitions (arranged alphabetically) outline key concepts and phrases within this chapter and thesis. Their involvement at this stage is to highlight their relative importance to the discussion of concepts and the removal of uncertainty within this thesis’s terminology.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Map</td>
<td>A raster map used within a mashup on which information is layered (Das and Kraak, 2011).</td>
</tr>
<tr>
<td>Citizen Science</td>
<td>“Where citizens provide information voluntarily”, usually for professional or scientific use (Das and Kraak, 2011, Goodchild, 2007b).</td>
</tr>
<tr>
<td>DigiPlace</td>
<td>From a geographic perspective: “The use of information ranked and mapped in cyberspace to navigate and understand physical places” (Zook and Graham, 2007)</td>
</tr>
<tr>
<td>Geo Web or ‘Geospatial Web’</td>
<td>Focused around the technological aspects of implementing and developing interactive geographic mashups. “The Geospatial Web is an integrated, discoverable collection of geographically related Web services and data that spans multiple jurisdictions and geographic regions” (Lake and Farley, 2007)</td>
</tr>
<tr>
<td>Geocollaboration</td>
<td>Focuses on GIS as a tool to aid and increase collaborative efforts. Users volunteer geographic information in discussion processes. Collaboration with geospatial information through geospatial technologies (MacEachren and Brewer, 2004)</td>
</tr>
<tr>
<td>Geographic Information (GI)</td>
<td>Geographic Information constitutes any information that can be referenced to a specific location, such as a grid reference or postal address. All GI can be represented on a map (The Northern Ireland Executive, 2008).</td>
</tr>
<tr>
<td>Geographic Information Science (GIS)</td>
<td>The basic research field that seeks to redefine geographic concepts and their use in the context of geographic information systems (GIS) (University of Buffalo, 1999).</td>
</tr>
<tr>
<td>Geographic Information Systems (GIS)</td>
<td>Medyckyj-Scott and Hearshaw (1993) described GIS as “tools that capture, store, manage, manipulate, analyse, model and display information with respect to geographical space”. A wider more adopted definition can be taken as “a system for capturing, storing, checking, manipulating, analysing, and displaying data which are spatially referenced to the Earth” (Department of the Environment (DoE), 1987, Grimshaw, 1996).</td>
</tr>
<tr>
<td>Mashup</td>
<td>An alternative and colloquial term for neogeography.</td>
</tr>
<tr>
<td>Neocartography</td>
<td>Alternative name for neogeography (Haden, 2008, Jobst and Döllner, 2009), used infrequently in literature and not within this thesis.</td>
</tr>
<tr>
<td>Neogeography</td>
<td>Turner (2006) defined neogeography as “people using and creating their own maps, on their own terms and by combining elements of an existing toolset”. In a broader research application context, Das and Kraak (2011) described this as “the domain where users make use of geographic information (GI) using web 2.0 applications”.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Neogeography Map</td>
<td>A map based on Web 2.0 mashup technology, combining web maps data; sometimes from VGI sources (Das and Kraak, 2011).</td>
</tr>
<tr>
<td>Professional Geographic Information (PGI)</td>
<td>While not a phrase in common use throughout the current literature, the term <em>Professional Geographic Information</em> (PGI) has been utilised within this thesis to make reference to geographic information not originating from volunteers; in opposition to VGI. This may be defined as structured geographic information produced by trained personnel (Fonseca and Sheth, 2002), or those of able to provide detailed geographic information that can be verified and integrated at the national level (Goodchild, 2007b).</td>
</tr>
<tr>
<td>Public Participatory GIS (PPGIS / PGIS)</td>
<td>Sieber (2006) defined <em>Public ‘Participatory Geographic Information’</em> (PPGIS) as “the use of geographic information system to broaden public involvement in policymaking as well as to the value of GIS to promote the goals of nongovernment organizations, grassroots groups, and community based-organisations”. However, Dunn (2007) offered an alternative concept, ‘Participatory GIS’ (PGIS) as a newer approach within the GIS field, being “context and issue-driven rather than technologically led and seek to emphasize community involvement in the production and/or use of geographic information”. Within this thesis PPGIS/PGIS is used to refer to them together since both definitions focus on involving non-professionals in organisational decision making. Importantly, PPGIS/PGIS is driven by the managers of the project which the GIS is related to.</td>
</tr>
<tr>
<td>Ubiquitous Cartography</td>
<td>“Generation of personalized maps according to the objective and spatial context; mapping system development considering participation, collaboration, and partnership of users; cross cultural comparative studies to clarify similarities and differences between ubiquitous mapping implementations” (Morita, 2004)</td>
</tr>
<tr>
<td>Use-Generated Geo-Content (UGGC)</td>
<td>This phrase is not referenced through this thesis and may be taken as an alternative, but less used and known phrase for VGI. UGGC has been defined as “UGC which has ‘geo’ component can be termed as user generated geo-content” (Das, 2010).</td>
</tr>
<tr>
<td>User Generated Content (UGC)</td>
<td>“Different kinds of content (text, photo, video, etc.) generated and displayed by users” (Das and Kraak, 2011). This is a catch all phrase to cover non-professional information, and may or may not contain a geographic element.</td>
</tr>
<tr>
<td>Volunteered Geographic Information (VGI)</td>
<td>Goodchild (2007a) referred to this phenomenon as “geographic information created by largely untrained volunteers”, which is “potentially unstructured or ‘naive’” (Fonseca and Sheth, 2002).</td>
</tr>
</tbody>
</table>
1 Introduction

1.1 The Rise of Volunteered Information

The concept of non-professionals having a profound impact on the nature and language of Geographic Information (GI) is not a new phenomenon. In 1507 cartographer Martin Waldseemüller drew an outline of a continent and labelled it America. While such an action by skilled cartographers is not in itself remarkable, Waldseemüller was particularly influenced by the Soderini Letter, the work of the amateur Amerigo Vespucci, a claimant for the continents’ discovery (Goodchild, 2007a, Laubenberger and Rowan, 1982). Yet with the increase of complexity in cartographic technique, the generation, influence and control of GI became the exclusive pursuit of the professional, utilising skills and equipment outside the reach of the average hobbyist (Crone, 1968, Haklay and Weber, 2008).

Arguably, one of the most important developments in cartography came in 1983 when U.S. President Ronald Reagan signed a directive that allowed civilian access to the military Global Positioning System (GPS: Pellerin, 2006). With a GPS tracker, an amateur volunteer could (at a low cost and with minimal operational knowledge) know the exact location of points of interest (e.g., phone boxes, pubs, traffic lights etc.) or the course of a path with the same precision as a professional cartographer.

Moving forward 22 years, the 2005 conference titled Web 2.0 was a landmark event in the history of technology. Here the concept of dynamic interactivity was heralded as the new life of the internet over the old web 1.0; a network of sites that are visited, seen, but rarely changing (Tapscott and Williams, 2008). Rather than proposing a new generation of technologies, O’Reilly (2007) stated that Web 2.0 should became a term for a loose collection of technologies and web based applications which:

1. Treats the web as a platform for services and participation,

2. Harnesses the collective intelligence of the crowd, and not just developers,
3. **Relies on data richness and completeness to prove advantage over competition,**

4. **Are based on lightweight technologies which may be exploited by the home developer,**

5. **Provide continual updates and upgrades to web services,**

6. **Span multiple platforms (not just PC, Mac or select mobile devices)**

7. **Provide a rich user centred experience**

The significance of this was not the naming of the phenomenon, but recognition that lead-users and developers were moving away from a static hierarchical Design and Use model towards a Use Centred Design model. One of the movements occurring online, which prompted O’Neil to create the term Web 2.0, was that of taking geo-located data from various online locations and combing it with the newly formed digital earths; such as Google Maps. The result has come to be known as Neogeography (Turner, 2006); commonly termed a mashup.

Driven by the ability to know the precise location of any point on the earth’s surface with a relatively cheap GPS reader, and being able to dynamically share data in interactive ways never before possible, the mashup began evolving. GI products began taking in data not only from trained professionals, but also from untrained amateurs and the modern scene of cartography was formed. Rather than being purely for enthusiasts, these volunteer generated maps started permeating society, leading Goodchild (2007b) to coin the term Volunteered Geographic Information (VGI). Despite all these advances, Idris et al. (2011a) commented that “there is little guidance for map mashup developers on how to design a good map that considers the quality elements before placing and publishing the data on the map”.

This thesis takes a look at the roles in which volunteered and professional information play within neogeography from a human factors perspective. The unique advantages of each information type are considered alongside how they may be utilised to create products and services delivering highly functional, efficient and satisfying experiences to their users.
1.2 The Fundamental Issues

At the start of this research, VGI was a new phenomenon with few established practices for enhancing its usability. Therefore, the range of issues which need to be addressed in order for VGI to be successfully implemented in the modern connected world is substantial. Because of this, an interdisciplinary research approach was required in order to capitalise on current research, and to communicate the user centred findings to those practitioners currently working on the development of VGI. This section aims to highlight the most prevalent of those issues in geography, computer science, information science and human factors which then led to the aims and research questions of this thesis.

Neogeography, Volunteers and Users

Web 2.0 in cartography first entered popular consciousness in 2005 with Paul Rademacher’s housemaps website. This overlaid rental listings from the online classified-ad service Craigslist (http://www.craigslist.org) onto the recently released Google Maps (Tapscott and Williams, 2008). Since its creation this process has been named neogeography (or more commonly, a mashup). Although first defined in its modern sense by Turner (2006), neogeography is possibly best defined by Tuchinda et al. (2008) as:

A web application that integrates data from multiple web sources to provide a unique service, involves solving multiple problems, such as extracting data from multiple web sources, cleaning it, and combining it together.

Crucially, the advent of the neogeography opened the door to the distribution of GI created by largely untrained volunteers (Haklay et al., 2008). Goodchild (2007a) phrased this phenomenon as Volunteered Geographic Information (VGI), referencing the complete or partial inclusion of volunteered information in mashups. As noted by Pultar et al. (2009), VGI can come in many different forms (e.g. restaurant reviews, travel logs, or geo-tagged photos), but in order to use any VGI for analysis and visualization in a Geographic Information System (GIS) it must be in a proper geospatial data format. While this has allowed for an in depth interaction between multiple information sources
previously too complex to comprehend, Al Bakri and Fairbairn (2011) presented a series of new and previously unmet challenges to both the GI professional and the end user including:

- Accuracy
- Data Integration
- Quality
- Region of geographic description
- Information attributes

Many of the issues which may be associated with Web 2.0, Neogeography and VGI have a long standing presence in academia. For example Bédard (1986) brought attention to *meta-uncertainty* (uncertainty about uncertainty) and *uncertainty absorption* to describe the financial risks associated with providing/using spatial data. This, as noted by Devillers et al. (2010), is a fundamental concern when dealing with the new questions raised by the arrival of spatial data mashups and VGI.

Coote and Rackham (2008) commented that in the wider picture of Geographic Information (GI), two key principles are “understanding the users’ requirements” and “being able to assess the fitness for purpose of data and systems in an appropriate context”. In a similar vein, Harding et al. (2009) called for a better understanding of users of VGI in terms of:

1. Which users/personas need to be understood for digital GI products to be considered usable;
2. How are existing products and formats used, by whom and for what purposes;
3. What has changed and why over the history of digital GI use, when comparing producer selected formats to user selected formats;

Considering the relation of VGI to other participation projects, Tulloch (2008) commented that for VGI to become widely accepted within the GIS field, the wider elements which contextualise the phenomenon must be understood. The comment was somewhat echoed by Goodchild (2008a) in his call for clearly
defined limits of how personal VGI may be used within the wider ranges of society. Building upon these themes, Feick and Roche (2010) highlighted the question of whether the emergence of VGI alters our understanding of what constitutes GI, the way users may value data and how value may be understood and determined in a concept with zero transaction or delivery cost. Ultimately, at the outset of this thesis the geographic, cartographic, computer science and information science perspectives on the worth of VGI had largely been addressed as to if VGI can be used within neogeography. What was however unknown was how users of neogeography react to, perceive and value VGI, and if its use is beneficial or detrimental to the utility and usability of the products.

**Users of volunteered information**

Within the context of GI Science and spatial analysis, VGI has been shown to be “more than accurate enough” in its spatial positioning and content to be used alongside or instead of PGI (Haklay et al., 2009). However, the reaction of users to VGI, how they perceive it, and its effect on their activities is currently unclear. The importance of this is not the representation of the current state of VGI, but the potential level of accuracy and utility which VGI may achieve with sufficient development and contribution. Both Elwood (2008b) and Zielstra and Zipf (2010) proposed that both VGI and PGI pose specific advantages and disadvantages for the end user, suggesting that no single information type may fulfil all of a user’s requirements. It is therefore important to consider the role that the users of VGI have on its presentation, use and perception.

Questioning the importance of data quality in neogeography, Coote and Rackham (2008) commented that neogeography (and VGI) pose a distinct paradigm shift within the world of GIS:

> For those of us who have been around the industry for a while and have lived through various “paradigm shifts” observe that there are some underpinning principles that have been important throughout. Two of these principles are to i) understand the users’ requirements and ii) be able to assess the “fitness for purpose” of data and systems in that context.
Therefore, understanding the users of VGI and neogeography is essential. Without the knowledge of 1) who the users are and 2) their cognitive, behavioural and attitudinal characteristics, then attaining user requirements for usability design is an impossible task (Gould and Lewis, 1985).

Coleman et al. (2009) highlighted that although empirical research into the contributors and contributions of open source projects has been conducted, the volunteers’ motivations still need to be understood alongside the relative quality of their output (Benkler, 2002, Krishnamurthy, 2002, Raymond, 1999).

Since the advent of Web 2.0 and neogeography, GIS tools and applications on our home and work computers (e.g. laptops, tablets, smart phones, etc.) have entered the daily lives of millions around the world (Goodchild, 2008b, Tapscott and Williams, 2008). Predictions for future use point to widening involvement of GIS in our everyday life, with increasing levels of sophistication and complexity. One example of this is the Living Earth Simulator project, which aims to produce a Digital Earth (Gore, 1998), collecting data from billions of sources and aiming to create a simulator that can replicate everything happening on earth (Morgan, 2010). The prominence and ubiquity of such systems in today’s society is best summed up by the comments of Google Earth founder John Hanke (2007) who stated that “it is staggering to think that Google Earth and Google Maps were only introduced in the summer of 2005”.

Although such developments carry much weight and prestige within the literature, Haklay and Singleton (2008) have commented that despite all the advances in user centred geography, nothing is actually new: it is just online and interactive. However what may be considered new is the distribution of GI tools (e.g. remote sensing via Google Earth) previously only available to Geography Professionals (Ewert and Hollenhorst, 1989).

If the pursuit of cartography and GIS products is disassociated from the professional body - as called for by Livingstone (1992) - then the user may effectively become the designer and generator of their own products in a very real and effective way (Shirky, 2009). There arises the question of why users volunteer their time to produce products not just for their personal use, but to share with others. Trogemann and Pelt (2006) reported that “despite all
available technology, people in modern societies feel more excluded from society, more isolated with respect to their communities and more disenfranchised from the system of government and democracy”. While this may suggest the volunteer is seeking a feel of engagement through social interaction - social intercourse (Kanpp, 1978) - through the internet, not enough is yet known in the literature to fully understand the impact of such situations. However, this should be considered in relation to the comments of Fox (2010) that the internet has levelled the social, economic, racial and cultural divides within the USA, and to a lesser degree the relationship between its citizens and the international community.

One definition of geocollaboration is of “collaborative activities in which two or more individuals work together on a single task or closely related subtasks, constructing and maintaining a shared problem concept” (MacEachren and Brewer, 2004). If the issue of geocollaboration surrounds the user centred understanding of neogeoography, then an understanding of the catalysts for conversation between individuals and groups may prove beneficial to those wishing to utilise geocollaborative systems for the benefit of their own products (e.g. Google My Maps). Currently the understanding of why these groups come together to produce highly usable results (Haklay et al., 2009) for almost no perceivable benefit is limited.

**Data richness of volunteered information**

When considering VGI it may be difficult to assess whether the data has been produced to a relevant specification of accuracy and content, so the level of data richness may be highly unknown (Daft and Lengel, 1986). Coote and Rackham (2008) commented that consumers want products to work above all else, with other simple attributes such as accuracy important to them, yet they may be unable to articulate such needs. The example of “where are the best pubs along the route” was given by Coote and Rackham (2008) as a simple scenario that highlights how to the user the most important factor is the information directly relevant to their need, whereas other information such as phone boxes, village greens and corner shops may be interesting, yet
irrelevant. The issue that arises here is the degree to which the information is relevant to the context of use (Coote and Rackham, 2008).

Keen (2007) vocally attacked the notion of user-generated content and Web 2.0 as empowering the user's creativity, yet producing overall less satisfactory outcomes of low data richness. However, Tapscott and Williams (2008) refuted this as allowing small organisations or individuals to gain an equal platform with the established professional, increasing the talent for users to choose from. Similarly, Hall (2007) reported that Google Earth's technology chief [Michael Jones] believed that individuals volunteering data creates a convergence of truth, since each contribution represents a portion of truth. In addition to this, Jones insisted that those local to the information have a stake in its accuracy. However Haklay et al. (2008) commented that the distribution of contributions over a national (UK), continental and global level - described as data richness - is currently unknown. 

OpenStreetMap founder Steve Coast (reported in Black, 2007, Haklay and Weber, 2008) commented that “nobody wants to [contribute VGI about] council estates”, creating a patchwork geography with important areas missing due to contributor bias. Such an uneven spread of focus from crowd sourced projects is not new. This is highlighted by Gilmartin and Lloyd (1991) that “there is higher interest in events and geography that are local to the user, relative to faraway places”. What is unknown here is to what impact a patchwork spread of VGI and data richness will have on the end users experience of using the information.

**Trust in volunteered information**

Ahituv et al. (1998) commented that “the real value of information is derived from comparative measuring of differences in a decision maker’s behaviour when he or she is provided with the different information sets”. In practice, individuals typically search for and use information, they make choices whether to accept or reject discovered sources, and derive value from information based on its relevance to the task at hand (Tóth and Tomas, 2011). Within this use situation, trust in the information being utilised becomes a very important aspect to the user.
Harvey (2003) described trust as being an expression of a user’s underlying confidence; be it rational or irrational. Additionally, Harvey commented that trust in GIS is closely related to the users understanding of the technology with which the information is delivered. Similarly Goodchild et al. (1998) reported that the development of an understanding of trust in GI is complementary to addressing technological barriers in applications.

The subject of trust in VGI has yet to be directly addressed in the published literature. However, a large body of research has been generated on the issue of trust in traditional GI. On this, Goodchild (2008b) commented that “if something appears to be in the wrong place would you trust it?” Contextualisation is provided by the remarks of Kneale (2003) that “most geographic data are noisy, imprecise, inconsistent, and may also be biased. The trick is to recognise sources of error”. Similarly, Crampton (2010) remarked that a user must consider critically the “truth claims of maps and GIS” and that “knowledge is not ‘out there’ but is created and then is privileged by being divided between truth and falsity”.

Harvey (2003) commented that trust can be seen as a relationship between two parties, and is scalable in its nature. Of this Harvey counted existing social, political and professional relationships between bodies as factors which increase the level of trust in the GI being provided. An example of this was given as a government body in the U.S.A finding it easier to build a relationship of trust in GI from another U.S.A based government body (i.e. the National Spatial Data Infrastructure: NSDI) than a further removed non-governmental body. However, since trust is a personal construct in the relationship between the user and provider, it is expected that trust issues in VGI should mirror that of traditional geography.

In the literature there is no dispute that the level of trust the user has in the information they are using is important. However, what is less clear is what factors influence the user to perceive the information they are using as trustworthy enough for their given needs?
1.3 General Aim of Thesis

The overall aim of this thesis is to address the issue of how VGI can be combined with PGI to satisfy the information search requirements of consumer-users via highly usable mashups. Firstly, this required the development of an understanding of the way different users perceive VGI and PGI in terms of its benefits to their activities and information needs. Secondly, the benefits that VGI may bring to the user experience of a mashup (which cannot be attained through the use of PGI) needed to be understood. In order to achieve this, a user centred design perspective was implemented throughout the research. Through the analysis of the fundamental issues relating to human factors in VGI, the following research questions are investigated in this thesis:

RQ 1. What is VGI and how is it distinct from PGI?
   - A Taxonomy of Neogeography
Chapter 4: Research Methods

- Scoping Study: User Perceptions Of VGI in Neogeography

RQ 2. What are the human centred aspects of VGI in terms of its generation, production and utilisation by the end users?

- A Taxonomy of Neogeography

- Scoping Study: User Perceptions Of VGI in Neogeography

RQ 3. What influences the way users judge VGI in terms of its relevance to their needs, and how does VGI compare to PGI?

- Study Two: Understanding Design with VGI Using an Information Relevance Framework
- Data Generation: Generation of a VGI Data Set
- Study Three: Assessing the Impact of VGI

RQ 4. What recommendations can be made for combining PGI and VGI for the production of highly usable neogeographic products?

- Data Generation: Generation of a VGI Data Set
- Study Three: Assessing the Impact of VGI
- Overview and Synthesis

1.4 Chapter Summary and Structure Of The Thesis

Figure 1.1 presents the structure of the thesis relative to the research questions and logical flow through the PhD.
Chapter 1 – Introduction

This chapter has introduced the general topics and phenomenon addressed within this thesis, as well as providing suitable background information. The problem space, scope, aims, objectives and limitations of the research were presented along with the resulting research questions that this thesis set out to tackle.
Chapter 2 – Literature Review

The main purpose of this literature review was to understand the various aspects of Geographic Information Systems (GIS), Neogeography and VGI relevant to a human factors investigation. Additionally, specific gaps in the literature relating to these issues were identified to inform the research process. From this literature review, it was clear that there were multiple perspectives that were useful in addressing the user centred design of mashups, which could influence the design and outlook of research studies. Several areas were particularly relevant, in particular the role of VGI within neogeography and GIS, definitions of users and their inter-relationships, user judgements of information, sources of information and the way online mashups influence user behaviour.

Chapter 3 – A Framework of Neogeography

The literature up to and including 2008 presented a vague landscape of terminology related to neogeography that was often confusing, contradictory or wrong. This chapter focused on presenting a clear and in depth appraisal of the origin and role of VGI within the larger field of GIS, presenting the terminology used within this thesis and explaining the differences between different forms of volunteered information. This allowed for a greater understanding through each of the study chapters of what characteristics of VGI may be considered unique in relation to PGI, and consequently how VGI may be effectively used in online interactive products.

Chapter 4 – Research Methods

This chapter outlines the key scientific perspectives on research, from the philosophical approach to the selection of appropriate methods of investigation. Consequently, this chapter further outlines the methodology used within each study in relation to the research questions posed within Chapter 1.
Chapter 5 – Scoping Study: VGI Users And Their Value Perceptions

The users, their perceptions of VGI and how the different user groups differed from one another was not clear in the literature. Consequently, a scoping study\(^1\) was required in order to generate a first-hand understanding of these issues. This scoping study outlines the first qualitative investigation within this thesis and involved participants from all of the relevant user groups; consumers, local communities, special interest groups and professionals. This study was undertaken in order to understand the differences in attitudes towards VGI within the different user groups, the interaction between users and the potential opportunities for VGI to enhance the online information search experience of users. The outcomes described a complex social/professional environment where each user group exhibited a perspective on VGI unique to them, influencing their uptake of technology, use of information and perspective on developments outside of their user group.

Chapter 6 – Study Two: Involvement Of VGI And PGI In Activities

After the scoping study, the basic differences in the value of VGI to the user was understood, but how important the useful that information is to the consumers was still unknown. Study Two aimed to take the findings of the scoping study that consumers were potentially the most appropriate user group to investigate, and understand how VGI is currently used and what its strengths and weaknesses are relative to PGI. This study was based on a multi-methods design embodying participatory observation and focus groups. Amongst other factors, this study identified that the trust users place in the information is a central issue.

Following Study Two, the ways users perceive VGI in use was understood, but how VGI may influence users in a realistic, information search context was unknown. Consequently, it was decided to undertake a quantitative investigation into the utility of VGI in use.

\(^1\) **Scoping Study**: a preliminary study to define the scope of a project (Collins, 1984)
Chapter 7 – Data Generation: VGI And PGI Data Sets

This chapter aimed to generate both a PGI and a VGI data set for a series of specific public transport routes in London. The main aim of this was to enable an investigation into the influence VGI has on the user when combined with PGI to be conducted (Chapter 8). The data generation study was undertaken through multi-methods data collection techniques embodying participatory observation and an in-depth literature review. As well as creating two appropriate data sets, this study highlighted how PGI contains more objective data, with VGI being more subjective.

Chapter 8 – Study Three: Interaction Between VGI And Online User Judgements

Study Three utilised the VGI and PGI collected during Chapter Seven to create a website to serve as the host to an online experiment. The aim of this experiment was to understand the influence that (1) knowing the mashup contains VGI, and (2) actually including VGI within a mashup, has on the quality, accuracy and usability perceptions of the user. Analysis was undertaken through statistical MANOVA in order to understand the influence of the various user judgements of quality, authority. Study Three demonstrated that the greatest influence comes when the user utilises the mashup containing VGI; irrespective of whether or not the participant believed the mashup contained VGI.

Chapter 9 – Overview and Synthesis

Chapter 9 brought together and summarized the main findings of Studies One to Four in relation to the research questions of this thesis. Particular attention was given to assessing the appropriateness of the proposed taxonomy framework of VGI (RQ1), the unique nature of VGI (RQ1, RQ2), the ways in which VGI in combination with PGI influences user judgements (RQ3), the limitations of VGI (RQ1, RQ3) and benefits of VGI within neogeography (RQ3). Additionally, the outcomes of this thesis were compiled into a series of recommendations which designers may be able to utilise in the production of neogeographic products with higher usability.
Chapter 2: Literature Review

Chapter 10 – Thesis Conclusions and Further Work

This thesis was concluded within Chapter 10, stating the most important contributions of this thesis and identifying future research questions that have emerged
2 Literature Review

2.1 Introduction
This literature review aims to provide a multidisciplinary view on the theoretical perspectives underpinning this thesis, particularly the user centred perceptions of VGI by users. To address the research questions, this literature review consists of four main sections reflecting the interdisciplinary nature of this thesis:

- Geographic Perspectives
- Human Factors and GIS
- User Perceptions of Information
- Human Factors and Information

2.2 Geographic Perspectives
Despite the academic focus of this thesis coming from a human factors perspective, the information central to investigation is geographic. While a complete review of all geographical literature is outside the remit of this thesis, an understanding of the key concepts central to neogeography, and those relating to human factors, is required in order to conduct informed and appropriate research.

2.2.1 Maps and mapping
In addressing the question what is a map, Liben and Downs (1989) demonstrated that rather than being a singularly defined artefact, it is in fact a representation of culturally learned knowledge. In presenting this, Liben and Downs moved away from the traditional view of “Map as in graphical representation of the relations of points and features on the earth’s surface to each other” towards “maps are creative statements about the world, not merely degraded reflections of it”. Despite this, Crampton (2010) commented that the core of what makes a map a map is culturally invariant. This is testified to by the discovery of native American maps (Ojibwe) which, while spatially
inaccurate, related key information about the environment to a framework which gave geospatial context (Krygier and Wood, 2005).

Although the importance of maps as an interface to connect human and geographic information is very prevalent, comment by Crone (1968) was made on their inherent limitations:

> It should be understood that a map cannot itself solve a problem. It can demonstrate significant correlations, or their absence, and in this way satisfy the scientist that he is proceeding on the right lines, or suggest fruitful subjects for further research.

Crone (1968) commented further that modern maps are also not free from errors “since the easiest way to make a map is to copy an old one, and considerable capital has been locked up in printing plates or stock, maps must never be accepted uncritically as evidence of contemporary knowledge and technique”.

Although the widespread importance and use of geographic information is increasing (Sui, 2008), worldwide the act of mapping has been in decline (Dodge and Perkins, 2008). One example of the badly mapped world theory is how as recent as 2005 aid workers after the Nias (also referred to as the Sumatra) earthquake in Indonesia were forced to work from a 10” x 12” Dutch map from the 19th century; the best available to them at the time (Thompson, 2009). Additionally, many cities around the world (until recently including Dublin) suffer the problem of not having a cheap and readily available digital map (Goodchild, 2007a). One suggested solution to this problem is to create volunteer generated maps driven by the easy accessibility of GPS trackers (Goodchild, 2007b). The GPS system allows rapid and accurate positioning of any location in the world within a high tolerance\(^2\), and thus information may be provided at a quality close to that generated by professionals (Nicholson et al., 2002). However, it is important to highlight how simply having easy access to technology is not enough to guarantee adoption and participation, people require motivation and education for this to occur (Rogers, 2003).

\(^2\) Almost 1mm - 100m depending on factors (Barnes and Cross, 1998)
Here, the subject of accuracy may be seen as subjective, as in *what tolerance is required for the job at hand*. While predicting certain uses of information may be either impossible or impractical, the levels of accuracy for both professional and volunteered mapping systems may be measured. OpenStreetMap (OSM), the open source, volunteer generated map is accurate to the geographic *true* location 80% of the time for motorways, with 3-8m positional accuracy for manmade features and locations (Haklay et al., 2009). To place this within context, Marston (2010) reported the accuracy of the UK’s official map company Ordnance Survey, and its subsequent key product MasterMap, to be within a maximum tolerance of 2.6cm. In comparing these two data sets (and with Ordnance Survey’s low resolution data set – Meridian), Haklay et al. (2009) demonstrated that while further development in OSM is required, it was *beyond good enough* for use in a wide range of activities.

Considering *map inaccuracy*, it should be noted that with the use of modern technology, newly surveyed features may be largely free from many of the errors of the past due to the surveyor’s reliance on technology such as GPS, with 50cm inaccuracy being considered critical (Marston, 2010).

Early demonstration of mass collaboration as a necessity in humanitarian situations was presented in the wake of the 2005 US hurricane Katrina tragedy (Joffe, 2005). Essential updated maps took days to create not through lack of volunteers, but because paper maps had been destroyed and federal digital maps were inaccessible (Joffe, 2005). Mills (2008) commented that unless the GIS community considers ways of collecting and analysing data relevant to this process [of humanitarian aid], recovery will continue to be disappointingly experienced. As a mechanism for aid distribution, Google Earth proved useful as satellite and aerial imagery allowed volunteers to identify flood free areas (Grasso and Singh, 2007) remotely from their computers.

As testament to the lessons learnt from the geocollaboration of hurricane Katrina, tangible results in the efficiency of humanitarian aid and response were

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3 Charged by the [UK] government with recording every physical element of Great Britain; Northern Ireland has its own organisation, OSNI (Marston, 2010)

4 Resolution: The smallest unit that can be detected, providing limit to the precision and accuracy of geographic information (Moellering, 1985)
made through VGI collaboration efforts (Zook et al., 2010). Here, Zook et al. commented that this was because when the earthquake hit the region, there was a need for maps in humanitarian aid, which were not available from traditional mapping agencies, or corporate mapping agencies (e.g. Google, Bing, etc.). However the potential was somewhat hampered by conflicting mapping by different VGI projects (Google Map Maker Vs. OpenStreetMap), which when compiled gave a full coverage of the region and disaster area, but non-overlapping roads and areas where the same location had been mapped twice (Haklay, 2010c).

Professional Geographic Information (PGI) is information created through traditional/ professional methodologies; e.g. Ordnance Survey, Google Maps, Bing Maps, etc. When using PGI, the user may be limited by the legal and technical boundaries imposed by the data owners. In the UK, Ordnance Survey charges from £18.30 per hectare for topographic data, to £500,000 and upwards (Ordnance Survey, 2012). Users may utilise Ordnance Survey information via their ‘OpenSpace’ application (Ordnance Survey, 2010b), although many licensing issues constrain how many tiles\(^5\) may be downloaded per 24 hour period, what the data may be used for, and the technical specification of the tile itself (Ordnance Survey, 2009b). One is also restricted by the technical limitations of the OpenSpace application. Breaking of these legal boundaries may also be seen as breach of copyright, an issue which landed the UK based Automobile Associated (AA) a £20 million fine (Clarke, 2001). With volunteer generated systems utilising open source practices, the potential of the electronic map may be greater explored by the user beyond the boundaries currently imposed by the official routes (Coast, 2009).

While a theoretical overview of what constitutes trust is given in Section 2.4.2.4 (page 52), it is worth giving an overview of the trust people place within cartographic systems. The reason for this, as explained by Indiramma and Anandakumar (2008), is that “trust is a basic feature of social situations and plays a critical role in problem solving, organizational performance and organizational communication”. Rather than being a single user perception,

\(^5\) The Ordinance Survey map is divided into square renderings called tiles. These are stitched together to produce the map of the desired area.
trust is formed from a multitude of perceptions and judgements, which allow the user to “make a bet” that the information will turn out to be true and reliable in unknown future situations (Sztompka, 1999). Dodge and Kitchen (2012) commented that, traditionally, cartography achieves its associated level of trust from the user from the authority of the author. In most cases, this constituted the official state run mapping agency such as Ordnance Survey in the UK and USGS in the USA. These bodies demand authority from the user through their official nature. Further to this, official maps have a long history of being utilised to wield power in fields from military campaigns to housing planning and social services, emphasis authority and influencing user perceptions (Crone, 1968).

Consideration is therefore required of the trust users may place within VGI products. While they do not have the same authoritative power as national mapping agencies (Dodge and Kitchin, 2012), volunteers working within technical and scientific domains have a long history of user trust in their outputs (Goodchild, 2007b, Nicholson et al., 2002, Winchester, 1999). Consequently, such VGI efforts have the potential to be trusted. However, such trust has to be built over time through repeated and proven quality, as well as the detection and removal or errors to create a product which survives the users cogitative bet many times (Goodchild, 2007b). Such a development can be seen paralleled in the ubiquity of Google Maps, which rose from being and untrusted start-up (originally Keyhole) to become the world’s single most used and trusted map. This was, as Bishr and Kuhn (2007) commented, was due to its quality, reliability and features (as described by Goodchild above), proving its merit over time.

2.2.2 Geographical information systems (GIS)

Medyckyj-Scott and Hearnshaw (1993) described Geographical Information Systems (GIS) as “tools that capture, store, manage, manipulate, analyse, model and display information with respect to geographical space”. In practice GIS is the matured discipline of spatial analysis of Geographic Information (GI) to meet the requirements of the modern age, reliant on geographic knowledge (Burrough and McDonnell, 2006, Medyckyj-Scott and Hearnshaw, 1993). While slightly light-hearted in nature, Devellers et al. (2010) reported that “we should
not focus on “killer GIS” but should instead look at all the great aspects that the technology brings”. This highlights the role of GIS not as a one solution for all situations but as a tool kit which can allow the right implement to solve the right problem at the right time, if handled correctly.

Figure 2.1 presents the standard cartographic perception of how information is managed; not as a whole item but layers of specific information laid over one another. As described by Jones (1997) “Some GIS organise spatial data into layers. Typically layers represent information belonging to particular classes, and can be combined to create new layers containing information specific to a particular query on the GIS”.

It is important to be aware of the comments by Haklay and Singleton (2008) that despite all the advances in GIS, nothing is actually new; just online and interactive. However what may be considered new is the distribution and ease of access of Geographic Information tools (Ewert and Hollenhorst, 1989). Further to this, is the question of what constitutes GIS? As Turner (2008) remarked “the claim that a web map is GIS is similar to saying that a light
"switch is electrical engineering". By this, Turner meant that the outputs or products of modern digital cartography are not themselves GIS, but it is the integration of databases, systems, tools and practices which constitute GIS.

### 2.2.3 Web 2.0 and neogeography

One of the most dominant phrases to describe the internet in the 21st century has been Web 2.0. Rather than being an engineering build, the term was first coined by O'Reilly (2005) to describe the dissemination of information, practices and collaborative tools which had become prevalent in the killer apps of the time. Murugesan (2007) described Web 2.0 as being the second phase in the internet’s evolution, “harnessing the Web in a more interactive and collaborative manner, emphasizing peers’ social interaction and collective intelligence, and presenting new opportunities for leveraging the Web and engaging its users more effectively”.

O'Reilly made clear the importance of web based services no longer tied to a single machine (e.g. Microsoft Office), but instead accessible from a multitude of devices and across all available platforms; e.g. Windows, OS-X, Linux, PCs, Tablets, etc.). The core competencies of Web 2.0 systems according to O'Reilly (2009) therefore are:

- Services, not packaged software, with cost-effective scalability,
- Control over unique, hard-to-recreate data sources that get richer as more people use them,
- Trusting users as co-developers,
- Harnessing collective intelligence,
- Leveraging the long tail through customer self-service,
- Software above the level of a single device,
- Lightweight user interfaces, development models, and business models.

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*Long Tail: Small sites make up the bulk of the internet's content; narrow niches make up the bulk of internet's the possible applications. Therefore: Leverage customer-self service and algorithmic data management to reach out to the entire web, to the edges and not just the centre, to the long tail and not just the head (O'Reilly, 2005)*
The importance of Web 2.0 from a human factors perspective (relating to information use) can be highlighted by Metzger and Flanagin (2011) that utilising such technologies can lead to an “ideal combination of scientifically sound, high-quality information that is imbued with experiential insights from a multitude of individuals”.

Haklay et al. (2008) noted that been there has an “increased awareness by numerous Web 2.0 technologists of the importance of geography and location as a means to index and access information over the Internet”. In this new Web 2.0 environment, where maps are used as a platform for participation, Eisnor (2006) coined the term Neogeography - A socially networked mapping platform which makes it easy to find, create, share, and publish maps and places”. This is further detailed by Turner (2006) who remarks that:

Neogeography means ‘new geography’ and consists of a set of techniques and tools that fall outside the realm of traditional GIS, Geographic Information Systems. Where historically a professional cartographer might use ArcGIS, talk of Mercator versus Mollweide projections, and resolve land area disputes, a neogeographer uses a mapping API like Google Maps, talks about GPX versus KML, and geotags his photos to make a map of his summer vacation. Neogeography is about people using and creating their own maps, on their own terms and by combining elements of an existing toolset. Neogeography is about sharing location information with friends and visitors, helping shape context, and conveying understanding through knowledge of place.

An early example of neogeography appeared in 2005, when Paul Rademacher merged information from the newly released Google Maps service with listings from a small-ads website Craigslist, creating HousingMaps.com (Tapscott and Williams, 2008); see Figure 2.2.
Although limited in scope, HousingMaps.com is considered to be one of the world’s first Neogeographic Applications; or to give it its informal name, a Mashup\(^7\). Possibly due to its relative youth as a phenomenon, alternative names for mashups include Map Hacks, Wiki Mapping and Geocollaboration (Crampton, 2008, Tulloch, 2008).

An early definition for Mashups was given by Miller (2006) as “new services built from the code and functions of two or more different, sometimes even disparate, projects”. On how mashups differ from traditional cartography, Wilson (2009) commented that from a GIS perspective ‘mashups elude our traditional ways of knowing and seeing’. Further to this, Floyd et al. (2007) commented that the technologies utilised in mashups are not necessarily innovative or new, but “what is innovative is how mash-ups are being widely used for the rapid realization of creative ideas which would be too time consuming, or expensive”.

\(^7\) It is interesting to note that the term Mashup first originated by music artists fusing songs digitally from completely different genres to produce hybrid single and albums (Gunderson, 2004, Tapscott and Williams, 2008). Additionally, it should be noted that the term Mashup is also used in the computer sciences field relative to Ubicomp Mashups (Hartmann et al., 2008) or Patchwork Prototyping (Floyd et al., 2007). These are the combination of web infrastructure services, off-the-shelf software, electrical hardware and mechanical and physical phenomena (Hartmann et al., 2008).
Although many positive reflections may be applied to neogeographic systems, they may not be without their flaws. Das and Kraak (2011) described the chaotic and sometimes confusing map products generated through neogeography, which for serious application require traditional cartographic skills to be applied. However, recent research bears testament to the benefits and high quality of neogeography and its associated products (Elwood, 2008a, Foth et al., 2009, Goodchild, 2011, Haklay et al., 2008).

Interestingly, the concept of a mashup is not new. Possibly the most famous example of geo-referenced information being combined with a map for enhanced understanding is that of Dr John Snow’s Cholera Map of 1854; see Figure 2.3. In considering the importance of the work of Snow on the prevention of disease, Johnson (2008) comments that without the utilisation of this mashup, Snow’s discovery of cholera being a water born disease and the subsequent phenomenal revolution in medicine would have been impossible. Johnson considered the greatest strength of this visualisation not to be the map itself, but the contextualising of information, demonstrating the very close correlation of death rates to their proximity to the infected pump.

Figure 2.3 - A section of John Snow’s famous Cholera Map of Broad Street, London (Snow, 1854)

Further similarities between Dr Snow’s 19th century investigation and 21st century mashups may be seen in the how the cholera map was created, not
from original material but by combination of existing map data and published death rates within the local area (Johnson, 2008).

In a use situation, Coote and Rackham (2008) highlighted that similar to other geographic systems, neogeographic mashups are subject to user concerns of *completeness, consistency, quality control and quality assurance*. These issues are all relative to the user’s requirements. Therefore, assessment of *quality* and *fitness for purpose* of mashups should be considered parallel to that of traditional GIS.

In addition to this, Goodchild (2008b) highlighted the concept of accuracy in neogeography and mashups. Here he demonstrated that although the methods for communicating geographic information has changed over the last 14 years (at the time of writing), the issues that existed before are still persistent, but in a different form. Crucially, Goodchild (2008b) highlighted how the issue of accuracy is equally prevalent in volunteered as well as professional information. However, it should be considered in context with the comments of Coote and Rackham (2008) that *quality assurance* of a data set provides “*maximum levels of inaccuracy*”. Goodchild (2008b) remarked that within a mashup an analyst must consider two sets of inaccuracies, firstly the geographic truth of the map relating to the real, and secondly the position of the artefact on map. Consequently, no mashup may be considered completely accurate, but only of a limited quality and accuracy relative to the users’ requirements. However, it is important to note that in most cases mashups do not require the establishment of a logical linkage between features (Goodchild, 2008b). The comments by Goodchild are also close to the comments of Clarke et al. (1987) that higher accuracy implies that a measurement is nearer the truth, with the truth being either absolute or relative.

### 2.2.4 Crowd sourcing and user generated content

Tutty and Martin (2009) described the role of the user in an information seeking capacity as a *learner*, who engages with Web 2.0 driven information in a number of stages. Initially, the user engages with a social/ collaborative environment where information is received and ingested in a way unique and fitting to the individual. This leads to the user utilising the tools of Web 2.0 to
accumulate and generate knowledge based on their interest, increasing the meaningful relationships between the users and their technological environment. Finally, the user is able to manage their knowledge and information effectively, which in turn influences future social collaborations.

Within this framework, it is clear that rather than being a set of tools that the user may engage with, Web 2.0 technologies actively encourage and promote a cyclic process of information acquisition, generation, management and dissemination (Tapscott and Williams, 2008). While a precise definition of crowd sourcing is potentially elusive due to the broad range of projects which elicit the use of volunteers within a multitude of tasks, Doan (2011) defined this as a system which “enlists a crowd of humans to help solve a problem defined by the system owners”.

Shiels (2010) reported that although consumers and users of online technology (e.g. social media websites) have become increasingly concerned about security of their personal data, the activity of data mining these resources by corporations has also become increasingly prevalent in society. In particular, Shiels reported on the growing movement for such corporations who wish to make use of user’s online data (e.g. data or birth, interests, social networks, etc.), and to pay users since their data may be considered a consumable product by the corporations.

2.2.5 Volunteered geographic information

Pickles (2004) commented that “throughout most of the history of cartography, maps have been used by elite groups, to control and administer people and places”. However as demonstrated by the popularisation of freely available GIS distributed via the internet, maps and mapping have undergone a seemingly significant democratisation in their access, use and appeal (Hall, 2007). This was exemplified by Google Earth being downloaded over 350 million times between 2005 and 2008 (Haklay et al., 2008, Taylor, 2008). The challenge is therefore to capture this wide spectrum of users to best represent the general phenomenon of VGI.

An important comment to add here is the nature of VGI in its application. In its early days, VGI could be seen as pure VGI in that many projects such as
OpenStreetMap contained only information from amateur volunteers (Haklay and Weber, 2008). However, within a few years open data such as the US mapping agencies TIGER began to be integrated into the data set (Black, 2007). Additionally, services which did not shift to integrate with and accommodate PGI failed to gain significant ground, and in some cases failed; e.g. The People’s Map (peoplesmap.com, 2010). Consequently, while pure VGI may have once existed, and may still exist, as a concept it is not common or useful in the current neogeographic terrain.

This concept of interaction between the user and information may be considered relative to the comments of Bishr (2007) that geospatial information and its semantics contain an intrinsic social element. Here, information communities were defined as “a community of geodata producers and users who share a common set of feature definitions and ontology of real world phenomenon”. Under such a definition, the social networks of users generating content must be considered as data producers in the same way as traditional sources; irrespective of the associated quality and authority of their output. Similarly, VGI may be considered an element of social media in how a person freely volunteers information which is then distributed by a third party system before being consumed by another. Because of this, interactivity can be seen as the core of VGI:

Members of the former audience can now be producers, not just consumers. Every time somebody joins this new media landscape a producer joins as well because the same equipment, phones, computers, lets you consume and produce (Shirky, 2009).

In appraising the synergistic relation between people and place in the age of Web 2.0, Hardey (2007) commented that user generated geo-located information is one of the driving forces behind the revolution in experiencing the world around us. Rather than being a fad or passing phase in the cultural landscape, it appears that this VGI is in fact a vital part of the web revolution.

Goodchild (2007a) described VGI as the creation of geographic information by largely untrained volunteers. VGI is not confined to traditional geographic identifiers such as trees and streets but to any data where a geospatial element
is present. In discussion of the mixed and multi method approaches to research in VGI, Elwood (2008c) commented that VGI covers a wide range of terrain extending from the generation of geographic features through to the arts and human rights. In addition to this, Goodchild (2007b) and Elwood (2008b) remarked that VGI can be a global patchwork of valuable data, with space and time being the contextual glue.

Although VGI is often thought of as an entity exclusive to Web 2.0, it can exist outside the digital domain. One example of such activities which could be counted as VGI in the modern sense is the *Christmas Bird Count*. This is an event that started in 1900, 37 years before Alan Turing’s conceptualisation of the computation in the Turing Machine; providing a blueprint for the electronic digital computer (Butcher, 1990, Goodchild, 2007a, Gray, 1999). However, this thesis focuses exclusively on the use of VGI within Web 2.0 and the neogeographic domain.

In academia, early comment was made for the need for “more specialist maps” to help chart niche interests; such as geographic dispersion of people, rainfall and temperatures (Crone, 1968). Since 1534, cartography has been a mathematical pursuit due to the need to pinpoint positions using complex geometry (Crone, 1968). However, the uptake of the personal GPS device within the public through specialist devices and smartphones may place cartography, at least in part, back into the reach of the non-professional. Goodchild (2007a) commented that the utilisation of these technologies for the purpose of crowd sourcing for geographic data could present a modern solution to this need.

Some degree of caution should be given to the degree to which VGI may be the solution to the need for more specialist maps. Addressing Collaboratively Contributed Geographic Information (CCGI, a term which is synonymous with

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8 (Butcher, 1990) – The *Christmas Bird Count* (CBC) is the oldest and largest wildlife survey in the world. It is sponsored by the National Audubon Society, and the results are published in American Birds. It began in 1900 when 26 individuals responded to an editorial in Bird-Lore magazine by spending an hour or two counting birds in their neighbourhood on Christmas afternoon. Since then, the increase in both the number of counts and the number of participants has been dramatic. In 1986-87, 41,249 individuals participated at 1,544 locations, including 1,508 locations in the United States (excluding Hawaii) and Canada.
VGI) by Bishr and Mantelas (2008) showed that VGI comes in a degree of qualities and should be filtered to ensure high quality content is presented; possibly through the perception of user trust. While such filtering has been shown to be of use, Flanagin and Metzger (2007b) remarked that for VGI in general the “professional and scientific gate-keeping that usually filters and reviews data may not be present in sufficient forms and subsequently can lead to information which is prone to being “poorly organized, out-of-date, incomplete, or inaccurate”.

Additionally Tsou (2005) commented that “most internet mapping users may lack sufficient cartographic training to manage or interpret the dynamic representation of geospatial information”. While this may be considered a generalisation of the wide variety of users associated with VGI, it does highlight one of the potential limitations to VGI fulfilling Goodchild’s vision for the widespread crowd sourcing of geographic data.

VGI may additionally be a natural progression within cartography, a field which sees the cartographer more of a team leader than foot soldier (Crone, 1968). Under this situation, the cartographer becomes the editor and quality controller of the volunteered information forming the body of information. Furthermore, VGI promises an increase in accuracy (Haklay et al., 2009) and decrease in cost (Goodchild, 2009), advantages that also drove the introduction of maps and atlases at a much earlier point within the development of cartography:

\[\textit{From the point of view of those who use maps and atlases the benefit from such advances should come in the form of better maps at lower prices} \textit{(Crone, 1968)}.\]

The possibility of quality metrics for VGI is an important development within this field since quality has been highlighted as one of the crucial issues to be overcome if VGI is to be utilised to its full potential by users (Brown et al., 2012, Cooper et al., 2011, Mummidi and Krumm, 2008).

Considering the role of the data contributor, OpenStreetMap takes the concept of VGI further by producing a map in competition to those of traditional electronic map producers such as Tele Atlas derived Google Maps (Marchetti,
2006). Here, users’ volunteer roads, buildings and other geographic features under a creative commons licence (Creative Commons, 2009) to form a diverse and evolving map where almost every part (disregarding the operating software) may be described as VGI.

An early investigation into this phenomenon by Holone et al. (2007) investigated the impact of users modifying the base map of a navigation device. The user - in this case pushing a pram - provided feedback to the system when they felt the path was uncomfortable, inaccessible or good. This study demonstrated how VGI may improve the system to a high degree of accuracy; with limited input requirements. The advantage and importance of such features may be highlighted in the use situation reported by BBC News (2007) where a woman was almost killed on a train crossing which was not present on her Sat-Nav. While the information present may have been accurate and suitable for most journeys, the lack of completeness and level of detail in this case was almost fatal.

To conclude this section, it is worth mentioning the remarks by Goodchild (2008a):

\[
\text{The rapid growth of VGI in the past few years is one more step in a lengthy process that began almost two decades ago, and will likely continue for some time to come. It is one part of a fundamental transition as society redefines its vision of the role of public information in the early years of the 21st century.}
\]

2.2.6 The accuracy of VGI

From the perspective of GIS, the term accuracy does not refer to an ethereal absolute, but the degree to which confidence may be given to the data by the user, or “the final measure of the worth of the data” (Clarke et al., 1987). In an early paper discussing the issues and details of GIS, Goodchild (1991) commented that “ideally, we would like every product of a GIS to be accompanied by confidence limits, based on knowledge of the uncertainty present in the database and the process of error propagation in each GIS operation”.
A strong representation of the improvement of OSM over time was offered by Haklay (2010b) by presenting two maps of England separated by two years; see Figure 2.4 (below).

From analysing Figure 2.4, it is clear to see that in 2008 the Meridian map data was of significantly higher quality than OSM, yet within a relatively short period of time OSM has made great advances. While such a study may be seen as subjective (it does not facilitate multiple use scenarios) it does present a case for VGI to embody a high degree of detail, accuracy and quality.

In a similar study to Haklay (2010b) and Zielstra and Zipf (2010) both concluded that the rapid growth and maturity of VGI has demonstrated that it is certainly of usable accuracy, yet it is not yet at a stage where it may replace professional GI providers such as TeleAtlas. Importantly, the work of Haklay (2010b) served to effectively demonstrate the comments by Cooper et al. (2011) that the quality of VGI can only be assessed as relative to other data within the data set, as well as the purpose and context of use.

The increase of accuracy within VGI sources over time may be accounted for by Linus Law, that if enough persons with sufficient skills look at a problem, all
challenges can be overcome (Raymond, 1999). This principal was echoed by Google Earth’s chief technologist Michael Jones (as reported by Hall, 2007) “giving everyone access to GIS tools, you’ll end up with ‘a big number of users converging on a truth... locals are closer to most GIS data than experts and have a vested interest in its accuracy”. Such was the proposition of Mummidi and Krumm (2008) who demonstrated that when VGI is aggregated from multiple sources the quality (in terms of commonly used characteristics being described) of the information increases. This proposition was also given weight by the comment by Goodchild (2008b) that user generated content can potentially provide a powerful mechanism for error correction.

However, such a premise has come under criticism. Firstly, the general application of the open source mantra of Linus Law has been questioned by those both inside of core development circles and in the wider community (Dawson, 2010). This has been from the perspective that although many people may be viewing the product (e.g. Linux OS kernel) those eyeballs may not have the necessary skills to see the bug or do anything about it. From a geographic information perspective, Haklay et al. (2009) has demonstrated that although a loose correlation between number or eyeballs and geographic quality exists, it is too early to say if Linus Law is applicable to VGI in a general or specific sense. Finally, considering the broader subject of volunteered information, Fildes (2011) reported that although Wikipedia is billed as "the free encyclopaedia that anyone can edit", its founder Jimmy Wales considers it too complex for many internet users to modify. This is a situation which is only going to increase in relevance to the contributor base considering the need for ever more sophisticated and complex wiki editing systems (Priedhorsky and Terveen, 2011).

In seeking to validate Linus Law in VGI applications, Haklay (2010) demonstrated how the accuracy of VGI data sets may be addressed through considering spatial data quality indicators that are intrinsic to the dataset itself. By this, the contents of VGI may be understood through Linus Law rather than through comparison with professional bodies; such as Ordnance Survey.
Reflecting on the accuracy within VGI systems within the context of user-annotated maps, Mummidi and Krumm (2008) commented that users do not necessarily intend for their contributions to be publically visible, and thus the contributors may not be concerned about spelling, attribute or positional accuracy. This supports the notion that the importance of information accuracy is relative to the intended use from its user.

2.2.7 Contribution to thesis

While this thesis is rooted in the development of design principles for the use of VGI within products, the central focus of all investigations is information with a strong geographic element. The most significant contribution of Section 2.2 therefore must be the exploration of geographic principles relative to information and use, which allows for an informed and critical appraisal of information viewed within research. This section has also shown that Web 2.0 concepts must be seen as a crucial underpinning to the literature review. Whilst geographic information provided by volunteers and mashups have existed to astounding success before the computer was ever conceived (e.g. Dr Snow’s Cholera Map; see Figure 2.3), it is the primary focus of Web 2.0 on crowd sourcing, data utilisation and participation that provides the potential for VGI to be utilised in unique ways.

2.3 Human Factors and GIS

GIS revolves around data with geospatial elements and those products and services that allow the user to interact with such information. While this may be considered a specialised form of information, the user exhibits requirements of efficiency, function and satisfaction as with any other product or service they use, creating the overall impression of usability which human factors works within. In their book ‘Human Factors in Geographical Information Systems’, Medyckyj-Scott and Hearnshaw (1993) highlighted how rather than there being a need for a specialised form of human factors to make usable GIS, there is a need to apply existing practices and theories to the discipline. Naturally, the outlining of human factors as a discipline lies outside the scope of this thesis and literature review. Instead, this section aims to highlight the theories most relevant to understanding the human factors issues related to GIS.
2.3.1 Users and stakeholders

Above all else, human factors is the discipline relating products and services to best fit the end users. Consequently, the issues relating to the users of GIS need to be understood in detail for a human factors understanding to be undertaken. This was implemented through applying a User Centred Design (UCD) approach to research within this thesis. Although a fuller overview of human factors and UCD in general is given in 2A, it is useful at this point to present the importance on UCD as given by Norman (1986):

*User-Centred Design (UCD) emphasizes that the purpose of the system is to serve the user, not to use a specific technology, not to be an elegant piece of programming. The needs of the users should dominate the design of the interface, and the needs of the interface should dominate the design of the rest of the system.*

Crucial to the overall understanding of the end-user is the notion of the group, a “network of people who have intentionally invested part of their personal decision making power in the authority of a larger social unit in pursuit of mutually desired but separately unobtainable goals” (Mabry and Barnes, 1980). Considering neogeography, it is clear that not all persons associated with it may be bound by a single grouping. Therefore, ways of describing these different networks of people are required. Two of the most common and useful descriptors are that of the user and the stakeholder. While overlapping to a degree, it is important that (relative to the geographic context of this review) the nature of these terms is explored.

The concept of a user is a relatively ambiguous one, which in a general sense can be taken as “one who has or makes use of a thing” (Oxford University Press, 1989), or in a more focused, computer sciences sense as “the participant [in a product or service] with choice” (Thimbleby, 1990). Overall, the user may be taken as any person interacting directly with the item in question. Josselin (2003) describe the user as being more than a name of a group of people who utilise a product or service, but as a person’s profile, personal experience, points of view, habits, standing amongst peers and relation to the product or service. This highlights how although two people may both be
categorised as similar users (e.g. both consumers), they may share very different general characteristics. It is important to highlight here the relevance of the user interacting with product or service; being the focus of the investigation.

Possibly due to VGI being a young phenomenon, there has been little work published on how the associated users can be described. To date, the best categorisation has come from Coote and Rackham (2008), who demonstrated that it is useful to consider the wider net of users as consumers, special interest groups, local communities and professions. This is discussed further in Table 2.1.

Table 2.1 - Segmentation Of Target Respondent User Groups (Coote and Rackham, 2008)

<table>
<thead>
<tr>
<th>User Group</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumers</td>
<td>A person who purchases [or selects] any product or service for personal use.</td>
</tr>
<tr>
<td>Special Interest Groups (SIG)</td>
<td>Individuals who come together to collaboratively achieve some shared goal.</td>
</tr>
<tr>
<td>Local Communities (LC)</td>
<td>local people who have a common desire to protect and/or improve their local area.</td>
</tr>
<tr>
<td>Professionals</td>
<td>Users who are employed by organisations that use geographic data to perform their business activities, whether to analyse, report, navigate or otherwise maintain systems.</td>
</tr>
</tbody>
</table>

The concept of the stakeholder is however somewhat different. A collection of working definitions has been gathered to define the term *stakeholder* since as Preece et al. (2002) identified that “the net of stakeholders is really quite wide”. Sommerville (2001) described stakeholders as “people or organisations who will be affected by the system and who have a direct or indirect influence on the system requirements”. Therefore stakeholders may fundamentally be “resource users and managers” within the system (Röling and Wagemaker, 1998). They may appear as a subgroup of a wider faction which they operate within (Freeman, 1984). They have an interest or share in the undertaking of the Geographic Information System (Carroll, 1996). Mark and Shotland (1985) however took broader views by defining stakeholders as simply those with a stake in the focus for evaluation. Because of this, and unlike the users,
stakeholders do not necessarily have to have direct engagement with the product or service in question.

To give contextualisation to spatial data infrastructures\(^9\) associated with VGI, Raj Budhathoki et al. (2008) established a theoretical model for the interactions between users and producers, while considering levels of professionalism; see Figure 2.5.

![Diagram of Production-Use Dynamic Resulting From The VGI Phenomenon (Raj Budhathoki et al., 2008)](image)

Figure 2.5 (above) highlights how the role of the user and producer are symbiotic. By this, producers contribute to (as well as derive from) contributions of others and the end users supplement the activities of the producers by providing feedback and additional data. Figure 2.5 also highlights how the precise definition of a user within the context of VGI is hard to specify since the information dynamics are complex and inter-related. It is important at this stage to note how Raj Budhathoki et al. (2008) described the inter-operability of the VGI user community, that it doesn't provide an in depth categorisation of the users relative to their tasks, or reflect on the complex nature of data flow within the community.

\(^9\) **Spatial Data Infrastructures**: internet based mechanisms for the coordinated production, discovery and use of geospatial information in the digital environment (Raj Budhathoki et al., 2008)
2.3.2 Defining professionalism

The *Collins Dictionary of the English language* (1984) defines professional as one who is engaged in an activity as a means of livelihood (or one of extreme competence in a job) and a volunteer as a person who performs voluntary services. However, when considering the comments by Goodchild (2007a), a third definition of *the amateur* is required to take into account the component of the volunteer being *largely untrained*:

*Amateur n. 1. a person who engages in an activity, esp. a sport, as a pastime rather than professionally or for gain... 3. a person unskilled in or having only a superficial knowledge of a subject or activity...* (Collins, 1984)

Taking this into perspective, activities which can be considered VGI (e.g. OpenStreetMap) are built by volunteers (people contributing without demand or financial gain), yet those who volunteer may be either professionals or amateurs. This position was echoed by Flanagin and Metzger (2008) who made the distinction between professional bodies with credibility volunteering their data to the public (e.g. U.S. Geological Survey), as opposed to amateurs who are not geographers.

As mentioned by Tapscott and Williams (2008) the role of the professional and the amateur in the world of *open source* and collaboration is often blurred; leading to the modern take on the phrase *prosumer*; originally defined by Toffler (1980) when he predicted that the consumer will act as a consumer and as a producer at the same time and that the differences between these two roles will begin to blur (Poplin, 2010). Quite literally this is a mashup of the words *Producer* and *Consumer*; Prosumer. The *Oxford English Dictionary* (Oxford University Press, 1989) takes a rather more traditional approach to the term ‘prosumer’

1. A consumer who adopts an active role in the design of the products he or she purchases, or who purchases component elements of products in order to build or administer his or her own goods and services.
2. An amateur who takes an enthusiastic interest in technologically advanced products that are intended chiefly for professionals. *Freq. attrib.:* designating a class of products.

Away from being simply content creators, these are amateurs who have high enough skills to produce content of sufficient quality to be accessed and utilised by other consumers alongside professional content. This is echoed in the previous definition of a professional as one being “A person who engages in an activity with great competence” (Collins, 1984, Monroe and Chapman, 1987). Finally, Goodchild (2009) recognised that “the old distinction between non-expert amateur and the expert professional is quickly blurring”.

Considering a simplistic professional/amateur breakdown of contributors being too simplistic, Coleman et al. (2009) categorised volunteers into five categories; highlighted in Table 2.2.

**Table 2.2 - Characteristics of Amateurs, Prosumers and Professionals (Coleman et al., 2009)**

<table>
<thead>
<tr>
<th>Volunteer Types</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Amateurs</strong></td>
<td></td>
</tr>
<tr>
<td>Neophyte</td>
<td>Someone with no formal background in a subject, but possessing the interest, time, and willingness to offer an opinion on a subject.</td>
</tr>
<tr>
<td>Interested Amateur</td>
<td>Someone who has “discovered” their interest in a subject, begun reading the background literature, consulted with other colleagues and experts about specific issues, is experimenting with its application, and is gaining experience in appreciating the subject</td>
</tr>
<tr>
<td><strong>Prosumers</strong></td>
<td></td>
</tr>
<tr>
<td>Expert Amateur</td>
<td>Someone who may know a great deal about a subject, practices it passionately on occasion, but still does not rely on it for a living</td>
</tr>
<tr>
<td><strong>Professionals</strong></td>
<td></td>
</tr>
<tr>
<td>Expert Professional</td>
<td>Someone who has studied and practices a subject, relies on that knowledge for a living, and may be sued if their products, opinions and/or recommendations are proven inadequate, incorrect or libellous</td>
</tr>
<tr>
<td>Expert Authority</td>
<td>Someone who has widely studied and long practiced a subject to the point where he or she is recognized to possess an established record of providing high-quality products and services and/or well-informed opinions -- and stands to lose that reputation and perhaps their livelihood if that credibility is lost even temporarily</td>
</tr>
</tbody>
</table>
Due to the blurring of the boundaries between professional and amateur, Coleman et al. (2009) commented that the five definitions presented in Table 2.2 are not sufficient enough to solely categorise the contributor. Instead, a contributor may be better considered by each role undertaken. For example, a contributor to OpenStreetMap may be an Expert Authority (Professional) on kayaking, but with limited general geographic knowledge or GI Mapping software making him/her a Neophyte (Amateur). In this case, the contributor is both a professional and an amateur. Importantly, it would be incorrect to assume that a person who does not engage in an activity for their livelihood will produce information inferior to that of a person who does. However, it may be assumed that the professional may produce contributions ranging from the intermediate to the exceptional; the amateur may (while replicating the heights of exceptionalism) also sink to producing very poor contributions. This should, however, be considered on a case-by-case basis, rather than inferred onto the contributor by their level of professionalism.

Such an approach to the democratisation of information has led to a high degree of criticism within the professional and business literature. The mood of the traditional school of thought on information generation and management might best be summed up by Keen (2007) who remarked “instead of a dictatorship of experts, we’ll have a dictatorship of idiots”. This is of course in direct contrast to the views of Tapscott and Williams (2008) who assert that although the variation of ability within the amateur community does vary greatly, on the whole, the ‘amateurs’ are able to produce content to the same or as high standard as the professionals.

To help categorise individuals or organisations under the correct heading, Table 2.3 presents the working definitions of both volunteers and professionals for the purpose of this thesis. The terms and definitions may be considered generalisations, where not all characteristics of one group (e.g. professionals) will apply to all members of that group (e.g. all professionals).
Table 2.3 - Characteristics Of Volunteers And Professionals

<table>
<thead>
<tr>
<th>Volunteer Characteristics</th>
<th>Professional Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Contributes to a collaborative project</td>
<td>• May contribute to a collaborative project as a professional (wiki.openstreetmap.org, 2010) or work for a professional organisation producing products in competition to collaborative projects (e.g. Ordnance Survey to OpenStreetMap)</td>
</tr>
<tr>
<td>• Largely Untrained (Goodchild, 2007a)</td>
<td>• Undertakes the activity for one’s livelihood (Monroe and Chapman, 1987)</td>
</tr>
<tr>
<td>• Unpaid by activity (Goodchild, 2007a)</td>
<td>• Of high enough skill to be considered significantly above the average activity participant in terms of skill, knowledge and ability (Monroe and Chapman, 1987)</td>
</tr>
</tbody>
</table>
Table 2.4 - Fundamental Terms For Geographic Knowledge And Spatial Cognition (Mark, 1993)

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognition</td>
<td>A wide range of mental processes including thought, reasoning, memory, perception, etc.</td>
</tr>
<tr>
<td>Spatial Cognition</td>
<td>The knowledge and internal or cognitive representation of structure, entities and relations of space; the internalised reflection and recognition of space in thought.</td>
</tr>
<tr>
<td>Perception</td>
<td>The sensation in the brain in the immediate presence of sensory stimuli; excluding memory, reflection, consciousness, reasoning, etc.</td>
</tr>
<tr>
<td>Cognitive Science</td>
<td>A field bringing together ‘what is known about the mind from academic disciplines’ and computer science.</td>
</tr>
<tr>
<td>Metaphors</td>
<td>A fundamental cognitive process, existing when an unfamiliar conceptual domain is understood in terms of a familiar one.</td>
</tr>
<tr>
<td>Spatial Vs. Geographic(al)</td>
<td>Considerable overlap in the use of terms, yet distinction may be found (Oxford University Press, 1989) which places ‘spatial’ as a general concept and ‘geographic’ as a more specific concept:</td>
</tr>
<tr>
<td></td>
<td>• Spatial – pertaining to or relating to space</td>
</tr>
<tr>
<td></td>
<td>• Space – Denoting area or location</td>
</tr>
<tr>
<td></td>
<td>• Geographical – Of or pertaining to geography</td>
</tr>
<tr>
<td></td>
<td>• Geography – the science which as for its object the description of the earth’s surface</td>
</tr>
</tbody>
</table>

Krieg-Brückner et al. (1998) described spatial knowledge as comprising location (view of one’s surroundings from a position), route (a sequence of locations or views) and survey knowledge (an abstraction and integration of specific routes). This is essentially the product of processes such as crowd sourcing, user generated content (i.e. VGI) and geographic information retrieval (Winter et al., 2011). Academics such as Sholl (1987) referred to survey knowledge as a cognitive map; being like a picture or map in the head of the user. Indeed, Thorndyke and Hayes-Roth (1982) commented that spatial knowledge resides in a person’s “memory in images that can be scanned and measured like a physical map”. This concept of a person’s cognitive map becomes important when considering how people perceive the world.

In psychology, research has demonstrated that people divide space up into two general categories; small-scale (what a person can see from a given vantage
point: Ittelson, 1973) and large-scale (what cannot be perceived from a single view point, and thus required locomotion through space to perceive them: Downs and Stea, 1977). From a GIS perspective, Frank (1996) demonstrated that GIS allows users to interact with large-scale spaces as though they were small-scale spaces. This was contextualised by Montello (1993) who noted that people’s perception of space, spatial cognition, and spatial behaviour are scale-dependant and experience-based (Freundschuh and Egenhofer, 1997). Therefore, the user experience for a GIS system may not be treated as an absolute, but as personal to each individual user; dependant on their experience. From a human factors perspective, the concept of spatial cognition becomes important when considering the comments by Frank (1996) and Mark (1993). Here, the way people conceptualise space is an important consideration for the design of GIS because a better match with people’s thinking is expected to lead to easier-to-use information systems.

### 2.3.4 Contribution to thesis

This section has provided an overview of the key factors within the producer-consumer dynamics relating to VGI. For these protagonists a series of models have been presented which allows for an understanding of their motivations, actions and reactions to information use, adoption and dissemination. Such perspective are crucial to investigating the human factors of VGI since, as highlighted within Section 2.1, understanding the user reactions, and the inter-user relations is a fundamental concept in developing multi-information products of high usability. Consequently, actors as defined by this thesis may be categorised relative to their relation to information use and their relation to one another.

### 2.4 Information Perspectives

Despite offering interesting and engaging ways of thinking about the world, neogeography is centrally about displaying different forms of information within a geographic context. To consider the human factors of neogeography is therefore to consider the impact which information has on the users of the

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10 For a more detailed comparison of geographical spatial models, see Freundschuh and Egenhoder (1997)
mashup. Consequently, an in depth overview of information and the way people react to it is important to help form a strong theoretical base for investigation.

### 2.4.1 What is information

Although a great deal of work has been conducted on what is information value and quality, ambiguous definitions means that a universal classification is almost always elusive to the literature reviewer (Zeithaml, 1988). Within this section rather than aim to present a definitive dictionary of definitions relating to information, a selection of definitions relating to contexts relevant in this thesis shall be sought.

Table 2.5 provides a selection of definitions of information, and their appropriate explanation for the relationship between knowledge and information as collected by Badenoch et al. (1994); quoted by Menou (1995).
### Table 2.5 - Distinctions Between Information And Knowledge (Badenoch et al., 1994); Adapted From Norrie (1994)

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition of Information</th>
<th>Relationship between information and knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information as something which develops knowledge</td>
<td>Data recorded, classified, organised, related or interpreted within context to convey meaning</td>
<td>Information is the link between knowledge and observed phenomena</td>
</tr>
<tr>
<td>(Bell, 1974, Blumenthal, 1969, Burch et al., 1983, Deeson, 1991)</td>
<td>A pattern or design that rearranges data for instrumental purposes</td>
<td>Information is the link between knowledge</td>
</tr>
<tr>
<td></td>
<td>The result of modelling, formatting, organising or converting data in a way that increases the level of knowledge for its recipient</td>
<td>Information supplies and supports knowledge</td>
</tr>
<tr>
<td></td>
<td>That which adds to human knowledge</td>
<td>Information supplies knowledge</td>
</tr>
<tr>
<td>Information as a function of probability</td>
<td>The reduction of uncertainty</td>
<td>Knowledge is manifest in terms of uncertainty about outcomes in the real world; information is change in this probabilistic state; implies that information is ‘useful knowledge’</td>
</tr>
<tr>
<td>(Arrow, 1984, Stonier, 1990)</td>
<td>Information is a function of complexity</td>
<td>Knowledge is ‘organised information in peoples’ heads’</td>
</tr>
<tr>
<td>Information as something created by knowledge</td>
<td>Representation of knowledge or of thought</td>
<td>Information is an expression of knowledge</td>
</tr>
<tr>
<td>(Farradane, 1976, Oxford University Press, 1989)</td>
<td>Is designed to produce a state of knowledge</td>
<td>Information affects knowledge by adding something to it or restructuring it</td>
</tr>
</tbody>
</table>

In addressing *information value*, Badenoch et al. (1994) distinguished between two forms of information; *epistemic* and *systemic*. According to Badenoch et al. (1994) *epistemic* information is where information is considered in the context of human knowledge and understanding. *Systemic information* however is where information is studied in the context of particular means of physical representation. Although an in-depth review of these two forms of information is of great interest, its application lies outside the remit of this thesis. However, it is sufficient to conclude that due to its direct and relevant application to both web based interfaces as human factors, epistemic information is the most relevant information form for this thesis (Gelfond, 1994, Preda and Popescu, 1994).
2005). From this, six key characteristics of information were highlighted from an epistemic information perspective:

1. Uncertainty
2. Knowledge
3. Ambiguity
4. Indeterminacy
5. Redundancy
6. System-Dependency

2.4.2 Characteristics of information

The aim of this section is to investigate the various characteristics of information relevant to the content of this thesis. While not explicitly related to the design and user experience of neogeography, these dimensions are crucial to the understanding of the user’s first time and continued selection of information sources or products.

2.4.2.1 Price (Cost)

In a general sense, Koops (2004) defined costs as “information acquisition costs that can be incurred through use of resources (e.g. effort), increased risk, or lost opportunity”. The importance of the cost of information relative to the aims of this thesis can be seen in the cost associated with the transfer of information. Luthje et al. (2005) described information that is costly to transfer (and thus stays with the originator) as sticky. Von Hippel (1994) described incremental expenditure required to transfer a unit of information to a specified location in a form usable by a specified information seeker as a unit of information. Consequently, “when this expenditure is low, information stickiness is low; when it is high, stickiness is high”. Of particular relevance to this thesis, Luthje et al. (2005) comment that:

When information is sticky, it is reasonable that a bias will be created toward the use of local information over sticky non-local information – simply because local information can be accessed more cheaply.
Further to this, Koops (2004) noted that as the cost of information acquisition increases, its relative value to the user decreases due to its restricted accessibility. Rouse (1986) added to this that information will only be accessed if its perceived value is greater than its perceived costs.

As Von Hippel (1994) highlighted, the stickiness is a result of information transfer cost rather than a description of it. The reason for transfer cost is, as with most fields of research, not generated from a single cause. Cohen and Levinthal (1990) noted that causes may range from attributes of the information itself to access fees charged on the information seeker obtaining the information. Considering impacts on a user’s cost assessment, Karim (1997) identified that using more information to support a decision as to acquire the information or not may prove to be of only marginal benefit and may just add to the acquisition costs.

It is important to highlight how the user’s perception of cost is situation dependant. Burns and Vincent (1996) provided the example of a designer looking for information during a slow day compared with the same activity just before a major design meeting. As pressure on the designer increases, the cost threshold also increases and its relative importance decreases.

From a geographic perspective, acquiring information is more than simply procurement, but a process of searching, analysing, acquiring and testing (Poplin, 2010). Here the transaction costs are presented in different phases, taking resources (including time) to find the right information and provider irrespective of monetary worth. What is obvious from this is that the way in which the user related to the information presentation is crucial in the question process. This gives validity to the purpose of this thesis, seeking to understand neo-geography so that it may be designed to have maximum benefit to the user, whilst enhancing the chances of that product being acquired.

2.4.2.2 Timeliness

Time, as Omar et al. (2007) commented, is a dimension along which information can be organised and explored due to the rapid increase in general information. Understanding the relation to information of time thus allows for a
contextualisation and ranking of relevance. Goodchild (2008b) commented: “perhaps the most significant area of geospatial data qualities for VGI is currency, or the degree to which the database is up-to-date”.

To begin an understanding of timeliness is to understand the ways time is thought about. Three main categories of temporal expressions have been offered by various authors (Alonso et al., 2007, Schilder and Habel, 2001) and should be considered useful to this thesis:

- **Explicit** - Date expressions such as 08.04.2001 refer explicitly to entries of a calendar system. In addition, time expressions such as 3 p.m. or Midnight denote a precise moment in our temporal representation system.

- **Indexical** - All temporal expressions that can only be evaluated via a given index time are called indexical. Expressions such as today, by last week or next Saturday need to be evaluated with regards to the article’s time stamp.

- **Vague** - Some temporal expressions express only vague temporal information and it is rather difficult to precisely place the information expressed on a time line. Expressions such as in several weeks, in the evening or by Saturday the latest cannot be represented by points or exact intervals in time.

Considering the quality of the PGI data source Google Earth, Goodchild (2008b) remarked that “the date and time at which the base imagery was acquired” are an expression of the spatial accuracy of the data set. This sits well in relation to the concluding remarks by Omar et al. (2007) that “when a user is engaged in tasks that require time-related investigation and sense making, traditional information retrieval and search engines fall short if they do not fully exploit the various types of temporal information embedded in documents”.

### 2.4.2.3 Value

The important distinction between information and information value was raised by Sheridan (1995) when he described the two concepts as being independent;
where information value is what arises from the use of information. To consider the context of use in a work environment (Rouse, 1986), the judgements made by designers at the beginning of information acquisition include:

- Will this information be valuable to me?’
- Will it require resources (e.g. cost/effort) to obtain it?’
- How many resources am I willing to expend trying to obtain this information?

Consequently, rather than being just a descriptive category, value is a vital driving force in the users’ activities. However, the value of information can be rather an elusive concept (Zhao et al., 2008). Relative to this, Badenoch et al. (1994) commented that to define value “one must set out by defining the terms of use”. To do so, various approaches have been positioned, which as Badenoch et al. noted “have changed with time and (presumably) will continue to do so”. In a similar use context, Sheridan (1995) defined the value of information “as the reduction in uncertainty about the state of an event after the data has been received relative to the uncertainty about the state of the event before the data has been received”. Information value has been further discussed in terms of normative, realistic or subjective determinants (Ahituv et al., 1994), where distinct relevance is made of these concepts to a human factors theoretical framework.

<table>
<thead>
<tr>
<th>Approach Type</th>
<th>Summary of Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Normative value of information (information economics)</strong></td>
<td>A quantitative calculation of the value of information based on objective or subjective probabilities of occurrences of events and expected costs and payoffs.</td>
</tr>
<tr>
<td><strong>Realistic/revealed value of information</strong></td>
<td>An outcome measure, the measure difference in actual (not possible) performance due to informational factors Information processing/decision making is considered a black box, there is no attempt to understand or model these processes.</td>
</tr>
<tr>
<td><strong>Subjective value of information</strong></td>
<td>Reflects peoples comprehensive impression of information, a personal judgement of the worth of information.</td>
</tr>
</tbody>
</table>
Within the context of Social Science the value of information is defined as the power that information has to affect actions. In this sense, power (influence or control) is the “capacity for one actor to do something affecting another actor, which changes the probable pattern of specified future events…The amount of power the actor has in this situation is expressed by the magnitude of the change he introduces” (Polsby, 1967). From this, that part of the value of information is the magnitude of difference made by the inclusion of the said information, relative to its non-inclusion. Discussion has also been made within similar context (Koops, 2004) that:

By introducing the concept of reliability into the value of information… the level of risk an information consumer should incur when using information will depend on the control of reliability. If the consumer has no control over the reliability of information, then it pays to respond when the reliability of information exceeds a threshold level.

When considering above perspectives, information value is relative to the variance in outcomes from an action, when the information being perceived to initiate one’s action exceeds a perceived threshold of reliability.

It is useful at this point to consider a definition of risk from an information user perspective since (although not a central area of study in this review) it forms a central principal underpinning the subjects within this section. The Oxford English Dictionary (Oxford University Press, 1989) defines risk as (Exposure to) the possibility of loss, injury, or other adverse or unwelcome circumstance; a chance or situation involving such a possibility.

Within a human factors investigation, Burns and Vicente (1996) conducted a questionnaire study of professional nuclear power plant control room designers. Their claim was that “information would only be accessed if its perceived value was greater than its perceived costs”. In the study, the participants were asked to rate hypothetical information search questions in terms of relevance, importance, cost and effort (Rouse, 1986), with Equation 2.1 being generated (where Effort is a reflection of Accessing Behaviour):
Among other things, the study found Importance was always highly correlated to Relevance. Cost was also found to be a reducing factor, where the effort one puts into a design process is increased by the value (importance and relevance), yet kept in check by associated costs (for effort to be high the costs must be relatively low compared to the assessed value of information being obtained).

2.4.2.4 Trust

Trust has been (and continues to be) a core research topic in psychology, sociology, political science, economics, philosophy and a multitude of fields within computer science (Bishr and Janowicz, 2010, Pusey et al., 2007).

From a traditional viewpoint, the Oxford English Dictionary (1989) defined trust as “confidence in or reliance on some quality or attribute of a person or thing, or the truth of a statement”. A similar perspective from a social context was provided by Sztompka (1999) who defined trust as “a bet about the future contingent actions of others”. An alternative definition can be found in the work of Harvey (2003), that trust is “an indicator of people’s willingness to place faith in relationships and institutions in which they have limited influence”. Harvey went on to describe how trust may be rational or irrational, yet in both cases it expresses the user's underlying confidences.

To consider a definition of trust is also to consider an element of risk, since “trust is a solution for specific problems of risk” (Luhmann, 2000). Using this, Jøsang and Pope (2005) made the distinction between trust in the sense of the reliability of something or someone, and trust in the sense of decisiveness, whether or not a person can use the information to enter into a given situation:

**Reliability Trust** - Trust is the subjective probability by which an individual, A, expects that another individual, B, performs a given action on which its welfare depends.
**Decision Trust** - Trust is the extent to which one party is willing to depend on the other party in a given situation with a feeling of relative security, even though negative consequences are possible.

Jøsang and Pope (2005) used the phrase *Trust Purpose* to express the semantic content of an instantiation of trust; i.e. the personal specification of trust. Through this demonstration was given as to how the issue of trust may or may not be transferable between parties, depending on each party’s *trust purpose*.

In addressing the trust relationship between two parties, Pusey (2007) concluded that “with information exchange we see two categories of trust, to trust another agent with valued information and to trust information provided by an agent”. Returning to the concept of risk, Jøsang and Presti (2004) highlighted that *trust* and *risk* may be considered two separable tools for making decision in potentially volatile environments. Within an e-commerce context, this perception is possibly best demonstrated by the model of Manchala (2000) which avoids measuring trust directly, but uses two or more trust variables with which formulates trust; see Figure 2.6.

![Figure 2.6 - An Example Of A Trust Matrix Showing A Trust Zone (Manchala, 2000)](image.png)

In order to address the challenges of effective utilisation of volunteered information in the Geoweb (see page 48) and the reduction of risk from its inclusion, *trust* has been proposed a potential proxy measure for the quality of geospatial information (Bishr and Kuhn, 2007, Bishr and Janowicz, 2010, Keßler et al., 2011). This is also backed by the theory of Punj and Staelin.
Consequently, the user is driven to perform a more in depth information search (Richins and Bloch, 1986). Therefore, trust is a factor directly related to the perception of risk and user’s relationship with the information.

Bishr and Janowicz (2010) considered that trust can only be an interpersonal construct, since “trusting a company like Lufthansa to take you to your destination is, in fact, trusting the people behind the company”. This consideration led to the generation of informational-trust; where a trusting tie between a trustor and an information entity such as VGI is mediated by interpersonal trust between the VGI originator and the VGI consumer.

Finally, and within a use context, Bishr and Kuhn (2007) described the trust users place on the contributors as the foundation for building an alternative measure of quality for collaborative environments. Various researchers (Golbeck, 2005, Richardson et al., 2003, Ziegler and Lausen, 2004) have stated how the perception of trust within collaborative environments is a measure of how information produced by users is relatively valuable to others. Importantly, this is given meaning by the reflections of Bishr and Kuhn (2007) in that “If some trust-rated geospatial information is useful and relevant to a larger group of users, it can then be assumed to have satisfactory quality in a more objective sense”.

2.4.2.5 Quality

As Mummidi and Krumm (2008) pointed out, “one of the potential problems with VGI is ensuring quality”. Before this may be addressed, a distinction must be made at the start of this section between the notion of quality control and quality.

Quality Control is the processes of examining a product or system to determine whether or not it accomplishes was what was specified by the designer in the design (DeGarmo et al., 2003). While quality control factors in VGI pose an interesting area of research (Goodchild, 2008a, Mummidi and Krumm, 2008), it lies outside the scope of this literature review and thesis.
Quality, however, is what may describe the product, and its definition and relation to other factors is the focus of this section. This is highlighted by ISO 9241-11 (1998) in its consideration of quality from a human factors perspective as being a “broader view of the ergonomic concept of usability”. The importance of quality should not be undervalued since, as Keller and Staelin (1987) pointed out, the quality of information can be more important than the quantity. This is in part derived from their observation that the consumer’s perceptions of information usefulness are strongly associated with the measure of information quality.

Ultimately, there is no universal theory of quality but rather a series of theories that may be applied according the context of the system or product. In an exploratory study into the perceptions of quality, price and value of beverages, perceived value were defined as “the consumer’s overall assessment of the utility of a product based on perceptions of what is received and given” (Zeithaml, 1988). The difference between value and quality may therefore be distinguished as follows. Value is the user’s unique emotional perception of gains and sacrifices originating from the use or acquisition of a system or product. Quality however is the extent to which the product or service satisfies the technical or specific needs of an individual or organisation. Under this distinction, two products may have the same quality (both satisfy the technical specification of doing X, Y and Z), yet a different value (product A has a different ecological presence in the market, causing an improved emotional perception from the user different to product B).

In a general overview, Garvin (1988) suggested six forms of quality: transcendent, manufacturing-based, product-based, value-based, competition-based and user-based. However, a simpler format has been presented by Jakobsson and Tsoulos (2007) consisting of production, planning, customer and system-centred. Alternatively, from a software perspective, ISO 9126 (1991) characterised quality from a user perspective as functionality, reliability, usability, efficiency, maintainability and portability; see Figure 2.7. A further definition for quality was presented in ISO 8402 (1994) as “the totality of characteristics of an entity that bear on its ability to satisfy stated and implied needs”. In considering these two standards along with ISO 9001 (2008), Bevan
(1999) concluded that quality should be specified and evaluated at the level of the source attributes. The importance of ISO 9126 (1991) is the way in which these attributes are associated with each other relative to the end user perspective.

![ISO 9126 (1991) Software Quality Characteristics](image)

**Figure 2.7 – ISO 9126 (1991) Software Quality Characteristics**

It is interesting to consider the above statements in relation to the work of Keller and Staelin (1987) while to a degree multiple sources of information improve the user’s overall assessment of quality, the ambiguous notion of *too much* information causes a reduction in the user’s overall assessment of information quality. Consequently, the amount of information, and the type of information which that set consists of has as much of an impact on the user as the characteristics of the information which the user interacts with. Considering the multiple perspectives of quality presented above, Tóth and Tomas (2011) summarised that quality should be considered from the *internal* (related to data collection) and *external* (the aspects necessary for reusing the data) viewpoints.

In describing the quality principles of geographic information, Coote and Rackham (2008) asserted that geographic information consists of both subjective and quantitative elements of quality; see Table 2.7. Subjective elements provide “a valuable initial indication as to how useful a particular data are going to be for certain purposes”, while quantitative elements “imply a quality evaluation involving measurement and an objective result”. 

<table>
<thead>
<tr>
<th>Functionality</th>
<th>Reliability</th>
<th>Usability</th>
<th>Efficiency</th>
<th>Maintainability</th>
<th>Portability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy</td>
<td>Maturity</td>
<td>Understandability</td>
<td>Time behaviour</td>
<td>Analysability</td>
<td>Adaptability</td>
</tr>
<tr>
<td>Suitability</td>
<td>Fault tolerance</td>
<td>Learnability</td>
<td>Resource</td>
<td>Changeability</td>
<td>Installability</td>
</tr>
<tr>
<td>Interoperability</td>
<td>Recoverability</td>
<td>Operability</td>
<td>Utilisation</td>
<td>Stability</td>
<td>Conformance</td>
</tr>
<tr>
<td>Compliance</td>
<td>Security</td>
<td></td>
<td></td>
<td>Testability</td>
<td>Replaceability</td>
</tr>
<tr>
<td>Security</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2.7 - Quality Principles of Geographic Information (Coote and Rackham, 2008)

<table>
<thead>
<tr>
<th>Nature</th>
<th>Element</th>
<th>Descriptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjective</td>
<td>Purpose</td>
<td>The rationale for creating the data set</td>
</tr>
<tr>
<td></td>
<td>Usage</td>
<td>The application to which the dataset has been put</td>
</tr>
<tr>
<td></td>
<td>Lineage</td>
<td>The history of the dataset</td>
</tr>
<tr>
<td>Quantitative</td>
<td>Positional Accuracy</td>
<td>The accuracy of the position of features or geographic objects in either two or three dimensions. Positional accuracy can be expressed either as the absolute accuracy; the closeness of coordinate values to values accepted as true, relative accuracy; closeness of the relative positions of objects in a dataset to those relative positions accepted as true, or gridded data position accuracy; the closeness of gridded data position values to those accepted as being true</td>
</tr>
<tr>
<td></td>
<td>Temporal Accuracy</td>
<td>This is the accuracy of temporal attributes, such as dates and time, and the temporal relationships of features, such as ‘later’ or ‘earlier than’ relationships. Temporal accuracy can be expressed as the accuracy of time measurement; i.e. if the stated recorded dates of objects are correct, temporal consistency; the correctness of ordered events, or temporal validity; the validity of data with respect to time.</td>
</tr>
<tr>
<td></td>
<td>Thematic Accuracy</td>
<td>This is the accuracy of quantitative attributes; such as population, non-quantitative attributes; such as geographic names, and classifications; how correct classes assigned to attributes are in relation to ground truth.</td>
</tr>
<tr>
<td></td>
<td>Completeness</td>
<td>This is the presence and absence of objects in a dataset at a particular point in time. These can be errors of omission; data missing from the dataset which should have been included at the time of capture (such as missing streets or street names) or commission; Data that is present in the dataset but should have been omitted (such as buildings now demolished).</td>
</tr>
<tr>
<td></td>
<td>Logical Consistency</td>
<td>This is the level of adherence to logical rules of data structure, attribution and relationships. This can be characterised as conceptual consistency, domain consistency, format consistency and topological consistency.</td>
</tr>
</tbody>
</table>

To give consideration to quality issues associated with collaborative systems, Bishr and Kuhn (2007) commented that there exists no centralised attribute controls, and non-experts produce a bottom-up approach to geospatial information quality attributes; e.g. lineage, accuracy, consistency, completeness. Consequently, the lack of quality measures, semantics and...
metadata\textsuperscript{11} adversely affect the usability of information generated in this manner. Additionally, Devillers et al. (2007) remarked that non-specialist users often find metadata difficult to read, understand and map to their requirements, adding an additional level of complexity to their tasks.

Further testament to quality issues within VGI were noted by Mummidi and Krumm (2008) who stated that “volunteers may not know nor care about the quality of their contributions”. This comment was attributed to the purpose for which a volunteer contributes information, with lower use of contributions by others, and higher levels of contributor anonymity decreasing the potential quality of contributions.

A more formal insight into this consideration for a bottom up approach amongst volunteers was provided by Goodchild (2008b) in his remarks that PGI generates certain expectations about quality from users, based on the experience of standardised use and reputation. Therefore, PGI may be considered authoritative, being that it demands credibility and belief from the user (Wilson, 1983). VGI however has no brand and does not deliver a past level of experienced use to the user, and encompasses no standardisation; thus it is asserted.

From a geographic science perspective, Haklay et al. (2009) described quality as the answer to the question ‘how good is the data’. Here, quality was described as being comprised of positional accuracy (the position of features or objects), temporal accuracy (how up to date the data are), Thematic Accuracy (qualitative and quantitative attributes), Completeness (the presence and absence of objects in a dataset) and Logical consistency (adherence to the logical rules of the data structure).

Although diverse, common themes in quality theory have been identified by Lochner and Matar (1990) as being:

- Quality is a measure of the extent to which customer requirements and expectations are satisfied;

\textsuperscript{11} Metadata – Data about data, or information which is often highly structured about documents, books, articles, photographs or other items that is designed to support specific functions (Mathes, 2004).
• Quality is not static, since customer expectations can change;

• Quality involves developing product or service specifications and standards to meet customer needs (quality of conformance).

2.4.2.6 Authority

As evident by the way authority has been mentioned in the above sections as being central the perceptions of value, trust and quality, the perception of authority is highly relevant and important to this thesis. The degree to which authority may be considered as woven into the fabric of users perceptions can be seen through the work of Rieh and Belkin (2000): “when searching for ‘useful’ information, people often base their actions on the concepts of quality and authority”. In common usage, authority can be taken as the power to influence others in either actions or events (Oxford University Press, 1989). However, a more information focused definition is required in order to understand this label placed on the power of data to invoke actions.

In a paper presenting a model that uses elements of user interaction within a Collaboratively Contributed Geographic Information (CCGI) infrastructure, Bishr and Mantelas (2008) presented a model which effectively assesses collaborative authority of information; see Equation 2.2.

\[
t_{mh} = \sum_{i=1, g=1}^{k} \frac{t_{ng} r_{(n,m)}}{log(c_i)}
\]

Equation 2.2 – Spatio-temporal trust and reputation model, where \( ci > 1 \) (Bishr and Mantelas, 2008)

\( T_{mh} = \) trust rating of information entry \( m \), \( n = \) number of contributors to the network, \( m = \) set of all CCGI contributions, \( r = \) trust rating by actors \( N \) to CCGI entry \( M \), \( c_i = \) the distance between \( n \) and \( m \), \( t_{ng} = \) trust rating of a contributor given by the community

A simplified version of Equation 2.2. is shown within Equation 2.3 below.

\[
Trustworthiness = (Ability \ of \ Contributor) \times (Rating \ of \ Contribution)
\]

Equation 2.3 – Simplified Spatio-temporal trust and reputation model (Bishr and Mantelas, 2008)

While Equation 2.3 may provide a useful solution to quantifying the amount of trust an entity of data are worthy of, it relies on a community of contributors generating information and providing ratings of each other’s contributions. More
importantly, it demonstrates the close link between trustworthiness and authority. This position is supported by the work of Barry and Schamber (1998) in that if information carried insufficient authority, it will be trusted by the user. A limitation to this theory exists in how for the authority to be given to information from a user, the user has to be aware of certain information about the contributor. This relates further to the work of Arrow (1984) and Stonier (1990), that information is the reduction of uncertainty. It may therefore be taken that the degree to which the information is able to assert itself on the user, reducing uncertainty, then the more authoritative it is.

Considering the above perspectives, it is necessary to consider the origins of the users trust. As given further discussion within Section 2.5.2 (User information judgements) Rieh (2002) described authority as the product of the user’s overall assessment of the information, its source and the way it was presented. However, rather than describe authority as a singular judgement in the mind of the user, it was used as an umbrella term constructed by the individual judgements of trustworthy, credible, reliable, appropriateness to the situation, official and authoritative implications.

2.4.2.7 Relevance

From an Information Science perspective, relevance (manifested in a judgement of the quality of the relationship between a user’s information problem and the information itself) has been highlighted as the central theme in understanding end-users as the ultimate assessors of information quality (Alonso et al., 2008, Barry and Schamber, 1998, Cooper, 1971). Further definition by Cooper (1971) put relevance as the main characteristic to be looked for when the [user] makes its decisions about what to retrieve and what not to retrieve. In essence, the relevance described the extent to which information is relevant to the user by characteristic.

In contrast to this Saracevic (1997) criticised the sole use of relevance-based measures in evaluation of information search and called for proper measures at the levels of users and uses, markets and products, and social impacts.
In comparing data from two studies where participants undertook an information search, Barry and Schamber (1998) attempted to bring a general agreement to the definition of relevance. Five assumptions made regarding relevance were that it is:

- Cognitive and subjective, depending on the user; knowledge and perceptions
- Situational, relative to users’ information problems
- Complex and multidimensional, influenced by many factors
- Dynamic, changing constantly over time
- A systematic phenomenon, observable and measurable at a single point in time

Table 2.8 presents the criterion for defining relevance evaluation common in both of the studies undertaken by Barry and Schamber (1998).

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessibility</td>
<td>The extent to which some effort is required to obtain information; some cost is required to obtain information</td>
</tr>
<tr>
<td>Accuracy, validity</td>
<td>The extent to which information is accurate, correct or valid</td>
</tr>
<tr>
<td>Affectiveness</td>
<td>The extent to which the user exhibits an affective or emotional response to information or sources of information; information or sources of information provide the user with pleasure, enjoyment or entertainment.</td>
</tr>
<tr>
<td>Availability of information, sources of information</td>
<td>The extent to which information or sources of information are available</td>
</tr>
<tr>
<td>Clarity</td>
<td>The extent to which information is presented in a clear and well-organized manner</td>
</tr>
<tr>
<td>Currency</td>
<td>The extent to which information is current, recent, timely, up-to-date</td>
</tr>
<tr>
<td>Depth, scope, specificity</td>
<td>The extent to which information is in-depth or focused; is specific to the user’s needs; has sufficient detail or depth; provides a summary, interpretation, or explanation; provides a sufficient variety or volume</td>
</tr>
</tbody>
</table>
Quality of sources
The extent to which general standards of quality or specific qualities can be assumed based on the source providing the information; source is reputable, trusted, expert

Tangibility
The extent to which information relates to real, tangible issues; definite, proven information is provided; hard data or actual numbers are provided

Verification
The extent to which information is consistent with or supported by other information within the field; the extent to which the user agrees with information presented or the information presented supports the user’s point of view

Additional context may also be attained through considering the work of Cool (1993) who remarked that the “meanings of relevance change throughout an information search as a result of their encounters with people, things and ideas”.

Finally, importance must be given to the other, interrelated factors of information, of which relevance is only one. The trust and confidence a user has in the information may be a deciding factor in its use, as if the information source is not trusted, then the perceived risk of using it is increased, and the information is of a lower utility to the user, irrelevant of its relevance (Luhmann, 2000).

2.4.3 Sources of information
Information searches occur at the most general level when a question is asked of a person or situation where information is needed; with the intention to exact an outcome. Chang et al. (2001) described information search as issues relating to the efficiency, feasibility, scalability and usability of searching techniques. An early examination of the information search behaviours of tourists highlighted that despite the investment by agencies and entrepreneurs in the tourism field, very little appears to be known about which sources of information consumers use to acquire information about destinations (Gitelson and Crompton, 1983). Of what is known, Gitelson and Crompton highlighted that the two information search activities which are common are the internal and external searches; agreed on by Bettman (1979) and Hawkins et al. (1995).
Hawkins et al. (1995) described *internal* searches as the retrieval of relevant information from a person’s memory to determine if satisfactory solution to a problem is known, what the characteristics of potential solutions are and what are the appropriate ways to compare solutions. *External* searches were described as when a resolution cannot be reached through internal search, and then the search process is focused on external stimuli relevant to solving the problem. Further definition to the understanding of *relevance* was offered by Badenoch et al. (1994) in that personal experience can be described as “*relevance within context*”.

Additionally, information sources which provide awareness to potential users can be categorised as *formal* and *informal* sources (Hawkins et al., 1995, Weiss and Heide, 1993). Here, *formal* sources include printed media, destination-specific literature, broadcast media (e.g. radio, TV, etc.) and discussions with professionals, whilst informal sources include family, friends and other users (Gitelson and Crompton, 1983).

### 2.4.4 Measures of Information Value

Although this thesis concerns itself primarily with information delivered over the internet, Finch and Cromwell (2001) have stated that “the evaluation of Internet *information is similar to the evaluation of print materials, and that many of the same evaluative criteria apply in both media*”.

Possibly due to the disciplines practitioners arise from, or their personal research scope, there exists great and varying differences in content and semantics defining what is meant by the terms relating to value (Equation 4, Badenoch et al., 1994). As a measure to describe behaviour, Burns and Vincent (1996) identified value and cost as being two key constructs, yet other practitioners have described value and being the product of benefit and cost (Equation 5, Koops, 2004, Luthje et al., 2005). However, despite these two opposing perspectives, Ahituv et al. (Ahituv et al., 1994) commented that in general, the essence of what is being described is that information is a function of benefits to the individual and costs occurred.
In order to understand the prerequisite to developing mobile services to users approaching a wider understanding of information value was approached by May (2008), describing four key perspectives on information value and their relevant means of measure. This was as an understanding to measure or predict the value of information to the end user.

Table 2.9 - Approaches to measuring information value (May, 2008)

<table>
<thead>
<tr>
<th>Perspective On Information Value</th>
<th>Means Of Measuring Information Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monetary or economic value (from the demand side)</td>
<td>The monetary sum that a user is willing to pay</td>
</tr>
<tr>
<td>Monetary or economic value (from the supply side)</td>
<td>The monetary sum that a supplier is willing to sell information for</td>
</tr>
<tr>
<td>Realistic, actual or revealed value</td>
<td>The behaviour (or change in behaviour) that the information results in</td>
</tr>
<tr>
<td>Perceived or subjective value</td>
<td>The individuals perceptions, in terms such as perceived usefulness, perceived emotional support</td>
</tr>
</tbody>
</table>

It should be noted that the conditions of Table 2.9 are not mutually exclusive, in that they describe the overall situation of information value rather than specific conditions. In particular (as demonstrated by Burns and Vicente, 1996, Denant-Boèmont and Petiot, 2003) that the value and how it should be considered is relative to situation.

Lin et al. (2005) commented that two key measures of value exist; 
unidimensional (measuring customers overall perception of value) and 
multidimensional (measuring the various value perceptions using various benefit and sacrifice dimensions) perspectives. The unidimensional theory of value can be seen as the benefits and sacrifices associated with only one element of perceived value, e.g. price or service (Lin et al., 2005).
However Sweeney and Soutar (2001) noted on the unidimensional perspective that “a more sophisticated measure is needed to understand how consumers value products and services”. Further to this Lin et al. (2005) noted that the “unidimensional conceptualization strategy is effective and straightforward, but it cannot discern the complex nature of perceived value”.

**Figure 2B.1 – Studies Conceptualising Perceived Value as Unidimensional (Lin et al., 2005)**

<table>
<thead>
<tr>
<th>Study</th>
<th>Antecedents of Value</th>
<th>Consequences of Value</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feick et al. (1982)</td>
<td>Perceived service quality (4)</td>
<td>Professional business service value (1)</td>
<td><em>M</em> represents that the construct is not measured but rather is manipulated by the researchers</td>
</tr>
<tr>
<td>Brady and Robertson (1997)</td>
<td>Functional service quality (5)</td>
<td>Satisfied (1)</td>
<td></td>
</tr>
<tr>
<td>Croolo et al. (1997)</td>
<td>Service quality (5)</td>
<td>Service value (2)</td>
<td></td>
</tr>
<tr>
<td>Greml al. et al. (2002)</td>
<td>Perceived quality (6)</td>
<td>Service value (1)</td>
<td></td>
</tr>
<tr>
<td>Patterson and Sprang (2002)</td>
<td>Functional service quality (5)</td>
<td>Service value (2)</td>
<td></td>
</tr>
<tr>
<td>Sweeney et al. (2002)</td>
<td>Performance (1)</td>
<td>Service value (1)</td>
<td></td>
</tr>
<tr>
<td>Vala and Olgetre (2001)</td>
<td>Service quality (1)</td>
<td>Service value (2)</td>
<td></td>
</tr>
</tbody>
</table>

Note: Numbers in parentheses denote the numbers of manifest indicators for measuring the construct.
In defining the\textit{ multidimensional} perspective Sweeney and Soutar (2001) included the components of emotion, social enhancement, price and performance; see Table 2.10. Within this model, each construct may be considered a \textit{give}, a \textit{get} or a considered trade-off between a \textit{give} and a \textit{get}.

Crucially, the multidimensional perspective of value aims to consider all of the various information perspectives together, rather than the independent factors under the unidimensional perspective.

\begin{table}[h]
\centering
\begin{tabular}{|l|p{10cm}|}
\hline
\textbf{Multidimensional Component} & \textbf{Definition} \\
\hline
\textit{Emotional Value} & the utility derived from the feelings or affective states that a product generates \\
\hline
\textit{Social Value (enhancement of social self-concept)} & the utility derived from the product’s ability to enhance social self-concept \\
\hline
\textit{Functional value (price/value for money)} & the utility derived from the product due to the reduction of its perceived short term and longer term costs \\
\hline
\textit{Functional value (performance/quality)} & the utility derived from the perceived quality and expected performance of the product \\
\hline
\end{tabular}
\caption{Definition of the Multidimensional Value Components (Sweeney and Soutar, 2001)}
\end{table}

In a similar theory by Sheth et al. (1991) price has been rejected for the more hedonic constructs of \textit{epistemic} and \textit{conditional} value. Although the theory of Sweeney and Souter has been shown to work in post purchase value analysis (Mackay, 1999) (the value of the item in use), both of these frameworks were developed to predict and describe consumer behaviour (Sheth et al., 1991). However, the theory put forward by Sheth et al. has been tested in the areas of ‘to use or not to use’, product type choices and brand choices. When one considers the premise that an electronics map of any description is a product, being an item intentionally produced for human use, then the relevance of these theories in the understanding of ‘what is the value of a VGI map’ becomes apparent.

Considering the multidimensional perspective, Zeithaml (1988) conducted an exploratory study into the perceptions of quality, price and value of beverages. Here perceived value was described as “the consumer’s overall assessment of the utility of a product based on perceptions of what is received and given”. She
also points out that “What constitutes value – even in a single product category – appears to be highly personal and idiosyncratic.”

The concept of ‘give’ and ‘get’ elements constructing one’s perception of value is derived from finding value being used in four definitions by her participants: “(1) value is low price, (2) value is whatever I want in a product, (3) value is the quality I get for the price I pay, and (4) value is what I get for what I give” (Zeithaml, 1988). Each of the four conditions may be considered descriptions of a user’s sacrifice (e.g. money, time and effort), rewards (e.g. quantity, quality and functional/ social enhancements), or a trade-off between the two factors. Therefore, the core concept of value being a trade-off between salient ‘gives’ and ‘gets’ may be considered justified.

Lin et al. (2005) reviewed the different dimensional views of value and concluded that “perceived value should be conceived of as an overall abstraction and specified as a second-order construct with first-order value components as formative indicators, each manifested by multiple reflective indicators”. This is presented in Figure 2B.2.

Figure 2B.2 - Perceived value as a second order multidimensional formative construct identified through structural relations (Lin et al., 2005)

Lin et al. (2005) summarised:

The unidimensional and first-order multidimensional specifications are appropriate when the objective is to assess overall value perceptions or
value perceptions at the component level. These models are easily implemented and have merits for evaluating organizational effectiveness, for example, benchmarking management. When the objective is to confirm interrelationships of constructs in a nomological network, the proposed second-order formative specification is a theoretically convincing structure.

This emphasises the important first order multidimensional specifications in initial research, and provides a possible direction for deeper investigation once the basic theory in VGI value has been produce.

2.4.5 Contribution to thesis

This section has provided an overview of the key perspectives on information relating to the research questions of this thesis. The various characteristics of information, their interlinking theories and models and implications to this body of work in general have been presented and discussed. From this, the theoretical frameworks for the investigations within this thesis can be drawn, and selected for their appropriateness to the situation at hand.

2.5 Human Factors and Information

As highlighted previously, human factors is the relation of the product or service to the users. While human factors related to geography has been highlighted earlier within this chapter, a need exists to consider the ways in which users relate to information, and how it influences their activities.

2.5.1 Users and information search

Burns and Vicente (1996, based on Rouse, 1986) empirically evaluated the position that information search behaviour, as governed by three attributes:

1. Perceived relevance
2. Perceived Importance
3. Perceived cost

Their findings demonstrated that each of the factors are interrelated, so to increase the effort a user spent in obtaining information, the cost in monetary or time terms could be reduced. Additionally, each of the three elements is
perceptual and personal to the information searcher making judgements on the information discovered. Hogarth (1980) presented two forms of judgements users make during information search, predictive (what the user expects to happen/ find) and evaluative (the values by which the user expresses preference and critique towards the information discovered). Essentially the quality associated with a user’s information search and choice may be seen as “the extent to which evaluative judgements really translate true preferences, and predictive judgements are accurate” (Hogarth, 1980). With regards to this thesis, it is useful to consider user judgements within these two categories, where for example, a user may exhibit two sets of value judgements rather than one. Consequently in order to produce a full understanding of the user information perceptions this multiplicity needs to be considered.

Bates (2002) decomposed the information search into active and passive information acquisition via directed and undirected exposure to information. In turn, this gives rise to four states of information search; Searching, Monitoring, Browsing and Being Aware; see Figure 2.3.

![Figure 2.3 - Modes of information seeking (Bates, 2002)](image)

According to Kuhlthau (1991, 2004) there are six stages of the Information Search Process:

1. **Initiation** – Recognise information needs
2. **Selection** – Identify general topic
3. **Exploration** – Investigate information on general
4. **Formulation** – Formulate focus
5. **Collection** – Gather information relating to focus

6. **Presentation** – Complete

These six stages of the ISP and their relation to cognitive experiences and physical actions are highlighted in Figure 2.4.

<table>
<thead>
<tr>
<th>Stages</th>
<th>Initiation</th>
<th>Selection</th>
<th>Exploration</th>
<th>Formulation</th>
<th>Collection</th>
<th>Presentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feelings (affective)</td>
<td>Uncertainty</td>
<td>Optimism</td>
<td>Confusion/frustration/doubt</td>
<td>Clarity</td>
<td>Sense of direction/confidence</td>
<td>Relief/satisfaction or disappointment</td>
</tr>
<tr>
<td>Thoughts (cognitive)</td>
<td>General/Vague</td>
<td>Narrowed/clearer</td>
<td>Increased Interest</td>
<td>Clearer or focused</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actions (physical)</td>
<td>Seeking background information</td>
<td>Seeking relevant information</td>
<td>Seeking relevant or focused information</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 2.4 - Model of the information search [seeking] process (Kuhlthau, 1991)**

Within a recreational context, individuals require information to find potential opportunities and the sources of this information (Mathieson and Wall, 1982, Schuett, 1993). This process of information requirement has been termed as **Information Search** and has been categorised as internal and external (Bettman, 1979, Hawkins et al., 1995).

Hawkins et al. (1995) described internal search as the retrieval of relevant information from one’s memory to determine if satisfactory solution to a problem is known, what the characteristics of potential solutions are and what are the appropriate ways to compare solutions. External searches were described as when a resolution cannot be reached through internal search, and then the search process is focused on external stimuli relevant to solving the problem. Within this thesis, all forms of information used to inform a user or influence their judgement are considered external sources, but provided the overarching name of **information** for simplicity.

With regards to the timeline of information search, Bettman (1979) suggested that an internal search is usually performed initially, and is followed by external search if there is insufficient information in memory to make a decision (Moore and Lehmann, 1980). Further studies have demonstrated that the user returns
to the process of internal search once information has been found/presented from an external search (Jacoby et al., 1977, Van Raaij, 1977). From a unidimensional value perspective Moore and Lehmann (1980) suggested that a person will continue to acquire and process information until the cost of additional acquisition and processing outweigh the benefit. As commented by Katona (1960) product [or task] importance would imply higher benefits and hence more search.

Hawkins et al. (1995) highlighted that a consumer decision requires information on 1) the appropriate evaluative criteria for the solution of a problem, 2) the existence of various alternative solutions and 3) the performance level or characteristics of each alternative solution on each evaluative criterion. This is demonstrated in Figure 2.5.

Figure 2.5 - Process flow of information search (Hawkins et al., 1995)

The extents to which an individual conducts an information search could be considered an elusive concept to define since every individual sets different criteria relative to their objectives. However, Moore and Lehmann (1980) considered *market environment, situational variables, potential payoff, product importance, knowledge and experience, and individual differences* to be key determinants. This overarching framework was produced to combine the findings of Newman (1977) and Bettman (1979); reconciling the differences between in their work. Of this, Schuett (1993) concluded that the more knowledge and experience a person possesses about a product, the less information he or she seeks before a purchase. Finally, and within the context of extracting information from multiple online sources, Chang et al. (2001) described information search as issues relating to the efficiency, feasibility, scalability and usability of searching techniques.
Primarily, research into information search has come from a market research discipline, focusing on the act of purchasing, in particular consumer goods (Schuett, 1993), food (Jacoby et al., 1977, Moore and Lehmann, 1980) and automobiles (Hupfer and Gardner, 1971, Richins and Bloch, 1986). Key to understanding the energising factors of information search is (within a consumer purchasing sense) the involvement with the product which the information pertains to. This Richins and Bloch (1986) defined as the state of arousal and degree of interest a consumer has for a product on a day-to-day basis.

Describing the motivating factors behind a consumer’s information search in terms of *Situational Involvement* (involvement in the product in specific situations, e.g. purchasing) and *Enduring Involvement* (on-going concern with the product), Richins and Bloch (1986) described how consumer interest dictates the engagement with the information relating to the involvement. Richins and Bloch also noted the correlation between high involvement in a product and the increased interest in information concerning the reduction of risk. Hupfer and Gardner (1971) commented that while in everyday life an individual may have low *enduring involvement* in automobiles, their *situation involvement* increases greatly when considering a new purchase in order to minimise potential risk. Similarly, Urbany et al. (1989) demonstrated that the lower familiarity a user has with a product the greater their information search becomes when faced with a *risk* situation. To consider price as risk within a consumer purchase concept, Calson and Gieseke (1983) showed that with increased risk comes increased information search. Finally, both Bloch et al. (1986) and Zaichowsky (1985) both concluded that the process of information search increased in consumers when the overall importance of the product to the individual, or the product involvement is high.

Relative to the objectives of this thesis, Xiang and Gretzel (2010) commented that there is general a lack of understanding of the role *information search* plays within online information search behaviour; particularly that relating to social media and travel information. This is particularly interesting when considering the earlier comment by Schuett (1993) and Manfredo (1989) that information
search behaviour within a recreational tourism field had at their time of writing gained little attention.

A final point for consideration within the context of the user’s information search is the importance of information presentation on the judgements the user makes. Hawani Idris et al. (2011b) demonstrated that the more professional and good the information appears to be in its presentation, then the higher it is perceived by the user. However, further research is required on exactly how influential the presentation factors are relative to the other issues addressed above.

2.5.2 User information judgements

An important concept within this thesis is the judgements that a user makes on information. Hogarth (1980) described that within choice situations two forms of judgement are formed; predictive and evaluative. Here, predictive judgement refers to what people expect to happen, while evaluative judgement denotes the values by which they express preferences.

A context to this process can be seen in the work of Wang and Soergel (1998) who defined the steps users take in selecting a document for use; see Figure 2.6.
Figure 2.6 – Stages of Document Selection (Wang and Soergel, 1998)

Here, the key steps are how the information is used to form judgements (e.g. information elements such as title, author) through user-based criterion (e.g. criteria such as topicality, orientation), leading to the formation of value judgements (e.g. values such as potential benefits against potential costs). The combination of these judgements through the cognitive model as presented in Figure 2.6 leads the user to accept, consider or reject the information object being processed. Crucially, Wang and Soergel (1998) highlighted that at each of the processing stages, the user’s knowledge and experiences influences the perceptions and outcomes.

Within the context of this thesis, the predictive judgement is what guides the user towards looking at certain pieces of information. However, when it has been investigated an evaluative judgement is made; e.g. Wang and Soergel (1998). Therefore, in investigating the user experience of neogeography, it is the users’ evaluative judgement which needs consideration.

Previous research has demonstrated information relevance to be a useful model with which to understand a user’s information search behaviour (Alonso et al., 2008, Barry and Schamber, 1998, Cooper, 1971). However, as pointed out by Rieh (2002), a substantial number of empirical studies (Barry, 1994, Cool et al., 1993, Park, 1993, Schamber, 1991, Spink, 2001, Wang and Soergel, 1998) have revealed that people use more diverse criteria than a simplified topical relevance to make judgements in the traditional information retrieval environment. Complimentary to this, in an investigation into how consumers perceive information presented online, Rieh (2002) commented that the extent to which users think that they can trust the information is an operationalization of the concept of cognitive authority. More specifically, “When searching for ‘useful’ information, people often base their actions on the concepts of quality and authority” (Rieh and Belkin, 2000). Therefore, an understanding of the user’s judgement of information has been shown to be an effective and useful way of assessing the user’s acceptance of online information, critical if one desires to create a mashup of high usability.
A useful additional consideration is given by Das and Kraak (2011) who brought into question the informal aspect of data within neogeographic systems, in terms of its impact on the user’s perception of *credibility* and *quality*. This was particularly based on the lack of control from professionals, leading to the inability to assess *credibility* and *quality* aspects. No new framework for utilising such perspectives was brought forward, but rather they proposed the use of metadata to help the user explore the “chaos” demonstrated by neogeographic/VGI maps. While this presents an interesting way forward, the user judgements are not considered, so an argument may be made that fundamental issues remain unaddressed.

An important element of information judgement is that of cognition, defined in a general sense as a person’s faculty or knowledge, or apprehension and perception (Oxford University Press, 1989). *Cognitive authority* has been described by Wilson (1983) as “influences that a user would recognize as proper because the information therein is thought to be credible and worthy of belief”. To give further credibility to this perspective from a psychological context, Klaczynski and Gordon (1996) demonstrated the link between *that which a person holds to be true* and *their ability to recognise external information as credible*. Of importance to this study, the essential elements which describe the users’ cognition of a source’s authority (i.e. Cognitive Authority) have been laid out by Wilson (1983) as 1) *identity of the author of a work*, 2) *determining the author’s competence and trustworthiness* and 3) *determining which types of authority are applicable* (Fritch and Cromwell, 2001). Further to this, Rieh and Belkin (1998) found that the author’s organisational affiliation was a critical factor in their determination of the authority of information on the internet. This concept has been ratified by Devillers et al. (2010), who noted that *decision makers* often rely on perceived information *quality* to infer the degree to which they see the information as *reliable*. Importantly, reliability can be seen as synonym for *trustworthiness* or *authority* (Rieh, 2002, Wilson, 1983). It is of course important to remember that it is the user who is determining these factors, not an information manager or supervisor. In a wider sense, Alexander and Tate (1998) cited *authority*, *accuracy*, *objectivity*, *currency* and *coverage* as the key factors in assessing the
appropriateness of an information source to a user’s information search requirements.

It is important here to present three general definitions of authority (Fritch and Cromwell, 2001, Wilson, 1983).

1. **Cognitive Authority** – Influence on thoughts
2. **Administrative Authority** – Influence on Actions
3. **Institutional Authority** – Influence Derived from Institutional Affiliation

Only the first definition of authority is relevant to the research in this study since focus is given to the end consumer, who (during their information search) may discover a variety of information sets, and it is up to the consumer to assess their authority, rather than for the information to assert its authority over the user.

The role of authority of information on the internet is an interesting subject in itself. On one side, various authors have claimed that information online is to be perceived the same as information in traditional printed media (Brandt, 1996, Katz, 1997, McMurdo, 1998, Tate and Alexander, 1996). Alternatively, the internet has been presented as a host of misinformation or disinformation due to the nature of electronic media (Fitzgerald, 1997, Floridi, 1996, Hernon and Altman, 1995, Keen, 2007). The possible cause for general dissatisfaction with media on the internet was put forward by Fritch and Cromwell (2001) as not derived from the internet as an information conduit, but due to the lack of descriptors commonly associated with traditional media; e.g. *title, author, authenticity*, etc. To relate this definition to the realm of human factors in GIS, Figure 2.2 presents a model for the principal facets of GIS-supported decision making.
Figure 2.7 - Aspects of Decision-Making Using GIS (Turk, 1993)

The importance of this framework is that at almost every aspect of decision making the general process being described is that of the users’ cognition of the information being provided, and then using that cognition to effect a decision. An interesting consideration alongside professional information focused Figure 2.2 is how a volunteered information decision making schematic may appear. While such speculation lies outside the remit of this thesis, the anarchic nature of many non-professional neogeographic may suggest a less rational and more emotional approach.

In recent years various models have been developed which calculate the objective quality of a user’s contributed information (e.g. positional accuracy) as a proxy for assessing the trustworthiness of information (Bishr and Mantelas, 2008, Buskens, 2002, Nohria and Eccles, 1992, Rieh, 2002, Wasserman and Faust, 1994). This presents the opportunity to utilise past theoretical work to ensure that the content of the VGI presented to participants within this experiment is of high quality, and to assess the users’ judgements of that information.
Various models exist to describe how information may be received by the consumer, including collaborative assessment (Bishr and Mantelas, 2008). However, a more holistic approach is required to measure the judgement a consumer makes while searching for information online. In investigating the judgement of information involved in an interaction by a user, Rieh (2002) presented a model to describe how users perceive the quality and cognitive authority in online information; see Figure 2.8.

In reflecting on her findings, Rieh commented that relevance criteria may be used to explore and assess the users’ perception of information; as in Study Two of this thesis. The terms used within Figure 2.3 are defined within an earlier work by Rieh and Belkin (2000). It is important to note that terms within such frameworks are not necessarily consistent, where information may be judged by a user to be (for example) accurate, but not useful (Hilligoss and Rieh, 2008).
Table 2.11 – Definition Of The Holistic User Perceptions (Rieh and Belkin, 2000)

<table>
<thead>
<tr>
<th>Facets</th>
<th>Values</th>
<th>Description (keywords)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Information Quality</strong></td>
<td>Good</td>
<td>Good job, bad, better, excellent, fine, nice, great, best, perfect, wonderful, incredible, cool, the state of art, well-kept site, well developed site</td>
</tr>
<tr>
<td></td>
<td>Accurate</td>
<td>Accurate, correct, right, precise</td>
</tr>
<tr>
<td></td>
<td>Current</td>
<td>Current, recent, up-to-date, out-of-date, old, timely</td>
</tr>
<tr>
<td></td>
<td>Useful</td>
<td>Useful, useless, hard to use, informative, helpful, doesn’t help, can’t understand, it’s not going to be of much use, didn’t make good use</td>
</tr>
<tr>
<td></td>
<td>Important</td>
<td>Important (being of importance to the user)</td>
</tr>
<tr>
<td><strong>Cognitive Authority</strong></td>
<td>Trustworthy</td>
<td>I trust it, trustworthy, believe in, confidence that this is true, seems real, faith in the quality</td>
</tr>
<tr>
<td></td>
<td>Credible</td>
<td>Credible</td>
</tr>
<tr>
<td></td>
<td>Reliable</td>
<td>Reliable, reliably done</td>
</tr>
<tr>
<td></td>
<td>Scholarly</td>
<td>Scholarly, serious, academic, professional, biological, superficial, deep thing</td>
</tr>
<tr>
<td></td>
<td>Official</td>
<td>Official</td>
</tr>
<tr>
<td></td>
<td>Authoritative</td>
<td>Authoritative</td>
</tr>
</tbody>
</table>

This framework has also been used in a similar and recent study by Idris et al. (2011a), giving additional demonstrated credibility to its appropriateness. Consequently, the dimensions of information judgement as highlighted above make up the dependant variables of this study.

2.5.3 Contribution to thesis

This section has highlighted how information, is a product of the user’s relation to the data and its use. Consequently, while data may be considered a constant entity, information as an experiential construct is unique to both the user and the information use. The most significant contribution this section has made is the presentation of various models with which to investigate and understand the user perceptions and judgements for volunteered and professional geographic information. Through this thesis, these various models are used to develop a theoretical framework to represent the reactions users have towards the various forms of information presented. These reactions form the bedrock of the
outcomes of this thesis and allow for the development of models relating to VGI inclusion within products for use by mashup designers.

2.6 Conclusions

The aim of the literature review was to explore the contributions of multiple disciplines relative to the fields of human factors, user behaviour, geography and information relative to the use of Volunteered Geographic Information. One of the key themes which emerged from this review was that the fields of VGI and Neogeography are (at the time of writing) in their infancy, and we are yet to fully understand or perceive their benefits.

Considering the content of this literature review, the two categories may be formed from the chapters, those relating to describing the domain relating to geographic information and neogeography, and those relating to the user perspectives on information. While further discussion is given in Chapter Four, it is important to highlight that while neogeography may exist without VGI by utilising PGI, VGI can only exist as a data source within neogeography. Consequently, to understand and make sense of the information and human factors perspectives within this thesis, they must be seen through the combined lens of VGI within neogeography.

Through this thesis (research chapters 5-8), the sections of this review relating to the investigations are highlighted and expanded upon relative to the focus of the chapter. However, based on the literature review in this thesis, the following are the main messages relating to the human factors perceptions of volunteered geographic information:

2.6.1 Geographic perspectives

- Geographical Information Systems (GIS) aim to use technology to describe and predict the conditions of the world around us.

- While the tools of GIS may be recent developments, the theories and practices which underpin their use are firmly established in the field of geography.
- Understanding of the spatial environment is prevalent through society in relation to solving problems.

- User’s visualise geographic information in terms of small scale and large scale viewpoints relative to what the information relates to, an important issue for the design of GIS based products.

- VGI has the potential to fill and overcome the shortcomings of PGI and the need for increasingly specialised maps to solve user needs.

- All GI has a degree of inbuilt tolerance of *inaccuracy* which can only be considered in relation to its use.

- VGI offers degrees to legal and technical freedom which PGI does not, offering different advantages to the user in terms of perception, judgement and interaction.

- Web 2.0 is a concept of collaboration and openness brought about through the use of technology rather than a hard and fast set of technologies which would inevitably be superseded in time.

- Neogeography is the use of Web 2.0 tools to enable greater social focus and unique user utilisation of existing GIS information and techniques.

- Mashups combine various forms of GIS to produce interactive map products which would not otherwise be commercially available, allowing explicit fulfilment of a single user’s needs.

- User generated content may take the form of both *voluntary* and *involuntary* provision of data from the user base

- VGI is the creation of geographic information by potentially unqualified volunteers and refers only to the data set produced.

- VGI may contain mixed accuracies, which may be filtered to produce a highly accurate data set relative to the needs of the user.
VGI may be used as an integral part of a neogeographic mashup, where if different data layers are turned on and off, the data itself may be customised and reshaped to fit the need of the user.

2.6.2 Information perspectives

- Information is an expression of knowledge relative to use, consisting to various degrees of the elements of uncertainty, knowledge, ambiguity, indeterminacy, redundancy and system dependency.

- The impact information has on a user may be measured in terms of the benefits gained from using the information against the state possible without the information.

- The value of information is a personal construct relative to the user, the potential benefit of the information and the use of the information.

- The cost of information is an expression of what must be sacrificed in order to obtain and utilise the said information.

- The degree to which a cost is acceptable is highly dependent on the user, the perceived value and the use of the information.

- Quality is the factor that may describe the objective aspects of an item, while quality control is the factor that aims or shapes the objective aspects of the product that are accessible by the user.

- Quality may be drawn from singular factors, or from user assessments of the item relative to use and expectations.

- Quality should be considered through various subcategories including functionality, reliability, usability, efficiency, maintainability and portability.

- Accuracy within VGI systems is directly proportional to the number of contributors who work on the piece of information.

- Trust is a personal expression of the belief a user has in information that it will fulfil their expectations and requirements in the future.
• The trust a user has in information allows for the management of risk and critical use of information, which may be perceived differently for VGI and PGI sources.

• The judgements made by a user on a set of information may be described in terms of relevance, in other words the user’s perceptions of accessibility, accuracy, availability, clarity, depth, quality, tangibility and verification.

• The aspects of information as presented above are subject to the timeliness of information, being the rate at which the thing being described changes.

• Users conduct information searches when their own internal information is not sufficient for their needs, and thus external information is required.

• Information searches and acceptance of information is governed by the perceived relevance, importance and cost of that information.

2.6.3 Human factors perspectives

• Professionals are persons who possess enough knowledge and experience to engage with GI for their livelihood, amateurs pursue the use of GI on a recreational basis.

• Both Professionals and Amateurs may be volunteers, although most volunteers are amateurs.

• The boundary between the professional and the amateur are blurring through continual improvement of more sophisticated technologies of higher usability and lower cost.

• A user is one who makes use of an artefact while a stakeholder is one who has an active interest in the success of that same artefact.

• Stakeholders may be considered as consumers, special interest groups, local communities and professionals.
• *Technology* is the application of knowledge for practical purposes, which may be utilised with a product or service in the form of an *innovation*.

• The factors which help technologies diffuse through society are a useful indicator to the success of an innovation utilising those technologies.

Social networks form a key role in developing VGI systems, therefore providing a strong and powerful communication channel for the *diffusion of innovation* naturally within the VGI framework.
3 A Framework of Neogeography

### Research Questions Addressed In This Chapter

1. What is VGI and how is it distinct from PGI?

2. What is the human centred nature of VGI in terms of its generation, production and utilisation by the end users?

3. What influences the way users judge VGI in terms of its relevance to their needs, and how does VGI compare to PGI?

4. What recommendations can be made for combining PGI and VGI for the production of highly usable neogeographic products?

3.1 Introduction

Within the current literature, confusion exists as to the terminology used for the various technologies, innovations and phenomenon associated with VGI. This is best highlighted by Elwood (2008a) in that “these developments [in geotagging data] have been referred to with a plethora of terms, including neogeography... web mapping ... volunteered geographic information... ubiquitous cartography... and wiki-mapping”. This extensive list is added to by Crampton (2008) with Spatial Media, Locative Media, Spatial Crowdsourcing, Geocollaboration and Map Hacking. Suggesting an explanation for this, Tulloch (2008) suggests that initial islands of research producing unique or proprietary vocabulary may introduce buzzwords which suit their cause, yet die out over time. As Crampton (2008) commented, the [neogeographic] situation has from its birth been both increasingly important and interestingly messy, with its confusing terminology being linked with the emergence of the Web 2.0 and Neogeographic phenomenon itself (Das and Kraak, 2011).

The confusion highlighted by Elwood (2008a) and Crampton (2008) is further underlined in how neither goes on to distinguish between these various definitions. Neither do they present a distinction between the types of data type or technique being described. The lack of agreement on terms by these and other authors (Coote and Rackham, 2008, Haklay et al., 2008, Shin, 2009) highlights the lack of consensus in terminology, leading to multiple authors
using various different phrases to describe the same thing. In order to avoid such detrimental mistakes within the thesis, the following must be achieved:

- Set out the *true* definitions of the terms related to neogeography, providing a consensus for this thesis and hopefully further work.

- Discuss the way in which the different elements of neogeography interact with one another, providing a framework on which the information types in this thesis shall be based.

- Develop a framework of neogeography so neogeographic projects may be effectively compared and contrasted through this thesis.

Aside from providing clarity within this thesis, the development of such a framework may be of benefit to the wider research community. However, the beneficiary of such work is not intended to be the consumer of data, but instead the professional. This is a person who needs to fully understand the field of neogeography in order to research phenomenon, develop applications or relate different factors within a neogeographic framework without confusion or misunderstanding.

### 3.2 Background Literature

#### 3.2.1 The nature of neogeography

Often in the literature, the terms *Neogeography*, *Mashup* and *VGI* are substituted for other terms such as Public Participatory GIS (Aberley and Sieber, 2010) or Geoweb (Haklay et al., 2008). This is often without full justification for the change, and without full and proper definitions. Although adding to the general confusion of what is VGI, this helps to suggest that the different names given to VGI and Neogeography need to be addressed and fully defined, allowing their appropriate use through common understanding.

One example includes the comments by Hawani Idris et al. (2011b) who claimed “*neogeography relies on user generated content that is locationally tagged*”. Although Hawani Idris et al. were correct on the reliance of locational data within neogeography, their statement that user generated content (VGI) is a necessary component to Neogeography was incorrect.
While the term *neogeography* has been used in various forms from at least 1944 (Miller and Miller, 1944), it was Turner (2006) who cemented the term in the form it is used and understood within this thesis:

*Neogeography means “new geography” and consists of a set of techniques and tools that fall outside the realm of traditional GIS, Geographic Information Systems. Where historically a professional cartographer might use ArcGIS, talk of Mercator versus Mollweide projections, and resolve land area disputes, a neogeographer uses a mapping API like Google Maps, talks about GPX versus KML, and geotags his photos to make a map of his summer vacation.*

According to the above description, neogeographic systems may exist and function in the fullest sense while relying only on professional information sources; see Figure 3.1. However, the need to present the disconnection between neogeography, VGI and PGI denote a degree of further explanation is required in order to fully define the terminology relevant to this thesis.

To understand neogeography this chapter deals with the various elements of the phenomenon, with each taxonomy list relating to one particular element of the phenomenon. For simplicity, these elements are referred to as:

- **Data Generation Aspect** - People, either volunteers or professionals creating raw data; VGI or PGI.

- **Neogeographic Aspect** - Combining geo-data with a form of map to produce a mashup.

- **User Aspect** - Referring to any group or individual who takes the product of the neogeographic element and utilises it in some way.

The interaction between these three elements is highlighted in Figure 3.1 below.
Importantly, Figure 3.1 highlights how neogeography is the process of combining geo-data with maps to create mashups, whereas VGI and PGI are simply the creation of one form of data.

It is important to mark the distinctions between VGI and PGI. VGI is essentially geographic information created by largely untrained amateur volunteers (Haklay and Weber, 2008). In defining VGI, Goodchild (2007a) opened up the scope of geographic objects that could be described through volunteered means to be “not confined to traditional geographic identifiers such as trees and streets but to any data where a geospatial element is present”. However, it does not exclude professionals or organisations from contributing. This has resulted in projects where the quality in terms of positional accuracy and data richness of VGI projects may outreach that of similar PGI projects (Haklay, 2010b). However, while a professionally trained person may contribute to a VGI project, it would be predominantly as a hobby using the same tools as the amateur volunteer, and without any privileges or advantage.

Further to the naming of the information based on the professionalism of the author is the issue of how the geographic objects are being described in a more general sense. In the context of consumer products, Zeithaml (1988) regarded
the elements of \textit{price}, \textit{quality} and \textit{value} as important descriptors for the ways different people interact with information. However, according to Zeithaml (1988) and Sheridan (1995), the perspectives of \textit{quality} and \textit{value} are relative to both application and use. This suggests that utilising user perceptions of information may not necessarily be the best way to categorise projects within the framework. This is because a user may perceive two very different mashups (containing different data and use characteristics) as being equal in utility, efficiency and satisfaction. Additionally, price is not necessarily a good descriptor either, due to the non-traditional business model usually applied to neogeographic products. This is providing core services and information for free, with additional revenue streams found in add-ons and advertising (Tapscott and Williams, 2008).

To take a more user centred design perspective, mashups and neogeography are tools utilised by users to achieve their goals and to create products specific to their personal requirements. Das and Kraak (2011) gave the example that a user can create a map \textit{showing} all local fitness centres; presenting collected data. Alternatively, a user may use the same map to \textit{explore} local fitness centres. This creates two distinct design opportunities since although the data required by both user groups is the same, their use and relationship with the data are different.

\subsection*{3.2.2 Issues with current taxonomies}

From a GIS perspective, Grimshaw (1992, 1996) highlighted how previous taxonomies had oversimplified the viewpoints of the GIS discipline and assumed a static technological infrastructure, rather than one that changes over time. Consequently, Grimshaw produced a more complex and overarching framework consisting of Management Strategy, Technology and Decision; see Figure 3.2 below.
Bai et al. (2009) noted that the framework of Grimshaw (1996) is rooted in the key concepts of information systems, yet departs from the concrete functionalities, specific communication protocol definitions and expected usage scenarios within geospatial sciences. This has in turn prevented it from being properly utilised. However, the largely dynamic, unstructured and anarchic nature of neogeography (Raj Budhathoki et al., 2008) suggests that the production of a framework along a similar approach may prove more useful than when applied to the more rigid platforms in GIS. Additionally, while a justification for using the framework of Grimshaw (1996) may be possible, the dimensions do not sit comfortably within the neogeographic literature. Therefore a more appropriate and accessible framework is required to fulfil the need for a relevant classification system for neogeographic projects.

Coleman et al. (2009) produced a series of models relating specifically to VGI, characterising, amongst other things, the spectrum of contributors, characteristics of use, motivations to contribute and the institutional requirements. Whilst interesting and insightful, their disjointed nature (i.e. the lack of connection and integration between the models) makes them difficult to
use in an overarching framework. A more recent attempt at classifying VGI within a taxonomy was provided by Cooper et al. (2011), who identified dimensions of VGI and Neogeography as being:

- The continuum of responsibility for determining the specification of the data
- The classification of data from base (e.g. streets networks) to Points of Interest (POIs)

Figure 3.3 (below) presents the framework for categorisation of VGI.

A weakness of the framework – in line with the guidelines of Wille (1982) - is that the presentation of the framework is largely inaccessible due to its reliance on unconventional terminology (e.g. custodian and POI not commonly used in neogeographic literature) and its basis on informality. This is a theoretical perspective at odds with the lack of universal standards of procedures across the spectrum of neogeography, constantly changing to fit the desire or needs of the producers. Additionally Cooper et al. (2011) combined both neogeographic project with GIS phenomenon (e.g. tracks4africa and PPGIS), which while
interesting from a taxonomy perspective are two incompatible concepts within a single framework.

3.3 A Framework of Neogeography

3.3.1 A terminology of neogeography

The provision of a terminology is necessary in order to overcome the potential confusion amongst neogeographic creators and those wishing to discuss neogeographic phenomenon. Although a detailed overview of definitions relative to this thesis is provided in the glossary at the start of this volume, it is necessary to highlight the key terms this taxonomy related to; see Table 3.1 below.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographic Information Systems (GIS)</td>
<td>Medyckyj-Scott and Hearnshaw (1993) described GIS as “tools that capture, store, manage, manipulate, analyse, model and display information with respect to geographical space”.</td>
</tr>
<tr>
<td>Base Map</td>
<td>A raster map used within a mashup on which information is layered (Das and Kraak, 2011).</td>
</tr>
<tr>
<td>Neogeography</td>
<td>Turner (2006) defined neogeography as “people using and creating their own maps, on their own terms and by combining elements of an existing toolset”. In a broader research application context, Das and Kraak (2011) described this as “the domain where users make use of geographic information (GI) using Web 2.0 applications”.</td>
</tr>
<tr>
<td>Professional Geographic Information (PGI)</td>
<td>While not a phrase in common use throughout the current literature, the term Professional Geographic Information (PGI) has been utilised within this thesis to make reference to geographic information not originating from volunteers; in contrast to VGI. This may be defined as structured geographic information produced by trained personnel (Fonseca and Sheth, 2002), or those of able to provide detailed geographic information that can be verified and integrated at the national level (Goodchild, 2007b).</td>
</tr>
<tr>
<td>Volunteered Geographic Information (VGI)</td>
<td>Goodchild (2007a) referred to this phenomenon as “geographic information created by largely untrained volunteers”, which is “potentially unstructured” (Fonseca and Sheth, 2002).</td>
</tr>
</tbody>
</table>

In the advent of neogeography, Al Bakri and Fairbairn (2011) presented a series of new and previously unmet challenges to the world of geo-information, focusing on accuracy, data integration, quality, region of geographic description, and information attributes. This list may be added to by considering
more traditional metrics of GI; quality (Devillers et al., 2010), accountability (Coleman et al., 2009) and data standards (Brando et al., 2011).

While a full consideration of how these (and more) attributes is presented within the literature review, and developed through the research chapters, a brief consideration of the most prominent dimensions which distinguish between these two information forms is useful. This is particularly true since while GIS and Neogeography describe a form of holistic process, VGI and PGI describe a different approach to data generation, yet both produce [sometimes highly complementary] Geographic Information

Although research has demonstrated VGI to be able to produce information to the same quality as PGI (Haklay et al., 2009, Haklay, 2010a), the optimal word here is ‘able’. That being, simply because one project (e.g. OpenStreetMap) is able to produce maps as good as OS Meridian, does not mean that all are (e.g. ThePeoplesMap). While looking further into the reason for this high accuracy coming from amateur volunteers, Haklay (2010) demonstrated that at least five edits from proficient persons is required to converge on a truth of high enough quality. Therefore, we may consider the degree of standardisation in how data are produced as a mechanism for achieving high quality products. While PGI sources have a long and established history of standardisation of practices (Crone, 1968), VGI may be considered anarchic (Raj Budhathoki et al., 2008). As Brando (2011) demonstrated, the way in which VGI is produced, categorised and retrieved may be standardised within a project to an efficient and effective level, there is no guarantee of such implementation. Further too this, the very concept of standardisation of VGI is alien to the anarchic mechanism of producers doing as they will to produce the products they desire in the way they see fit. A concern of professionals which is prevalent within the scoping study of this thesis is the concern for accountability and trust as derived from VGI. Due to the high degree of quality control within PGI (Goodchild, 2000), this information form has been the bedrock of personal through to governmental actions since the creation of GI, notably in police, fire, rescue and military situations (etc.). Due to the lack of standardisation with VGI (Cooper et al., 2011, Zook et al., 2010) such equal implementation has been hampered and continues to be the alternative to PGI only when PGI is not fully available.
However, quality control metrics have been, and are included within crowd-sourced projects. Examples for this range from the peer review and peer pressure of Wikipedia, through to automatic quality control filters of Tracks4Africa where contributed data must reach a minimum degree of logical consistency before it is accepted into the main data set (Cooper et al., 2011).

3.3.2 A framework for neogeography

The background literature highlighted the need for a clear classification system that may be used to categorise and distinguish between different Neogeographic products. In particular, such a framework would be of great benefit if it allowed the viewer to assess the compatibility of alternative products to fit their needs. These needs can be taken as a combination of the information’s appropriateness and assurance of integrity.

The most fundamental aspect of a framework is the dimensions by which the subject matter is categorised. Within the general sense of geographic information, Coote and Rackham (2008) highlighted the four dimensions of completeness, consistency, quality control and quality assurance as key areas of concern within neogeography. While each of those points is valid, the one that stands out as most revenant to this section is quality control. This is for a variety of reasons; most notably (as highlighted above in the terminology of neogeography) that the amount of quality control put in place is of high concern to a variety of users. Additionally, Goodchild (2008a) highlighted this as one of the greatest challenges facing VGI, and Zeithaml (1988) and Sheridan (1995) placing quality as relative to both application and use. Furthermore, the conditions of completeness, consistency and quality assurance can either be considered as temporary states (i.e. the data set may become more complete over time), or can be addressed through proper quality control.

Alexander and Tate (1998) cited authority, accuracy, objectivity, currency and coverage as the key factors in assessing the appropriateness of an information source to a user’s information search requirements. Out of these, objectivity was selected as the most appropriate second dimension of the framework. Within a general research context, both Boudreau et al. (2001) and Janesick (2000) considered objectivity to be one of the most crucial to the ratification of
information. The remaining dimensions of appropriateness were not selected since it was not felt that their position was well enough supported in relation to VGI and its current understanding in the literature.

It should be noted that (as highlighted in the literature) these are not the only dimensions in which neogeography could be categorised. Instead, they are the most appropriate for describing the general development and use of neogeography.

It is clear that the wide variety of terminology that has been generated to describe the various functions of information use reflects the need to relate these two factors to the application of information. Because the evaluative judgement made by the user on information is comprised of opinions, attitudes and beliefs (Albaum, 1997, Mizumoto and Takeuchi, 2009) a need exists to quantify projects in an objective form. According to Preece et al. (2011), usually the most appropriate method of investigating the participant’s response to information presented in a study is through subjective rating using Rating Scales. Table 3.2 and Table 3.3 propose two Rating scales for quantifying both quality control measures and the level of objectivity.

Table 3.2 – Rating Scale for Assessing Quality Control

<table>
<thead>
<tr>
<th>Level of Quality Control</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 None</td>
<td>All data entries are accepted into the data base without any control over any attributes, data cannot be edited or removed by anyone but the author</td>
</tr>
<tr>
<td>2 Very Low</td>
<td>All data entries are accepted into the data base without any control over any attributes, data can be edited or removed by anyone</td>
</tr>
<tr>
<td>3 Low</td>
<td>Data may be accepted into the data base providing the minimum meta data requirements are met, data can be edited or removed by anyone</td>
</tr>
<tr>
<td>4 Intermediate</td>
<td>Data may be accepted into the data base providing the minimum meta data requirements are met, checked before being added to the system, data can be edited or removed by anyone</td>
</tr>
<tr>
<td>5 Absolute</td>
<td>All aspects of data entering the system must strictly comply to a pre-specified standards, data checked before being added to the system, edited and/or removed by any other person in the system with authority.</td>
</tr>
</tbody>
</table>
Table 3.3 – Rating Scale for Assessing Objectivity

<table>
<thead>
<tr>
<th>Level of Objectivity</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Totally Subjective</td>
<td>No way of verifying any of the data through quantitative measurements, can only come from users forming their own opinions.</td>
</tr>
<tr>
<td>2  Mostly Subjective</td>
<td>Most data has to come from users forming their own opinions, although a degree of quantitative measurement is required.</td>
</tr>
<tr>
<td>3  Equally Subjective and Objective</td>
<td>All data can be achieved through either qualitative measurement, or through users forming their own opinions.</td>
</tr>
<tr>
<td>4  Somewhat Objective</td>
<td>Most data has to come from quantitative measuring methods, although some data should come from users forming their own opinions.</td>
</tr>
<tr>
<td>5  Totally Objective</td>
<td>All of the data can only be achieved through quantitative measurements</td>
</tr>
</tbody>
</table>

Building on the Rating Scales of Table 3.2 and Table 3.3 and evolving the approach of Cooper et al. (2011), Figure 3.4 (below) presents a framework for how to consider and categorise neogeographic products. Within this framework, neogeographic products were assessed by the author on the criteria set out above.
It should be noted at this point that the position of the projects within the framework are categorised according to the opinions of the researcher rather than through objective research and analysis. In addition, PGI projects (Ordnance Survey and Google Maps) have been included to provide a degree of reference within the framework.

3.4 Discussion

The purpose of presenting this framework through a scatter graph is to allow a simple way to visualise how similar or dissimilar various projects may be, as judged by the objectivity and quality elements. For example, within Figure 3.4 the close proximity of Ordnance Survey, OpenStreetMap and Google Maps suggests that while their focus may be different, they may be considered alongside each other and be categorised together; even though they are VGI and PGI projects. However, OpenStreetMap is a very distant from Wikimapia, since OpenStreetMap is a project producing an objective map of features (e.g. roads, buildings, post boxes, etc.) while Wikimapia produces a subjective layer of descriptions on top of an existing map (e.g. ‘the pub in this part of the map is
Chapter 3: A Framework of Neogeography

The Red Lion…. here is why I think it is very good’). This means these two ventures should be categorised as different forms of neogeographic products; despite both products being VGI based.

An interesting outcome from Figure 3.4 is how when the various projects are considered against the categorisation of Table 3.2 and Table 3.3, there appears to be a correlation between objectivity and quality control. Although the causal link between objectivity and quality control has been disputed (Stiles, 1993), it does provide an interesting insight. If a neogeographic project seeks to capture rich user experiences about locations (e.g. the best spot on an island to watch the sun go down) then the framework suggests that low-level quality control is suitable for capturing such objective information. Similarly, to produce a mashup that describes geo-located information in a highly reliable fashion, information about locations (e.g. positions of post boxes), then a high degree of quality control is appropriate.

As highlighted previously, prior to this framework there did not exist a simple, effective and easily understood framework by which to consider different neogeographic and GIS products. Potential uses of such a framework could be considered as follows:

**Selection of a product for use** - This framework could be used to assess the degree to which new neogeographic products should be thought of in terms of their accountability and ability to provide meaningful, descriptive information to the user. This is particularly relevant when the information is to be used in highly sensitive situations where a degree of risk is involved; e.g. information for hospital paramedics.

**Understanding neogeography in research** - From a research perspective the framework outlines how although a large collection of projects can be considered neogeography, they can be very different. Therefore, future research should not look to treat (for example) Wikimapia and Tracks4Africa as the same since they fall into different categories of neogeography. However, comparing them as two different types of products, and understanding that their nature is very different may lead to a deeper and more useful investigation into how neogeography is used in
society. Utilising the framework in this way would help to reduce the confusion in how neogeography is discussed in the literature.

A framework for quality control – As proposed by Bishr and Mantelas (2008), VGI data sets could be filtered to remove instances of VGI which do not meet a pre-specified quality control metric. The categories of the framework could be employed as such a metric to automatically assess the suitability of individual VGI contributions. For example, to produce a VGI contribution framework that would allow the end product to occupy the same space within the framework as OS OpenSpace, data would have to comply to a strict metadata structure, and be verified by others before it is published. This would allow mashups of (to a degree) certified accountability to be developed from sources which in their complete state offer a wide variation in quality which make them unsuitable.

Development of new products – One of the most important aspects of any innovative new product or service is its unique attributes and ability to satisfy a currently unmet user need. By considering current neogeographic products alongside this framework the niches yet to be exploited may understood, making this framework a useful tool for designers.

3.5 Conclusion

One challenge faced when organizing a framework is that it is too easy to get complex and rigid within its framework, not reflecting their use (Bai et al., 2009, Vinson, 2007). This chapter has helped address the research question of what is VGI and how does it differ from PGI by producing a detailed terminology and a working framework based on two of the key variables in the field of neogeography; quality control and objectivity of the information. These two factors have been shown to be of high importance in distinguishing between neogeographic products during the literature review. Additionally utilising the framework allows for a useful way to discuss the differences and similarities between projects. As well as addressing the research aims, research within this thesis will aim to produce sufficient evidence to critically consider the dimensions that constitute this framework for their appropriateness and relevance to the user.
The framework has been used as a framework for thinking about the different neogeographic products mentioned by participants during Studies One – Four, but not used for in-depth inference. Additionally, the framework and received further revision and discussion in Chapter 9: Overview and Synthesis. However, it is important to note that the framework is conceptual, and requires further development and theoretical ratification outside the scope of this thesis.
4 Research Methods

4.1 Introduction

Robson (2002) proposed that in designing a research project five elements are essential as a framework. Firstly, the Purpose of project (what is the study trying to achieve) and the Theoretical perspectives (what theory shall guide or inform the study) relating to the phenomenon under investigation influence the Research Questions (which dictate what questions the research is geared towards providing answers). In turn the Research Questions influence the Methods (what specific techniques will be used to collect data) and the Sampling Strategy (from whom will you seek data); see Figure 4.1.

![Figure 4.1 - Framework For Research Design (Robson, 2002)](image)

While this could generally be seen as a simplified model of how research is conducted, the framework of Robson is useful in highlighting how the research methods are not an element in isolation from the research process. Instead they are an integral part of the overall research domain, requiring careful consideration to use the right methods for the right reason.

The purpose of this chapter is to highlight the different approaches to investigation and sampling of participants in order to identify the previously highlighted Research Questions. Rather than aim to provide an overview of all research methods, this chapter aims to provide discussion of those methods applicable to the investigation of Volunteered Geographic Information from a
user centred design perspective. By this, all research methods applied through this thesis were selected on the basis of understanding the purpose of the information to serve the user and their needs (Norman, 1986).

### 4.2 The Research Arena

Rather than being a collection of clear-cut practices, research is an evolving process to which perspectives and methods are selected, developed and evolved to suit the requirements of the research task consisting of several overlapping functions. While Figure 4.1 (above) presented a connection between the different theoretical and methodological sections of the research process, Saunders et al. (2009) provided an outline of the research processes in terms of their influence over the developed protocol; see Figure 4.2 below.

![Figure 4.2 - The Research Process ‘Onion’ (Saunders et al., 2009)](image)

Saunders et al. (2009) commented that the research philosophy chosen contains important assumptions about the way in which the researcher views the world. What makes the process onion of Figure 4.2 such an attractive presentation is not necessarily the fact that it presents a series of processes in logical order, but that it presents the relationship between philosophy and common practice in scientific research. Moreover, by understanding the influences on the methods (Figure 4.1), the process onion of Figure 4.2 is a useful tool in interpreting those influences into effective and appropriate
research proposals. The importance of this is highlighted by Johnson and Clark (2006), who argue that the important issue is not so much whether research should be philosophically informed, but it is how well a researcher is able to reflect upon their philosophical choices and defend them in relation to the alternatives.

4.2.1 Philosophies

4.2.1.1 Positivism Vs. Interpretivism

Bailey (2007) commented that the procedures for conducting field research are complicated because they depend on the paradigm employed by the researcher. This was defined by Denzin and Lincoln (2000a) as “the net that contains the researcher’s epistemological, ontological, and methodological premises... the basic set of beliefs that guide actions”. Although many sets of beliefs exist, the two key paradigms in research are positivist and Interpretivist. Saunders et al. (2009) described the difference between these two key research philosophies: “the ‘resources’ researcher is embracing what is called the positivist position to the development of knowledge whereas the ‘feelings’ researcher is adopting the interpretivist perspective”.

Gill and Johnson (2002) explained the positivist approach as “the construction of covering-laws that explain past and predict future observations, through casual analysis and hypothesis testing”; or variation in A causes variation in B. Although the positivist paradigm is still in much use to date (Pinto, 2010), it has come under scrutiny for its currency and relevance in contemporary science; particularly Social Sciences. Byrne (1998) famously commented: “positivism is dead. By now it has gone off and is beginning to smell”. Gill and Johnson (2002) commented that one of the weaknesses is that while it is adequate for the subject matter of natural sciences (e.g. chemistry, physics, etc.), it is not adequate for the social sciences. This is due to the differences in the subject matter of the social sciences and the natural sciences being governed by different laws; e.g. Newton’s Laws of Motion do not apply in Social Science.

Interpretivism holds that social reality is not independent of the social meaning given to it by those in the setting (Bailey, 2007). Klein and Myers (1999)
described interpretivist research as being the assumption that knowledge of reality is “gained only through social constructions such as language, consciousness, shared meanings, documents, tools and other artefacts”.

Contrary to positivism, interpretivism assumes that to one situation there are multiple realities perceived by a subjective researcher within a natural world (Denzin and Lincoln, 2000a). As Klein and Myers (1999) underlined, “interpretive research... has the potential to produce deep insights into information systems phenomena”.

### 4.2.2 Approaches

This section represents the theoretical perspectives which connect the Research Philosophies to the appropriate Research Strategies; methods for collecting and analysing empirical materials (Denzin and Lincoln, 2000b).

#### 4.2.2.1 Inductive Vs. Deductive

Gill and Johnson (2002) described deductive research methods as entailing “the development of a conceptual and theoretical structure prior to its testing through empirical observation... It begins with abstract conceptualisation and then moves on to testing through the application of theory so as to create new experiences or observations”. The alternative perspective is inductive, which Gill and Johnson (2002) noted consists of the logical ordering being the reverse of the deductive process. The key differences between these two opposing approaches are highlighted within Table 4.1 below.
Table 4.1 - Major Differences Between Deductive And Inductive Approaches To Research (Saunders et al., 2009)

<table>
<thead>
<tr>
<th>Induction emphasis</th>
<th>Deduction Emphasis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gaining an understanding of the meanings humans attach to events</td>
<td>Scientific principles</td>
</tr>
<tr>
<td>A close understanding of the research context</td>
<td>Moving from theory to data</td>
</tr>
<tr>
<td>The collection of qualitative data</td>
<td>The need to explain casual relationships between variables</td>
</tr>
<tr>
<td>A more flexible structure to permit changes of research emphasis as the research progress</td>
<td>The collection of quantitative data</td>
</tr>
<tr>
<td>A realisation that the researcher is part of the research process</td>
<td>The application of controls to ensure validity of data</td>
</tr>
<tr>
<td>Less concern with the need to generalise</td>
<td>The operationalization of concepts to ensure clarity of definition</td>
</tr>
<tr>
<td></td>
<td>A highly structured approach</td>
</tr>
<tr>
<td></td>
<td>Researcher independence of what is being researched</td>
</tr>
<tr>
<td></td>
<td>The necessity to select samples of sufficient size in order to generalise conclusions</td>
</tr>
</tbody>
</table>

What Saunders et al. (2009) achieves with these comparisons is demonstrating that although the two approaches may operate within similar arenas (e.g. data collection), they may be opposites in how they relate to the data and the concept of truth (e.g. qualitative vs. quantitative).

4.2.2.2 Confirmatory Vs. Exploratory

While there are many philosophies on the nature and position of research, two key type of research exist in the nature of confirmatory or exploratory research. Boudreau et al. (2001) made the distinction as “confirmatory studies are those seeking to test (confirm) a prespecified relationship. Exploratory studies are those which define possible relationships in only the most general form and then allow multivariate techniques to estimate relationships”.

4.2.3 Strategies

A research strategy may be considered the method by which research is conducted. However, a more elegant definition can be found in Denzin and
Lincoln (2000b) who defined the *research strategy* as a device to “locate researchers and paradigms in specific empirical, material sites and in specific methodological practices”. As presented in Figure 4.2, the choice of research strategy is influenced greatly by both the *Research Philosophy* and *Research Approaches*.

Boudreau et al. (2001) proposed the use of four key research strategies from an information Science perspective; *Laboratory Experiments, Field Experiments, Field Studies* and *Case Studies*. To help produce a more complete overview relevant to the objectives of this thesis *Grounded Theory, Ethnographic* and *Action Research* (Saunders et al., 2009) have been added to the list. These strategies are generalised within Table 4.2.

<table>
<thead>
<tr>
<th>Research Approach</th>
<th>Research Strategy</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Deductive</em></td>
<td><em>Experimental</em></td>
<td>The central feature is that the researcher actively and deliberately introduces some form of change in the situation, circumstances or experience of participants with a view to producing a resultant change in their behaviour.</td>
</tr>
<tr>
<td></td>
<td><em>Field Studies</em></td>
<td>The overall approach is the same as in the experimental strategy but the researcher does not attempt to change the situation, circumstance or experience of the participants.</td>
</tr>
<tr>
<td><em>Inductive</em></td>
<td><em>Case Study</em></td>
<td>Development of detailed, intensive knowledge about a single ‘case’, or of a small number of related ‘cases’.</td>
</tr>
<tr>
<td></td>
<td><em>Ethnographic Study</em></td>
<td>Seeks to capture, interpret and explain how a group, organisation or community live, experience and make sense of their lives and their world.</td>
</tr>
<tr>
<td></td>
<td><em>Grounded Theory</em></td>
<td>The central aim is to generate theory from data collected during the study.</td>
</tr>
</tbody>
</table>

While this chapter does not permit the explanation of each research strategy in full, the following sections present a general overview, influenced by the work within Table 4.2.
4.2.3.1 Experiment

The general approach of research by experimentation falls into two distinct categories; laboratory and field.

*Laboratory Experiments* take place in a setting especially created by the researcher for the investigation of the phenomenon (Boudreau et al., 2001). Here the researcher has control over the independent variable(s) and the random assignment of research participants to various treatment and non-specific conditions.

*Field Experiments* involve experimental manipulation of one or more variables within a naturally occurring system and subsequent measurement of the impact (Boudreau et al., 2001).

One of the key characteristics of the experimental approach is the manipulation of participants in order to test specific variables. Bagozzi (1977) commented that *manipulation checks* measure the extent to which treatments have been perceived by the subject. Boudreau et al. (2001) stressed the importance that during experiments participants must be aware of certain aspects of their manipulation; but not others. The purpose of this is ensuring participants are manipulated as intended by the experiment so the validity of results may be empirically determined. It should be noted that one of the greatest drawbacks of experimentation outside a naturalistic environment (field or laboratory) could be classified as the Hawthorne Effect (Roethlisberger et al., 1939). Here participants react to being observed rather than the intended variables of the experiment in a naturalistic manner.

4.2.3.2 Field Studies

Field studies are non-experimental inquiries occurring in natural systems, typically utilising questionnaires, coded interviews or systematic observation as data gathering techniques (Boudreau et al., 2001). Within field studies, a certain degree of interaction exists between the researcher and the people living or working within the environment under study. The role of the individual in influencing the conditions of the field was put elegantly by Gold (1969):
Chapter 4: Research Methods

Every field work role is at once a social interaction device for securing information for scientific purposes and a set of behaviours in which an observer’s self is involved.

The question therefore does not lie with is the researcher involved in the field, but how is the researcher involved in the field? Figure 4.3 was developed from the work of Gold (1969) and Bailey (2007), describing the four stages of involvement a researcher in the field may work within. These states range from anonymous engagement with the informants in the study (complete participant) through to simple observation (complete observer).

**Figure 4.3 - Potential States of Observation** (Bailey, 2007, Gold, 1969, Junker, 1960)

Bailey (2007) states that each designation indicates the role a researcher might occupy at any point in their research, which may change through a project or study depending on their objective or circumstance. Here, a researcher may not necessarily choose to be a Complete Observer or Observer-as-Participant, but rather inhabit a point somewhere on the matrix of Figure 4.3 which best describes a position of mixed participation.

Gold (1969) held that the position of the researcher in the field impacts greatly on the methodology taken in the field study, and the kind of results which may be achieved. Additionally Bailey (2007) commented that for many researchers...
the degree of engagement is often highly variable, and the mere act of observing can function as a form of interaction because of its potential for reactivity.

4.2.3.3 Case Studies

A case study is the intense examination of one or a few entities by the researcher, where independent variables are neither manipulated nor confounding variable controlled (Boudreau et al., 2001). As with field studies, case studies tend to employ either questionnaires, coded interviews or systematic observations as data gathering techniques. Boudreau et al. (2001) noted that unlike field studies the foremost concern is to generate knowledge of the particular being studied, from which analytic generalisation is possible. Overall, case studies may allow for deep insights in phenomena, from which hypothesis and/or theory may be generated (Stake, 1995, Yin, 1994).

4.2.3.4 Grounded Theory

Grounded Theory is considered a separate research approach as its distinct aim is to generate a theory to explain what is central to the data; placing theory generation as the central focus of the grounded theory approach (Robson, 2002). From its formation by Glaser and Strauss (1967) Grounded Theory was based on a pragmatic approach to social science research, where empirical reality is seen as the on-going interpretation of meaning produced by individuals engaged in a common project of observation (Suddaby, 2006).

Charmaz (2000) remarked that Grounded Theory consists of systematic inductive guidelines for collecting and analysing data to build middle range theoretical frameworks to explain the collected data. In application within a research context, Grounded theory is more than simply “analysis via correlations, word counts, and pure introspection” (Suddaby, 2006), but relies on two key concepts: constant comparison where data are collected and analysed simultaneously, and theoretical sampling where decisions about which data should be collected next are determined by the theory that is being constructed (Glaser and Strauss, 1967).
Suddaby (1967) commented that grounded theory is not a universal approach, but is more suited to answering questions aimed at understanding “the process by which actors construct meaning out of inter-subjective experience” and “individual interpretation of reality”.

4.2.3.5   Ethnographic Research

Ethnography involves an on-going attempt to place specific encounters, events, and understanding into a fuller, more meaningful context (Tedlock, 2000). Tashakkori and Teddlie (2003) described ethnography as the social scientific study of a people and their culture where data are collected through different procedures such as participant observation, interviews and examination of artefacts and records.

As with Field Experiments, the researcher may take a variety of positions in relation to their interaction with the community in study; see Figure 4.3. While the position one may take is a matter of situation, qualitative research approaches tend to favour the position of the Research as Participant, while Quantitative research approaches tend to favour the position approaching the Complete Participant.

4.2.4   Choices

Teddlie and Tashakkori (2009) highlighted three general categories of common social and behavioural science research approach:

- **Quantitative** – Primarily working with post-positivist\(^\text{12}\) paradigms; principally interested in numerical data and analysis.

- **Qualitative** – Primarily working within the Interpretivist (constructivist) paradigm; principally interested in narrative data and analysis.

- **Mixed Methodologies** – Working primarily within the pragmatist paradigm and interested in both narrative and numeric data and their analysis.

\(^{12}\) **Post-Positivism**: The belief that human knowledge is based not on unchallengeable, rock-solid foundations, but rather upon human conjectures (Philips and Burbules, 2000).
These three research perspectives are further presented with relation to research in practice by Saunders et al. (2009) in Figure 4.4.

Saunders et al. (2009) described mono-methods as using qualitative data collection techniques with qualitative data analysis procedures; or quantitative with quantitative.

Robson (2002) commented that qualitative designs, consisting of many forms and theoretical positions are the most saliently advocated within the field of social sciences. However, from a scientific perspective Teddlie and Tashakkori (2009) commented that fixed designs of quantitative approaches are considered the most scientific in nature, while the scientific status of qualitative approaches is in dispute. However, Green and Britten (1998) commented that “the value of qualitative methods lies in their ability to pursue systematically the kinds of research questions that are not easily answerable by experimental methods”.

Smith and Heshusios (1986) have commented that the dispute and apparent incompatibility between the qualitative/quantitative approaches prompt a need for a new perspective; resulting in the generation of the multiple methods research choices.

Saunders et al. (2009) made the distinction between two forms of multiple methodology, multi-methods and mixed methods. Here, multi-methods refers to the combination of more than one data collection technique used with
associated analysis, but is restricted within either qualitative or quantitative approaches (Tashakkori and Teddlie, 2003, Teddlie and Tashakkori, 2003). For example, the use of qualitative focus groups and qualitative participatory observation. Further to this Hunter and Brewer (2003) defined *multi-method* research as the practice of employing different types, or styles, or data collecting methods within the same study or research program. In contrast, *mixed methods* utilises both *qualitative* and *quantitative* research methods and analysis practices, seeking to triangulate and converge on agreeing conclusions from multiple positions (Erzberger and Kelle, 2003, Teddlie and Tashakkori, 2003). For example, the use of qualitative focus groups with quantitative surveys.

Although currently a young area of research, a growing body of support has emerged in favour of a *mixed methods* approach to researching VGI and other neogeographic phenomenon (Cope and Elwood, 2009, Elwood, 2010, Goodchild, 2007a). In designing a *mixed methods* approach, a key data collection method is supported or given an extra dimension of insight with observational participant accounts. This is described by Breitmayer et al. (1993) as *triangulation*, referring to the combination and comparison of multiple data sources (Teddlie and Tashakkori, 2009). Although within the literature such an approach is considered mixed method, Morse (2003) commented that because of the interdependencies of such methods, it is preferable to consider these studies as one method; albeit a mixed method.

### 4.2.5 Time horizons

Saunders et al. (2009) posed the question “*do you want your research to be a ‘snapshot’ taken at a particular time or do you want it to be more akin to a ‘diary’ and be a representation of events over a period*”. Through this, Saunders et al. highlighted the essence of both cross-sectional and longitudinal studies.

*Cross-sectional studies* seek to describe the incidence of a phenomenon or explain how factors are related in different organisations, based on qualitative or quantitative approaches over a relatively short period of time (Erzberger and Kelle, 2003).
Longitudinal studies however are able to capture change and development, exercising a measure of control over variables being studied (Burns, 2009).

4.2.6 Techniques and procedures

Due to the vast array of different data collection techniques, it is not feasible to include a comprehensive overview of relevant data collection methods in sufficient detail. Instead, details of the data collection methods used within this thesis (along with sufficient overview and justification) is provided in Section 4.5.

4.3 Research Validity

Various authors (Boudreau et al., 2001, Janesick, 2000) have considered Validity, Generalisation, Objectivity and Credibility to be crucial to the ratification of research. This importance of these factors is best outlined by Saunders et al. (2009) in relation to increased credibility of research findings “reducing the possibility of getting the wrong answer”.

4.3.1 Validity

Validity is the degree to which items in a research instrument reflects the content universe to which the instrument will be generalised; established through literature review and expert judges or panels (Boudreau et al., 2001). Janesick (2000) defined validation in a qualitative research context as being “to do with description and explanation, and whether or not the explanation fits the description”. Further to this, Robson (2002) provided the following reflective questions a researcher may ask of the study outcomes in order to assess their validity:

- Is the relationship what it appears to be?
- Is there a real, direct, link between the variable and the outcome?
- Can we have been fooled so that we are mistaken about the outcome relating to the data?

Reliability (a component of validity within a quantitative research framework) is a statement about measurement accuracy. This is essentially the extent to
which an instrument (i.e. data collection tool) produces constant or error-free results (Rogers and Rogers, 1995). In comment on defining reliability, Alreck and Settle (1995) remarked that “the most fundamental test of reliability is repeatability – the ability to get the same data values from several measurements made the same way”. Boudreau et al. (2001) identified five techniques used in the identification of reliability:

1. **Internal Consistency** – work out the correlations between different items within a dimension or construct

2. **Split Halves** – divide the sample into two and test that the same results are achieved with each subset

3. **Test** – retest, where the same assessment is made at two points in time

4. **Alternatives, Equivalent Forms Or Parallel Forms** – where you look for the same result being generated by a different set of measures

5. **Inter-Rater Reliability** – where the same result (e.g. observation or interview transcripts) are rated or coded by different people, and the results compared.

Mason (1996) noted that while reliability in quantitative studies is associated with the use of standardised research instruments, thinking in such terms is problematic for most qualitative researchers. This is - as Mason (1996) argued - partly due to the extensive use of non-standardised methods used in the generation of qualitative data. Crucially, Robson (2002) argued that although assessing reliability of measurables are necessary, it is not sufficient to ensure validity.

From a qualitative psychological perspective, Cronbach and Meehl (1955) considered validation to be constructed from four elements: *Predictive Validity, Concurrent Validity, Content Validity and Construct Validity*. They considered both *Predictive Validity* and *Concurrent Validity* might be considered *Criterion*¹³ Orientated Validity. Here, if the criterion is obtained sometime after the test is

---

¹³ *Criterion* – A test, principle, rule, canon, or standard, by which anything is judged or estimated (Oxford University Press, 1989)
given, the researcher is studying Predictive Validity, and if the test score and criterion score are determined at essentially the same time, he is studying Concurrent Validity.

- **Content Validity** is established by showing that the test items are reflective of the general phenomenon the researcher is interested in; normally established deductively (Cronbach and Meehl, 1955). For example, if a researcher was interested in the usability of mobile phones in the elderly population, systematic sampling of elderly persons who use (or do not use) mobile phones would ensure content validity.

- **Construct Validity** is the extent to which an operationalization of an instrument measures the concepts that it purports to measure (Boudreau et al., 2001).

- **Internal Validity** is the validation element to be considered once the construct validation has been assured. It is the plausible demonstration that the casual relation between treatment and outcome, or more specifically, whether the treatment being studied actually caused the outcome (Robson, 2002). This is achieved through eliminating (as far as possible) threats to internal validity.

While the issues identified above are important in presenting a scientifically valid argument through research, Boudreau et al. (2001) recommended the employment of *pre-tests or pilot studies* due to the need to precisely define the research methods at the beginning of the study. Alreck and Settle (1995) defined the *pre-test* as a preliminary trial of some or all aspects of the instrument to ensure there are no unanticipated difficulties. A *pilot study* however may be taken as a brief preliminary survey often using a small convenience sample (Alreck and Settle, 1995). Boudreau et al. (2001) stressed the importance of using both the mechanistic *pre-testing* and the *dress rehearsal* (Moser, 1958) of the *pilot study*. While the implementation of pre-tests and pilot studies cannot assure reliability and validity in the research outcomes, their use may reduce the extent to which the results may be considered unreliable or invalid.
4.3.2 Generalisation (external validity)

*Generalisation* (also referred to as External Validity, Campbell and Stanley, 1963, Rothwell, 2005) refers to the extent to which the findings of the enquiry are more generally applicable, for example, in other contexts, situations or times, or to persons other than those directly involved.

An observation made by Robson (2002), of some interest to this thesis, is how *internal* and *external* validity are inversely proportional, or the more internally valid a study the less applicable it is to persons other than those directly involved. Four key threats to generalisation (LeCompte and Goetz, 1982) are:

1. **Selection** – Findings being specific to group studied.
2. **Setting** – Findings being specific to, or dependant on, the particular context in which the study took place.
3. **History** – Specific and unique historical experiences may determine or affect the findings.
4. **Construct Effects** – The particular constructs studied may be specific to the group studied.

In making a distinction between *internal* and *external* validity, Maxwell (2005) wrote that Internal Validity refers to the generalizability of conclusions within the settings studied, while external generalizability is generalizability beyond that setting. However, the importance and relevance of generalisation to the validity of the research must be considered relative to the research aims and objectives.

4.3.3 Objectivity

Within the experimental context, *objectivity* is seen as key to the scientific approach, being the removal of the researcher from the participant in terms of interaction and involvement. Robson (2002) defined this as what multiple observers agree to as a phenomenon via *triangulation*. This is contrast to the subjective experience of the single individual, and thus can be seen as a contradiction to the research method of participatory observation (experimenter as participant). While this does not exclude such procedures being used, it
does caution against their utilisation in isolation of other, more rigorous and objective research methods. Particularly, this is of threat to the research outcomes if the personal bias of a single researcher may alter the outcomes of the experiment. Whilst a researcher may perform a valid research progress, the outcomes of the study may be questionable if the objectivity of the research is brought into question, due to the reduced reflection on realistic situations. While Lincoln and Guba (2000) noted that there are “fairly strong theoretical, philosophical, and pragmatic rationales for examining the concept of objectivity”, they also noted that even within a positivist framework, may be considered “conceptually flawed”.

### 4.4 Selecting a Research Strategy

Selltiz et al. (1979) defined the research design process as the arrangement of conditions for the collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure.

Saunders et al. (2009) proposed a philosophical approach to research strategy selection, working from an outside philosophical perspective towards an appropriate strategy and data collection method. Most importantly though, Saunders et al. advocated careful consideration of the elements which make up the research methodology, enabling research designs which are “more than simply the methods by which data are collected and analysed. It is the overall configuration of the piece of research”.

Following a similar methodological perspective of selecting appropriate research elements, Robson (2002) advocated considering the conditions and purpose of the study, leading to appropriate research strategy selection. In practice, this consists of putting three guiding principles on research method selection:

1. **Given the research questions and a decision on research strategy, what methods are most suitable?**

2. **Considering the area of interest (dictated by the research questions), what research methods are the most appropriate?** See Table 4.3.
3. Considering time, access and financial constraints, what is the most practical method available?

**Table 4.3 - Guidelines on selecting a research method based on the need of the study** (Robson, 2002)

<table>
<thead>
<tr>
<th>Area of Interest</th>
<th>Research Method (non-field specific)</th>
</tr>
</thead>
<tbody>
<tr>
<td>To find out what people do in public</td>
<td>Use direct observation</td>
</tr>
<tr>
<td>To find out what people do in private</td>
<td>Use interviews or questionnaires</td>
</tr>
<tr>
<td>To find out what people think, feel and/or believe</td>
<td>Use interviews, questionnaires or attitude scales</td>
</tr>
<tr>
<td>To determine their abilities, or measure peoples intelligence or personality</td>
<td>Use standardised tests</td>
</tr>
</tbody>
</table>

Selection of appropriate and justifiable research philosophies, approaches, strategies and data collection methods may be seen as crucial to not only conducting successful research, but ensuring the trustworthiness of results; delivering outcomes which reliably reflect realistic situation (Easton et al., 2000). Therefore, consideration should be given to the relative validity of research approaches to the subject being studied, while designing the research design.

### 4.5 Research Design Within This Thesis

Throughout this thesis a multiplicity approach was conducted, with the aim of “synthesizing data from multiple sources” (W.H.O, 2009). Through this, the research design for each study was carefully selected in order to produce information of relevance to both the research aims of this thesis, and the objectives of the study. This was done with consideration to achieving the most suitable data from participants while remaining relevant and generalizable to the wider audience in practice.

From a philosophical viewpoint, this thesis was conducted from an interpretivist perspective. That being the consideration that an element of truth may be discovered, but only through subjective interpretation of interventions made within the limitations of research. As a consequence of this, and due to the lack of published work into the human factors of neogeography, this thesis began
with the interpretivist philosophy, resulting in initial research being conducted through a general inductive research approach. Later, once pre-specified relationships were estimated by the research, a deductive research approach was taken, confirming and developing outcomes from previous studies (Boudreau et al., 2001).

Finally, issues of validity were addressed for each study, relative to the independent study aims, objectives and methods. Table 4.4 below summarises the empirical nature of studies within this thesis in terms of their context, task and sample size.
### Table 4.4 – The Empirical Nature of Studies Within This Thesis

<table>
<thead>
<tr>
<th>Study</th>
<th>Context</th>
<th>Task</th>
<th>Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scoping Study</strong></td>
<td>Participatory Observation</td>
<td>Understanding first-hand how VGI is collected and contributed, as well as discovering the ways in which VGI is used and talked about in the developer community</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Interviews</td>
<td>In-depth interviews with key users associated with VGI and PGI to understand how different people value VGI, and the inter-user relationships. Creating a basic understanding of VGI, scoping out research within this thesis.</td>
<td>16</td>
</tr>
<tr>
<td><strong>Study Two</strong></td>
<td>Participatory Observation</td>
<td>Understanding first-hand the role in which external information plays in the lives of people in kayaking environments.</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Focus Groups</td>
<td>In-depth interviews into how volunteered and professional information influence people’s information search and task execution activities</td>
<td>32</td>
</tr>
<tr>
<td><strong>Data Generation</strong></td>
<td>Map Walks</td>
<td>Creating a VGI data set about access issues around a set travel route in London. Simulating the creation of a VGI data set via crowd sourced methods</td>
<td>6</td>
</tr>
<tr>
<td><strong>Study Three</strong></td>
<td>Online Experiment</td>
<td>Presenting wheelchair using visitors to a website the data gathered through the Data Generation chapter (above) and then asking them to complete a 32 question Likert Scale survey. To determine through statistical analysis the influence of using VGI on information judgements.</td>
<td>101</td>
</tr>
</tbody>
</table>

### 4.5.1 Scoping Study

#### 4.5.1.1 Purpose

The following research questions were investigated through the scoping study:

- What is VGI and how is it distinct from PGI?

- What is the human centred nature of VGI in terms of its generation, production and utilisation by the end users?
The aims were consequently to investigate:

1. What is the nature of VGI in general?
2. What are the different characteristics of the key users?
3. How do different users perceive VGI in terms its value to them?

4.5.1.2 Theory

The scoping study took an inductive philosophy in order to explore, describe and find meaning to the use of VGI in a realistic situation (Morse, 2003). For this reason, and with the focus of this study on processes of use rather than measurable outcomes, a qualitative research approach was sought. A cross-sectional approach which seeks to describe the incidence of a phenomenon, or explain how factors are related in different organisations over a relatively short period of time was applied to the research (Erzberger and Kelle, 2003). During the scoping study, a qualitative multi-method approach was sought in order to afford a greater reduction of uncertainty in the analysis, and gain a better understanding of the social phenomenon of VGI from a user utilisation perspective (Greene et al., 2001).

4.5.1.3 Methods

A multi-methods approach was selected for this study, aiming to provide a high degree of understanding in the VGI user communities from a variety of perspectives (Brewer and Hunter, 1989, Johnson and Turner, 2003, Tashakkori and Teddlie, 1998). This consisted of a series of semi-structured interviews with a cross section of users related to VGI projects. Additional participatory observation was employed, from the perspective of the participant as observer (Gold, 1969), revolving around collection and contribution of VGI data for the OpenStreetMap project with a selection of its active members.

4.5.1.4 Sampling Strategy

Due to the lack of published material describing the demographics of VGI users, it was not possible to clearly predict who should be targeted for interviews before the start of the research. Because of this non-probability and
snowball sampling methods were employed to discover participants relevant to the research aims and objectives.

4.5.2 Study two

4.5.2.1 Purpose

The following research questions were investigated through Study Two:

- What influences the way users judge VGI in terms of its relevance to their needs, and how does VGI compare to PGI?

The aims were consequently to investigate:

1. How VGI and PGI offer different benefits to the end user in a realistic scenario;

2. The strengths and weaknesses of VGI and PGI relative to how they meet the information requirements of the user’s tasks and activities;

3. How VGI and PGI may be effectively integrated to produce highly usable and effective applications.

4.5.2.2 Theory

In Study Two the general research approach is Inductive, since the purpose of the study is to explore, describe, and attach meaning to the use of VGI in a realistic situation (Morse, 2003). In order to afford a greater reduction of uncertainty in the analysis and conclusions of the study, and gain a better understanding of the social phenomenon of VGI (Greene et al., 2001) a qualitative multi-method approach was sought.

4.5.2.3 Methods

Study Two took a multi-methods approach to utilise the complementary strengths and weaknesses identified in each of the data collection methods and gain a deeper insight into the use of VGI (Brewer and Hunter, 1989, Johnson and Turner, 2003, Tashakkori and Teddlie, 1998). The base project for this study were focus groups, providing the overall theoretical scheme into which findings of other projects fit (Morse, 2003). Additionally participatory observation
accompanied provided additional data for analysis. This approach is supported by the comments of Preece et al. (2002) in that focus groups alone cannot provide the whole picture, but instead allow for a detailed insight into what the participants can easily verbalise.

4.5.2.4 Sampling Strategy

Within Study Two a non-probability purposive sampling strategy was selected as a convenient method of identifying and involving groups whose activities exhibited properties required by the study. This was due to the selection of kayakers within social and trip planning settings as the study group. Consequently, probabilistic selection was not practical over the non-probabilistic method of interviewing members of local clubs.

4.5.3 Data Generation

4.5.3.1 Purpose

The following research questions were investigated through Chapter seven:

- What influences the way users judge VGI in terms of its relevance to their needs, and how does VGI compare to PGI?
- What recommendations can be made for combining PGI and VGI for the production of highly usable neogeographic products?

The study aims were:

1. Generate a body of VGI which offers a reflection of the user community activities while providing unique insights not presented through traditional PGI mediums.
2. Combine VGI into a series of descriptive mashups which allow for integration in various websites, as well as controlling under experimental conditions.
3. Gain insight into the differences between VGI and PGI in terms of how they describe locations and attributes to convey information.
4.5.3.2 Theory

In Chapter seven the general research approach is *Inductive*, since the purpose of the study is to explore, describe, and find meaning in the built environment through VGI data collection (Morse, 2003). Data was collected and compiled, but not analysed as it was used as the research data source for Study Three.

4.5.3.3 Methods

Chapter seven utilised a mono-method approach through a cross-sectional time frame in order to understand the built environment as described through volunteer wheelchair users (Saunders et al., 2009). The public transport environment and its associated access issues were experienced through the GIS-Participation technique of *map walks*, (Evans, 2009, Jones et al., 2008).

4.5.3.4 Sampling Strategy

Due to the non-socially focused activities of the study group (wheelchair users), *non-probability, purposive* and *convenience* sampling techniques were used as a convenient method of identifying and involving groups whose activities exhibit those required by participants in this study. Additionally, these strategies were selected since other (more rigorous) methods would be contrary to the anarchic, self-selecting approach of VGI contributors (Raj Budhathoki et al., 2008).

4.5.4 Study four

4.5.4.1 Purpose

The following research questions were investigated through Study Three:

- What influences the way users judge VGI in terms of its relevance to their needs, and how does VGI compare to PGI?

- What recommendations can be made for combining PGI and VGI for the production of highly usable neogeographic products?

The aims were consequently to investigate:
1. The extent to which the degree of homogeneity between the information author and user affects the users’ judgements on the mashup and its content.

2. The extent to which the content of the information within the mashup affects the users’ judgements on the mashup.

3. The extent to which the user’s judgements on the information influence the overall usability and system acceptance of the mashup.

4. The extent to which the different dimensions of the users’ judgements may be harnessed to optimise the design of future mashups combining both VGI and PGI information.

4.5.4.2 Theory

Study Three took a deductive research approach in order to test the outcomes from the previous research studies demonstrate user reactions within an empirical setting (Johnson and Gill, 2002). Consequently a quantitative mono-methods research choice was selected, applied to an experimental setting delivered via an online interactive website.

4.5.4.3 Methods

Participants were randomly assigned to one of four experimental groups and provided with different sets of information relative to travel. The study followed a traditional experiment form with independent and dependant variables being statistically assessed within a home based setting.

4.5.4.4 Sampling Strategy

Participants were sourced through online advertisements, and invitations to participate distributed through newsletters, blogs, forums, websites and social media networks. This was done in order to engage as wide a range of participants as possible, making the results saleable to the larger community of users. Importantly, since Study Three was a continuation of The data generation chapter, the same study group was used; wheelchair users.
4.6 Conclusion

This chapter has outlined the general scope of research within this thesis, identified the challenges faced by researchers in the field of VGI and highlighted the methods used to tackle the research questions within this thesis. Above all, and in consideration with the comments of Dourish (2004) that all interactions are influenced by their setting, research throughout this thesis aimed to consider multiple viewpoints, user groups, situations and measurements, in order to maximise the validity and usefulness of the research outcomes.
5 Scoping Study: User Perceptions Of VGI in Neogeography

<table>
<thead>
<tr>
<th>Research Questions Addressed In This Chapter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
</tbody>
</table>

5.1 Introduction

Current research into Volunteered Geographic Information – VGI (Goodchild, 2007a) – in the context of neogeography has revolved around the computer science perspectives of its utilisation for technical benefit (University of Heidelberg, 2010). Although VGI has been shown to be “more than accurate enough” in its spatial positioning, the reaction of users\(^\text{14}\) to VGI, how they perceive it, and its effect on their lives is less clear.

As highlighted in the literature review, neogeography is the combination of geolocated data within a map platform (a mashup), produced with the intent of delivering information to the end user (Turner, 2006). Additionally, VGI is one form of data that may be used in mashups, and should not be confused with neogeography itself. However, its seemly anarchic nature (Raj Budhathoki et al., 2008), and newness (Goodchild, 2007a) means that it is the least understood component of the neogeographic phenomenon.

While various authors have presented a series of conceptual frameworks to the classification of users associated with neogeography and VGI (Coote and Rackham, 2008, Raj Budhathoki et al., 2008, Sommerville, 2001), the

\(^{14}\text{User: one who is connected to a product or service via the association of use; see page 35.}\)
relationship between the user and their perceptions of VGI useful in a User Centred Design (UCD) context has (to date) not been covered in the published literature. In relation to the distinct lack of human factors research into VGI (Harding et al., 2009), any designer wishing to produce mashups utilising a UCD approach - and including VGI as a key data source - would be doing so without informed guidelines on how the users perceive the information they are interacting with. More importantly, it is unclear what the differences and similarities are between the perspectives of different user groups (i.e. those who are using a VGI for some purpose), and how might this effect the design of VGI inclusive mashups in the future. Consequently, a need exists to investigate the scope of users associated with VGI in order to set the theoretical foundations for a UCD understanding within this field.

5.2 Aims
The aim of this study is to better understand the phenomenon of VGI within the context of its use in neogeography. In order to tackle this, three objectives were produced:

1. What is the nature of VGI in general?
2. What are the different characteristics of the key users?
3. How do different users perceive VGI in terms its value to them?

Due to the lack of published work giving a human factors perspective on neogeography and VGI, this study aimed to lay the foundations of investigation. This was then to allow the development of hypothesis and then theory in later investigations. Consequently, this study did not set out to produce a simple snapshot of user perceptions, but instead gain a detailed and useful analysis of the relevant users and their associated stakeholders.

5.3 Study Rationale
The overall rationale of this study was to understand the differences in user perception of VGI through investigating the users of different neogeographic platforms through a value framework. A series of popular map platforms were selected to produce a useful cross section of opinions relating to the
overarching topic of neogeography. For each platform, appropriate users were sought and interviewed, alongside participatory observation in their activities. Through this, the study objectives laid out above were investigated. This section describes these processes alongside their rationale for the purpose of justifying the research within this chapter.

5.3.1 Choice of research approach

The general research approach was inductive, since the purpose of the study was to explore, describe, and find meaning to the use of VGI in a realistic situation using qualitative methods, rather than deductive movement from data to theory (Morse, 2003). While this philosophical stance is more synonymous with longitudinal multi-methods research processes (Saunders et al., 2009), consideration needed to be given to the purpose of the research. Although understanding the attitudes towards VGI, the benefits of such a study do not fit comfortably within the research aims specified in this chapter. Since no independent variable was investigated, and the only entity of interest is the value perceptions of VGI within the VGI user community, the research strategy of case study was selected (Boudreau et al., 2001).

During this study, a qualitative multi-method research choice was sought in order to afford a greater reduction of uncertainty in the analysis, and gain a better understanding of the social phenomenon of VGI from a user utilisation perspective (Greene et al., 2001). The main purpose of this was to enhance validity and credibility of inferences through convergence of results, and to aid a more insightful investigation. This is the convergence on conclusions by utilising multiple data collection techniques and analysis procedures from within appropriate qualitative methodology (Erzberger and Kelle, 2003, Tashakkori and Teddlie, 2003).

Since the time allocated to research within this thesis is limited, the measure of control over the variables studied was not practical (Burns, 2009). Therefore a cross-sectional study to describe the incidence of a phenomenon and explain how factors are related differently was the most appropriate (Erzberger and Kelle, 2003). A cross sectional approach also allowed for a more detailed insight into the relationships between users.
As commented by Sommerville (2001), those connected to VGI, and those who have an influence on mashup design requirements may be considered users. However, an alternative perspective could be attained in the form of stakeholders, defined by Mark and Shotland (1985) as those with a vested interest in the focus for evaluation. While the terms user and stakeholder are commonly found intermixed in the literature, it is important to make the distinction between the direct interactors – the users – and the wider net of those with influence – the stakeholders – (Preece et al., 2002). Consequently, this study focused on the users of VGI, yet reflects on the wider net of stakeholders interested in VGI. For the purpose of this study, a user is any person or individual within a group who generates and/or makes use of volunteered geographic information.

5.3.2 Selection of map platforms

Due to the exploratory nature of this study, it was important that the participants reflected the diversity of opinions and practices within the wider field of VGI. Consequently, three map products were selected, describing a useful cross-section of users, technologies and attitudes.

The first map product needed to reflect the most commonly used and respected form of VGI available. OpenStreetMap (OSM) was chosen as a popular VGI application, where potentially untrained volunteers create and “provide free geographic data such as street maps to anyone who wants them” (OpenStreetMap, 2009). Here, the main objective is the creation of the map and its associated metadata via volunteered means. OSM represents the best researched of all neogeographic products and is often used to define VGI.

The second map product needed to reflect the personal (and possibly anarchic) nature of neogeography. In line with current research into VGI creation through GIS tools (Foth et al., 2009, Miller, 2006, Rinner et al., 2011) Google Maps (My Maps) was chosen as a popular neogeographic tool where users “create personalised, annotated, customised maps” (Google Maps, 2010). Unlike OpenStreetMap, Google My-Maps users add pin-points or poly-lines which are then annotated with specific information.
The third map product needed to provide a perspective from the traditional/professional side of neogeography. An additional category of participant is the traditional GIS professional. It is important to study the neogeography phenomenon relative to traditional mapping, since recent developments have not added new functionality to geographic information, but rather new approaches to geographic information distribution, usability and application development (Haklay et al., 2008). For this, Ordnance Survey was selected because of its position as the official mapping agency of the UK.

5.3.3 Boundary conditions

The boundary conditions (i.e. those that limit the degrees of freedom, promote reliability and define the generalizability of results) employed within this study are shown below in Table 5.1.

<table>
<thead>
<tr>
<th>Boundary Conditions</th>
<th>Explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Users</strong></td>
<td>Constrained by specifying participants</td>
</tr>
<tr>
<td></td>
<td>All fulfilled the following criteria:</td>
</tr>
<tr>
<td></td>
<td>Aged 18 – 65, exhibit knowledge of VGI Systems, perceptions on VGI from a UK perspective</td>
</tr>
<tr>
<td></td>
<td>Varied on the following characteristics</td>
</tr>
<tr>
<td></td>
<td>Gender, experience and knowledge of GI and GIS, level of technical interest</td>
</tr>
<tr>
<td><strong>Tasks and Contexts</strong></td>
<td>Constrained by specifying the interview questions</td>
</tr>
<tr>
<td></td>
<td>Focus on perceptions of information rather than the information delivery system</td>
</tr>
<tr>
<td></td>
<td>Focus on multidimensional perceptions of value of VGI</td>
</tr>
<tr>
<td></td>
<td>Varied by conducting interviews</td>
</tr>
<tr>
<td></td>
<td>Allowing any range of emotional or tangible outcomes to be considered in the overall presentation of VGI perceptions.</td>
</tr>
</tbody>
</table>

5.4 Investigation Overview

This chapter comprised a multi-methods investigation into the way different user communities perceive VGI in terms of its value and meaning to them. Such an approach has been found useful in other studies including rural land use and GIS (Madsen and Adriansen, 2004). Two independent investigations were
conducted, comprising participatory observation to understand the social factors and interactions between users (Mason, 1996), and semi-structured interviews for in depth investigation into user perceptions. Participants were asked to consider past and current experiences, positive and negative aspects of VGI and PGI, as well as interactions between different information types and the user community. Data was analysed through thematic analysis, with multidimensional value used a theoretic framework. Results were analysed separately, but brought together in the discussion and conclusion.

5.5 Part A: Participatory Observation

5.5.1 Methods

Participant Selection

Participatory observation was undertaken to better understand the active creation and development of VGI with members of the OpenStreetMap user group; intended as a snapshot insight into the culture and perspectives. Because the Google Maps and Ordnance Survey map projects focus on the use of neogeography rather than the creation of information from volunteer sources, they were not investigated in such a way. Events with which to participate and observe within were found in the following ways:

- OpenStreetMap mapping parties within 100 Km of Loughborough were discovered through the OSM events calendar (http://wiki.openstreetmap.org/wiki/Current_events)
- Contact with the OpenStreetMap community via the news section of the website
- Personal contacts within Ordnance Survey

Observation Design

As McCall and Simmons (1969) noted, participatory observation “involves repeated, genuine social interaction on the scene with the subjects themselves as part of the data-gathering process”. Within this study, the position of marginal participant was sought (Gold, 1969, Junker, 1960) to allow a higher
degree of involvement and insight than the passive position of observer-as-participant; yet without the high involvement of participant-as-observer. Participatory observation took the form of attending various OpenStreetMap mapping parties to generate VGI data within the community and attending VGI and PGI focused conferences to talk with users.

**Procedure**

Data for participatory observation was captured using *descriptive observation* for the various scenarios of focus; see Table 5.2 below. Rather than take notes during observation, events were recorded after participatory observation has taken place, allowing for greater emersion within the activities.

<table>
<thead>
<tr>
<th>Descriptor</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Space</strong></td>
<td>Layout of the physical setting; room, outdoor spaces, etc.</td>
</tr>
<tr>
<td><strong>Actors</strong></td>
<td>The names and relevant details of the people involved</td>
</tr>
<tr>
<td><strong>Activities</strong></td>
<td>The various activities of the actors</td>
</tr>
<tr>
<td><strong>Objects</strong></td>
<td>Physical elements: furniture, etc.</td>
</tr>
<tr>
<td><strong>Acts</strong></td>
<td>Specific individual actions</td>
</tr>
<tr>
<td><strong>Events</strong></td>
<td>Particular occasions, e.g. meetings</td>
</tr>
<tr>
<td><strong>Time</strong></td>
<td>The sequence of events</td>
</tr>
<tr>
<td><strong>Goals</strong></td>
<td>What actors are attempting to accomplish</td>
</tr>
<tr>
<td><strong>Feelings</strong></td>
<td>Emotions in particular contexts</td>
</tr>
</tbody>
</table>

**Analysis**

McCall and Simmons (1969) stated that the output from participatory observation is “an analytic description of a complex social organisation”. This resulted in three key elements of the analytical description:

1. Employing concepts, proposition and empirical generalisations of a body of scientific theory as the basic guides in analysis and reporting

2. Thorough and systematic collection, classification and reporting of facts

Records of observation were not coded, yet the statements and outcomes were used as an alternative perspective on the outcomes from the focus groups.

5.5.2 Results and analysis

Participatory observation occurred on four occasions, involving over 50 different users of VGI associated with OpenStreetMap. In addition to taking part in the data collection and mapping session, the OpenStreetMap ‘State of the Map’ conference was also attended see Figure 5.1. This gave insight into the thoughts, feelings and actions of OSM members of the course of a few days in both formal and informal environments. Topics covered during this time included data collection, social interaction, contribution, perspectives on other map platforms and the meaning OSM has to the contributors on a personal level.
The following key outcomes were derived from the participatory observation during the study:

- Social interaction is a central activity at VGI data collection events, particularly comradery at the joint effort of creating the map which they feel will help influence society at large for the better.
  - **Example:** strong social interaction before and after mapping parties, more weekly meetings of members in pubs than mapping parties.

- Anarchic organisation; i.e. participants chose to engage with events due to their personal interest in their application rather than because of a prerequisite.

---

15 **Cake:** OpenStreetMap term for how a region (e.g. a city) is divide up into section to be mapped.

**Trace:** OpenStreetMap term for the GPS trace uploaded to the servers to be ‘traced over’ by a contributor in order to contribute streets to the map.
Example: Mapping parties organised by anyone for any reason without the need to comply to any guidelines or practices. Many mappers contributing vast amounts of data without engaging in the social functions, online discussions or other forms or guidance.

- Celebration of achievements, yet not much recognition of gaps in the data; e.g. celebrating mapping one section of the city as a triumph, yet ignoring the other sections still blank and not surveyed.
  
  Example: The State Of The Map conference focused heavily on achievements and developments within the community, without recognition of the pitfalls, shortcomings or errors within the data set (as mentioned by participants within interviews)

- Optimistic and exciting outlook driven by potential of the map rather than its current form.
  
  Example: Mapping party participants talked with much enthusiasm about what the map will be like, how it will be used and future developments before and after mapping sessions.

- Hostile towards criticism, especially from those outside of their group, even when giving a balanced appraisal.
  
  Example: Non-regular mappers at the mapping parties who voiced concern over validity or completeness were not brought into much discussion and non-verbally ‘shut out’ by some members.

- Low levels of standardisation towards how data should be captured, contributed and utilised. In particular, each instance of observation had a different outlook on these matters.
  
  Example: Much discussion at the mapping parties on how data could be captured, contributed and edited, without a single voice of universal agreement.
• Post data collection, there was limited feedback from the organisers on achievements or continued engagement with members of the group.
  
  o Example: No procedure of follow up emails or forums posts following any of the user engagements.

• Keen interest in geography in general from the participants, choosing to refer to more technical terms over standard terms wherever possible.
  
  o Example: specifying the meeting point (Leicester University canteen) not by name or address, but by GPS coordinates.

During these sessions, there was no evidence of users consulting professional information sources to confirm locations or features in the built environment. Interestingly, this extended to locating the meeting point, where GPS coordinates were given rather than an address in order to add to the spirit of the occasion. While non-referral to PGI sources while actually mapping may be taken as essential to avoid copyright infringement, other such extreme measures demonstrated the strong sense of independence within the VGI community.

5.6 Part B: Interviews

5.6.1 Methods

Participant Selection

At the start of this thesis, examples of research which demonstrated a useful categorisation of users associated with VGI was limited. However, in a study investigating the data quality issues within VGI, Coote and Rackham (2008) grouped users into four categories: consumers, special interest [mapping] groups, local communities and professionals; see Table 5.3. Although these users may not be mutually exclusive, (i.e. a user may be only a consumer, or also a consumer and a producer of VGI) this simplified model offered an effective framework of exploration. Following the completion of this study this distinction between the various users were highlighted as being useful for understanding the user interactions of VGI and offers a
Table 5.3 - Segmentation Of Target Respondent User Groups (Coote and Rackham, 2008)

<table>
<thead>
<tr>
<th>User Group</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumers</td>
<td>A person who purchases [or selects] any product or service for personal use.</td>
</tr>
<tr>
<td>Special Interest Groups (SIG)</td>
<td>Individuals who come together to collaboratively achieve some shared goal.</td>
</tr>
<tr>
<td>Local Communities (LC)</td>
<td>Local people who have a common desire to improve their local area.</td>
</tr>
<tr>
<td>Professionals</td>
<td>Users employed by organisations that use geographic data to perform their business activities, whether to analyse, report, navigate or otherwise maintain systems.</td>
</tr>
</tbody>
</table>

Consequently, participants were recruited in each of the four categories. Additionally, within each of the categories a range of participants was sought who represented at least one of the three main map products (see Section 5.3.2, page 130). Finally, the participants were required to fit the following specification:

- Regular involvement with their map product;
- Use of the map product for work or social reasons involving relating information to geographic locations;
- Have awareness of map products outside their chosen product
- Aged 18-65, being a non-vulnerable person according to the Loughborough Ethics Guidelines

In order to find participants who fitted the above criteria, the following recruitment techniques were employed:

potentially beneficial framework for human factors investigation (Brando and Bucher, 2010, Brown et al., 2012).
OpenStreetMap mapping parties\textsuperscript{17} were attended (Leicester and Milton Keynes) where contacts were made, flyers handed out and users discovered.

Posters advertising for Google My-Maps users to take part in this study were placed around Loughborough University student areas (e.g. Student Union, departments and halls of residence).

OpenStreetMap State of the Map 2009 conference was attended where contacts were made, flyers handed out and users discovered.

Searches for keywords such as Google Maps and My-Maps were conducted on Twitter, with results refined to the local areas (e.g. search for ‘My-Maps’ Google near:nottingham).

Email adverts for participation in the study were posted on the OpenStreetMap Mailing lists for the UK.

\section*{Theoretical Justification}

Considering the need to understand how the users value VGI within the context of neogeography, an appropriate theory on value had to selected. While a more in depth perspective is given in Section 2.4.4 (page 63), a brief discussion of the background theory and the rationale for selection is required.

Lin et al. (2005) commented that two key measures of value exist; unidimensional (measuring customers overall perception of value) and multidimensional (measuring the various value perceptions using various benefit and sacrifice dimensions) perspectives. As noted by Sheth et al. (1991), both have been demonstrated as being useful in understanding (and predicting) user behaviour.

The unidimensional theory of value can be seen as the benefits and sacrifices associated with only one element of perceived value, e.g. price or service (Lin et al., 2005). However, Sweeney and Soutar (2001) noted “a more

\textsuperscript{17} Mapping Party: VGI Contributors to the OpenStreetMap project getting together to do some mapping, socialising and chat about making a free map of the world (Open Streetmap Community, 2011)
sophisticated measure is needed to understand how consumers value products and services”. Further to this Lin et al. (2005) noted that the “unidimensional conceptualization strategy is effective and straightforward, but it cannot discern the complex nature of perceived value”.

In defining the multidimensional perspective, Sweeney and Soutar (2001) included the components of emotion, social enhancement, price and performance. Within this model, each construct may be considered a give, a get, or a considered trade-off between the two. Crucially, the multidimensional perspective considers all of the various value dimensions together, rather than the independent factors under the unidimensional perspective.

Importantly, the dimensions within the theory of multidimensional value are not fixed, as shown by the various contentions by authors such as Sheth et al. (1991) and Zeithaml (1988). Therefore, two conclusions may be drawn:

1. Due to the currently unknown, yet assumed complex nature of neogeography, the most appropriate theory of value to be used within this study was the multidimensional theory.

2. The dimensions which best predict the value perceptions of the uses is currently unknown. Therefore, the theoretical framework should start with the basic elements of emotion, social enhancement, price and performance, yet be prepared to adjust for the dimensions emerging from data analysis.

Interview Design

In order to extract the most relevant information from the participants during the interview, it was necessary to base the questions posed on the theoretical framework that would be used to analyse the transcripts. Additionally, it was necessary to structure and influence the interview design to allow for the full range of anticipated analysis tools to be used most effectively.

From an interaction design perspective to help understand the reasoning and expression of the themes and effects of user relationships in system design, Monk and Howard (1998) developed the tool of the rich picture. Development is
attained through analysing transcripts for references to other users, communication and data flow between users, as well as tensions and concerns of all those involved. It was the intention that the representation of user interactions would provide a framework to contextualise outcomes from the interview.

In order for the interviews to produce adequate results by which a rich picture may be drawn to represent inter-user relationships (Monk and Howard, 1998) and multidimensional value perceptions inferred, the interview question sheet was split into two sections, each addressing a different research requirement; see Table 5.4.

**Table 5.4 – Sections and Themes Required of the Interview Question Sheet**

<table>
<thead>
<tr>
<th>Section</th>
<th>Investigation Themes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tensions</td>
</tr>
<tr>
<td></td>
<td>Data Transfer</td>
</tr>
<tr>
<td></td>
<td>Knowledge of Other Parties</td>
</tr>
<tr>
<td></td>
<td>Social Enhancement</td>
</tr>
<tr>
<td></td>
<td>Price</td>
</tr>
<tr>
<td></td>
<td>Performance</td>
</tr>
</tbody>
</table>

Although questions were designed to focus on each of the components highlighted in Table 5.4, they were open ended enough for the participant to discuss whichever topics or themes they felt more relevant to them. Consequently, the following categories of question were employed:
1. Involvement in mapping project;
2. Background relative to project involvement;
3. Influence of project on life;
4. Interaction with others;
5. Feelings of completeness in mapping project;
6. Feelings towards user-generated content;
7. Missing features within mapping project;
8. Contribution of information in general;
9. Application of mapping project.

The full interview question sheet used in the scoping study is presented within Appendix 5A.

Procedure

Participants were contacted through email and personal communication and internet forums (e.g. forum.openstreetmap.org). Interviews were arranged for semi-public locations (e.g. coffee shops, libraries, etc.) at a time and place to suit the participant. Before the interview, full information as to the purpose the interview and how the data would be used was presented to the participant before consent being obtained. During the interview, an audio recording was taken to capture all questions and responses in detail, in line with established practice with interviews and analysis (Lapadat and Lindsay, 1998). Main questions were asked, with supplementary probing questions following to fully explore the topic areas.

Data Analysis

Interviews were digitally recorded and later transcribed in full. In order to produce a deeper insight into the dimensions of value within the transcripts, thematic analysis was conducted with the aid of NVivo 9 (QSR International, 2010). General categories of themes were built first, relating to the multi-dimensions of value (e.g. emotion, price, performance, etc.). Additionally, it was important to understand how those value dimensions described the user’s perception of VGI (e.g. how do users feel emotionally about the subject). Consequently, each value dimension was considered from a gains and sacrifices perspective, similar to that offered by the unidimensional theory of
value (Lin et al., 2005). The full coding rationale for this study is presented in Appendix 5B.

**Breakdown of Participants**

Over the course of the study, 16 participants were interviewed, see Table 5.5.

<table>
<thead>
<tr>
<th></th>
<th>Consumers</th>
<th>Special Interest Mapping Groups</th>
<th>Local Communities</th>
<th>Professionals</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VGI</strong></td>
<td>1</td>
<td>6</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>PGI</strong></td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>4</strong></td>
<td><strong>6</strong></td>
<td><strong>2</strong></td>
<td><strong>4</strong></td>
</tr>
</tbody>
</table>

When making contact with users each participant was sent an email detailing why the study was being conducted, what to expect, and a form to sign and return; providing consent. A date to suit the respondent would be arranged, and with the interview conducted in a semi-public location of their choosing.

### 5.6.2 Results and analysis

Qualitative analysis of the semi-structured interviews centred on understanding the relationships between user groups. In particular, describing the similarities and differences in how they operate and perceive both VGI and PGI. Importantly, these qualitative outcomes were used within this thesis as guidelines to user perceptions rather than as developed theory.

#### 5.6.2.1 Inter-User Group Relationships

Table 5.6 presents a breakdown of the most significant user interaction with other user groups. Importantly, the shading within the cells highlights the higher frequencies of data, rather than present an extra dimension of categorisation.
Table 5.6 - User Dimensions Of Tensions Associated With User Group And Information Use

<table>
<thead>
<tr>
<th></th>
<th>Consumers</th>
<th>SIGs</th>
<th>LCs</th>
<th>Professionals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VGI</td>
<td>PGI</td>
<td>VGI</td>
<td>VGI</td>
</tr>
<tr>
<td>Inside Community</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>collaborate with others</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Develop for and with them</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>hack weekends</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Importance of relations</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Critical</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Good working relationship</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Not important</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Interact with online community</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Interact with people I meet</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Easy conversation access data managers</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>I dont want to go to the pub</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Important Starting</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Meet every day contributors</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Social - talk about collecting data</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>None</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Using their data</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Outside Community</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Need better mapping experience</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Need more connection with ordinary users</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>With Mashup Community</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Co-developers</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>With Professional Bodies (not own)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cloud Made</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Google</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Microsoft</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Work with OSM developer company</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

User Relationships

Below is the rich picture developed through qualitative analysis of the transcripts and participatory observation, demonstration data flow (arrows), concerns (thought bubbles), and tensions (swords) between the various users associated with neogography.
Figure 5.2 - A Rich Picture Of VGI User Interaction

Table 5.7 presents a key to the features used in the rich picture:
Table 5.7 - Key To Symbols Used In Figure 5.2 (Monk and Howard, 1998)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crossed Swords</td>
<td>Tension between user groups</td>
</tr>
<tr>
<td>Arrows</td>
<td>Data Flow (in direction of arrow)</td>
</tr>
<tr>
<td>Thought Bubbles</td>
<td>Concerns of users</td>
</tr>
<tr>
<td>Cartoon Icons</td>
<td>User Groups</td>
</tr>
<tr>
<td>Yellow Boxes</td>
<td>Project Groups</td>
</tr>
</tbody>
</table>

**Inter-User Data Flow**

The most basic flow of data are from the producers (i.e. professionals, Special Interest Groups and local communities) to the consumer; i.e. the end user. The consumer does not return data to any sources as doing so would make them a contributor. The exception to this case could be where data are contributed to a mapping project unintentionally, as with the example of the *Tom-Tom HD Traffic Service* (Palmer, 2008).

Within groups, the data flow is relative to the structure of the organisation. For example, within traditional mapping agencies, flow of data relating to GI follows a managed, intentional and structured path from generation through to quality control and distribution. Within SIGs, data are shared openly amongst all members, with free expression of views and equal opportunity in development. The internal flow of data in both organisations is little observed and to an extent has little influence of those utilising their product; the maps they are generating. In professional organisations, trying to find a business model that would enable current data integrity while utilising the potential of VGI causes some tension as to the future direction of the company.

Within SIGs (being loose organisations with less structure than a formal corporation is) the main form of communication is through Wiki’s and mailing lists. Although working as an effective form of communication for levelling and democratising an organisation, these are the main channels of tension within
these groups, causing on-going back and forth mailing list arguments known as flame wars:

It’s an interesting time for OpenStreetMap and CloudMade as well as you can see some quite aggressive comments going back and forwards about, people now turning what they thought was a community project into a professional service; information services [#1-12]

Professionals receive data (VGI and/or PGI) from the producers in a similar way that consumers do, yet with greater access to data sets or technical capacity. This allows greater exploitation and customisation of their licensed map. Tensions arise when the cost of the data from proprietary producers is too high for their business model, causing lower return on investment than desirable, or when VGI is not up to their desired specification.

5.6.2.2 Multidimensional Value Dimensions

This section presents a breakdown of the multidimensional perspectives of value relative to the user groups investigated through this research. Through thematic analysis it was discovered that the dimensions of emotion, price, performance, social, epistemic and conditional were useful categories for describing user value (Sheth et al., 1991, Sweeney and Soutar, 2001). However, categories of legal and moral dimensions were observed and are therefore included.

Emotional Value

The emotional attitudes towards VGI relative to the user group and their mapping product of preference are shown in Table 5.8.
Table 5.8 – Emotional Dimensions By User Group And Information Source Of Interest; Number of References Made

<table>
<thead>
<tr>
<th></th>
<th>Consumers</th>
<th>SIGs</th>
<th>LCs</th>
<th>Professionals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VGI</td>
<td>PGI</td>
<td>VGI</td>
<td>VGI</td>
</tr>
<tr>
<td>Gains</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community Support</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Contributor Wanted to prove a point</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Emotional connection to subject</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Hope of future development</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Map Looking Good</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Maps are good</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Not had a bad experience</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Taking Pride in work</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>VGI is fantastic</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Sacrifices</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concerned about data vandalism</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Don’t trust other’s data</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Emotional Negative</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Fear of edit wars</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Fear of the linear ‘open source’ nature becoming dictatorship</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>No personal impact</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Worried about data integrity</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

VGI contributors have an emotional connection to subject

*I don’t do OpenStreetMap because I feel I have to; I do it because I get a warm fuzzy feeling out of doing it [#1-02]*

The strong emotional attachment of the contributors (not demonstrated by consumers) is the reason for their continued involvement in the VGI project. This may be seeing the continued improvement of their product or their contributions, and therefore is less likely to influence the consumers of any VGI products.

Users (not PGI professionals) are concerned about data vandalism

*One thing people always worry about is vandalism, people intentionally putting in... erroneous data [#1-07]*

The emotional concern of the users towards the data accuracy is not ideological, but revolves around the trust placed in the contributing community to deliver information which is accurate and reliable every time.

**Functional Value**

The functions of the VGI relative to the user group and their mapping product of preference; shown in Table 5.9.
Table 5.9 – Functional Dimensions By User Group And Information Source Of Interest; Number of References Made

<table>
<thead>
<tr>
<th></th>
<th>Consumers</th>
<th>SIGs</th>
<th>LCs</th>
<th>Professionals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VGI</td>
<td>PGI</td>
<td>VGI</td>
<td>VGI</td>
</tr>
<tr>
<td><strong>Gains</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Better than competition</td>
<td>2</td>
<td>4</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>Data is Ubiquitous</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Data of acceptable quality</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Data of high detail</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Data Reflects user needs</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Easy access to data set</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Enhances Work Efficiency</td>
<td>1</td>
<td>22</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Good performance</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Good reflection of reality</td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Maps where none exist before</td>
<td>0</td>
<td>1</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Unique data adds context in mashups</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>User Trusts data</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Utilises individuals skills</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>VGI Validates Pro Maps</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Sacrifices</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can't tell is roads on atlas need to be done are easter eggs</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Can't trust 100%</td>
<td>0</td>
<td>4</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Hard to use</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Incomplete Data set</td>
<td>0</td>
<td>3</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>Inconsistent data tags</td>
<td>0</td>
<td>1</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Limit to possible detail</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Limited accuracy</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Limited progression</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Many revisions required to make area right</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>No community definition of 'completeness'</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Functions, just data</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Not all areas have enough user activity</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>SPec driven by ROI</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Utility not as desired</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>VGI dumbs down knowledge</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>VGI has limited function</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>VGI is non-portable</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Volunteers may damage maps</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**VGI presents the zeitgeist of contributor interest**

You start to discover areas that have only just been built, new shopping malls for example, and you also come across social geography as well. So we don’t only look at the spatial coordinates associated with photos, we also look at the tags which are associated with it [#1-11]

This enabled companies with a geographic interest to make use of VGI in a new way. For example, if a region receives many contributions it reflects high activity geographically, and the data they contribute indicates the areas of interest.

**Users from all groups feel that their neogeographic project is better than the competition**

If I was completely abstract from OpenStreetMap, you’d look at OpenStreetMap and you would see there is more information, there is
more things that you can look at. I mean, you just look at the centres of Amsterdam; it’s even marked the prostitution areas [#1-02]

This experience may be explained by the users utilising one map over another for a personal (and potentially unique) reason. Additionally, prior preferences and bias may provide a key element of product choice.

**VGI enables information not found on traditional maps to be utilised**

*The practical side of it is there is no other system available that can give me the bits of maps that I want, like only maps with footpaths, and with bicycle parking, and with bike shops, and with this that and the other [#1-03]*

Non-commercial niche mapping may be one of the greatest strengths of VGI from the consumers’ perspective, providing a specific product they want rather than a generic map. Table 5.9 shows that a good proportion of SIGs and consumers desire more local information presented and accessible from their chosen map. This suggests that extra information not found on traditional maps may be a very important part of the user perception of VGI.

**Users perceived VGI as accurate enough for their needs**

*Giving me routes from one place to another... it doesn’t actually need it to be perfect for it to still allow me to do what I need to do [#1-03]*

The arguments against VGI use based on its accuracy may be correct, but not relevant from the user’s perspective. The strength at which this functional perception is supported across project groups is contradicted by the number of users who perceive VGI as *not completely trustworthy*.

**Users cannot always trust VGI**

*You can’t trust it 100% at any one time, especially because you have no idea who just messed it up last week, but nobody’s noticed yet [#1-03]*

This mixture of opinions over how much trust may be placed in VGI suggests some bias in the user base, e.g. they do not feel they can fully trust it, yet in practice, they can.
Users see mapping in regions not covered by PGI as a strong benefit of VGI

There’s a person… who’s working in Gaza at the moment making maps of Gaza which are being used by aid agencies… Now these are cities that… have no official maps, because the roads have been coursed, they haven’t been planned, they’ve just occurred [#1-02]

Although this may benefit travellers to developing countries, this is unlikely to directly impact the general public within (for example) the UK who perceive this as a benefit.

SIGs associated consider VGI to be more up to date than PGI

You’ve got the physical route that is essentially the most current. I mean I’ve been going in Wales on the Crib Loch path to Snowdon and the problem was that the path had changed. On the Ordnance Survey map it said it went ‘this way’ around the ‘pig path’, when in reality it went the other way [#1-02]

This highlights one of the potential strengths of VGI, how changes in human activities may be recorded and reflected with VGI to a much higher degree than through traditional cartography. However, this perception is not shared with any of the interviewed participants outside of the OpenStreetMap project, and may be related to their involvement in development of the base map.

The ability to customise or personalise maps with VGI is of benefit to work

I’m a member of the cyclist touring club… so mapping is essential for that, and when you come to cycle campaigning, working out cycle routes again involves mapping [#1-05 ]

This benefit may be associated with neogeography, delivering the ability to collaboratively work on a single project from remote locations with few time or technology limitations. However, within this study it is the VGI contributions which are powering such benefits since the information they use cannot come from PGI sources.
**Knowledge Value**

The knowledge centred dimensions of the VGI relative to the user group and their mapping product of preference are shown in Table 5.10.

<table>
<thead>
<tr>
<th>Table 5.10 – Knowledge Dimensions By User Group And Information Source Of Interest; Number of References Made</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gains</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>Benefits work activities</td>
</tr>
<tr>
<td>Exploration (local and national)</td>
</tr>
<tr>
<td>Extra data not found in PGI</td>
</tr>
<tr>
<td>Produce professional mashups</td>
</tr>
<tr>
<td>Sacrifices</td>
</tr>
</tbody>
</table>

VGI provides an increase in local knowledge from mapping their own area

*It’s also an occasional excuse when I can get off my backside and to go and explore parts of Leicester that I really think I would rather not know about [#1-01]*

This benefit is potentially an important motivation factor for continued contribution to VGI projects. However, it does not affect users outside of SIGs, unless this benefit is used to help recruit consumers to become contributors.

**Legal Value**

The legal centred dimensions of the VGI relative to the user group and their mapping product of preference are shown in Table 5.11.

<table>
<thead>
<tr>
<th>Table 5.11 – Legal Dimensions By User Group And Information Source Of Interest; Number of References Made</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gains</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>Allows for Flexibility</td>
</tr>
<tr>
<td>Assumes someone else has done the legal research</td>
</tr>
<tr>
<td>Data is ethical</td>
</tr>
<tr>
<td>Sacrifices</td>
</tr>
<tr>
<td>Cheat - stealing data from other maps</td>
</tr>
<tr>
<td>Complex licencing agreements</td>
</tr>
<tr>
<td>copyright maps bound in legal issues</td>
</tr>
<tr>
<td>Need to know how data is being used</td>
</tr>
<tr>
<td>Nobody responsible for errors</td>
</tr>
<tr>
<td>Worried about data protection</td>
</tr>
</tbody>
</table>

In Table 5.11, both positive and negative dimensions refer to the users’ relationship with the data licensing system; dictating what can and cannot be done with the data.
Users enjoy freedom to do what they like with the map data

> I use OpenStreetMap as my data set because it’s a free and open-source version of the dataset. I don’t have to pay a Navteq or Google for their data and also its relatively adjustable, which for myself as a student and as an entrepreneur, I can take that data set and do anything I want with it without cost considerations [#1-02]

From a business perspective the do what I want mentality removes barriers to innovation so that full utilisation is possible. However, this applies only to the open source examples of VGI (e.g. OpenStreetMap) but not closed source VGI; e.g. Google Map Maker.

*Moral Value*

The moral centred dimensions of the VGI relative to the user group and their mapping product of preference are shown in Table 5.12.

<table>
<thead>
<tr>
<th></th>
<th>Consumers</th>
<th>SIGs</th>
<th>LCs</th>
<th>Professionals</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gains</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data Benefiting others</td>
<td>0</td>
<td>2</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Fits ideology</td>
<td>0</td>
<td>1</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>Not business orientated</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Trust in data come from moral image of company</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**VGI benefits others**

> I also like the idea of helping someone in an area that’s not going to get the love of the companies because it just isn’t viable for them. Whereas you can help someone because you want to. [#1-08]

This perception was particularly strong in the SIG category, possibly due to their direct involvement in VGI for other [potentially anonymous] users. This altruism may be a motivating factor for contributors to continue contributing, or to help recruit consumers into becoming contributors. Professionals may use such VGI may increase their company or product image.

**Open source VGI fits the ideology of contributors**
There’s an ideological drive behind it as well. Behind the licensing, this is where it cuts different from just being a great map, is the license allows you to do things with it, gives you almost unrestricted access to whatever creative thing you come along with and so in the same way it doesn’t matter how little the cost of software is, the free software, the open source software is still important to me, and it’s the same with the mapping stuff [1-03]

This suggests a difference in the outlook between contributors and professionals, potentially a barrier to cross collaboration, such as SIGs not wanting to contribute to a professional/ proprietary project on ideological grounds.

**Price Value**

The price centred dimensions of the VGI relative to the user group and their mapping product of preference are shown in Table 5.13.

<table>
<thead>
<tr>
<th>Number of References Made</th>
<th>Consumers</th>
<th>SIGs</th>
<th>LCs</th>
<th>Professionals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gains</td>
<td>VGI</td>
<td>PGI</td>
<td>VGI</td>
<td>VGI</td>
</tr>
<tr>
<td>Good Investment</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Free Data</td>
<td>4</td>
<td>1</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>Sacrifices</td>
<td>VGI</td>
<td>PGI</td>
<td>VGI</td>
<td>VGI</td>
</tr>
<tr>
<td>Have to pay for use of data</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>How to sell VGI</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

The zero cost to access VGI maps is a large benefit to the interest of SIGs

*Is that not part of what the whole thing’s about, so people can generate maps for themselves without having to pay extortionate amounts?* [1-04]

This perception may be relative to the legal perspectives of open licences allowing users to *do what they like*. The importance of this may also be seen relative to Roger’s (2003) perspective that the zero price tag opens up the ability for the user to try the product out, and therefore helps increase the utilisation of the innovation in the community. Capitalising on this perception from a consumer’s perspective may help to increase use and overall positive judgements of VGI.
Social Value

The socially focused dimensions of the VGI relative to the user group and their mapping product of preference are shown in Table 5.14.

Table 5.14 – Social Dimensions By User Group And Information Source Of Interest; Number of References Made

<table>
<thead>
<tr>
<th>Gains</th>
<th>Consumers</th>
<th>SIGs</th>
<th>LCs</th>
<th>Professionals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VGI</td>
<td>PGI</td>
<td>VGI</td>
<td>VGI</td>
</tr>
<tr>
<td>Enjoyable Community</td>
<td>0</td>
<td>0</td>
<td>21</td>
<td>2</td>
</tr>
<tr>
<td>Facilitates social activities</td>
<td>0</td>
<td>10</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Increased community contacts</td>
<td>0</td>
<td>2</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Local Information</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>make Information Maps for others</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>New Hobby</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Partnerships</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Recognition of work</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Shared Presence</td>
<td>0</td>
<td>10</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Sacrifices</td>
<td>Cant tell community what to do</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Community flame wars</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Limited collaboration</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Others doubt project</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Reluctant to share personal info</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Seen as intruding into other’s territory</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Takes up time</td>
<td>0</td>
<td>0</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>Technical Base Level required</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Work on maps alone</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

An enjoyable community of VGI contributors and developers

Before, I was one of a number of contributors and I was able to actively actually develop for OpenStreetMap when I was working in Cloud Made. Also the access you get, I mean by sitting over a pint or a coffee and just explain, talking to the founder, he explained his motivations, and then you see the internal workings etc [#1-02]

It is possible that this strong community bond within these groups increases the overall perception of value of VGI (Sweeney and Soutar, 2001), keeping users involved with VGI. However possibly consumers and PGI professionals did not express any benefits of community involvement, outside their own workplace or organisation; separate from all GI.

Collecting and contributing VGI takes up personal time

Sacrifices… its time that’d be spent doing other things. My shed has needed reroofing since the middle of winter when the frost got to the felt,
and I've still not got round to doing it... I'd rather be mapping than working hard on the shed [#!-04]

The investment of time to learn the skills and to actively partake in geographic contributions could be a barrier to some users becoming involved in a VGI project. Alternatively it may cause slow progress or participants ending their contributions. The sacrifice of the free time of users to contribute VGI may act as a barrier to users becoming contributors.

5.6.2.3 General User Perspectives

The following is a summary of characterises for user groups within this study, intended to relate to user interactions represented in the rich picture.

Map Product Use

Consumers select their map to fit their circumstances with little loyalty

Apart from using it like everybody does in terms of looking for places and directions, I've used Google My Maps, at the moment mainly for my own use... I've used it in a work context because I was trying to organise a meeting [#!-10]

Consumers may be open to using (or at least trying) new map products from both VGI and PGI sources. However, emphasis needs to be placed on the utility and usability of such products rather than to expect product use based on the authority of the contributor.

Special Interest Mapping Groups (SIMGs), Special Interest Mapping Group Contributors (SIMGCs) and Professionals are loyal in the use of their group’s map

I'll often check out to see if the local CTC has a website [same map project involved in] to see what's on there. And being able to find where the tea places are in the locality is quite useful [#!-05]

Observation of SIG members also showed a great bias towards their map product (i.e. OpenStreetMap) and hostility towards rival map product. This was often in spite of rival map products with opinions that were in some cases
unfounded. This may limit the ability for cross-collaboration between map projects based on the low desire to switch to a different product.

**Information Use**

*SIMGcs produce data for group members and external parties to use their data*

> It’s mainly just a project to collect data... we hope other people will use it for whatever they feel free to use it for [♯1-08]

While contributors may also be consumers, they product VGI for the sake of its production rather than for specific pre-determined tasks with known outputs.

**Professionals however take the VGI combine it with VGI as long as it enhances their business position**

> The major proprietary vendors operate within the PND market sector, so Personal Navigation Device. If you can drive to it, great. If you can drive to it in an area of the world where the economy is sufficient to support a burgeoning Sat-Nav and hand-held community, great. Outside of that data uptake and data penetration is marginal; it’s very slow. And that means areas of the world are basically blank, and OpenStreetMap enables those blank areas to be filled in [♯1-11]

This shows a real benefit for VGI to be used alongside PGI in mashups and consumer products, but it relies on the VGI meeting strict requirements and the demonstration that it will enhance the user judgements of the product.

**Accuracy**

*SIMGcs are less concerned about inaccuracies in data than consumers are as they have a stake in improving the data*

> It has its faults but there are no glaring errors... It’s very much if you don’t like it you can fix it yourself which appeals to my, well, sense of working I suppose [♯1-02]
The perspective which SIMGCs have for the data may be out of sync with the feelings of the consumers. Therefore, better ways of filtering the data, or quality control should be implemented which meet the needs and concerns of the consumers.

*Professionals are concerned about data validity, how inaccuracies may hurt their business position and show concern over what VGI actually means to their customers*

*If I’m dispatching ambulances, and I know that I need to get to the patient within 7 minutes, can I trust the volunteer captured information? [#1-12]*

Although VGI has potential to be fully incorporated into the business plan of companies, a way of measuring quality assurance, or guaranteeing the accuracy and currency of the VGI is required.

*Influence on VGI*

Those not involved in the contribution and development of VGI have little influence on the product

*All we can do is we can influence the direction this takes by offering suggestions [#1-11]*

Low influence may cause a lack of understanding from the VGI producers as to what the consumers need and want. Consequently, they risk producing highly interesting products with limited consumer utility.

5.7 Discussion

5.7.1 User value dimensions

Considering Section 5.6.2.1(Inter-User Group Relationships, page 143), participants generally perceived that the *quantity* and *salience* of benefits outweighed the sacrifices involved in the use of VGI. Consequently, the participants tended to judge VGI as a product of high personal value when considering their overall appraisal of the subject matter. Table 5.15 (below) presents the breakdown of value dimensions drawn from the thematic analysis.
of the interviews, in relation to those value elements mentioned as being important to the user within the literature.

Table 5.15 - Analysis Of Value Dimensions Used In The Scoping Study

<table>
<thead>
<tr>
<th>Value Element</th>
<th>Suggested in Literature (Sweeney and Soutar, 2001)</th>
<th>Suggested in Literature (Sheth et al., 1991)</th>
<th>Emerged from The scoping study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emotion</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Price</td>
<td>Yes</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td>Functional</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Social</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Epistemic</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Conditional</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>Legal</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td>Moral</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 5.15 shows how *moral* (the user's basis of what is right and wrong) and *legal* (items relative to positions of statue in the law) values appear as salient categories of user judgements (Bruns, 2008, Coleman et al., 2009). However, these dimensions are not included within the multidimensional value theories of value; the theoretical framework of this study.

The existence of a moral dimension is not overly surprising, considering how participatory observation showed a strong social focus to the kayaking activities. In particular, the creation of VGI centred on helping other members enjoy themselves and achieve skill sets as time went on. In many cases, the social nature was the driving force behind the activities, celebrating their own achievements and the ability for their efforts to help benefit third parties.

Within a consumer purchase context, Carrigan and Attalla (2001) remarked that most consumers pay little heed to ethical considerations in their purchase decision-making behaviours. This is at odds with the moral values as presented within Table 5.12. However, the strongest response to moral value as a construct of their multidimensional value in VGI was from SIMGs. This is possibly a result of their ideology in contributing to a wider community without
an obvious personal return for their efforts. Such extrinsic perspectives in open source contributors was highlighted by Lakhani and Wolf (2003) in that open source contributors participate in these projects in part to help and aid others. This - in relation to the work of Carrigan and Attalla (2001) - demonstrates moral value as an important value dimension, particularly with SIMGs.

Legal issues were seen as salient amongst VGI related users with emphasis on the freedom to manipulate and use data without restrictions; see Table 5.11. In support of this, comments made by VGI contributors during participatory observation were generally hostile towards legal limitations on data access. This may be considered a constant undertone, explaining why the legal dimensions came through in the thematic analysis.

Currently the legal dimension is not discussed inside consumer activity related value theory. However, Coleman (2009) highlighted that within the open source community such freedoms are seen as intrinsic to the liberal freedom of expression and human rights relating to technical ability. While Lakhani and Wolf (2003) demonstrated the personal reasons for contribution, the legal freedoms allowed to the user through the open source licences facilitate these activities. This made the personal enjoyment, fulfilment, challenge and social enhancement possible. Consequently, the salience of legal value within a multidimensional context is useful in highlighting the attitudes of those associated with VGI more than describing the practices of VGI.

Table 5.15 shows the themes that emerged from the coding of this study contain a stronger correlation with the work of Sweeny and Soutar (2001) than the work of Sheth et al. (1991). Additionally, the categories used include price and exclude conditional knowledge, making the work of Sheth et al. less relevant. However, correlation with other dimensions within the results is still relatively high. This affords an additional richness in describing the user perceptions and reactions to VGI within neogeography.

5.7.2 Spatial-data infrastructure (SDI) relationships

The rich picture presented a complex and dynamic series of relationships between the users associated with VGI. This study has demonstrated that as a
tool for understanding such complexities, the rich picture is useful in creating an easily accessible framework to which further findings can be contextualised. Therefore, consideration should be given to the similarities between the rich picture and user relationships presented through the literature.

Raj Budhathoki et al. (2008) and Grira et al. (2010) presented a framework where all users associated with VGI communicate with each other; see Figure 2.5, page 38. Here the strongest connections exist between expert organisational users and expert organisational producers. One of the key contributions that this study has made is to place boundaries on this notion. The rich picture suggests that while - within a given community (e.g. SIGs such as OpenStreetMap) - the infrastructure as described by Raj Budhathoki et al. (2008) in Figure 2.5 may hold true, the model of Raj Budhathoki et al. does not describe the full range of users associated with VGI.

From a different perspective, McDougall (2009) described the relationship between the user and the Spatial Data Infrastructure (SDI) as one experienced through the medium of Value Added Resellers (VAR); see Figure 5.3.

![Figure 5.3 – Closing the SDI Loop (McDougall, 2009)](image)

The importance of the simple framework is that users of VGI do not directly experience the SDI. This is supported through participatory observation: how the VGI contributors talked about generating the SDI, ultimately for consumers to experience through VAR’s such as MapQuest. The relationships as presented through the rich picture, while in a different format, agree with this model in that consumers utilise products and services of VGI/PGI. However, the framework of Figure 5.3 does not effectively describe the relationship between SIMGs and VGI, and Professionals and VGI/PGI.

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[18] **MAPQUEST**: A voice-guided satellite navigation platform which uses OpenStreetMap as its core data set (MapQuest, 2012)
An additional insight into the relevance of the rich picture as a tool can be seen through the participatory observation and interviews. This showed that the tensions between user groups is affected by the user group ideology (and thus in part the clashes between user group ideologies) and the form of data the users interact with. This in turn affects the flow of information within the wider user group infrastructure described by Figure 5.2; page 145. During participatory observation, such tensions were observed in how just mentioning proprietary data to VGI contributors provoked highly hostile and negative comments, while affirming the virtues of their own projects. Such perspectives are not covered by the simplistic model offered by Raj Budhathoki et al. (2008). Therefore, this study has found that the more complex and insightful rich picture of Figure 5.2 to be useful in understanding and relating the experiences and information judgements of users.

5.8 Critique of Study

One of the fundamental elements of this scoping study has been the way users were categorised as Consumers, Special Interest Groups (SIGs), Local Communities (LCs) and Professionals. As shown within Figure 5.2, the interactions and roles different users play within the VGI landscape is diverse and complex. Consequently, the four categories to some extent place artificial limits on the users, potentially limiting insights and useful descriptions into user judgements and interactions. However, it is important to stress that these findings may only apply as far as those organisations and map projects included within this study, and those of high semblance. Consequently, further comparable research is needed before the outcomes of this study can be applied to the wider field of GIS and neogeography with confidence.

The target response of the study was 10-20 participants, with 16 participants recruited. Consequently, saturation of participants was not achieved for each user group. As Table 5.5 (page 143) demonstrates, the number of participants for Special Interest Groups was of a good sample size, and may be considered semi-saturated due to lack of new codes derived during transcription analysis towards the end of the interviewing process. However, Table 5.5 also shows how Consumers, Local Communities and Professionals were not populated.
sufficiency for saturation of findings to occur. This was due to the distinct difficulty in finding appropriate and willing participants within the period.

Although the interview question sheet was semi-structured to allow participants to mention any perceptions related to VGI, the main topics of the questions asked were based upon the multidimensional theory of value by Sweeny and Soutar (2001). This possibly introduced a bias for the participants to talk about perceptions that correlate to the multidimensional theory. Although this may be the reason behind the strong correlation of perceptions demonstrated by this study, Table 5.15 also shows the response of additional perceptions by participants not suggested by multidimensional value theory. This suggests that perceptions discussed by the participants were not strongly biased.

Future research should further investigate the multidimensional user perspectives on VGI for user groups, and focus on specific users and problem spaces. The following list demonstrates the most relevant opportunities for further research coming from the scoping study; relative to the thesis objectives:

- How does perceived accuracy of the information (VGI or PGI) influence the use of the information?
- In what context does VGI offer the higher potential to enrich the user experience and how does this influence the user experience of VGI within online environments?
- How does the relationship between the data producer and the data user influence the users’ perception of usability when utilising VGI?

5.9 Conclusions

5.9.1 Relating to the project aims

To assess the success of this study in addressing the research aims of this thesis, consideration should first be given to how successfully the study aims have been addressed.

1. What Is The Nature Of VGI
This study has also shown how VGI (such as OpenStreetMap) is predominantly being produced by members of Special Interest Groups, who also develop the VGI systems as a community for utilisation by Professionals and delivery to consumers. The majority of information flow in this context is between users occurs inside project groups (e.g. OpenStreetMap, Google My-Maps), with the product of each group being the inter project/ group data for transfer.

2. **What Are The Different Characteristics Of The Key Users**

The main outcome from this research has been that while users of VGI may often share common perceptions (e.g. SIMGs, SIMGCs and professionals having a vested in the use of their groups’ map), different users will often perceive elements of VGI differently, based on which user group they may be identified with and the VGI project they are interacting with. The greater outcome of this study has been the examination of how and to what extent these similarities and differences occur. Additionally, the rich picture provided a visual framework to identify the interaction of users in terms of information flow between users; and inter-group tensions relative to those users investigated in this scoping study.

Through participant interviews and participatory observation, one prevalent theme has been that those users who are involved in VGI (OpenStreetMap) contribution and development are more biased towards their VGI project, and more against PGI projects than non-involved users may be.

3. **Understand How Different Users Perceive VGI**

Although this study was based upon value theory, determining a user-collective perception of value is an elusive concept (Zeithaml, 1988). However, if considering value as the improvement to a users’ condition through utilising VGI (Menou, 1995), then a salient increase in user value can be observed in all functional and work related perceptions.
The analysis of user perceived value (Section 5.6.2.1) supports one of the key assumptions of this thesis, that different groups of users perceive VGI differently. This is possibly due to each user group having its own needs and objectives causing different aspects of the same phenomenon to be more important to one group than another. The relation of user perceptions within the multidimensional theory of value have been demonstrated as relevant to the assessment of VGI user perceptions. However moral constructs were perceived as salient within the SIMG user group despite not being mentioned as an important in user perception in traditional value theory (Carrigan and Attalla, 2001, Sweeney and Soutar, 2001). Due to the emotional, moral and social salience of user perceptions towards VGI, the theories of *Worth Centred Design* and *Value Sensitive Design* are highly applicable to the activity of designing applications which utilise VGI; especially relating to SIMGs. However, *Value Centred Design* may not be as applicable to such VGI projects.

5.9.2 Relating to the research questions

This scoping study provided a useful insight into the how VGI is generated and utilised within a variety of situations by a complex network of users. However, this study has also identified that the conditions of information generation and utilisation required by *Research Question One* are relative to the nature of the VGI project, the reason the user is accessing the information relative to task and its unique user community. Consequently, while generalisations may be drawn on these factors, future investigation into VGI from a *User Centred Design* perspective must treat each VGI project as unique in its own right to best design for its users.

This study also highlighted how while the nature of VGI and PGI may at times be similar, the ways in which these two information forms are processed by professions and utilised by consumers can provide a clear distinction. In addressing *Research Question Two*, this study led to the production of a clear framework of VGI; see Chapter 4. This demonstrates these similarities and
differences, as well as providing a framework for understanding the Neogeographic phenomenon.

Ultimately, the scoping study serves as a useful framework to contextualise the way in which different users perceive VGI. In order to successfully build on these outcomes, an understanding as to the ways consumers utilise and perceive VGI in relation to PGI is required. In particular, it is essential that further investigation focuses on existing use of information by consumers to produce useful outcomes within a design context.
6 Study Two: Understanding Design with VGI
Using an Information Relevance Framework

6.1 Introduction
The inclusion of information by potentially untrained volunteers (Volunteered Geographic Information, VGI: Goodchild, 2007a) alongside that of the trained professional (Professional Geographic Information, PGI) has been one of the most significant shifts in the way information delivers meaning about our environment since the birth of Web 2.0 and neogeography. Whilst in their most basic forms VGI and PGI may be similar, it is the different ways in which these forms of information describe the environment – e.g. the structure of data and terminology used – where their variances are most prominent.

Individuals typically search for and use information, making choices whether to accept or reject discovered sources and deriving value from information based on its relevance to their needs (Tóth and Tomas, 2011). In the context of data quality (Coote and Rackham, 2008) and User Centred Design (Preece et al., 2002), design of new information delivery systems should be based on the users’ capabilities, current tasks and goals, conditions of product use and constraints on the product’s performance. Elwood (2008b), alongside Zielstra and Zipf (2010) proposed that both VGI and PGI possess specific advantages and disadvantages for the end user, suggesting that no single information type may fulfil all of a user’s requirements. Consequently, the development of...
mashups that utilise the best aspects of VGI and PGI have great potential to enrich the user experience when delivering information. Importantly, the work of these authors relates to the different levels of actual utility provided by data rather than the perceived utility derived from the resultant knowledge.

Within this thesis, the scoping study demonstrated that the perception of VGI is dependent on the particular use group, and the nature of their information use. To date the majority of research into the use of VGI has focused on the delivery of information through mobile, Global Positioning System (GPS) enabled devices, (Sun and Song, 2009), the level of user trust\(^{19}\) in VGI by comparing it to PGI sources (Bishr and Janowicz, 2010, Haklay et al., 2010) and objective quality within VGI (Mummidi and Krumm, 2008). This however does not address the differences in user perception of VGI and PGI, describing how one source is selected while another may be rejected. This is the topic this chapter aims to investigate.

### 6.2 Aims

The aim of this study was to take a user centred approach to studying the role that VGI plays when used alongside PGI within a realistic context. This included the utilisation of information relevance (outlined below) as the guiding theory for investigating how VGI and PGI is perceived and used by the study participants. The scientific rationale for this approach was that it enabled analysis of how information is actually used, and its potential application to a wider set of usage contexts. This was based on identifying key characteristics of the users and their tasks, and attributes of the information used.

It was the intention of this chapter to produce a greater understanding of effective use of VGI alongside PGI in the design of consumer orientated applications products and services. Therefore, the objectives of this study were to explore:

1. How VGI and PGI offer different benefits to the end user in a realistic scenario;

\(^{19}\) see Lit Review Section 2.4.2.4, page 56
2. The strengths and weaknesses of VGI and PGI relative to how they meet the information requirements of the user’s tasks and activities;

3. How VGI and PGI may be effectively integrated to produce highly usable and effective applications.

6.3 Study Rationale

6.3.1 Selection of study community

In order to investigate the perception of VGI and PGI in use, a user group was required that already made critical use of both VGI and PGI. The broad category of Outdoor Adventure Recreation was selected for the focus of this study due to the key role of geographic information (GI) within these activities. Importantly, outdoor adventure activities exhibit a relatively high potential for personal risk due to uncertainty and temporal variation in the conditions of the environment in which they participate (Ewert and Hollenhorst, 1989). It was assumed that this relatively high level of uncertainty relating to environmental conditions (and the potentially serious consequences) would shape the accessing and use of information, and would encourage the participants to critically use a wide variety of information sources while being open to innovations where beneficial to them (Richins and Bloch, 1986).

Appendix 6A gives a detailed overview of the study communities considered for investigation within this study. These communities were highlighted through the 2009-10 GeoVation Challenge (Ordnance Survey, 2010a), presenting business concepts for novel and use of GI. The relevance of such an approach was how those communities had a demonstrated and prominent need for information, not yet covered by traditional PGI. Therefore, the most suitable and prominent communities within this pool would have the greatest benefit to demonstrate the unique attributes and benefits of VGI in use.

Kayakers were selected as the participant community for this study due to their existing reliance on GI, use of dynamic information (e.g. river levels), dependence on multiple and varied information sources (e.g. books, blogs, etc.), range of potential experience levels and the potential of VGI to have influence on activities alongside PGI. Additionally while their sporting skills are
specialist, their use of GI is an extension of those skills employed within normal/ non-professional information searches. Therefore, the outcome of this research is scalable to the larger issues of how VGI may add benefit over and above PGI in other use contexts (Zeller, 2009).

It is important to highlight here the relative complexity of the kayaking activity. As a sport, kayakers engage in training, small and large-scale river trips and social events. Within each of these activities, information in the form of internal and external information plays a crucial role in guiding the events in a safe manner. Therefore, it is essential that the tasks associated with these activities are understood, not for academic gain in describing the sport, but so information use (and the benefits of VGI and PGI) may be given their full and correct context of use.

6.3.2 Choice of research approach

Within this study, the general research approach was inductive, since the purpose of the study is to explore, describe, and find meaning to the use of VGI in a realistic situation (Morse, 2003).

Since no independent variable was investigated, with the aim of the research to explore user perceptions of VGI and PGI within use situations, the most appropriate research strategy was that of the case study (Boudreau et al., 2001).

In order to afford a greater reduction of uncertainty in the analysis and conclusions of the study, and gain a better understanding of the social phenomenon of VGI in a user utilisation perspective (Greene et al., 2001) the research choice for this study was qualitative multi-methods. This is the convergence on conclusions by utilising multiple data collection techniques and analysis procedures from within appropriate qualitative methodology (Erzberger and Kelle, 2003, Tashakkori and Teddlie, 2003). The two studies which constituting the investigation are summarised within this chapter are detailed in Table 6.1.
Table 6.1 – Multi-Methods Used Within Chapter Six

<table>
<thead>
<tr>
<th>Study</th>
<th>Research Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2A</td>
<td>Participatory Observation</td>
<td>Providing powerful insider knowledge on the relevance of VGI and PGI to kayakers that may be hard to verbalise within the relative formalities of a focus group, leading to deeper understanding (Sui and DeLyser, 2011).</td>
</tr>
<tr>
<td>2B</td>
<td>Focus Groups</td>
<td>An efficient way to collect a large volume of qualitative data, produces naturalistic responses, be cost effective and access opinions difficult to achieve through one-on-one interviews (Robinson, 1999).</td>
</tr>
</tbody>
</table>

6.3.3 Boundary conditions

The boundary conditions (i.e. those that limit the degrees of freedom, promote reliability and define the generalizability of results) employed within this study are shown below in Table 6.2.

Table 6.2 – Boundary Conditions Placed On The Study

<table>
<thead>
<tr>
<th>Boundary Conditions</th>
<th>Explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Users</td>
<td>Constrained by specifying participants</td>
</tr>
<tr>
<td></td>
<td>Unconstrained</td>
</tr>
<tr>
<td>Tasks and Context</td>
<td>Constrained by specifying participatory observation</td>
</tr>
<tr>
<td></td>
<td>Unconstrained by allowing the use of any external information</td>
</tr>
</tbody>
</table>

6.4 Investigation Overview

This chapter comprises a multi-methods investigation into the support that VGI and PGI may provide for end users undertaking a specific task. Two independent investigations comprised 1) participatory observation to understand the social factors and interactions between users and 2) focus groups to gain a deep insight into the way groups of users utilise VGI and PGI. The qualitative research methods centred on understanding why different forms of information were used, how they were utilised and the way in which the characteristics of that information shaped the community’s activities. Data was
analysed through thematic analysis, with relevance used a theoretic framework. Results were analysed separately, but brought together in the discussion and conclusion.

6.5 Study Two A: Participatory Observation

6.5.1 Methods

6.5.1.1 Participant Sampling
To ensure a diverse representation of opinions a range of kayak clubs were involved in the focus groups, all adhering to the following criteria:

- Regular meetings between members in a formal location such as club or boathouse,
- Membership is open to the public, rather than being a private club,
- The main activities of the club are recreational kayaking, as opposed to slalom or racing,
- Regular trips are organised by the club members for other club members,
- A wide range of abilities included in the club, from beginner to expert.

6.5.1.2 Data Collection
During data collection, the position of participant as observer was sought (Gold, 1969, Junker, 1960). This was selected since it offered a useful degree of separation from the participants, not afforded by the more involved complete participant, yet enough involvement to gain a deep understanding of the issues difficult to obtain through the marginal participant perspective (Gold, 1969). Participation took the following forms:

- Kayaking with club members on their weekly meetings
- Joining and training with the Loughborough Students Canoe Club (LSCC) throughout the study investigation period
- Kayaking river trips with clubs involved with this study.
Data for participatory observation was captured using *descriptive* observation under the dimensions highlighted in Table 6.3 to provide a rich and useful insight into user perceptions.

### Table 6.3 - Dimensions Of Descriptive Observation (Spradley, 1980)

<table>
<thead>
<tr>
<th>Descriptor</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space</td>
<td>Layout of the physical setting; room, outdoor spaces, etc.</td>
</tr>
<tr>
<td>Actors</td>
<td>The names and relevant details of the people involved</td>
</tr>
<tr>
<td>Activities</td>
<td>The various activities of the actors</td>
</tr>
<tr>
<td>Objects</td>
<td>Physical elements: furniture, etc.</td>
</tr>
<tr>
<td>Acts</td>
<td>Specific individual actions</td>
</tr>
<tr>
<td>Events</td>
<td>Particular occasions, e.g. meetings</td>
</tr>
<tr>
<td>Time</td>
<td>The sequence of events</td>
</tr>
<tr>
<td>Goals</td>
<td>What actors are attempting to accomplish</td>
</tr>
<tr>
<td>Feelings</td>
<td>Emotions in particular contexts</td>
</tr>
</tbody>
</table>

6.5.1.3  **Data Analysis**

McCall and Simmons (1969) stated that the output from participatory observation is “an analytic description of a complex social organisation”. Records of observation were not coded, yet the statements and outcomes helped to validate and put into context the data from the focus groups.

6.5.2  **Results and analysis**

Participatory observation occurred on 12 occasions, with over 100 members from independent kayaking clubs; see Figure 6.1.
Figure 6.1 – Examples of Participatory Observation. A) Very low water levels not predicted by VGI or PGI, B) Unpredictable events, a split in a Kayak while on river, no emergency plan, C - F) Engaging with participants during observation

The following key outcomes were derived from the observation during the study:

- Information serves to inform ideas about situations, critically analysed by participant based on past experience.

- Information is no substitute for experience; less experienced kayakers will seek to discuss issues with more experienced kayakers during an information search, and will value the opinions of their more experienced peers over third party information.

- The main role of information to the kayakers was allowing for the effective management of risk. Here, information was gathered up to the point where the participants felt they can kayak within the given risk conditions, creating a feeling a security.

- Activities centred on the social aspects of the sport, in some cases being seen as more important and prominent than the physical act of kayaking.
During the observation (on the water) sessions, there was no evidence of participants consulting reference material or official guides. This suggests that external sources of PGI and VGI were used during the planning phase only. This was surprising, since it was assumed that guide books and similar would be used while kayaking. However, it was clear that environmental information cues, such as river levels and potential obstructions were actively sought, the main objective being the effective management (as opposed to minimising) of risk. These environmental cues clearly satisfy several of the relevance criteria including accuracy, currency, and tangibility. In addition, verification was also important, where multiple cues (e.g. relating to presence of obstructions) were sought. The role of experience of fellow kayakers was also key, in the search for (and interpretation of) external environmental cues.

6.6 Study Two B: Focus Groups

6.6.1 Methods

6.6.1.1 Participant Sampling

Non-probability purposive sampling methods were used to identify participants from the diverse range of kayaking clubs selected originally for participatory observation. The specific criteria for participant selection were:

• A minimum of two years kayaking experience
• Familiarity in planning of kayaking trips
• Experience using professional and amateur volunteer information sources
• Are not excluded from participation under ethical terms

Participants in the focus groups were categorised by their number of years’ experience kayaking as it was assumed that the more experienced kayakers may respond to information differently than less experienced kayakers; see Table 6.4. For analysis, kayakers of over five years’ experience are referred to as experienced, whereas one to four years’ experience counted as intermediate. Thirty-two participants (23 highly experienced, nine intermediate)
from separate kayaking clubs took part in the four focus groups, and 50+ club members were involved anonymously in participatory observation. Although clubs had their own distinct focus (racing, white water, sea, social, flat water), all four were fundamentally recreational clubs.

Table 6.4 - Breakdown Of Focus Group Participants By Years Kayaking Experience

<table>
<thead>
<tr>
<th>Club Name</th>
<th>1 - 4 Years (intermediate)</th>
<th>5+ years (Expert)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paddleplus (Leicester)</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Holme Pierpoint Canoe Club (Nottingham)</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Rugby Canoe Club (Rugby)</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Loughborough Students Canoe Club</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>9</strong></td>
<td><strong>23</strong></td>
</tr>
</tbody>
</table>

For their time and involvement in the focus group, the participants were offered an incentive of £5 per person, donated to the club.

6.6.1.2 Data Collection

In order to ensure the appropriate nature of the questions put to the focus groups, and the correct interpretation of their answers, focus groups were conducted after participatory observation.

As commented by Morgan (1998), exploratory studies require a less structured approach to the group interview than formal interviews where a known entity is being tested. Questions were used to guide the group discussion, yet allow enough leeway to develop the content of the discussion. In order to keep a scientific rigour a set question sheet was developed to offer the same basic questions to all focus groups. A series of thematic questions were devised in order to extract the desired information from the participants through engaging conversation and exploration of topics amongst participants (Krueger, 1998b). Consequently, the questions centred on understanding:

- The information search process involved in planning of kayaking trips
- The positive and negative kayaking experiences of kayaking trips in relation to the impact of information
The benefits of both amateur and professional information sources

The nature of trust in information

The full question as used within the focus groups is presented in Appendix 6B. Sessions were recorded for later transcription, with group members being provided with additional material to make notes, sketches (etc.). The length of the session was not predefined, but tended to last for an hour.

6.6.1.3 Data Analysis

Thematic analysis was selected due to its focus on identifying themes and patterns in participant behaviour, and the development of deep insights in phenomena from which hypothesis and/or theory may be generated (Boyatzis, 1998, Stake, 1995, Yin, 1994). From the work of Aronson (1994) and Boyatzis (1998), the following thematic analysis practice relating to this study was recognised:

1. Developing Themes and Codes - Combine and catalogue related patterns into sub-themes, producing a comprehensive story of their collective experience.

2. Sensing Themes - Patterns of Experience are collected from the data, recognising a code-able moment.

3. Consistent and Reliable Coding - Identify all data that relate to already classified patterns.

4. Review of Codes – allow for the coding structure to change with themes emerging from the data.

5. Testing Reliability and Interpreting The Information - Build a valid argument for choosing themes and formulate 'theme statements' to develop a ‘story line’. “When the literature is interwoven with the findings, the story that the interviewer constructs is one that stands with merit”.

Figure 6.3 demonstrated the relation between the study objectives and theory used to guide the research and analysis within this chapter. From this, the basic categories used in coding were generated.

Note: The order of this process may differ for different qualitative analysis approaches. For example, a grounded theory approach (Robson, 2002) may require the order 2 – 3 – 1 – 4 – 5.
Table 6.5 - Outline of coding scheme used within the study

<table>
<thead>
<tr>
<th>Study Objectives</th>
<th>Guiding Theory</th>
<th>Coding Category</th>
<th>Sub-Category</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. How VGI and PGI offer different benefits to the end user in a real world scenario.</strong></td>
<td>Information can benefit users in one of three stages of activity: planning, doing and reflecting (Davis, 2005, Gitelson and Crompton, 1983, Money and Crotts, 2003)</td>
<td>Impact on Trip Activities</td>
<td>Planning</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Undertaking Trip</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Post Discussion</td>
</tr>
<tr>
<td><strong>2. The strengths and weaknesses of VGI and PGI relative to how they meet the information requirements of the users' tasks and activities.</strong></td>
<td>Dissemination of information sources on unknown destinations (Gitelson and Crompton, 1983, Hawkins et al., 1995, Weiss and Heide, 1993)</td>
<td>Source of Information</td>
<td>Formal</td>
</tr>
<tr>
<td></td>
<td>Professionalism is relative to authority of source (Coleman et al., 2009)</td>
<td>Identification of Volunteered and Professional Information</td>
<td>Informal</td>
</tr>
<tr>
<td><strong>4. How VGI and PGI may be effectively integrated to produce highly usable and effective applications</strong></td>
<td>Relevance of information to the user (Alonso et al., 2008, Barry and Schamber, 1998, Cooper, 1971)</td>
<td>Information Characteristics</td>
<td>Accessibility</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Accuracy</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Affectiveness</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Availability</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Clarity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Currency</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Depth</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Quality</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Tangibility</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Verification</td>
</tr>
</tbody>
</table>

A more detailed coding rationale is provided within Appendix 6C. While handling focus group transcripts, qualitative analysis software NVivo 9 (QSR International, 2010) was used as a tool to store, sort, code and integrate the data into meaningful descriptions and phenomenon. Since Boyatzis (1998) remarked that “converting themes into codes and then counting presence, frequency or intensity does not in and of itself create a link between qualitative and quantitative methods”, frequency counts of different codes were used in conjunction with the intensity in participant statements and the linguistic content of those statements in order to describe the relevant phenomenon.
6.6.2 Results and analysis

Thirty-two participants took part in four focus group sessions. During the focus groups, PGI sources mentioned included guidebooks, maps and official reports, with VGI focusing mainly on forums, amateur reports and social media. A detailed coding of the focus group - including the number of references made to each theme and the number of participants who mentioned that theme - enabled an investigation of the relative importance of the information relevance attributes and a comparison between VGI and PGI. Figure 6.2 shows participants in the focus groups during this study.

Krueger (1998a) highlights frequency, extensiveness and intensity of participant comments as the key to understanding their general importance. For this reason the results within this section presents both the frequency of coding references, and the number of participants who voiced opinion on that subject. The intensity to which phenomenon was expressed during the focus group is considered during the analysis phase.
6.6.2.1 Hierarchical Task Analysis

In order to contextualise the impact of VGI and PGI across the entire trip process, a Hierarchical Task Analysis (HTA) was performed based on the focus groups and participatory observation. The HTA was required in order to identify which activities are more likely to draw on external information sources and to provide a framework for understanding the roles and influence of VGI and PGI. Table 6.6 presents the number of participants who mentioned each trip activity (cases coded), and Table 6.7 presents the total number of references made (coding references).

Table 6.6 - Kayaking Trip Activities – Cases Coded

<table>
<thead>
<tr>
<th>Activity Sub Activity</th>
<th>Task</th>
<th>Intermediate (1-4)</th>
<th>Expert (5+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan kayaking Trip</td>
<td>Book Amenities</td>
<td>Accommodation</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>logistics</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Decide on group &amp; area</td>
<td>Select People - then water</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Select Water - then people</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Gather Information</td>
<td>Check Water Conditions</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Plan for River Safety</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rehearse Trip from Experience</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Research Access Rights</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Understand River as a whole</td>
<td>2</td>
</tr>
<tr>
<td>Go on Trip</td>
<td>Get into Water</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Get out of Water</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Planning when at water</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Scout ahead while on water</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Taking Rest</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Post Trip</td>
<td>Share Trip Experiences</td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

Table 6.7 - Kayaking Trip Activities – Coding References

<table>
<thead>
<tr>
<th>Activity Sub Activity</th>
<th>Task</th>
<th>Intermediate (1-4)</th>
<th>Expert (5+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan kayaking Trip</td>
<td>Book Amenities</td>
<td>Accommodation</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>logistics</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Decide on group &amp; area</td>
<td>Select People - then water</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Select Water - then people</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Gather Information</td>
<td>Check Water Conditions</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Plan for River Safety</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rehearse Trip from Experience</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Research Access Rights</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Understand River as a whole</td>
<td>3</td>
</tr>
<tr>
<td>Go on Trip</td>
<td>Get into Water</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Get out of Water</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Planning when at water</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Scout ahead while on water</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Taking Rest</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Post Trip</td>
<td>Share Trip Experiences</td>
<td></td>
<td>15</td>
</tr>
</tbody>
</table>
Figure 6.3, based on the work of Bhavnani and Bates (2002), was drawn from analysis of all data collection methods used. The HTA was developed to demonstrate the decomposition of goals, their relation to information types and the information required to execute each stage. Of this, the two categories of information considered (as describing an impact on the user in terms of their information needs) were declarative and procedural. Here, declarative information relates to information which must be understood and retained, whereas procedural information is the delivery of instruction (Ummelen, 1997).

After the first draft of the HTA was developed, reliability was assessed through two additional focus groups involving experienced kayakers at Rugby and Rutland Water Canoe Clubs. Participants were sourced through the same methodology as in the main focus groups. Following discussion of the draft HTA, amendments to the structure, process and description were made as required.
Further description to Figure 6.3 and the four levels of the HTA are described in Table 6.8.
### Table 6.8 - Declarative And Procedural Relations To The HTA Information Layers

<table>
<thead>
<tr>
<th>Layer</th>
<th>Declarative</th>
<th>Procedural</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Task</strong></td>
<td></td>
<td>Task Selection: First plan the trip, and then embark on it.</td>
</tr>
<tr>
<td><strong>Information Search</strong></td>
<td>Existence of: 1. Judging water conditions 2. Considering experience of others 3. Considering multiple information sources and converge on ‘truth’ 4. Organisation skills 5. Information search skills 6. Communication skills</td>
<td>Command Selection: 1. All information search options should be completed sequentially as indicated by their numerical indicator. 2. If a stretch of river has been predetermined, then only search options A3.1 – A3.5 should be completed. 3. Any of the search options provide information which would endanger trip members, return to A1 OR cancel trip. 4. Options A4.1 and A4.2 continue in iteration until amenities and logistics are organised.</td>
</tr>
</tbody>
</table>

Analysis of the focus group transcripts with reference to information use demonstrated that personal experience is used as a filter for volunteered and professional information. This observation is mirrored in the **declarative information** column. Here, rather than requiring information in order to execute
the various goals of the planning process, the participants require a certain degree of personal experience in order to fully complete the planning process.

An interesting outcome from the HTA generation was task C0 – Post Trip Discussions. When asked about the trip experience or activities, no responses were made towards activities after their time on the water. However, participants placed high relevance on interpersonal communication, using their friends and social networks as efficient and effective data sources. While this does not constitute VGI due to its very limited potential to be shared with a large audience, it demonstrates the desire to share information and experiences which is at the heart of VGI creation (Feick and Roche, 2010, Goodchild, 2008a, Scharl and Tochtermann, 2007). However, it also demonstrates how the participants did not see this activity as highly important or relevant, limiting the potential of this information.

**Impact Of Information On Trip Activities**

Table 6.9 and Table 6.10 present issues discovered in the data relating to the main activities involved in the trip.

<table>
<thead>
<tr>
<th>Plan kayaking Trip</th>
<th>Amateur Volunteered</th>
<th>Professional</th>
<th>Personal Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information Hard to Get</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Enables Critical analysis of info</td>
<td>1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Enhances Understanding</td>
<td>22</td>
<td>23</td>
<td>1</td>
</tr>
<tr>
<td>Give details about topography</td>
<td>3</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Helps with planning</td>
<td>5</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Lack of Information</td>
<td>4</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Post Trip Discussions</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Some Information is of little use</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Understand features that are important to you</td>
<td>11</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Go on Trip</th>
<th>Amateur Volunteered</th>
<th>Professional</th>
<th>Personal Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bad Info Led to Damage to Self</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Adrenaline, Challenge &amp; Achievement</td>
<td>2</td>
<td>1</td>
<td>17</td>
</tr>
<tr>
<td>Adventure or discovery (non adrenaline)</td>
<td>1</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>Allowed group to find a river at right skill level</td>
<td>2</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Allowed Personal Fulfillment</td>
<td>1</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>Allowed Social Interaction</td>
<td>5</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>Enabled Successful trip &amp; paddle</td>
<td>3</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Incorrect was Information</td>
<td>1</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Information Increased Safety</td>
<td>6</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Poor planning makes life hard</td>
<td>0</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Uncertain about what's on river - must check</td>
<td>6</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
Table 6.10 - Kayaking Trip Issues and Information Sources – Coding References

<table>
<thead>
<tr>
<th>Plan kayaking Trip</th>
<th>Amateur Volunteered</th>
<th>Professional</th>
<th>Personal Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information Hard to Get</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Enables Critical analysis of info</td>
<td>1</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Enhances Understanding</td>
<td>44</td>
<td>46</td>
<td>1</td>
</tr>
<tr>
<td>Give details about topography</td>
<td>4</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>Helps with planning</td>
<td>8</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>Lack of Information</td>
<td>4</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Post Trip Discussions</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Some Information is of little use</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Understand features that are important to you</td>
<td>16</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

| Go on Trip                               |                     |              |                     |
| Bad Info Led to Damage to Self           | 0                   | 2            | 1                   |
| Adrenaline, Challenge & Achievement      | 2                   | 1            | 28                  |
| Adventure or discovery (non adrenaline)  | 1                   | 0            | 29                  |
| Allowed group to find a river at right skill level | 2           | 1            | 13                  |
| Allowed Personal Fullfillment            | 1                   | 1            | 15                  |
| Allowed Social Interaction               | 8                   | 0            | 25                  |
| Enabled Successful trip & paddle         | 4                   | 3            | 6                   |
| Incorrect was Information                | 1                   | 6            | 0                   |
| Information Increased Safety             | 6                   | 6            | 13                  |
| Poor planning makes life hard            | 0                   | 2            | 5                   |
| Uncertain about what's on river - must check | 10                  | 1            | 0                   |

**Stage 1: Planning**

As shown in the HTA and Table 6.10, in the earliest stages of the kayaking activity (A1 – A2), *internal information* in the form of personal experience is the predominant information source. This was supported by the participatory observations made during the trip. For example, Figure 6. shows the water levels at the get in point, a water measure and a prominent bridge. While such measures may be categorised as *official*, it was the participant’s internal knowledge and experience that gave those features meaning rather than information acquired prior to the trip. Table 6.11 gives an overview of the outcomes of the focus groups, related quotes from the participants to support an overview of information use during trip planning.
Table 6.11 – Outcomes Relating To Planning

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Quote</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>The only theme in the results relating to information use and its accessibility was the negative response that professional information is hard to obtain (four cases, four references).</td>
<td>I found trying to get hold of access information can be quite hard. Quite often, I just resign myself to just asking a mate who's been there recently, or perhaps someone who is more in the know than me [#2-1-07]</td>
<td>The general low support for this comment suggests participants did not have trouble accessing the quantity of information they required for trip planning.</td>
</tr>
<tr>
<td>Some comment was made on the usefulness VGI and PGI. However, this was not a highly supported comment, and was voiced only by experienced kayakers for whom part of the excitement of kayaking is adventure and discovery:</td>
<td>I always read the guidebook just before, someone's driving me to the river you have a quick flick through it, and then when you are put on the water you only forget what was in there anyway; you just go with it [#2-2-04]</td>
<td>The issue of resolution of information(^{21}) may play an important role in its relevance to the user.</td>
</tr>
<tr>
<td>PGI provides details about the general topography of the river (ten cases, 13 references), while VGI provides information on specific points of interest (11 cases, 16 references).</td>
<td>VGI must be verified somehow [#2-4-05]</td>
<td>Made at a much higher rate than the need for participants to check PGI (one case, one reference). This is of particular interest when considering the high number of references made for VGI being up to date, and PGI out of date.</td>
</tr>
<tr>
<td>A relatively small sample (six cases, ten references) on how VGI needs to be checked before use:</td>
<td>Often rafters are also kayakers… but again you still have to take it with a pinch of salt… so what's easy for them isn't necessarily easy for you. So you still got to read the guidebook, scout as much of the river as you can as possible [#2-1-07]</td>
<td>Highlights an important factor that external information searches alone cannot provide for a successful user experience (a successful kayak trip).</td>
</tr>
<tr>
<td>Personal experience allows critical evaluation of external information sources (4 cases, 6 references)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^{21}\) Resolution – wide geographic range with low individual item detail equates to low resolution (but high coverage in m\(^2\)), low geographic range with high individual item detail equates to high resolution (but low coverage in m\(^2\)).
Very high responses were given to both VGI (21 cases, 42 references) and PGI (23 cases, 51 references) sources enhancing the participant’s general understanding. Suggests that the most relevant factor of information in the activity is its ability to enhance the understanding of the user.

Stage 2: Undertaking

The majority of responses made in reference to the impact on information on kayaking activities were in the context of the trip itself. Table 6.12 gives an overview of the outcomes of the focus groups, related quotes from the participants to support an overview of information use during the kayak trip.

Table 6.12 – Outcomes Relating To Undertaking

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Quote</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>The highest response was for personal experience being a useful tool in helping the participant to engage in further personal experiences. A significant amount of participants (17 cases, 28 references) commented that it is the adrenaline or challenge of the sport that they find highly enjoyable.</td>
<td>No one else has really seen it other than the people that have been down the river. And if you get to, you can get certain places that you’d never be able to walk to [#2-1-08]</td>
<td>This collection of positive experiences are enabled by personal experience, and while information may have enabled the trip to happen no information provides the positive experiences which the participants enjoy.</td>
</tr>
<tr>
<td>While information does not provide the participant with positive experiences, the negative aspects of the tangible outcomes demonstrate that a lack of information may allow for negative experiences.</td>
<td>We were in Austria and we were driving along a road. ‘Oh that looks like a good rapid’... didn’t scout it... It was just ridiculously steep and just huge holes. it was a blur [#2-4-03]</td>
<td>This section suggests that information does not provide the kayaking participants with good experiences, but it can prevent them from having bad experiences and thus enables an enjoyable trip to occur.</td>
</tr>
<tr>
<td>Only five cases with six references made note that professional information sometimes provided incorrect information, against one case and one reference for VGI</td>
<td>We rang up the river information office and I said “what’s the levels like?” and he said “very favourable”. And when we got there we had to walk around half of it was so low! I was like ‘if this is favourable....’ [#2-2-01]</td>
<td>Related to the high proportion of participants who commented that professional information has a tendency to be out of date (see Table 6.27). This suggests that the more up to date the information is the more likely it is to reflect the current conditions and thus be correct.</td>
</tr>
</tbody>
</table>
Stage 3: Post Trip Discussion

Table 6.13 – Outcomes Relating To Post Trip Discussion

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Quote</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>The salience of VGI during the trip planning stage suggests dissemination and volunteering of information post trip to other kayakers is a key element of the trip activities:</td>
<td>By chatting to paddling friends, I usually can decide whether the particular river is within my comfort zone and abilities [#2-2-04].</td>
<td></td>
</tr>
<tr>
<td>This dissemination process may be formal processes but mostly they are informal chatting to other kayakers in informal settings</td>
<td>if you’re padding a stretch of river there’s generally certain points you can get on… and there’s always a pub along that stretch at some point. So if you see other paddlers you talk to them [#2-1-02]</td>
<td></td>
</tr>
</tbody>
</table>

6.6.2.2 Relevance Of Information Sources

Table 6.14 and Table 6.15 present the relationship between positive and negative characteristics of amateur volunteered and professional information in a kayaking trip-planning scenario. Table 6.14 presents the number of participants who commented on the theme, while Table 6.15 presents the number of time the themes were mentioned by the focus group participants.
Table 6.14 - Information Characteristics Results – Cases Coded

<table>
<thead>
<tr>
<th>Relevance Theme</th>
<th>Sub Category</th>
<th>Themes From Data</th>
<th>Amateur Volunteered</th>
<th>Personal Experience</th>
<th>Professional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessibility</td>
<td>Negative</td>
<td>Costs money to acquire</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Positive</td>
<td>Easy to access</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Free to get hold of</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Accuracy</td>
<td>Positive</td>
<td>Accurate</td>
<td>7</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Less biased</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Affectiveness</td>
<td>Negative</td>
<td>unfriendly sources</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Friendly sources</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Availability of Information</td>
<td>Positive</td>
<td>Large volume of info available</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Clarity</td>
<td>Negative</td>
<td>Sometimes Vague</td>
<td>1</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Positive</td>
<td>Well structured</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Currency</td>
<td>Negative</td>
<td>Out of date</td>
<td>3</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Positive</td>
<td>Up to date</td>
<td>16</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Depth, Scope, Specificity</td>
<td>Negative</td>
<td>Incomplete</td>
<td>4</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Positive</td>
<td>multiple sources converge on truth</td>
<td>6</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unique Information</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Quality</td>
<td>Negative</td>
<td>Opinionated</td>
<td>11</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Purposeful Misinformation</td>
<td>7</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unreliable or incorrect</td>
<td>14</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Positive</td>
<td>Reliable</td>
<td>11</td>
<td>0</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Trust personal contacts the most</td>
<td>9</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Tangibility</td>
<td>High Tangibility</td>
<td></td>
<td>7</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Low Tangibility</td>
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<td>20</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>Verification</td>
<td>Negative</td>
<td>not as good as experience</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Positive</td>
<td>The best form of information</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 6.15 - Information Characteristics Results – Coding References

<table>
<thead>
<tr>
<th>Relevance Theme</th>
<th>Sub Category</th>
<th>Themes From Data</th>
<th>Amateur Volunteered</th>
<th>Personal Experience</th>
<th>Professional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessibility</td>
<td>Negative</td>
<td>Costs money to acquire</td>
<td>0</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Positive</td>
<td>Easy to access</td>
<td>3</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Free to get hold of</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Accuracy</td>
<td>Positive</td>
<td>Accurate</td>
<td>15</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Less biased</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Affectiveness</td>
<td>Negative</td>
<td>unfriendly sources</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Friendly sources</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Availability of Information</td>
<td>Positive</td>
<td>Large volume of info available</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Clarity</td>
<td>Negative</td>
<td>Sometimes Vague</td>
<td>1</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Positive</td>
<td>Well structured</td>
<td>0</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Currency</td>
<td>Negative</td>
<td>Out of date</td>
<td>4</td>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Positive</td>
<td>Up to date</td>
<td>23</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Depth, Scope, Specificity</td>
<td>Negative</td>
<td>Incomplete</td>
<td>8</td>
<td>1</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>Positive</td>
<td>multiple sources converge on truth</td>
<td>11</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unique Information</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Quality</td>
<td>Negative</td>
<td>Opinionated</td>
<td>26</td>
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<tr>
<td></td>
<td></td>
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<td>0</td>
</tr>
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<td></td>
<td>Unreliable or incorrect</td>
<td>18</td>
<td>0</td>
<td>5</td>
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<tr>
<td></td>
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<td>Reliable</td>
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<td>0</td>
<td>33</td>
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<td></td>
<td></td>
<td>Trust personal contacts the most</td>
<td>18</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Tangibility</td>
<td>High Tangibility</td>
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<td>14</td>
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<td>9</td>
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<tr>
<td></td>
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<td>not as good as experience</td>
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<td>3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Positive</td>
<td>The best form of information</td>
<td>4</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

To give meaning to Table 6.14 and Table 6.15, outcomes and their connotation to the study aims are presented in the sub-sections below.
Chapter 6: Study Two

Accessibility

Table 6.16 – Relevance of Information Sources: Accessibility

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Quote</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Although one of the key characteristics of PGI is its premium association(^2), only five participants mentioned this as a problem accessing information, concentrating on the cost of PGI being an inconvenience rather than a preventing factor</td>
<td>Quality of info varies a lot and you need to pay before you see what you get [#2-3-09]</td>
<td>Paying for information is not seen as a great burden on the information seeker, more a way of passage to the information that will make their trip success; if proprietary information is sought.</td>
</tr>
<tr>
<td>Very high salience (29 cases with 77 references) was given to VGI from kayaking websites and forums. In addition to this, only four participants made five references towards VGI being free:</td>
<td>People don’t generally want money for it [#2-3-09]</td>
<td>This suggests that while free information is of benefit to the user, it is not a factor which makes the information appear more attractive to the user.</td>
</tr>
</tbody>
</table>

Accuracy

Table 6.17 – Relevance of Information Sources: Accuracy

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Quote</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>While more references were made to VGI sources being accurate than were made towards PGI sources, more VGI sources are used in the convergence of truth than PGI sources.</td>
<td>multiple sources converge on truth rather than hold truth within a single source [#2-1-04]</td>
<td>Accuracy of the information being received is an important factor, but it is most important when considering multiple sources and factors which can confirm or reject the statements made.</td>
</tr>
<tr>
<td>Through the research no comment was made on the emotional connection between the participant and professional information. Instead, the only emotional connection was down to persons encountered during trips which falls outside the remit of VGI:</td>
<td>They always seem to be having a worse day than us though......the fourth one [fisherman] jumped up and down, looked miserable, looked like we have ruined his whole day, we just laughed [#2-2-03]</td>
<td>This suggests that while affectiveness towards an information source may influence the sources a user goes to in their information search, it does not influence their general preference for use of PGI or VGI.</td>
</tr>
</tbody>
</table>

\(^2\) the professional(s) selling their certified information as a source of income (O'Brien, 2010)
### Affectiveness

**Table 6.18 – Relevance of Information Sources: Affectiveness**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Quote</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very high salience can be assigned to the use of VGI from kayaking websites and forums, yet limited comment was made by participants about the volume of information available.</td>
<td>Either the participants are not overly concerned with the volume of information available, or the information sources available fulfil their need. One explanation may be some kayakers enjoy the sense of the unknown, and therefore a lack of information may add to the user experience.</td>
<td></td>
</tr>
</tbody>
</table>

### Availability

**Table 6.19 – Relevance of Information Sources: Availability**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Quote</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>A salient number of participants (nine cases with 12 references) commented that they found PGI at time vague and hard to understand</td>
<td>If you’re reading it out of a book you might not quite understand certain aspects [#2-3-06]</td>
<td>VGI offers a certain degree of clarity above that of professional information. This may be because most if not all of the VGI relevant to kayakers comes from homogenous sources, and thus should be easier for the information seeker to ingest.</td>
</tr>
</tbody>
</table>
### Clarity

#### Table 6.20 – Relevance of Information Sources

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Quote</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Five cases with eight references noted that professional information was in general well structured:</td>
<td>[It’s] often produced in a more usable format and more accessible (published bodies/websites), not trawling through information on forums [#2-4-05]</td>
<td>While these outcomes may suggest that PGI has a communicatory advantage over VGI in terms of clarity, the lack of comment towards VGI makes it difficult to state a definite outcome in terms of relative strengths and weaknesses.</td>
</tr>
<tr>
<td>A salient portion (17 cases with 30 references) commented that professional information tends to be out of date:</td>
<td>What maps and guidebooks don’t give you is up to date information. Just because it was a good guide to the river five years ago doesn’t mean it’s a good guide to the river now [#2-1-05]</td>
<td></td>
</tr>
</tbody>
</table>


## Currency

### Table 6.21 – Relevance of Information Sources

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Quote</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three cases with four references commented that VGI was out of date.</td>
<td>You get things like ‘trees’ across big rivers’ and things like that.</td>
<td>However, only six percent of participants referred to professional information being up to date.</td>
</tr>
<tr>
<td></td>
<td>Quite often within a few days you will get a notice on a forum saying “be careful there is a big tree stuck on the rock on ‘this’ bend” sort of thing [#2-3-09]</td>
<td></td>
</tr>
<tr>
<td>Information needs to reflect the conditions of the outdoor environment when the participant experiences it. The importance of this is highlighted by the information sources which can capture rapidly changing and largely unpredictable factors (such as river conditions) being seen as more accurate than slower responding sources:</td>
<td>[VGI is] often more accurate with [the inclusion of] real time information [#2-1-02].</td>
<td>Inferring the paddleable conditions of a river and reporting them through VGI channels as observed during participation demonstrated VGI’s unique ability in delivering this need compared with the planned surveying practices of PGI.</td>
</tr>
<tr>
<td>Although a proportion of participants made comment that VGI is incomplete (four cases with eight references), a far greater salience can be given to participants perceiving professional information as incomplete (11 cases with 22 references):</td>
<td>Like we said with maps, you can’t gauge, like I said, bank levels, and you can’t, it’s, there more for distances and everything like that [#2-1-08]</td>
<td>The focus groups also suggested that PGI can (at times) describe the general overview of the outdoor environment, yet misses key details about the features most important to the participants.</td>
</tr>
</tbody>
</table>
Table 6.22 – Relevance of Information Sources: Depth

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Quote</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rather than utilise a single VGI source, they access multiple sources and converge on the truth:</td>
<td>I think you use it, all these little bits of information to build a whole picture of what you want to do [#2-1-04].</td>
<td>This contrasts with use of PGI – with only 9% of participants stating that they would use multiple sources of information rather than use a single PGI source. Regular emphasis was used by participants to stress the importance of using information to confirm discovered VGI.</td>
</tr>
<tr>
<td>An almost equally strong resonance (11 cases with 26 references for amateur volunteered, 13 cases with 22 references for professional) was perceived by the participants that the information they receive is opinionated or subjective depending on the originator:</td>
<td>[VGI] It’s very open to interpretation. Someone else’s grade 5 can be someone else’s grade 3 [#2-4-05]</td>
<td>Kayakers use predominantly personal experience while on the water. Personal experience acts as a filter for information use while planning a trip. This suggests that the information seeker is subjective, in that what they consider to be difficult is personal to them and thus they must understand the conditions of the water being described to match it to their understanding of difficulty rather than take the as stated level of difficulty. This may explain why both VGI and PGI are seen as subjective in the eyes of the information seeker.</td>
</tr>
</tbody>
</table>
Quality

Table 6.23 – Relevance of Information Sources

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Quote</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>An interesting outcome from the data was a proportion of the participants (14 cases, 18 references) said VGI was unreliable:</td>
<td>Locals will probably know more about access, but locals are often not kayakers [#2-1-07]</td>
<td>Although there was relatively limited reference to VGI being purposefully misguided or otherwise unreliable, its presence indicated a level of distrust in the potential quality of VGI. This suggests that for volunteered systems to be seen with confidence from a user case, a mechanism is required to overcome this perceived sacrifice in obtaining and using VGI.</td>
</tr>
<tr>
<td>a number of participants (11 cases with 23 references) perceived VGI reliable:</td>
<td>I think it’s possibly more reliable, up to date, and you could be talking to somebody who is local and knows the river and walked past it that morning [#2-1-02]</td>
<td>What is also interesting but not unexpected is that a larger proportion of participants (19 cases with 33 references) perceived professional information as reliable. Participants in the focus groups commented that PGI creators are “honest and trying to the best of their knowledge; it’s their reputation” [#2-4-03] and their material is “usually [a] very trustworthy source with high level of experience” [#2-4-01].</td>
</tr>
<tr>
<td>a proportion of the participants commented that they trust their personal contacts more than anonymous sources such as guide book authors or forum posters:</td>
<td>I’ll chat to my friend and he will say ‘yeah your able to do that’... Whereas if he said ‘ooh’, I’m not doing it. I put that much sway on what he says that it really does influence where I want to go, what I want to do... you just done get from websites or books [#2-2-04]</td>
<td>This suggests that factors such as social networks, homogeneity and interpersonal trust in the information originator may be key factors in the information seekers perception of the information’s quality</td>
</tr>
</tbody>
</table>

---
### Tangibility

#### Table 6.24 – Relevance of Information Sources: Tangibility

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Quote</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additionally, the forms of information that may be authoritative (e.g. Ordnance Survey) may not be able to report changes in the environment at a fast enough rate to be considered tangible:</td>
<td>OS Maps - out of data if in paper and costly [#2-2-06]</td>
<td>Demonstrates how the information kayakers rely in the most relates to the fast changing environment (e.g. water levels) rather than static features (e.g. hills). This is unique to kayakers.</td>
</tr>
<tr>
<td>Although of low frequency (four cases with five references across all information types), comment was made that both professional and VGI are no substitute for experience.</td>
<td>And at the end of the day you have to have faith in your own ability, either as a team or as a paddler as to what you’re going to do or what you’re not going to do, because with all the best information in the world you’re not going to know until you get there [#2-1-04]</td>
<td>The intangible, personal experience plays a more prominent role in the kayaking activity than the tangible external information from VGI or PGI sources.</td>
</tr>
</tbody>
</table>

### Verification

#### Table 6.25 – Relevance of Information Sources: Verification

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Quote</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants commented that personal experience and other people sharing their personal experience is the best form of information; above professional and anonymous VGI</td>
<td>I think people that have done the river before are the best people to talk to. They know your level of paddling ability and if they think ‘oh no, it’s not for you’, they’ll say ‘it’s a great river… but I don’t think you’re at that level yet’ [#2-1-08]</td>
<td>these outcomes suggest that while third party information sources are vital to the planning process, they may not make up 100% of the information search process. While this study does not conclude if these interpersonal communications are necessary in an information search context, they are of high importance and lead weight to the concept that complete mixed source information sets should contain volunteered, professional and interpersonal elements in order to produce a highly effective and satisfying solution to the end user.</td>
</tr>
</tbody>
</table>
6.6.2.3 **Sources of external information**

Based on comments made during the focus groups, Table 6.26 and Table 6.27 present the relationship between the formal and informal information sources utilised, and amateur volunteered and professional information in a kayaking trip scenario. Table 6.26 presents the number of participants who commented on sources of external information, while Table 6.27 presents the number of times the sources of external information were mentioned by the participants.

### Table 6.26 - Sources of Information – Cases Coded

<table>
<thead>
<tr>
<th>Category</th>
<th>Theme</th>
<th>Amateur</th>
<th>Volunteered</th>
<th>Personal Experience</th>
<th>Professional</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Formal</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kayaking Guidebooks (print &amp; web)</td>
<td>13</td>
<td>4</td>
<td></td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Kayaking Magazines</td>
<td>0</td>
<td>0</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Maps (paper &amp; electronic)</td>
<td>4</td>
<td>1</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Official Body Websites</td>
<td>1</td>
<td>0</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Official Data Websites (e.g. MET Office)</td>
<td>3</td>
<td>0</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td></td>
<td>River Officials</td>
<td>1</td>
<td>0</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Tourist Info</td>
<td>1</td>
<td>0</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td><strong>Informal</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fishing info</td>
<td>2</td>
<td>0</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Kayaking websites &amp; forums</td>
<td>29</td>
<td>1</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Local Knowledge (non-kayak)</td>
<td>9</td>
<td>0</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Local river guides (people)</td>
<td>3</td>
<td>0</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Own Club Resources</td>
<td>8</td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Social Media (e.g. YouTube)</td>
<td>8</td>
<td>0</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Water Sports Centres</td>
<td>4</td>
<td>0</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Word of Mouth</td>
<td>26</td>
<td>4</td>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

### Table 6.27 - Sources of Information – Coding References

<table>
<thead>
<tr>
<th>Category</th>
<th>Theme</th>
<th>Amateur</th>
<th>Volunteered</th>
<th>Personal Experience</th>
<th>Professional</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Formal</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kayaking Guidebooks (print &amp; web)</td>
<td>21</td>
<td>5</td>
<td></td>
<td>71</td>
</tr>
<tr>
<td></td>
<td>Kayaking Magazines</td>
<td>0</td>
<td>0</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Maps (paper &amp; electronic)</td>
<td>8</td>
<td>1</td>
<td></td>
<td>56</td>
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<td>0</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Official Data Websites (e.g. MET Office)</td>
<td>3</td>
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<td></td>
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<td>River Officials</td>
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<td>0</td>
<td></td>
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<tr>
<td></td>
<td>Tourist Info</td>
<td>1</td>
<td>0</td>
<td></td>
<td>17</td>
</tr>
<tr>
<td><strong>Informal</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fishing info</td>
<td>3</td>
<td>0</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Kayaking websites &amp; forums</td>
<td>77</td>
<td>1</td>
<td></td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Local Knowledge (non-kayak)</td>
<td>18</td>
<td>0</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Local river guides (people)</td>
<td>6</td>
<td>0</td>
<td></td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Own Club Resources</td>
<td>10</td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Social Media (e.g. YouTube)</td>
<td>15</td>
<td>0</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Water Sports Centres</td>
<td>4</td>
<td>0</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Word of Mouth</td>
<td>64</td>
<td>5</td>
<td></td>
<td>10</td>
</tr>
</tbody>
</table>

As shown in Table 6.15, information identified as PGI was more likely to be perceived as out of date, while VGI had a higher tendency to reflect current

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Formal sources include printed media, destination-specific literature, broadcast media (e.g. radio, TV, etc.) and discussions with professionals, whilst informal sources include family, friends and other users (Gitelson and Crompton, 1983).
conditions. However, Table 6.27 shows that this is not a reflection of the level of professionalism (or amateurism), but is due to the typical channels of delivery of these types of information. As shown in Table 6.27, PGI predominantly comes from formal sources such as printed media, while volunteered information comes from informal (and particularly online and face-to-face) sources. The most prominent informal (VGI) sources are expressions of people’s personal experience through either word of mouth, or online discussion groups. Additionally, the features used to assess the conditions of the water during kayak trips (highlighted in Table 6.15) may be official landmarks such as a water gauge, but require personal experience to understand and make use of these information cues.

6.7 Discussion

6.7.1 Impact of information depth and scope in understanding the outdoor environment

As highlighted in the HTA (Figure 6.3), information has the greatest potential to impact on the activities of the user during the trip planning process. Consequently, this discussion section focuses on the role of VGI and PGI within an information gathering and event preparation context.

Analysis of VGI and PGI according to the relevance framework of Barry and Schamber (1998) has shown some clear differences in the perception of these information sources by end-users. This study demonstrated that PGI has a lower degree of perceived overall depth about specific locations than VGI, but a greater degree of overall scope and consistency of coverage. The participatory observations showed that when the users talked about VGI sources, the topics covered were also of greater diversity than their PGI counterparts. Consequently, PGI provides information on the general, wide reaching topography, while VGI provides detail about specific locations, sometimes in much greater detail, but with patchy coverage. These elements may be considered as intrinsic to the scope and level of detail in the GI, which as Levitin and Redman (1995) suggested, are important dimensions of data quality. This (alongside price and value) is one of the key criteria for product selection (Zeithaml, 1988). Quality judgements in relation to information-based
products are therefore important in terms of their adoption by potential consumers.

Unexpectedly, low-level dissatisfaction with PGI due to incompleteness relative to the needs of the users was evident within the focus groups. Consequently, a need exists to understand the user’s information needs further, and then tailor the information provided to fit these needs. Ivergård (1982) commented that users’ reactions to information are typically in relation to the amount of information expected rather than the amount actually found. Ivergård’s comment may explain the level of dissatisfaction with PGI sources, which (as this study has shown) are seen as having broad scope, but are perceived as incomplete in relation to contextual detail.

Table 6.10 and Table 6.15 show that personal experience is influential in how it enables analysis and validation of external information sources. This outcome is consistent with the work of Xiang and Gretzel (2010) who demonstrated how when planning tourism activities people already utilise social media to advise them on their activities once they have decided on the general location of their trip. Consideration should be given here to the information sources mentioned within this chapter. While focus groups reduce the degree to which important information may be overlooked (Robson, 2002), certain information types may lend themselves to being mentioned more frequently than others. For example, forums can be considered vast repositories of information, and thus worthy of mentioning. However, less established sources such as video websites (e.g. www.youtube.com) may not be seen as important or formal enough, so not mentioned. Therefore, it is important to consider all outcomes within this study relating to utterance of sources as indicatory, rather than as a measure of importance or prevalence.

As highlighted by Manchala (2000) the user’s overall experience of interacting with information is dependent on trust and the user’s willingness to utilise the information in future instances. Consequently, if VGI is utilised alongside PGI in applications in such a way as to increase the positive experiences for the user then the trust perceived by the user towards the application may be increased.
This research has demonstrated how the different dimensions of user perception (e.g. accessibility, accuracy, etc.) relate to their overall trust in the information. This is a useful development in the overall understanding and application of VGI relative to the work of Mummidi and Krumm (2008) in the need for objective quality in VGI. Consequently, the depth and scope of the information sources are most important to the user when searching for trip planning information. Although the completeness of individual information sources is important, it is more important that the whole collection of information sources (i.e. VGI and PGI together) produce a complete image when they are combined and considered alongside each other. Additionally, this may be in line with Grira et al. (2010) who demonstrated that by including the contributions of amateur volunteers a GIS may improve its overall objective quality.

The level of precision in the explanation of the outdoor environment can be considered alongside the work of Corona and Winter (2001) who commented that “people that move in unfamiliar environments need precise instructions to reach a specific location”. It may be expected that the more precise information the user requires, the higher the potential dissatisfaction with PGI may be felt. This presents a great opportunity for VGI to be a highly usable form of information to the user; being effective, efficient and satisfying (ISO 9241-11, 1998). This however, may only hold true if VGI can be demonstrated to provide the highly precise and detailed descriptions of specific points in the outdoor environment - as suggested by this study.

This discussion highlights that the depth and scope of the information sources are important to the user when searching for trip planning information. Although the completeness of individual information sources is important, it is more critical that the collection of information sources (e.g. all recent posts on all kayaking forums) produce a complete image when they are combined and that all are considered relative to the time frame of their origin.

6.7.2 Influence of information currency

This study highlighted how VGI sources were preferred in situations where the geographic features being described altered regularly (e.g. water levels). In contrast, PGI sources were preferred when describing relatively static
geography (e.g. topography). It was clear from this study that the extensive use of VGI and its perceived usefulness is due to its currency; i.e. the ability for it to reflect recent changes within the application domain. These findings are in agreement with Nolan (1976), Gitelson and Crompton (1983) and Schuett (1993) who demonstrated that in recreational environments information received from informal sources can be the most informative due to its ability to reflect changes in the environment.

This is not simply due to the volunteered nature of the information, but critically is also influenced by the channels through which VGI tends to be communicated. Information collected and distributed through regularly updated, interactive channels (rather than through the slower mediums such as print with longer refresh cycles) has a higher chance of reflecting current conditions, and satisfying the currency requirement within the relevance framework of Barry and Schamber (1998). The finding that VGI is best suited for fast changing geography that may be hard to capture through traditional methods is directly in line with the concepts outlined by Goodchild (2007a) when he defined the term Volunteered Geographic Information.

An interesting consideration is the degree of information redundancy inherent in traditional PGI systems: the inclusion of non-essential information from the user’s perspective (Badenoch et al., 1994). Since Ivergård (1982) commented that users react to information in relation to the amount of information expected rather than the amount actually found, an additional perspective on the user may be gained. In particular, when the user expects the information to reflect the current conditions, yet that expectation is not met, the abundance of non-essential additional information in PGI may have a negative impact on the user experience.

### 6.7.3 Importance of real time information

One of the most unexpected findings from the study was the lack of either actual or desired access to GI in real-time while undertaking the kayaking trip. The kayaking environment itself presents challenges to information access: in particular the water-based environment and the lack of free hands. To date, much geographical user research has focussed on the delivery of location-
based information; e.g., delivery to mobile phones (Sun and Song, 2009, Tsou and Kim, 2010, Xiaolong, 2007). However, the findings from this study question the extent to which such real-time information is useful, and instead suggest that when users are actually engaging with the environment, they are not necessarily motivated to find out more about geographical features but instead draw on internal information derived from their personal experience or direct communication of relevant facts from fellow participants.

This is shown in the records of participatory observation, where the members of the kayaking trip would look to the leader for guidance and advice, who in turn would rely on his personal experience and internal knowledge. Additionally, as highlighted by Arnould and Price (1993) this observation may be explained by the kayakers’ desire for river magic, or a hedonic experience coming from the adventure of overcoming risk rather than simply engaging in kayaking on a river. Further generalizability of this may be seen in fields such as general tourism (Gursoy and Chen, 2000) and store shopping (Cox et al., 2005), where the lack of complete knowledge (creating a degree of uncertainty) provides opportunities for uncertainty, and thus discovery leading to enjoyment. This outcome highlights how VGI has the greatest potential to impact on the outcome of the information-seeking user during the planning (rather than the activity) phase.

6.7.4 Importance of information access

Although VGI is often distributed under a Creative Commons licence - and is therefore free to access (Goodchild, 2008a) - this does not make it appear more appealing to the user; or to make PGI comparatively less attractive. The focus groups showed that participants used whichever information source they felt most likely to solve their information needs; be it either free as in a forum or at cost at in a book. This may be explained by the work of Richins and Bloch (1986) who asserted that the higher the perceived risk, the higher the involvement in the information search. This would suggest that individuals are more willing to spend resources (effort and/or money) for information if there is risk associated with an activity. As Borlund (2003) commented: “the relevance of a document should be judged on the basis of its content rather than its
physical properties, such as physical availability or monetary cost”, which would explain this use of PGI. The finding that participants would pay for information if it was seen as appropriate and useful is interesting, partly due to the fact that proponents of VGI hold the free nature of their information up as a key reason why VGI is better and more appropriate for general use than PGI (Flanagin and Metzger, 2008). Consequently, there may be an inverse relationship between an activity’s risk and importance of the accessibility attribute -including the free nature of VGI.

6.7.5 Importance of trust in information

Participants used multiple sources of information to converge on truth rather than take single information sets as true; see Table 6.15 – page 189. However, the multiplicity of sources used is not a direct indicator of their importance or impact, so further insight into the user judgements is required. Additionally, this section may be seen within the context of selecting information to fulfil a given purpose of the user. As described by Wang and Soergel (1998) in the context of document selection – see Figure 2.6, page 74 – this is the final stage of user judgement in deciding if an information item should be used or not, following processing of information elements and combining of criteria.

As demonstrated within Section 6.6.2.2 (Relevance Of Information Sources), personal contacts are a more trusted group than any other information source. This is a mirror of the work by Manning and Lime (1999) that many sources of information are used by outdoor recreation visitors for trip planning. Additionally, they demonstrated that these sources were not directly produced by management agencies (e.g. outdoor clubs, professional outfitters, guidebooks, newspaper, etc.) but by volunteers presenting their past experiences. This finding is also in line with observations by Rieh (2002) who pointed out that traditionally information search has focused on how accurately the topic the user is searching for matches the topic of the documents found, yet with online information searches people use diverse criteria of search topics simultaneously.

One explanation for the reliance on personal contacts more than professional information (as shown by this study) is offered by Schuett (1993), who
suggested that the inherent risk involved in outdoor adventure activities may be the main reason for the use of more personalised sources such as friends, outdoor stores, and professional outfitters. Schuett also commented that friends and family are easier to get hold of, and because of interpersonal relationships already have an inherent measure of trust and reliability, which the consumer does not exhibit for the non-personal information sources. This is in line with Beatty and Smith (1987) who within the wider context of consumer product purchases noted that friends and family are consistently reliable sources for information.

However, this reliance on interpersonal relations in an information search environment is somewhat at odds with the comments of Rieh (2002) that web users’ judgments of quality and authority are influenced more by institutional level of source (e.g. source reputation, type of source, and URL domain type) than by the individual level (e.g. author/creator credentials).

As shown in Section 6.6.2.2 (Relevance Of Information Sources) the more knowledgeable and accurate an information source is (in the sense of reflecting the conditions of reality in line with how the information searcher will experience them), the more likely it is to be seen as authoritative and professional. In this situation, it is accuracy that might be inferring professionalism to the users, rather than a professional label emphasising accuracy. Importantly, professionalism in this context refers to the quality of the work rather than the credentials of the author. Additionally, accuracy can only be asserted after the information use event, and thus demonstrates the need for a feedback loop within the user/ contributor context. If this was engaged with, it is possible that such a function may lead to increased judgements of professionalism in the data over time.

This may be explored further through the concept of cognitive authority, defined by Wilson (1983) as influences that a user would recognize as proper because the information therein is thought to be credible and worthy of belief. The significance of this is highlighted by Rieh (2002) - that in contrast to information quality (the extent to which information is actually useful, good, current and accurate) cognitive authority is operationalized as to the extent to which users
think that they can trust the information. Consequentially, for VGI use by kayakers, the quality of the information influences the cognitive authority exhibited by the information.

A further explanation for the participant’s perception of cognitive authority was offered by Rieh (2002), who observed that when academic participants were presented with work that appeared academic, they perceived its cognitive authority to be higher than work that appeared less scholarly. It is however not clear whether this refers to scholarly as an indication of absolute quality, or as an indication of the homogeneity of the contributor and user of the info. This offers further opportunity for investigation into the link between VGI presentation within neogeography and its perceived authority.

The link between accuracy and cognitive authority may be explained by the work of Corona and Winter (2001), who commented that “people that move in unfamiliar environments need precise instructions to reach a specific location”. Within such unfamiliar environments as Kayakers interact with, information accuracy may become more important than other factors such as cost or diversity of content. Additionally, Rieh (2002) mentioned that if there are a number of information resources related to their topical interests, then the consumer would want to find useful and appropriate information, and would be likely to base their actions on the concept of quality and authority. This also links (1) the outcome that multiple sources of information are used to converge on the truth to (2) the critical analysis of utility in the information and ultimately, the impact on cognitive authority.

6.7.6 Volunteer reporting of activity experiences

Within the kayaking community, feeding back of experiences via informal channels is crucial to the information search activities when planning trips, yet is not explicitly stated as an important activity. Therefore, there exists a lack of perceived need to more formally feed such experiences back to others through VGI channels.

The low importance placed on actively disseminating experiences gained during the trip means that within the kayaker community a vast pool of potential
VGI within individuals’ personal experiences exists that is not freely available and easily accessible to others. This repository of information may therefore be considered sticky (Luthje et al., 2005), where the cost of accessing such information is effectively the ability to ask a question to the individual who holds it. Without being in contact with that person, or knowing that they may hold such information their experiences are consequently inaccessible.

6.8 Critique Of Study

The main potential limitation of the study is generalising research findings from kayakers to a wider audience. Kayakers were used solely as an example of a single demographic, necessary in order to study situated use of information sources. Kayakers and the kayaking task can be characterised in terms of social groups seeking information in order to plan and undertake an activity where outcomes matter. These characteristics are seen in a wide range of information seeking activities, where it is important to maximise the relevance of information available to end users. In addition, a theoretical framework was employed that focuses on the core qualities of information – i.e. the information relevance framework is user-task and information-source agnostic and has been applied widely in a range of application domains (Saracevic, 2007). The data from the study relates to kayakers, since they were the subject of study, yet, the findings are applicable to multiple instances of information use that share the characteristics described above. However, consideration should be given to the applicability of such findings outside of the kayaking realm, since the outcomes of this study relate specifically to the kind of tasks undertaken by kayakers.

Additionally, there was a social bias imposed through the use of kayaking clubs as data sources. Those participants who agreed to take part in the study would therefore be regular members who are comfortable with the idea of sharing their experiences with a stranger. Therefore, while the results may apply to users with similar information use requirements, they may not necessarily apply to all kayaking forms since the clubs approached during the study had a strong social focus. It is also uncertain how these results would necessarily compare with other outdoor or risk inclusive activities; e.g. hill walking.
Further to this, the tasks which the kayakers required information to achieve (see Figure 6.3, page 182) limit the applicability of this study. Notably, VGI and PGI were only required in a limited way, referring mainly to amenities and logistics rather than high risk situations. Consequently, further comparable research is needed in the relevance of VGI and PGI to situations and contexts different to kayaking in order to understand the commonalities in user perception of these information types.

6.9 Conclusions
Through investigation, this study has addressed the study aims in the following ways:

1. How VGI And PGI Offer Different Benefits To The End User In A Realistic Scenario

   This study has shown that within the context of outdoor recreation, the commonly held assumptions that VGI is inferior to PGI, and that the most beneficial, accurate and useful GI can only come from professional sources is no longer correct. In describing the outdoor environment for special recreation interest, PGI is more likely to describe the general geography and conditions of wide reaching features while VGI comes from a convergence of amateur sources describing specific regions of interest. Consequently, the end-user seeking information may discover relatively high levels of detail about specific locations from VGI, related to one another through the general description of the environment derived from a PGI source. One of limitations identified with VGI has been the relative difficulty in tapping into experiences of users due to the reluctance of seeing contribution as an important part of the trip process.

2. The Strengths And Weaknesses Of VGI And PGI Relative To How They Meet The Information Requirements Of The User’s Tasks And Activities

   The verification of VGI and the quality of the source are critical issues that influence the extent to which VGI is deemed relevant by a user. In discovering information about the outdoor environment that is not understood through internal information, verification can be achieved by
reference to multiple sources that converge on the truth. Quality of source may come from knowing (and understanding the significance of) the credentials of the contributor.

From forums, websites and community noticeboards, VGI was shown to be easy to access while offering a wide spatial coverage of potentially up-to-date information on geographic regions important to the disseminating community. Although it can be influenced by subjective interpretation from contributors it was generally considered reliable and relevant by participants.

It is more useful to consider the attributes of information (e.g. the update rate, ease of access) than just the level of professionalism of the author; i.e. whether it is VGI or PGI. This brings into question the practicality of the terms VGI and PGI in describing the usefulness of information from different sources.

The greatest opportunity for VGI to impact on outdoor activities is in situations where the current conditions of the geographic area are either not accessible via traditional cartographic means, are not sufficiently predictable through scientific methods, or are likely to have changed since they were last reported.

3. How VGI And PGI May Be Effectively Integrated To Produce Highly Usable And Effective Applications

The study suggests great potential for VGI to counteract the shortcomings of PGI sources in relation to the needs of the user. The integration of these two forms of data within a mashup could combine the structure, consistency and source quality of PGI with the currency and intuitive appeal of VGI. Such mashups would have higher personal relevance than could be achieved by either VGI or PGI alone.

This study has focused on kayaking, yet it points towards a significant opportunity for increasing the usability of GI by integrating volunteer and professional sources in other contexts. Developers of future GIS could maximise the synergy of VGI and PGI through understanding how different
characteristics of each source can be used together to meet the needs of specific user groups and use contexts. The implication for those wishing to combine VGI and PGI when designing applications is to consider both information sets not as simply volunteer or professional, but as two different yet equally valid information sets within the rich tapestry of GIS.

In order to understand how the outcomes of this chapter may be applied to the wider range of consumers it is important that further research is undertaken with a different yet comparable consumer group to kayakers. Additionally, it is important that further research may add additional context to the outcomes of Study Two by focusing on the reactive perceptions of users to VGI during an information search.
7 Data Generation: VGI and PGI Data Sets

Research Questions Addressed In This Chapter

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>What is VGI and how is it distinct from PGI?</td>
</tr>
<tr>
<td>2</td>
<td>What is the human centred nature of VGI in terms of its generation, production and utilisation by the end users?</td>
</tr>
<tr>
<td>3</td>
<td>What influences the way users judge VGI in terms of its relevance to their needs, and how does VGI compare to PGI?</td>
</tr>
<tr>
<td>4</td>
<td>What recommendations can be made for combining PGI and VGI for the production of highly usable neogeographic products?</td>
</tr>
</tbody>
</table>

7.1 Introduction

In this thesis, research has sought to understand the way in which users perceive the utility of VGI to help aid them in their activities. The scoping study demonstrated that the users’ decision to utilise VGI within professional, personal and social settings comes from their level of trust in the data and degree of homogeneity between the data user and the data contributor. More importantly, the scoping study suggested that the consumer would consider both VGI and PGI using the same criteria, in order to achieve their personal needs. Study Two highlighted how the consumer perceptions of VGI and PGI are influenced by their use requirements, where it is more useful to consider the attributes of the data (e.g. its currency) rather than the professionalism of the contributor. Study Two also demonstrated that the user judgement of trust is a key perception in the analysis of information during an information search, alongside cognitive authority and overall quality.

Current research in the fields of quality (David and Jason, 2008), human-computer interaction (Fogg and Tseng, 1999) and geo-sciences (Idris et al., 2011b) have highlighted trust and credibility as major factors in user judgements of online information. In the wider sense, Flanagin and Metzger (2008) highlighted the concerns for utilising VGI alongside PGI in terms of its

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24 see Lit Review Section 2.4.2.4, page 56
quality, reliability and overall ability to add value to the user; situated as credibility. However, of most importance is the direct need to research the impact of such issues on the user. Although research within Studies One and Two have begun to outline the ways in which VGI as a single data source is perceived, how these perceptions influence the overall usability of a mashup is currently unknown. Consequently, the interaction between the various aspects in the user judgement relating to mashups containing VGI and PGI need to be understood.

7.2 Research Aims
The general aim of this study is to generate a VGI data set to be used to address the research aims above. Consequently, this study aims to address the specific objectives below:

1. Generate a body of VGI that can provide unique insights not presented through traditional PGI.
2. Combine VGI into a series of mashups that allow for integration in various websites, and can be used as the basis for controlled experimental study.

7.3 Study Rational

7.3.1 Selection of a study community
To address the study aims a set of participants was required whose information use would allow for an in depth exploration of how different forms of information are utilised, and how this influences their activities. In addition, participants were required to be already familiar with using both VGI and PGI relating to location-based information. This was necessary to ensure the outcomes of the study are applicable to realistic information use; rather than reactionary opinion of first time use (Baum et al., 1981). Additionally, the research which the user group undertakes before their activity must be understood as having a real and beneficial impact on future events for the user.

Previously research into the benefit of VGI within an end user context has been successfully conducted with:
Parents pushing children in prams around an urban environment (Holone et al., 2007)

Wheelchair users navigating an unfamiliar urban environment (Beale et al., 2006, Holone et al., 2008)

Travellers with visual impairments navigating an urban environment (Kulyukin et al., 2008)

Ray and Ryder (2003) pointed out how even the most outgoing and risk-taking of the wheelchair user community actively and carefully evaluate the risks before traveling and engaging in travel. Importantly, within a travel context this is not experienced in the same fashion by able-bodied persons. This level of risk management as a central part of the group's activities allows for an enhanced connection between this investigation and the previous studies of this thesis.

Access and the ability for VGI to offer a reduced risk while engaging in travel situations has been a key theme in contemporary research. Therefore it was decided that wheelchair users (non-sensory or cognitively disabled) in travel situations was the most appropriate user group.

7.3.2 Selection of the research approach

Within this study, the general research approach was Inductive, since the purpose of the study was to explore, describe, and find meaning in user perceptions of wheelchair access in a realistic situation (Morse, 2003). Because of this study's Inductive approach, interest in narrative data and descriptive user experiences, this study exhibits a qualitative research perspective (Teddlie and Tashakkori, 2009). Since no independent variable was investigated, the most appropriate research strategy was that of the case study (Boudreau et al., 2001). Due to the lack of interactions required of the participant in considering the access issues they are faced with, a mono-method research choice was sought (Saunders et al., 2009). A cross-sectional time horizon was selected to explain how factors are related in different users (Erzberger and Kelle, 2003).
7.3.3 Selection of a geographic location for research

London was chosen as the location of the investigation because of:

- Well established network of underground trains, buses and pedestrian routes allows for diverse travel scenarios to be presented to the participants.
- Large volumes of professional and volunteered information relating to the city and its travel network.
- Large and diverse number of locations, allowing travel from and to locations off the tourist map, which the participant is less likely to have first-hand experience of.

7.3.4 Selection of travel routes

The transport routes were restricted to those navigable for disabled travellers within a timeframe of 2-5 hours (start to finish). In order to produce a representative description of the issues faced by travellers in London, it was also important to incorporate as many different transport modes as possible; train, underground; bus; light rail. Considering these factors, the following routes were selected (Figure 7.1):

- **London Victoria** to Stratford via London Waterloo (bus, underground)
- **Stratford** to Angel Islington via Bow Street (bus)
- **Angel Islington** to Greenwich via London Bridge (bus, train)
- **Greenwich** to London Bridge (DLR light rail)
7.3.5 Selection of the mashup base map

Since the focus of this thesis is the interaction between the user and the information presented to them, the role of the base map within the mashup was coincidental, being the relation of points of information to each other geographically (Crone, 1968). Consequently, the map needed to be simple and neutral, so as not to overshadow the information presented within the mashup. After considering numerous maps and map styles (e.g. Bing, Google, Ordnance Survey), the CloudMade Pale Dawn map (CloudMade, 2011) was selected for its appropriate simplicity; see Figure 7.1.

7.3.6 Boundary conditions

The boundary conditions, which defined the scope and generalizability of this study, presented in Table 7.1.
### Table 7.1 – Boundary Conditions Placed In The Study

<table>
<thead>
<tr>
<th>Boundary Conditions</th>
<th>Explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Users</strong></td>
<td></td>
</tr>
<tr>
<td>Constrained by specifying participants and intended recipients of information</td>
<td>Wheelchair user participants with existing knowledge of London public transport routes and challenges.</td>
</tr>
<tr>
<td>Unconstrained</td>
<td>Gender/ age/ nationality mix</td>
</tr>
<tr>
<td></td>
<td>The type of wheelchair used by the participant and the extent of mobility it affords the individual.</td>
</tr>
<tr>
<td></td>
<td>Generation of descriptions of the good and bad access issues experienced through travelling around London</td>
</tr>
<tr>
<td><strong>Tasks and Context</strong></td>
<td></td>
</tr>
<tr>
<td>Constrained by specifying the travel route</td>
<td>The ‘surveying’ of specific destinations successfully, with all participants experiencing the same set of challenges at different periods of time.</td>
</tr>
<tr>
<td>Constrained by limiting external information</td>
<td>While the participant has access of their own internal information from personal experience, the only external information provided during the survey session is the route between points.</td>
</tr>
<tr>
<td>Unconstrained by time period</td>
<td>The access surveys were conducted over a period of 4 weeks, accessing long term access issues rather than temporary issues (e.g. broken lifts)</td>
</tr>
</tbody>
</table>

In addition to the boundary conditions of Table 7.1, and in line with the recommendations of Bishr and Mantelas (2008), it is assumed that the participants (authors of VGI) have no specialist or particular training in their field of contribution.

#### 7.4 Investigation Overview

This study was an inductive investigation to produce two usable sets of information from volunteer and professional sources that may be utilised during phase two of this investigation (Study Three). A navigation route around London was selected, with both VGI and PGI data relating to transport accessibility issues collected. This was done through a combination of literature review and participant observation. During participatory observation, five wheelchair users travelled around the research route, accompanied by the researcher who took notes relating to their experiences and feelings about
access issues, verbalised by the participant. Once collected, the VGI and PGI data sets were combined and displayed within a mashup.

7.5 Part A: VGI Data

7.5.1 Methods

7.5.1.1 Participant Sampling

In investigating the link between the number of VGI editors and the quality of the contributed project, Haklay et al. (2010) concluded that the first five contributors of VGI provide the bulk of accurate data, while successive contributions serve to increase *accuracy* and *quality*. Although this may appear to be a relatively small figure, Holone et al. (2007) demonstrated a relatively small number of amateur volunteer contributions can be sufficient to generate good bespoke information relating to access and accessibility needs. Considering this, five participants were targeted.

For the purposes of this study, eligible participants were defined as follows:

- Physical disability necessitating the use of a wheelchair
- Only exhibits physical movement disabilities, excluding cognitive, sensory and audible disabilities
- Compatible with non-vulnerable persons description under the Loughborough University Ethics committee
- Confident in attempting travel via public transport

Participants were recruited through a combination of social networking (e.g. twitter, Facebook, forums, etc.) and professional contacts with disability groups; i.e. NHS, Backup Trust, etc. All reasonable expenses encountered during the day were paid for by Loughborough University. Additionally, each participant was entered into a lottery for £150, drawn at the end of Study Three. The breakdown of participants involved within this study is presented within Table 7.2.
Table 7.2 – A Breakdown Of The Study Participants By Gender And Wheelchair Type

<table>
<thead>
<tr>
<th>Chair type</th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
</tr>
<tr>
<td><strong>Manual Chair</strong></td>
<td>2</td>
</tr>
<tr>
<td><strong>Powered Chair</strong></td>
<td>2</td>
</tr>
<tr>
<td><strong>Able Bodied Assistant</strong></td>
<td>0</td>
</tr>
</tbody>
</table>

All procedures and data handling were taken under Loughborough Universities’ ethics and data handling guidelines (generic ethics protocol G04-P4). However, this data collection study involved the investigation of potentially vulnerable participants (disabled tourists) and thus needed special treatment.

As the number of participants recruited into this study met the target of five set out by Haklay et al. (2010), the data collected can be seen as appropriate for simulating a VG data set, but not exhaustive or extensive. Consequently, outcomes from the VGI data should be seen as qualitative indications rather than quantitative certainties.

7.5.1.2 Data Collection

In studies into collecting VGI describing the built environment, various authors (Abley and Hill, 2005, Cinderby et al., 2006, Evans, 2009) demonstrated how the data collection method of map walks was effective, simple and insightful. Here, the participant is accompanied around the environment by the researcher, having their thoughts and opinions collected on route relative to their location. Consequently, this form of Participatory Observation was selected as the data collection method for this study. Due to the researcher being able bodied and unable to fully appreciate the level of severity access issues from the perspective of a wheelchair user, the position of Observer-as-Participant was taken. The structure of the data collection sessions was based on the principles of accessibility; see Table 7.3 based on Handy and Niemeir (1997).
Table 7.3 – Investigation of Accessibility through Data Collection

<table>
<thead>
<tr>
<th>Attribute of Accessibility</th>
<th>How investigated through Data Collection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spatial distribution of potential destinations</td>
<td>All points along the travel routes are accessed sequentially, allowing the culminative effects of spatial distribution to be reflected in participant comments and opinions.</td>
</tr>
<tr>
<td>The ease of reaching each destination</td>
<td>Participants asked to comments on situations related to accessing, travelling on and departing from the various transport modes along the travel routes.</td>
</tr>
<tr>
<td>Magnitude, quality, and character of the activities</td>
<td>To every access issue commented on by the participant, they must also give an indication of how severe the issue is to their movement within the given environment.</td>
</tr>
</tbody>
</table>

Due to the level of difficulty that potentially faced the participants travelling on public transport (PTT, 2010), only one participant was involved in the study per day.

7.5.1.3 Procedure

During participant observation to produce the VGI data set, the following procedure was followed:

- Prior to data collection participants were provided with materials by email outlining the purpose of the data collection, procedure for the session, map of the travel route and terms and conditions of participation.

- Participants arranged to meet at London Victoria Station at a time and date that suited them, being the first point on the study’s travel route.

- The participant and researcher set out along a pre-specified route (see Section 7.3.4) with the researcher guiding the choice of transport. Due to the physical limitations of the participants, and for their general ease, the researcher carried the data capture sheet to record the location, access issue and its severity; see Appendix 7A. During the observation period, prompts and questions were asked of the participant at relevant moments, such as “how did you find that?” or “after getting onto that underground train, is there anything that another wheelchair user should know before they arrive?”
- The participants were not told what to record, only that they should notify the researcher of all positive and negative accessibility issues that they see as important to another wheelchair user’s making the same journey as them on a different day.

7.5.1.4 Analysis

Experiences and access issues encountered along the route were collected together to show the experience of all participants; see Table 7.4. The weighted mean was used to understand the average severity of the access issues identified by participants; see Equation 7.1 below. Rather than present all issue severity scores collected through participation, average severity was included within the mashup, giving context to the collected VGI.

\[
\bar{x}_w = \frac{\sum w_i x_i}{\sum w_i}
\]

Equation 7.1 – Equation for the Weighted Mean (Currie and Svehla, 1994)

7.5.2 Results and analysis

Figure 7.2 shows important stages of data collection with the study’s participants.
Figure 7.2 – Data Collection with Participants During Access Surveys

The full tables of data as collected through the study can be found in Appendix 7B. The opinions from participants within this study were collated into Table 7.4. Importantly, issues identified within the table more than once represent more than one participant highlighting that issue during observation.
Table 7.4 – VGI Data Relating Wheelchair Access In London

<table>
<thead>
<tr>
<th>Station</th>
<th>Transport Area</th>
<th>Accessibility Issue</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Average Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. London Victoria</td>
<td>Bus Station</td>
<td>Lack of information</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>Train Station</td>
<td>Couldn’t take train wanted</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3.0</td>
</tr>
<tr>
<td>2. Clapham Junction</td>
<td>Large Step between platform and train</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>4.0</td>
<td></td>
</tr>
<tr>
<td>2. London Waterloo</td>
<td>Bus Station</td>
<td>Steep off ramp</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>On Tube</td>
<td>Train is very loud</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td>Train Station</td>
<td>Raised foot mat (4cm), needed to go over it</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>Tube Station</td>
<td>Gap between train and platform difficult</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2.6</td>
</tr>
<tr>
<td>3. Stratford</td>
<td>Bus Station</td>
<td>Ramp at off angle, bus had to adjust</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>On Bus</td>
<td>Bad information delivery</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>Bell in bad position</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Worry about ramps not being deployed</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Train Station</td>
<td>exit had deep gutter</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>Lifts unmarked</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Smooth surfaces</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>4. Bow Church</td>
<td>Bus Stop 1</td>
<td>Steep off-ramp</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>Bus Stop 2</td>
<td>Bad information</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>On Bus</td>
<td>Steep ramp onto bus - needed help</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>Walk</td>
<td>Drop Curb very difficult to pass</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>Lifts unmarked</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Smooth surfaces</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>5. Angel Islington</td>
<td>Bus Stop 1</td>
<td>Steep curbs around bus stop</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>Steep off ramp</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>On Bus</td>
<td>No rear view mirror</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>Not much room to move</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>6. London Bridge</td>
<td>Bus Station</td>
<td>not much room off ramp</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2.3</td>
</tr>
<tr>
<td></td>
<td>On Train</td>
<td>No wheelchair zone</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>Train Station</td>
<td>Had to change platforms to be accommodated</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>Lack of information</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Long steep tunnel - needed help</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>4.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Semi-steep ramp</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>7. Greenwich</td>
<td>Drop curbs difficult to manage</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lack of information</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lifts very small</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Steep off ramp</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3.0</td>
<td></td>
</tr>
</tbody>
</table>

Table 7.4 shows the diversity of experiences and opinions that may come from a single group of people who share a similar disability. Additionally, Table 7.4 clearly shows that, with an attributed severity of 5, the worst problems experienced were the noise of the train (London Waterloo underground station) and lack of information (Greenwich train station). Other serious problems (average severity of 4) related to the position, inclination and availability of ramps (Stratford bus station, Bow Church bus stop and London Bridge bus station) and poor information delivery (on bus, Stratford). Problems reported to be moderately severe (2.5 to 3 on the scale) included architectural barriers, such as gaps, steep inclines or curbs, and the absence of a wheelchair area (London Bridge train).
7.6 Part B: PGI Data

7.6.1 Methods

7.6.1.1 Data Collection

In order for the professional information to be applicable to the research aims it had to conform to the following specification:

- Structured geographic information produced by trained personnel (Fonseca and Sheth, 2002)

- Provide detailed geographic information that can be verified and integrated at the national level (Goodchild, 2007b)

- Carry a degree of professional authority; i.e. be from an official body (Coleman et al., 2009)

PGI data were collected from the most widely accessed professional sources relating to wheelchair travel in London in order to give a comprehensive overview of the information currently available:

- **Direct Enquiries**: online repository of professional information about disabled access to a wide variety of locations around the UK (directenquiries.com, 2011).


- **London Transport for London Website**: official information on all forms of public transport in London (TFL, 2011d).

7.6.1.2 Procedure

Key literature (as identified in the background research) was searched, for information relative to the issue of wheelchair access at locations along the travel routes. Professional tourist information organisations such as Transport for London were also contacted to ensure that all information sources easily accessible by untrained persons was captured.
7.6.1.3 Analysis

Since PGI was gathered from existing professionally produced documents, the most direct and appropriate analysis technique was content analysis; described by Krippendorff (1980) as “a research technique for making replicable and valid inferences from data to their context”. Here the categories of general and specific geographic location - as identified through the travel routes and observation methods - provide a general framework for data collection. PGI sources were then searched for their applicability to the relative transport methods used through the journeys and the relative modes of travel. The collected data was then collated into a table, generating a coded summary of accessibility information for this study.

While more advanced content analysis techniques exist – e.g. in depth review from software such as NVivo (QSR International, 2010) - such approaches would over complicate the relative simplicity of the analysis task. However, by basing the categorisation of the content analysis on the outcomes of the thematic analysis of the observation data, it is possible to make the VGI and PGI data collected through this study compatible with each other.

7.6.2 Results and analysis

The professional data relating to wheelchair travel in London is presented in Table 7.5.
<table>
<thead>
<tr>
<th>Location</th>
<th>Transport Mode</th>
<th>Describe The Access</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>London Victoria</td>
<td>Underground</td>
<td>No access to the underground for wheelchairs</td>
<td>(TFL, 2009)</td>
</tr>
<tr>
<td></td>
<td>Train Station</td>
<td>Staff on hand to help 24 hours a day, 7 days a week, wheelchairs always permitted. Train access ramps available, best booked at least 24 hours in advance. Step free access through the station; not to the underground.</td>
<td>(Network Rail, 2011b)</td>
</tr>
<tr>
<td>Waterloo</td>
<td>Underground</td>
<td>Step between platform and the train = 50mm</td>
<td>(TFL, 2009)</td>
</tr>
<tr>
<td></td>
<td>Train Station</td>
<td>Gap Between platform and the train = 70mm</td>
<td>(Network Rail, 2011c)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wheelchair access to the train and staff help to be confirmed by station operator. Train access ramps available, best booked at least 24 hours in advance. Step free access through the station</td>
<td></td>
</tr>
<tr>
<td>Stratford</td>
<td>Underground</td>
<td>Step between platform and the train = 50mm</td>
<td>(TFL, 2009)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gap Between platform and the train = 78 - 85mm</td>
<td></td>
</tr>
<tr>
<td>Angel Islington Station</td>
<td>Underground</td>
<td>No access to the underground for wheelchairs</td>
<td>(TFL, 2009)</td>
</tr>
<tr>
<td>London Bridge Station</td>
<td>Train Station</td>
<td>Staff on hand to help 04:00 – 01:00, 7 days a week, wheelchairs always permitted. Train access ramps available, best booked at least 48 hours in advance. Step free access through the station</td>
<td>(Network Rail, 2011a)</td>
</tr>
<tr>
<td>Greenwich</td>
<td>Train Station</td>
<td>Staff help Monday-Friday 06:00-21:30, Saturday 06:00-21:30, Sunday 06:00-21:30 Station is step free Train access ramps available, ask staff Wheelchair access to be confirmed by station operator</td>
<td>(Southeastern, 2011)</td>
</tr>
</tbody>
</table>
It should be noted that although bus routes play an important part in the travel routes within this study, no professional information was available regarding the bus stops or the area around the bus stops outside that detailed in Table 7.6.

Table 7.6 – PGI Data Relating To London Travel Wheelchair Accessibility; General Transport Information

<table>
<thead>
<tr>
<th>Transport Mode</th>
<th>Describe The Access</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underground</td>
<td>Occasionally, a lift or escalator may be out of service. You can check this before you travel by using Journey Planner or calling our Customer Service Centre. You can ask a member of staff to help you get to the platform. All our staff have regular training on how to assist disabled passengers and will help you as far as it is safe to do so. Many stations have a vertical step into the train which may be as high as 12 inches (300mm). There may also be a gap between the train and the platform. Please check if you can manage this before you travel. The Step-free Tube guide shows the step and gap at each step-free station.</td>
<td>(TFL, 2011c)</td>
</tr>
<tr>
<td>Train</td>
<td>There is likely to be a step of a few inches between the platform and the train. We recommend that passengers requiring assistance give at least 24 hours’ notice by calling the helpline number below.</td>
<td>(TFL, 2011b)</td>
</tr>
<tr>
<td>Bus</td>
<td>All of London's 8,000 buses are now low-floor vehicles (excluding Heritage buses on routes 9 and 15). Low-floor buses enable all customers, including people using wheelchairs to get on and off easily. Every bus also has a retractable ramp, which must be in full working order at all times. On all buses, there is room for one person using a wheelchair. Wheelchairs can be accommodated up to a size of 70cm wide by 120cm long. Wheelchair users have priority over everyone else for use of the wheelchair space. There is no limit on the number of assistance dogs allowed on the bus, as long as there is space. The wheelchair space on buses cannot take a wheelchair bigger than 70cm in width and 120cm in length. Each bus has a retractable ramp which makes access easier. Most wheelchairs, including motorised types, will fit onto buses but motorised scooters with handlebars can't be carried onto buses. If you are unable to board a bus because of a broken ramp, please wait for the next one and tell Customer Services as soon as possible on 0845 300 7000.</td>
<td>(Visit London, 2011) (TFL, 2011a)</td>
</tr>
</tbody>
</table>
7.7 Mashups

Once VGI and PGI data sets were collected, they were combined and presented using the UMapper mashup platform (www.umapper.com). This was done by creating icons on the map, which when clicked on would display the information collected during the study relating to that location; see Figure 7.3.

![Figure 7.3 – Creating a Mashup with VGI and PGI Data (left a VGI node, right a PGI node)](image)

Figure 7.4 demonstrates an overview of the base map as a user may see it, and the additional overlaid PGI information.
Figure 7.4 – Example of Mashup Set 1: PGI Data Investigation

Figure 7.5 demonstrates the mashup containing both PGI and VGI data for use in Study Three.
7.8 Discussion

The primary aim of the work in this chapter was to generate content for the study described in Chapter 8. However, it is interesting to reflect on the process of data generation and the production of map mashups. A short discussion of this therefore follows below.

7.8.1 Content of collected data

While the impact of the collected VGI on the user in comparison to the PGI data set is tested through Study Three, it is clear from comparison of Table 7.4 - Table 7.6 that while PGI concentrated on objective facts and practices, VGI focused primarily on the experiences of the user. This is in line with Goodchild (2010) who commented that PGI guarantees associated quality control, whereas VGI does not. In relation to this thesis, it is this level of professional quality control that prevents emotional, personal or experiential data from being presented within a PGI framework.

Further note should also be given to the way in which information is presented. While PGI revolves around a formal explanation of access features (e.g. step free, 50mm gap, etc.) VGI presents access issues, often described in terms of...
the personal meaning and implication (e.g. gap too large, ramp too steep). On
the basic level this may be the result of the untrained amateur describing a
feature in the way which makes most sense to them rather than the trained
professional delivering information in a tested, controlled and formal fashion
(Goodchild, 2008a, Tsou, 2005, Tulloch, 2008). This concept of PGI being
objective and VGI being experiential is in line with the comments of van Excel
and Dias (2011), who also noted that due to the limited levels of quality control
associated with VGI, objectivity is a rarer occurrence than in PGI.

Considering the points above, the uniqueness of VGI is apparent, being a data
collection method which captures the human centred issues. While this may be
considered true at the current point, technologies such as HADRIAN (Porter et
al., 2004) offer a professional and human centred way to assess the built
environment. However, such systems are based on anthropometric data, and
therefore cannot capture the emotional or experiential dimensions of the user in
the environment. For example, current PGI data could be used to establish
whether gaps between trains and platforms are too large, and future systems
such as HADRIAN could be used to evaluate the suitability of the environment
for the wheelchair user. However, neither method could ascertain data relating
to the angle of bus ramps, concern over access at next stops or stress
associated with waiting for access, or perceived treatment as a second-class
citizen. Consequently, this study has demonstrated – to a degree – how VGI
can capture information not traditionally covered by PGI, but also capture
information which cannot be captured through PGI.

Within this study, the majority of access events provided by the participants
related to negative experiences. This may be explained by Holone et al. (2008),
who demonstrated that wheelchair users are more likely to contribute
experiences about their environment when those issues relate to access issues
faced at that moment in time. Consequently, sections along a travel route which
did not result in access limitations were unlikely to be remarked on, even if their
access could have been classified as good or excellent. The significance of this
is that the possibility for single VGI projects to provide a universal travel
directory as a one-stop shop for other homogenous users is limited due to the
demonstrated focus on negative rather than all-encompassing experiences.
However, considering the wider range of information available from both information types within this study, creating mashups utilising both VGI and PGI could create provide a more balanced perspective on the built environment.

### 7.8.2 Success of data collection

At the most basic level, this chapter succeeded in its aims of generating two data sets which could then be combined within a series of mashups for use in a further experiment. However, discussion needs to be given to the level of success and appropriateness with which those data sets were collected.

Although the data as collected through this study appears to represent the level of detail suitable for utilisation with effective and satisfying navigation products (Holone et al., 2007, 2008), this is in the context of a low fidelity system. One of the most promising systems for assessing the human factors of the built environment is HADRIAN\(^{25}\), developed to assess key user requirements from access issues to information delivery (Porter et al., 2004). In investigating the role in which crowd sourcing may be utilised to enhance this system, Evans (2009) demonstrated that such amateur volunteer contributions can be effective and useful. However, as shown by Table 7.4, data collected through this chapter did not reach saturation. There the degree of detail renders the data collected in this study inappropriate for use within the HADRIAN system. Therefore, it may be assumed that the data collected through this study is sufficient for delivering informative information about the built environment for other wheelchair users, but is probably not suitable for advanced definitive assessment.

A further consideration is the degree to which the VGI and PGI data agreed with each other. Because the participants in the study were not provided with a pre-specification of what to look for or comment on (e.g. pay special attention to kerb height) the two data sets are not directly comparable. This is despite both data sets focusing on the same geographic locations and for the same user group; wheelchair users. Therefore, a direct comparison is not feasible. However, from viewing both data sets it is clear that in some instances the VGI

\(^{25}\) Build on the earlier AUNT-SUE project, described by Evans (2009)
and PGI both comment on the same issue (e.g. London Victoria – no access to trains), while in others the VGI and PGI cover different issues (e.g. PGI: Greenwich station is step free, VGI: ramps are very steep). The picture which this creates therefore is not one of VGI confirming PGI, but PGI and VGI being used together to create a more complete image of the issues in the built environment.

This ability for VGI to add additional richness to the data set (where PGI is less complete) was originally presented by Goodchild (2007b) who postulated the use of the world’s six billion inhabitants as sensors to make up for this shortcoming in traditional GI. Additionally, utilising multiple information sources to counteract the limitations of a single information source (PGI or VGI) is supported by Hertzum et al. (2002) and Fallis (2004). Finally, Bishr and Janowicz (2010) also commented that as long as a proxy for establishing trust in VGI is put in place, the multiple combination of information has great potential for realising the concept of a fully integrated digital earth.

### 7.9 Critique of Study

The most prominent limitation within this study is the relatively small sample size of participants. While the six participants engaged within the data gathering could be considered representative of the habits of data contribution for VGI projects (Bishr and Kuhn, 2007, Haklay et al., 2010), the results did not demonstrate significant saturation relating to the majority of issues. Under the guidelines of Morse (2000), further participants would be required in order for the collected data to more fully represent the accessibility issues of the built environment. However, this study aimed to generate two data sets to be used within a controlled research environment, which, as highlighted below, was successfully achieved. In light of this, this limitation should not be of major concern to the validity or reliability of the data.

### 7.10 Conclusions

Investigation within this chapter addressed the Study Aims in the following ways:
1. Generated a data set of VGI from the selected user community, and PGI from currently available sources. Both related to access issues on and around public transport in London.

2. The VGI data set agreed with the access issues raised by the PGI, yet additionally provided information not attainable through any other means.

3. Data sets were combined into a series of custom mashups, which may be utilised by untrained users during later experimentation under controlled conditions.

This chapter focused on data for a larger research aim; understanding how users react to VGI in an information search context. A series of mashups were produced, representing a high quality mashup containing both volunteered and professional information. These data sets are therefore taken further and utilised to produce objective outcomes within Study Three.
8  Study Three: Assessing the Impact of VGI

Research Questions Addressed In This Chapter

1  What is VGI and how is it distinct from PGI?

2  What is the human centred nature of VGI in terms of its generation, production and utilisation by the end users?

3  What influences the way users judge VGI in terms of its relevance to their needs, and how does VGI compare to PGI?

4  What recommendations can be made for combining PGI and VGI for the production of highly usable neogeographic products?

8.1 Introduction

Study Two demonstrated that in a realistic use scenario, consumers are more likely to use VGI and PGI alongside each other (where available) in order to converge on a truth than to use individual VGI or PGI data sets. However, as highlighted by Rieh (2002) the way in which information is perceived by a consumer during an information search is based on a multitude of influences. The perception of information is critical, since it will influence the extent to which it is used.

Before this chapter, the data generation chapter focused on the generation of a VGI and a PGI data set, both describing the same geographic region so they may be compared and contrasted. The aim of the data generation chapter was primarily to generate the data sets necessary for the study described in this chapter. For this study it is important to focus on a consumer user group that is the same as the contributor group since Studies One and Two highlighted this form of homogeneity to be both common and beneficial in neogeography.

Through the manipulation of variables in the information presentation, this study seeks to understand the unique abilities for VGI to influence the user perceptions when combined with PGI through an online interactive mashup.

This focus on user perceptions is critical to fulfilling the current need for design guidance on mashup creation (Idris et al., 2011a). Several authors (Boin and
Hunter, 2006, Devillers et al., 2002, Frank, 1998) have commented that assessment by the descriptors of information alone (its metadata) is difficult and potentially inappropriate, while eliciting user feedback has been proposed as a useful and effective way of assessing the quality and appropriateness of online information (Comber et al., 2007).

The study reported within this chapter was an empirical investigation into the extent that including VGI alongside PGI, or including and telling the user that there exists VGI alongside PGI within a mashup, influences the user experience of a neogeographic system. In particular, this study focused on the effects on the trust that users place in information (see Lit Review Section 2.4.2.4, page 52). Study Two highlighted how trust - both in information and as an emergent property to utilising information – is a critical factor in the users evaluation of VGI. Since trust may be taken as “confidence in or reliance on some quality or attribute of a person or thing, or the truth of a statement” (Oxford University Press, 1989), this study aims to derive it from the user’s perceptions of quality and authority of a mashup, as discussed in Chapter 0:
Literature Review. If including VGI within such information portals increases the user perception of neogeography then this study would demonstrate some of the effective boundaries and influences of VGI from a human factors perspective. Importantly, this experiment was based on the perceptions of information by users, rather than objective and repeatable measures of truth.

8.2 Research Aims
The research aims for Study Three are:

1. The extent to which actually including VGI within the mashup alongside PGI affects the users’ judgements;

2. The extent to which the users react to the information that their mashups contain VGI;

3. The extent to which aspects of the users’ judgements that may be harnessed to optimise the design of future mashups combining both VGI and PGI information.

8.3 Study Rational

8.3.1 Selection of study community
As this study uses the data from the data generation chapter, the same study community (wheelchair users without cognitive or sensory disabilities in a travel context) was carried forward into this study.

8.3.2 Choice of research approach
In order to investigate the hypothesis that user judgements differ between VGI and PGI, and that VGI exerts a positive influence on the user, a deductive research approach was sought within this study (Johnson and Gill, 2002).

Following the recommendations of Preece et al. (2002) an experimental research strategy was selected in order to investigate the key variables associated with the study aims. This involved the deliberate introduction of change in experimental situations and user experience to produce a measurable and repeatable change in the user behaviour. Consequently, a
quantitative mono-method research choice was selected as being the most suitable approach considering the above conditions (Saunders et al., 2009).

In order to reduce the *Hawthorne Effect*\(^{26}\) this study endeavoured to take place within a *field environment*, measuring the impact of the changed variable within a naturally occurring setting (Boudreau et al., 2001). Considering that the *natural setting* for users of VGI within the context of this thesis is using their personal computer equipment (e.g. PC, laptop, tablet, etc.) hosting the experiment via an online experimental website to be accessed by the participant in their home is the most suitable option. Taking this position also allows for a comparison with the work of Rieh (2002) who conducted research into information online within a laboratory setting.

Finally, a cross-sectional time horizon was selected in order to describe the incidence of the user perception phenomenon and explain how different variables interact on the user judgements rather than capture change of opinion over time (Burns, 2009, Erzberger and Kelle, 2003)

### 8.3.3 Boundary conditions

The boundary conditions of this study which were implemented to enable an experimental approach are summarised in Table 8.1.

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\(^{26}\) *Hawthorne Effect* – This is where the act of a participant being involved in an experiment where they know they are being observed or measured changes the outcome of the research (Roethlisberger et al., 1939)
Table 8.1 – Boundary Conditions Placed In The Study

<table>
<thead>
<tr>
<th>Boundary Conditions</th>
<th>Explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Users</strong></td>
<td></td>
</tr>
<tr>
<td>Constrained by specifying participants</td>
<td>All fulfilled the following criteria: Aged 18 – 65, experienced and non-impaired use of a standard PC, unfamiliar with geographic area presented in the study</td>
</tr>
<tr>
<td>Varied on the following characteristics</td>
<td>Gender, general familiarity with GI and GIS, computer literacy</td>
</tr>
<tr>
<td><strong>Information</strong></td>
<td></td>
</tr>
<tr>
<td>Constrained by specifying data sets</td>
<td>Only content of sufficient high quality is presented</td>
</tr>
<tr>
<td>Varied on the following aspects</td>
<td>Participants presented with either a purely professional data set, or a professional data set with added VGI aspects.</td>
</tr>
<tr>
<td><strong>Tasks and Contexts</strong></td>
<td></td>
</tr>
<tr>
<td>Constrained by specifying the experimental task</td>
<td>All participants were asked to do very simple tasks (consider getting from A to B in a wheelchair) using public transport, not taking into account amenities or other normal activities.</td>
</tr>
<tr>
<td>Constrained by the experimental context</td>
<td>All information related to a series of public transport routes, where all participants could only consider those routes as provided to make their judgements.</td>
</tr>
<tr>
<td>Controlled on the following characteristics which effect judgements of cognitive authority and quality</td>
<td>Characteristics of Information Objects: Type, title, content, organisation/structure, presentation, graphics, functionality</td>
</tr>
<tr>
<td>Characteristics of Sources</td>
<td>URL Domain, type, one-collective, Source reputation, user affiliation</td>
</tr>
<tr>
<td>User’s Knowledge</td>
<td>Domain knowledge, system knowledge, 1st hand experience, 2nd hand experience</td>
</tr>
<tr>
<td>Other Factors</td>
<td>Ranking in search output</td>
</tr>
<tr>
<td>Varied on the following information source characteristics</td>
<td>If VGI is present within the mashup alongside PGI.</td>
</tr>
<tr>
<td></td>
<td>What the users have been told the mashup contains</td>
</tr>
</tbody>
</table>
8.4 Methodology

8.4.1 Overview

This study comprised an online experiment to assess the influence of presenting users with mashups containing PGI or PGI + VGI, and the influence of telling users that their mashups contain PGI or PGI + VGI has on their judgements of the websites quality and authority. Four independent groups of participants were used, each with a unique combination of the independent variables. The mashups as presented to the participants contained information on public transport around set routes in London, comprising bus, overground, underground and light trail trains. Participants were asked to consider how confident and comfortable they would be making the journeys as presented to them in the near future if the only information they had was that within the mashup. A Likert scale questionnaire was then presented to the participants in order to collect their judgements, including the dependant variables of quality and authority.

8.4.2 Experimental variables

8.4.2.1 Independent Variables

Within this study, the independent variables were as:

1. Information as presented to the participant
   a. Mashup only contains PGI
   b. Mashup only contains PGI + VGI

2. Information as told to the participant
   a. Participant told that their mashup contains PGI
   b. Participant told that their mashup contains PGI + VGI

Due to time and budget constraints of the study, VGI on its own was not included within the independent variables. This was because doing so would vastly reduce the likelihood of achieving the minimum numbers of participants required by the assumptions of the statistical tests. While reducing the number
of conditions (and thus groups) increases the number of participants per group within the study, the main reason for this decision was that this study investigated the influence of VGI on PGI, rather than to understand the differences between VGI and PGI.

### 8.4.2.2 Dependant Variables

The dependant variables within this experiment needed to be dimensions of user judgement that have been demonstrated to be related to holistic perceptions of information within an online context. In investigating the judgement of information involved in an interaction by a user, Rieh (2002) presented a model to describe how users perceive *quality* and *cognitive authority* in online information; see Figure 2.8, page 78. These judgements are *good, accurate, useful, important, trustworthy, credible, reliable, scholarly, official* and *authoritative*; see Table 2.11 page 79. This framework has also been used in a similar and recent study by Idris et al. (2011a), giving additional demonstrated credibility to its appropriateness. Consequently, the dimensions of information judgement as highlighted above make up the dependant variables of this study.

### 8.4.3 Experimental Design

Users were presented with a mashup unique to their assigned group according to the independent variables; see Table 8.2.

<table>
<thead>
<tr>
<th>Participant Told What Mashup Contained</th>
<th>Information Presented In Mashup</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PGI</td>
<td>PGI</td>
<td>PGI + VGI</td>
</tr>
<tr>
<td>PGI + VGI</td>
<td>Group 1</td>
<td>Group 3</td>
</tr>
<tr>
<td></td>
<td>Group 2</td>
<td>Group 4</td>
</tr>
</tbody>
</table>

The participants were presented with a number of travel routes (see Section 8.4.5) that create engagement between the participant and the information. They were then asked to consider how the they would feel making that journey tomorrow if the only information they had was that presented to them. This
allowed judgements relating to the mashup as a whole to be formed. A similar approach was successfully undertaken by Collins (2006) who presented a data set online to experiment participants while informing them that it was either from source A or B in order to understand perceived bias in information judgement perceptions. Previous research has shown such an approach to be highly relevant and beneficial when researching GI use and utilisation (Bishr and Mantelas, 2008, Idris et al., 2011b, Mummidi and Krumm, 2008).

8.4.4 Design of the user judgement survey

8.4.4.1 Likert Scale Questionnaires

The questionnaire provided to the participants at the end of the experiment was designed to investigate the influence of the independent variables on the dependant variables. Consequently, the structure of the questionnaire was set to reflect the structure of Rieh’s facets of judgements - quality and authority; see Figure 2.8, page 78.

Because the evaluative judgements made by the user on the information comprised their opinions, attitudes and beliefs (Albaum, 1997, Mizumoto and Takeuchi, 2009) the most appropriate method of investigating the participant response to information presented in the study was through Likert Scales (Preece et al., 2011). In forming the statements within the Likert Scale, words and phrases used by the participants in the work of Rieh and Belkin (2000) to relate to the facets of information judgement were utilised. However, the category relating to the scholarly nature of the work was removed from the survey since it held no direct relevance to the investigation within the study.

Table 8.3 - Table 8.4 contain the questions as presented to the participants within the questionnaire. For a full overview of the arrangement of the questions as presented to the study participants, see Appendix 8A. Following the advice of Levine et al. (1993), each section of sub section of the question sheet aimed to provide 50% positive and 50% negative statements to the participant.
Table 8.3 – Questions on the Judgements of Information Quality (based on Rieh and Belkin, 2000)

<table>
<thead>
<tr>
<th>Values</th>
<th>Likert Scale Statements (1 – completely Disagree, 5 – completely agree)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Good</strong></td>
<td>The information provided by the maps</td>
</tr>
<tr>
<td></td>
<td>Did a good job at informing me about accessibility</td>
</tr>
<tr>
<td></td>
<td>May not have been the best possible</td>
</tr>
<tr>
<td></td>
<td>Was for my needs perfect</td>
</tr>
<tr>
<td></td>
<td>Could have been better</td>
</tr>
<tr>
<td><strong>Accurate</strong></td>
<td>The content of the maps</td>
</tr>
<tr>
<td></td>
<td>Was as accurate as I could hope for</td>
</tr>
<tr>
<td></td>
<td>Was not always correct</td>
</tr>
<tr>
<td></td>
<td>Should be considered right</td>
</tr>
<tr>
<td></td>
<td>Was not always as precise as I would want it to be</td>
</tr>
<tr>
<td><strong>Current</strong></td>
<td>The materials I engaged with on the maps</td>
</tr>
<tr>
<td></td>
<td>Reflected the current conditions well</td>
</tr>
<tr>
<td></td>
<td>Seemed to be old and out of date</td>
</tr>
<tr>
<td></td>
<td>Appeared to have been generated recently</td>
</tr>
<tr>
<td></td>
<td>Did not capture the timely importance of travel information</td>
</tr>
<tr>
<td><strong>Useful</strong></td>
<td>Overall, I found the maps</td>
</tr>
<tr>
<td></td>
<td>Useful for my needs</td>
</tr>
<tr>
<td></td>
<td>Useless for what I needed to find out</td>
</tr>
<tr>
<td></td>
<td>Informative in its contents</td>
</tr>
<tr>
<td></td>
<td>Did not help me feel confident I could travel without problems</td>
</tr>
<tr>
<td><strong>Important</strong></td>
<td>The data presented to me through the maps</td>
</tr>
<tr>
<td></td>
<td>Would be important to me when planning future travels</td>
</tr>
<tr>
<td></td>
<td>Would be unimportant to me when planning future journeys</td>
</tr>
<tr>
<td></td>
<td>Does not need to include any more information</td>
</tr>
<tr>
<td></td>
<td>I would require more diverse information</td>
</tr>
</tbody>
</table>
Table 8.4 – Questions On Cognition Of Information Authority, (based on Rieh and Belkin, 2000)

<table>
<thead>
<tr>
<th>Values</th>
<th>Likert Scale Statement</th>
</tr>
</thead>
</table>
| **Trustworthy** | After using the website  
I do not believe it would help me travel without access issues  
I feel I can rely on the information to help me travel freely  
I do not have faith in the quality of the content  
I feel confident that the information provided is true |
| **Credible** | I feel like the information provided  
Was credible  
Did not provide information from sources that were experienced in disabled travel  
Came from sources that knew that were knowledgeable  
Did not come from credible sauces |
| **Reliable** | I feel I can rely on the information to help me travel without encountering access issues  
May need other forms of information to help me travel freely  
Can depend on the information when I go traveling  
Would rather use other forms of information when planning a trip |
| **Official** | The maps should be considered  
As presenting official information  
As secondary to official websites  
Worthy of inclusion on key tourist websites  
As containing unofficial information |
| **Authoritative** | The information I was presented with  
Felt authoritative  
Is not respected in my mind  
Should be considered worthy of respect  
Did not feel like it embodied much authority |

8.4.4.2 Validity and Reliability

The wording, structure and presentation of the Likert scale was tested within the pre-pilot and pilot stage of the website analysis; see Section 8.4.5.2. As recommended by various authors (Brown, 2006, Pallant, 2010) factor analysis was required within the study to ensure that the data collected presents a faithful measure of the factors being investigated. Since the pre-test and pilot
showed favourable reactions towards the survey (as presented within Section 8.4.4, page 240), confirmatory factor analysis was run post-data collection to ensure suitably robust sample sizes per factor could be reached; see Appendix 8F.

### 8.4.5 Design of the website

#### 8.4.5.1 Initial Development

Both PGI and VGI data presented to the participants through the experimental mashups was collected and collated prior to the planning and execution of this study. For full details, see Chapter 7. An example of the mashups developed within mashups is seen in Figure 8.1 below.

![Figure 8.1 – Example of Mashup Set 2: PGI + VGI Data](image)

As participating within the experiment was voluntarily undertaken in a home setting, it was necessary to keep participants engaged during their time on the website to prevent the participants leaving the session prematurely. The website was therefore produce in accordance with the experiment website guidelines of Frick et al. (2001) and Reips (1996, 1999):

- Make web pages shorter and more attractive the further participants get.
• The loading time at the start of the website should be short in order to engage participants with low interest or little time.

• Announce a lottery with prizes for all successful participants.

The website as developed within the experiment is presented in Figure 8.2 below. Further screen shots of the website are presented within Appendix 8C.

![Figure 8.2 - Example Of Mashup Presenting VGI Alongside PGI](image)

As detailed in Table 8.2, various levels of information are required to be presented to the user. While a number of delivery methods are available, instructional videos hosted online (YouTube) were felt to be the most appropriate since they:

• Ensures consistent delivery of information to all participants

• May provide a level of professionalism in the instruction, increasing the cognitive authority of the website equally for all groups as not to introduce an experimental variable.

• Provide an engaging experience which is complimentary to the interactive nature of Web 2.0 and VGI (Bishr and Mantelas, 2008, O'Reilly, 2005).
• Allow simple dissemination of information over the internet 24 hours a day without requiring the researcher to be present.

As pointed out by Rieh (2002) the participants need to be presented with active information-seeking tasks in order for them to form valid judgements, and thus allow the investigation to gain a true understanding of how information is used and perceived in a realistic situation. The tasks within the experiment were characterized as *generic tasks* in order to outline the information seeking activity, but not to restrict the specific experiences. This left the perception of the information unconstrained by the experiment. In order for the participants to encounter *problems* on their virtual journey, routes were selected for the initial data gathering which went through known problem spots. These were identified through the Transport For London website a few days before the VGI data was gathered. At each of the tasks, the participants were instructed to consider:

- Previous journeys made which may be similar (e.g. train travel)
- What information they would need if they were to make a similar journey
- To what extent the information presented to them fulfils their information needs (e.g. completely, partly, not at all)
- How confident the information would make them feel if they were to conduct that journey in the near future.

**8.4.5.2 Validity & Reliability: Pre and Pilot Testing**

A critical element of the validity of this experiment is the choice to host the experiment online, therefore accessible by the participants in their natural home environment rather than within a laboratory. In practice, participants would visit the experiment website via their home computer at a time of their choosing, be allocated to a group, given a pre-experiment briefing via video and then presented with a series of mashups before answering a survey. During use of the mashups, participants were asked to consider the route shown and how they would feel making that journey tomorrow if that was all the information they had. This, as Robson (2002) pointed out, would influence subjects to “do what they think the researcher wants them to do” rather than what they would do in
their natural setting. Therefore by presenting the information to participants in their *realistic* natural setting they are less likely to engage in this form of *game playing* and the factors being investigated by the experiment are more likely to be those actually measured.

A pre-test was run exploring the initial mechanisms of the study using non-disabled members of Loughborough Design School. The aim of this *pre-test* process was to trial some or all aspects of the instrument to ensure there are no unanticipated difficulties (Alreck and Settle, 1995). This consisted of a custom, interactive website, embedded instructional videos, embedded interactive mashup and full survey. Critically, the independent variables presented to the participants during the pre-test were 1) the mashup contained only PGI and 2) participants were told that the mashup contained PGI + VGI. Screen shots of this website may be seen in Appendix 8B. In total eight participants took part in the pre-test. The key outcomes from the pre-test were:

- General website usability improvements needed to convey a *high quality* user experience through the experiment.
- The need for more demonstrative, clearer and professional instructional videos
- The need for clearer presentation of information within the mashup

Additionally, protocol analysis was conducted to assess the suitability of the experiment survey, see Section 8.4.4; page 240. Here, individual participants within the pre-test group were asked for their opinions on the survey questions; notably what the intention of the questions were and what was being asked (Ericsson and Simon, 1993). Within the survey, minor issues relating to grammar and clarity were corrected. Overall, the survey was found to be suitable and appropriate by the pre-test protocol analysis.

Once the website, mashups and survey elements of the experiment had been created and adjusted according to the pre-test, a small scale pilot study was conducted to ensure that the experiment would run as designed. In total 36 wheelchair users (17 male, 19 female) engaged with the interactive survey, providing data for the study using the online website. From feedback collected
from participants it was clear that although the mashup and survey was appropriate and effective, the website needed to have better usability in order to prevent some users from abandoning the interactive survey part way through due to frustration. The outcomes from the pilot test and how they were addressed is presented in Table 8.5.

Table 8.5 – Pilot Test Issues and How They Were Addressed

<table>
<thead>
<tr>
<th>Usability Issue</th>
<th>How Addressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple Mac users experienced ‘load’ problems with the website</td>
<td>Help section for Apple Mac users added explaining how to fix runtime issues</td>
</tr>
<tr>
<td>Some users found navigating the maps difficult</td>
<td>A help section for navigating the maps, was added to the tutorial practice map pages</td>
</tr>
<tr>
<td>Some participants were unsure of exactly what to do on the maps</td>
<td>Simple text added to the map mashup pages explaining that all that was required was considering the Information</td>
</tr>
<tr>
<td>The end of the survey seemed uncertain</td>
<td>A video message was added to the end of the survey thanking participants for their time and asking them to share the survey with others.</td>
</tr>
</tbody>
</table>

8.4.5.3 Website Usability Assessment

A usability assessment of the experiment website was conducted to ensure that the judgements as measured by the dependable variables were the result of the independent variables, rather than overly influenced by a poorly designed website. This was achieved by including questions based on the Software Acceptance Questionnaire (Maguire, 1998) within the Likert Scale survey. The assessment found that although clarity of information delivery could be improved upon, the website exhibited of high-level overall usability; see Figure 8.3.
Figure 8.3 - Box Plots Representing User Acceptance of the Website

Additionally, when a Two-Way MANOVA test was run, no statistically significant interactions were observed between the groups. The assessment found the website to have suitable usability for the function of the experiment. A full overview of this assessment can be found in Appendix 8E.

8.4.6 Participant sampling

8.4.6.1 Demographics Specification

It was important that the participants who engaged with the experiment were in a position to critically evaluate the information to form realistic judgements. In order for this to be achieved, the following screening criteria was generated.

- Physical disability which limits movement and necessitates the use of aids similar to and including wheelchairs
- Only exhibits physical disabilities, excluding cognitive and sensory disabilities
• Compatible with non-vulnerable persons description under the
Loughborough University Ethics committee, except in circumstances
listed above

• Full access to and competence using a PC, Laptop, Tablet or other
internet enabled computer with a full sized screen; e.g. excluding pocket
portable devices such as mobile phones.

• Have a good to excellent familiarity and confidence using online maps;
e.g. Google Maps.

Due to the virtual tour nature of how information was delivered to the
participants, no existing knowledge of London public transport was required of
the participant.

8.4.6.2 Sample Representativeness and error
The issue of culture has been raised as a potential differentiator in holistic and
analytic perception, usability and cartographic perception (Edsall, 2007, Nisbett
and Miyamoto, 2005, Shi, 2010). This study sought to contact participants
within the international community, although limited to economically developed
English speaking countries; i.e. United Kingdom, USA, Canada and Australia.
This also increases the number of participants responding to the survey,
making the outcomes more statistically reliable, as well as increasing the
overall external validity of the results.

While sampling errors may be considered unavoidable (Caswell, 1995) its effect
on this research study is limited by using appropriate and diverse participant
recruitment, accessing a wide spectrum of participants from within the
wheelchair user community.

8.4.6.3 Recruitment
In order to access as wide a variety of participants as possible (in line with the
boundary conditions) multiple points of contact were used; see Appendix 8D
and below:

• Wheelchair specific disability services and groups
• Internet forums that served an international audience

• Social Media presence and adverts (i.e. Facebook, Twitter, Google+) targeted at residents of the target countries

In order to accommodate the wide variety of locations where recruitment took place, the experiment was branded *Free Traveller*. This provided an effective synergy between multiple social media profiles (e.g. Twitter, Facebook, Google+, etc.), printed and electronic flyers and the website itself.

By hosting the experiment within an online and interactive website, the issue of participant availability was reduced, since they may take part in the experiment at any time they have access to the internet. Within the UK (2010) 30.1 million adults (60 per cent of the UK population) accessed the internet every day in the UK, and only 9.2 million did not ever access the internet (ONS, 2010).

Considering the wider use of the internet worldwide, Fox (2010) commented that 54% of adults living with a disability use the internet in the USA, compared with 81% of able-bodied adults (Carter, 2011). Therefore, access to the internet was not a barrier to participation in the experiment. Overall, by hosting the experiment online the limitations on time, energy and resources posed by traditional experiments held within laboratory conditions are overcome, as well as increasing the ecological validity of the research.

Considering the number of participants required for a survey-based experiment, Borg and Gall (1989) recommend about 100 observations per sub-group within an experiment. This would require 400 participants in the experiment. However, Pallant (2010) recommended that the minimum number of cases required for two-way statistical analysis could be calculated to 36 from the number of dependent (nine for the nine dimensions of information judgement within the survey) and independent variables (two for information presented and information told) - dV and iV - within the data set (Pallant, 2010); see Equation 8.2.

\[ N = dV \times 2(iV) \quad \text{Equation 8.2} \]

\[ N = 9 \times 2(2) \]
After considering the two estimates, it was decided to achieve a representative sample of 100 participants, before ending data collection and running statistical analysis.

8.4.6.4 Rewarding Participant Time

In order to reduce the number of participants who drop out of the experiment part way through, and to maximise engagement with the website from first visit (Frick et al., 2001), a financial incentive of being entered into a lottery to win £150 was offered to participants who successfully completed the survey. Frick et al. (2001) demonstrated that providing incentives to participants in the form of a lottery reduced the number of dropouts of the online experiment yet did not provide a bias in the answers that they provided.

8.4.7 Procedure

Participants were contacted through a variety of methods, as detailed in Section 8.4.6.3; page 249. Within recruitment, participants were asked only to respond and take part if they corresponded with the demographic specifications outlined in Section Error! Reference source not found.; page Error! Bookmark not defined.. Following this, participants were directed to the Free Traveller website. They then worked through the following stages:

- **Stage 1**: Placing them in experiment groups
- **Stage 2**: Delivering basic instructions
- **Stage 3**: Telling them that their maps contained PGI or PGI + VGI
- **Stage 4**: Using the Mashup
- **Stage 5**: Assessment questionnaire
- **Stage 6**: Giving out Prize

None of those involved with the collection of the VGI data set took part in the online experiment to prevent contamination of data by experience.
8.4.8 Statistical analysis

8.4.8.1 Overview

The first stage of analysis was confirmatory factor analysis, selected to ensure the data faithfully represents the factors being measured. To understand how the dependant variables are influenced by the independent variables within this experiment, an appropriate statistical method based on analysis of variance is required. Although the data created through using Likert Scale is ordinal, the most powerful tool was Two-Way Multivariate Analysis Of Variance (MANOVA). In this case, the two-way refers to the number of independent variables. Using MANOVA also reduces the risk of a type 1 inflation error in the data analysis (Pallant, 2010). MANOVA is primarily designed for parametric data, however, it may only be used with ordinal (non-parametric) data when all assumptions are met prior to its calculation; particularly Kolmogorov-Smirnov achieving significance and thus demonstrating sufficient normality within the data; see Appendix 8G, page 394.

In the case where assumptions within the data set are violated, the non-parametric equivalent of MANOVA would be used; Kruskal-Wallis. However, this test is not as powerful as MANOVA in understanding the influence of the independent variables on the dependable variables (Caswell, 1995, Field, 2004, Pallant, 2010) and thus is a backup approach rather than a main tool.

Prior to statistical analysis, the following considerations were given to the data:

- **Sampling error** within the analysis was reduced through 1) ensuring that enough participants were sampled to satisfy the assumptions for each statistical tool and 2) sampling users from geographically dispersed regions, embodying a ride range of mobility disabilities.

- **Measurement error** was reduced by collecting data through a specially designed survey, measuring only those factors of interest to the experiment on a five point Likert scale.
Estimation error was reduced by ensuring that the data set met the assumptions required by the statistical tools (including outliers) analysis was conducted; see Appendix 8G.

All statistical analysis within this study was undertaken with the aid of SPSS 19 (IBM, 2011).

### 8.4.8.2 Confirmatory Factor Analysis

In order to assess the suitability of the grouping or utilisation of the various dependable variables (Keller, 2006, Pallant, 2010), confirmatory factor analysis was selected to ratify the outcomes of the survey.

The 10 dependant variables of the User Judgement Survey were subjected to principal components analysis (PCA) using SPSS version 19. Prior to performing PCA, the suitability of data for factor analysis was assessed. Inspection of the correlation matrix revealed the presence of many coefficients of .3 and above, demonstrating sufficient correlation (Pallant, 2010). The Kaiser-Meyer-Oklin value was .93, exceeding the recommended value of .6 (Kaiser, 1970, 1974) and Bartlett’s (1954) Test of Sphericity reached statistical significance, supporting the factorability of the correlation matrix.

Principal components analysis revealed the presence of one component with an eigenvalue exceeding 1.0, explaining 71.2% of the variance. An inspection of the screeplot revealed a clear break after the first component. Using Catell’s (1966) scree test for rotation sums of squared loadings, it was decided to retain one component for further investigation. Parallel Analysis also showed only one component with an eigenvalue exceeded the corresponding criterion values for a randomly generated data matrix (Watkins, 2000) of the same size (10 variables x 101 respondents). See Appendix 8F for the scree plot and unrotated loadings. Since a one-component solution was found, explaining 71.2% of the variance, oblimin rotation is not necessary to reveal the structure of the data, or its loading on alternate components (Thurstone, 1947).

### 8.4.8.3 Scale Reliability Measures

Since the judgement scale was developed from the work of Rieh (2002) specifically for this experiment no previous data are available on its internal
consistency. In the current study, the Cronbach alpha coefficient was .95; suggesting exceptionally good internal consistency in the scale.

8.4.8.4 Descriptive Statistics

A breakdown of the participants involved within the study by gender is given below in Table 8.6 and by geographic location in Table 8.7.

| Table 8.6 – Breakdown of Participants Per Group by Gender |
|---|---|---|
| Group | Male | Female | Total |
| 1 | 11 | 12 | 23 |
| 2 | 16 | 17 | 33 |
| 3 | 6 | 16 | 22 |
| 4 | 7 | 16 | 23 |

| Table 8.7 – Breakdown of Participants by Location |
|---|---|
| Country | Frequency |
| Australia | 2 |
| Canada | 10 |
| Ireland | 2 |
| New Zealand | 3 |
| UK | 63 |
| USA | 20 |
| Other | 1 |
| Total | 101 |

A two-way between-group multivariate analysis was performed to investigate the influence of the confounds of gender, country of residence, regional settlement type, computer use, confidence using online maps and confidence travelling on the dependant variables of the experiment. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance-covariance matrices, and multicollinearity, with no serious violations noted. For all confounds, no statistically significant interactions were observed.
The confidence and familiarity of the user with online mashups was a potential limiting factor to the analysis. Negative judgements may be formed during the experiment not as an influence from the independent variables, but from the lack of confidence in using the system; a variable not covered by this investigation. However as Figure 8.4 demonstrates, the vast majority of participants were very confident using online maps prior to engagement with the Free Traveller experiment. Consequently, the influence of participants being uncomfortable using mashups similar to those included in the experiment can be considered negligible.

Figure 8.4 - Participant Confidence Using Online Maps
(1 = very low confidence, 5 = very high confidence)

8.5 Hypotheses
Based on previous research being applied to the pre-specified design model, the following null and alternative hypothesised were constructed; see Table 8.8. Due to the uncertain nature of the influence of VGI and PGI on users, a 2-tailed hypothesis was taken.
Table 8.8 – Alternative Hypotheses Within Study Three

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>Alternative Hypothesis (2-Tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No significant interactions in the quality and authority judgements of maps containing PGI or those containing PGI + VGI</td>
<td>Presenting groups with maps containing PGI + VGI (rather than just PGI) influences their judgements of quality and authority.</td>
</tr>
<tr>
<td>No significant interactions in the quality and authority judgements of maps when users are told they contain PGI or PGI + VGI</td>
<td>Informing the participant that the information they are using is volunteer generated influences their judgements of quality and authority.</td>
</tr>
</tbody>
</table>

8.6 Results and Analysis

8.6.1 Two-way MANOVA

A two-way between-group multivariate analysis was performed to investigate (1) the inclusion of VGI alongside PGI within a mashup, and (2) the influence of being told a mashup contains VGI alongside PGI, on the user judgement of mashups quality and authority.

Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance-covariance matrices, and multicollinearity, with no serious violations noted. Importantly, the Kolmogorov-Smirnov test for normality was significant, demonstrating the appropriateness of MANOVA as the statistical analysis tool. For full details see Appendix 8G, page 394. However, due to the statistically high correlation between the authority elements of trustworthiness and reliability \( \rho = .846 \), the item reliability was removed from the data set since of the pair it exhibited the highest level of correlation with other items. This was done to meet the assumptions of MANOVA (Pallant, 2010) and to allow insight into not only the statistical significance of dependable variables, but also their effect sizes (Field, 2004).

In addition to the assumption testing as detailed in Appendix 8G, the Levene’s Test for Quality of Variance produced a statistically significant outcome \( \rho = .04 \). Consequently, it was necessary to use a lower alpha (.025) to be sure of significance in the univariate F-test (Tabachnick and Fidell, 2007).
Although the \( N \) values for the data were not equal, making Pillai’s Trace the most appropriate multivariate test (Pallant, 2010, Tabachnick and Fidell, 2007), due to the small number of groups involved in the data, the F-tests for Wilks’ Lambda, Hotelling’s Trace and Pillai’s Trace were identical. Therefore, Wilks’ Lambda was used for its applicability to general use (Tabachnick and Fidell, 2007).

No statistically significant interactions were observed between those groups who were told that their mashups contained PGI + VGI and those groups who were told that their mashups contained only PGI, \( F (9, 89) = 1.20 \) \( p = .304 \); Wilks’ Lambda = .89; \( \eta^2 = .108 \).

There were statistically significant interactions between those groups who were presented with mashups containing PGI + VGI and those groups who were presented with mashups containing only PGI on the combined dependant variables, \( F (9, 89) = 3.91, p = .000 \); Wilks’ Lambda = .72; \( \eta^2 = .283 \).

When the results for the dependent variables related to the information as presented to the participants were considered separately, the only user judgement to reach statistical significance, using a Bonferroni adjusted alpha level of .006\(^{27}\), was currency: \( F (1, 97) = 10.81, p = .001, \eta^2 = .10 \). The \( \eta^2 \) of .10 represents 10 per cent of the variance in perceived currency scores explained by belief that the mashup in use contains VGI. Under the generally accepted criteria of Cohen (1988) this constitutes a medium effect size. An inspection of the mean scores indicated that those who believed that their mashup contained PGI + VGI reported slightly higher levels of perceived currency in the map date (\( \bar{x} = 13.98, SD = 2.68 \)) than those who had believed that their mashup contained only PGI (\( \bar{x} = 12.48, SD = 3.45 \)). This is graphically presented in Figure 8.5.

\(^{27}\) Bonferroni adjustment (0.006) = experiment alpha (0.05) / number of comparisons (9)
At no point was a statistically significant interaction between the fixed variables observed within this MANOVA test.

In assumption testing conducted prior to MANOVA, all of the dependable variables were demonstrated to have non-significance according to the Leven’s Test (see Appendix 8G). Therefore, non-significant outcomes from the MANOVA test may be discussed in terms of their significance of similarity influence; i.e. as opposed to significance of difference as measured by MANOVA and other analysis of variance tests.

### 8.6.2 Sample size estimation

Due to the low level significance of variables within the data set, it was useful to apply further inferential analysis to predict possible significance within larger groups. Sample size estimation\(^{28}\) aimed to predict the number of participants that could be in future similar research. Figures were reached with the aid of Appendix D within Murphy and Myors (2004).

Table 8.9 demonstrates the estimated sample sizes required for achieving statistical significance using MANOVA for each of the dependant variables found insignificant within the experimental data set; N = 101.

---

\(^{28}\) 80% power, 5% significance, 2-tailed for Type I and Type III Errors
Although estimation of sample size was increased to $N = 606$, no significance was predicted relating to accuracy or authority.

By estimating the sample size to be $N = 202$, significant interactions were predicted between those who were told that their mashups contained PGI + VGI and those who were told that their mashups contained only PGI.

Table 8.10 demonstrates the estimated sample sizes required for achieving statistical significance using MANOVA for each of the dependant variables found insignificant within the experimental data set.
Table 8.10 – Sample Size Estimations for Quality & Authority: Information Told

<table>
<thead>
<tr>
<th>Dependant Variable</th>
<th>Estimated N</th>
<th>Target $p$</th>
<th>$F$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authority</td>
<td>202</td>
<td>.02014</td>
<td>(1, 198) = 9.19</td>
<td>.003</td>
</tr>
<tr>
<td>Credible</td>
<td>303</td>
<td>.02014</td>
<td>(1, 299) = 7.46</td>
<td>.007</td>
</tr>
<tr>
<td>Usefulness</td>
<td>303</td>
<td>.02014</td>
<td>(1, 299) = 8.05</td>
<td>.005</td>
</tr>
<tr>
<td>Currency</td>
<td>606</td>
<td>.02014</td>
<td>(1, 602) = 6.20</td>
<td>.013</td>
</tr>
<tr>
<td>Goodness</td>
<td>606</td>
<td>.02014</td>
<td>(1, 602) = 6.32</td>
<td>.012</td>
</tr>
<tr>
<td>Official</td>
<td>606</td>
<td>.02014</td>
<td>(1, 602) = 6.05</td>
<td>.014</td>
</tr>
<tr>
<td>Importance</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trustworthy</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Although estimation of sample size was increased to $N = 606$, no significance was indicated relating to importance or accuracy.

8.6.3 Testing of Independent Variables

The first independent variable of the content of the mashup as presented to the participant was controlled by the study. Therefore, its ability to potentially influence the participants was assured. Although all participants were told that their mashup contained PGI or PGI + VGI, the degree to which the participants accepted this variable was not controlled. Therefore, in order to help explain the experimental results, participants were asked what information they believed the maps they had just used contained; see Table 8.11

Table 8.11 – Testing of the ‘told’ independent variable

<table>
<thead>
<tr>
<th>Group</th>
<th>Presented</th>
<th>Told</th>
<th>Believed Mashup Contained</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Professional + Volunteer</td>
</tr>
<tr>
<td>1</td>
<td>PGI</td>
<td>PGI</td>
<td>18</td>
</tr>
<tr>
<td>2</td>
<td>PGI</td>
<td>PGI + VGI</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>PGI + VGI</td>
<td>PGI</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>PGI + VGI</td>
<td>PGI + VGI</td>
<td>2</td>
</tr>
</tbody>
</table>
8.7 Discussion

8.7.1 Influence of VGI on quality and authority

The first point for discussion is that of the overall effect of presenting VGI alongside PGI within a mashup. Here the presence of VGI in the mashup data was shown to increase judgements of quality and authority by a significant amount. This was distinct and separate from the fact that some participants were told that their data included VGI. Based on the results, no support was given to the null hypothesis, and therefore this experiment accepts the alternative hypothesis: “Presenting groups with maps containing PGI + VGI (rather than just PGI) influences their judgements of quality and authority”. As shown by the comparison of means, this was a positive influence.

Consequently, the question that needs to be addressed is whether it was the fact there was more information that caused the increase in quality and authority perceptions, or the unique attributes of VGI that caused the change in perception.

In a study examining user perceptions of Wikipedia using the information judgement framework of Rieh (2002), Yaari et al. (2011) highlighted how increasing the amount of information available to the user increased perceptions of quality and authority. This outcome was consistent with the findings of Tillotson (2002), although in a more general study involving university students’ assessment of online information. However, in these studies it was the increase in quantity of the same kind of information that caused the increase in perceptions. As shown in the analysis of data used within this study (Chapter Seven) while the VGI and PGI data did not conflict with each other, and both focused on the same locations, the issues identified and the way they are described are very different. Therefore, within the context of this study, the VGI data did add additional information, but it was additional information unique to VGI. This suggests that if the same quantity of additional information was provided, yet the information was additional PGI not VGI, then less increase in information judgement would be observed. However, further experimental research is required to fully understand this outcome better.
The second point for discussion was the lack of statistically significant influence of the independent variable telling people the contents of their mashup. Therefore, based on the results, this experiment accepts the null hypothesis that there is “no significant interactions in the quality and authority judgements of maps when users are told they contain PGI or PGI + VGI”. The question therefore stands as to why telling participants that their mashups contained data from other wheelchair users made no statistically significant interactions in terms of quality and authority judgements.

The first consideration, as demonstrated within Section 8.6.2 (Sample size estimation), is that a sample of 202 participants was predicted to be needed in order to produce a statistically significant difference; an achievable sample size. This suggests that the independent variable of telling participants the content of the mashup did have a valid and realistic (but relatively minor) influence on the participants. However, under the experimental design of this study, that difference could not be demonstrated. Further research in this area with larger sample sizes is needed in order to take this investigation further.

The second consideration as to why this independent variable did not achieve statistically significant results is in the limitations of the experimental design. Table 8.11 (– Testing of the ‘told’ independent variable) shows that when asked, many participants did not correctly identify the content of the map as told to them during the tutorial; e.g. told PGI + VGI, believed only PGI. This is despite being told numerous times during the tutorials that their mashup would contain X. Unfortunately, due to the low sample size it was not possible to remove the noise in the data set generated by those participants who did not respond to the independent variable of ‘being told the content of the mashup’ as desired. This noise in the data could be the reason why non-significance was found relating to this independent variable. Unfortunately, as qualitative data relating to why the participants believed the content of the mashups to be what it is was not collected, further enquiry on this matter cannot be taken at this stage. This does suggest that simply telling participants the content of the mashups through text and video was not a powerful enough communication method to sufficiently influence their beliefs. However, an alternative proposition could be that participants could not remember what they had been told in the
tutorial, or had thought during the map use. It may be speculated that this is consistent with the theory of false memories, where participants recall memories, which are different to the ones held at the time of the event (Gallo, 2006).

A third consideration for the non-significance of the Independent variable was that irrespective of the influence of sample size or self-reported beliefs, the influence of the variable was relatively weak. If this is the case then the null hypothesis relating to this variable would be accepted. What is important is that the information itself provides the utility in an easily accessible and understandable fashion.

Consequently, the data appeared to indicate that there should be little concern about utilising VGI (or making users aware that their mashup contains VGI) for fear that it would dissuade the consumer from utilising the map product. As highlighted previously, the additional information within the mashup is most likely causing the increase in quality and authority perceptions, however an important point is that this information can only come from volunteers. Additionally a designer should not look to utilising VGI with the hope of such a crowd sourced label increasing user confidence or perceived quality or authority. Instead, the designer must focus on the utility and communication of all potential information sources, selecting the most appropriate one for the user group in a case-by-case situation.

Finally, consideration should be given to the medium effect size associated with the statistically significant outcome that presenting users with VGI alongside PGI increases judgements of quality and authority. This score represents the user’s overall perception of quality and authority as statistically determined within this study. Therefore, it may be inferred that within mashups presenting a mixture of VGI and PGI to a user whose information search is highly dependent on time-sensitive information (e.g. as for kayakers), positive judgements of the website as a whole should increase. This is irrespective of whether they know VGI is included or not. However, this increase may be minor, and not enough for a dramatic change in the way the website is seen and interacted with. Importantly, this was as a result of the increased quality of the data in the
mashup, and not due to the user perceiving the mashup to be better for the simple reason of “it includes volunteered data”.

8.7.2 Influence of VGI on currency

Presenting users with VGI alongside traditional PGI (irrespective of what they were told) produced a significant and positive influence on judgements of currency with a medium effect size; see Figure 8.5. Within the investigation into the role that presenting VGI has on user judgements, this was the most influential component of the experiment. This outcome is contextualised by Goodchild (2008b), who commented that “perhaps the most significant area of geospatial data qualities for VGI is currency, or the degree to which the database is up-to-date”. Consequently, the question needs to be asked, ‘why was currency influenced by the VGI data?’ While the VGI collected during the data generation chapter was undoubtedly more current than the PGI collected through literature review with regards to intermediate or fast changing information, comparison of the data sets showed no demonstrable disagreement.

Currency in this sense relates to the objective currency of information; e.g., the information can be demonstrated to reflect the current state of the environment and therefore utility may be derived. Under this definition, PGI may be seen as current, although this is particularly true when relating to static information. Currency has also been highlighted as an important dimension of a user’s perception of online information (Flanagin and Metzger, 2007a, Metzger et al., 2003). Within the current literature, a significant body of work (Barry and Schamber, 1998, Goodchild, 2007a) - as well as Study Two within this thesis - demonstrated the important connection between the currency of information and VGI. This finding may be explained by the work of various authors (Gitelson and Crompton, 1983, Nolan, 1976, Schuett, 1993) who demonstrated that information from informal sources is the most informative due to its ability to reflect changes in the environment. This benefit is, however, limited to where the data describes events and geography that changes faster than traditional cartography can document, or relate to information not captured by traditional PGI.
As the discussion within the data generation chapter demonstrated, the VGI collected (and presented to users within this study) contained not only objective data which could be achieved through traditional/professional methods, but also experiential and emotional data which can only come from users. PGI, however, covered more objective features; e.g., station is step free for easy wheelchair access. This means the VGI and the context of use within this study can be considered informal in the way which Gitelson and Crompton (1983), Nolan (1976) and Schuett (1993) meant it. This may explain why the participants in this study judged VGI enhances mashups to be of higher currency. However, further research to confirm this application of theory is required.

Finally, the quantitative approach to research within this study did not provide sufficient data to infer why presenting VGI alongside PGI to participants only seemed to influence the judgements related to currency. It would have been useful to have obtained more qualitative data on: the perceptions of participants towards the different versions of the mashups, the extent to which participants were fully aware of the presences or otherwise of VGI, and the benefits (if any) that they thought it conveyed.

### 8.7.3 Sample size estimation

While the sample size within this study passed the minimum assumptions required by MANOVA, the lack of significant outcomes may have been due to the number of participants in each case being too small to detect relatively small differences due to the manipulation of the independent variables. Therefore, sample size estimation was utilised in order to predict potential outcomes with increased sample sizes.

The most useful and robust outcome from this processes was that should the experiment be re-run in the future, a minimum of 400 (and ideally 600) participants should be sought. This would allow for the full range of influences on the dependable variables coming from the independent variables to be assessed. This supports the claims of Borg and Gall (1989) that 100 participants per cell are required for robust statistical analysis. Further to this,
sample size analysis has allowed for a number of inferences to be drawn that describe what may be found if sufficient participants were to be sourced.

### 8.8 Critique Of Study

The most prominent limitation of this study was the lack of qualitative information, which could have been collected from participants during the survey. This was done to reduce the number of questions being posed to the participants. However, further explanation as to why the participants judged the information in the way they did (as evident via the statistical analysis) could have been achieved. Considering this, further complimentary research is required in order to fully explore user perceptions to develop useful design guidelines.

This study contained a limitation that there may potentially be a difficulty in transferring the outcomes of this study to different user groups other than wheelchair users. While the participants engaged with during data collection were representative of the larger wheelchair user community, it is currently unclear how their collective views are compatible with other users with accessibility issues, or the wider able-bodied community. To provide a context, Holone et al. (2007, 2008) demonstrated that even within the relatively narrow constraints of accessibility in the built environment two related yet dissimilar user groups (parents with prams and wheelchair users) contribute and view VGI differently. Importantly, outcomes from this study can only be considered directly applicable to online mashups which utilise both VGI and PGI in an travel accessibility context. Consequently, further comparable research is needed in different use situations to understand the commonality and differences in user perception of neogeography and VGI.

As demonstrated by Section 8.6.3 (Testing of Independent Variables) the independent variable of telling participants the contents of the mashup was not fully effective. Future research looking to expand upon this study should look into revising the experimental design to use more persuasive and effective methods in communicating this variable. Doing so would allow a more in depth future testing of the null hypothesis, and shed light on why the null hypothesis was accepted for that variable within this study.
Exhaustive efforts were made to recruit participants for this study. However, a relatively small sample size was achieved within this experiment. Although the invitation to participate was offered over a wide geographic region, only 101 of the thousands of wheelchair users who saw the add means a degree of self-selection entered the study. It is possible that those who volunteered to participate were more socially motivated and confident using online maps than the general population. Despite the question of the participant’s confidence using online maps (Figure 8.4, page 255), which demonstrate a high average confidence; no comparable data of the wider public is available. Therefore, this assumption is difficult to ratify at this point.

8.9 Conclusions

Through investigation, this study has addressed the study aims in the following ways:

1. **The extent to which including VGI within the mashup alongside PGI affects the users’ judgements**

   Although VGI has a great potential to contain and represent a wide range of data not easily captured by traditional techniques (Burns, 2009, Goodchild, 2007a, Kingsbury and Jones III, 2009), its influence on user judgements within a simple, online mashup was limited. Within this context, including VGI within a data set has been shown to increase *quality* and *accuracy* judgements by a statistically significant amount. Here, the independent variable of perceived currency is the most sensitive the inclusion of VGI. Consequently including VGI alongside PGI in a mashup may enhance the user experience by a small yet noticeable amount, and without any negative impact on user perceptions.

2. **The extent to which knowing that mashups contain VGI influences user judgement**

   Telling users that their mashup contained VGI through embedded video and on-screen text had no statistically significant influence on the judgements of users. This suggests that the supposed assumption that
users feel VGI is inferior to PGI (and thus knowledge of its use is detrimental to the user experience) may not be true.

3. The extent to which understanding user reactions to VGI and PGI may influence the design of future mashups

While the inclusion of VGI within the data set may not necessarily produce a large benefit in the way users perceive the website, this study has highlighted the subtle yet beneficial ways in which VGI may enhance the user experience. Additionally, this study demonstrates how VGI is limited in what it may be able to achieve, so informing the designer to search for other, more efficient and useful ways at enhancing those elements that VGI is not able to enhance by a noticeable or useful amount. This study has shown that while the presentation and promotion of VGI are important and useful for the design of high quality user experiences in neogeography, consideration is needed as to the area of user judgement that may be enhanced. A human factors designer should consider if the potential gains of utilising VGI are worth the extra challenges that their successful implementation would bring.

This study supports the combined use of VGI and PGI over presenting just VGI or PGI. However, this study has also highlighted key limitations in the ability for VGI to enhance all areas of quality and authority within the mashup. It should be noted that although not all outcomes were statistically significant or had large effect sizes, there were no negative repercussions for the inclusion and utilisation of VGI. This is possibly one of the most interesting outcomes in that it answers the concern in the literature on the potential dangers of presenting users with information from untrained amateurs.
9 Overview and Synthesis

<table>
<thead>
<tr>
<th>Research Questions Addressed In This Chapter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What is VGI and how is it distinct from PGI?</td>
</tr>
<tr>
<td>2. What is the human centred nature of VGI in terms of its generation, production and utilisation by the end users?</td>
</tr>
<tr>
<td>3. What influences the way users judge VGI in terms of its relevance to their needs, and how does VGI compare to PGI?</td>
</tr>
<tr>
<td>4. What recommendations can be made for combining PGI and VGI for the production of highly usable neogeographic products?</td>
</tr>
</tbody>
</table>

9.1 Introduction

This thesis set out to investigate the relationship between Volunteered and Professional Geographic Information from a multidisciplinary perspective. To this end, this thesis has presented a relevant and unique framework for neogeography through an in depth literature review and framework of VGI. Additionally, two empirical studies focused on the human issues to do with the generation, and use of VGI and PGI. Chapters Two and Three set out to understand the phenomena of VGI, Chapters Three and Five considered the ways in which VGI is used and perceived by its users, and Chapters Six and Eight focused on particular advantages to the user derived from the use of VGI.

This chapter summarises and synthesises the main findings from this thesis, relating to the five research questions of this thesis:

1. A discussion of the nature of VGI as an information set distinct from PGI, within a human factors context (RQ1, RQ2)
2. An appraisal of the framework of VGI as proposed by this thesis (RQ1)
3. A discussion of how VGI influences the way users interact with online information (RQ3)
4. An assessment of the benefits and limitations of VGI within a neogeographic/ human centred use context (RQ1, RQ3)
5. Recommendations for the design of VGI within online information delivery mashups and neogeographic systems (RQ4)

9.2 The Nature of VGI as Distinct from PGI

This thesis has highlighted two central ways in which VGI and PGI are distinct from one another; the demonstrable differences in the data content, and the perceptual differences in information judgement from the user. While the literature review highlighted various methods of VGI generation through Web 2.0 and GPS technologies (amongst others), such technical aspects are outside the scope of this thesis, and therefore not discussed below.

9.2.1 Data content, use and contribution

Various insights into the differences between VGI and PGI in terms of their content have been observed. Studies One and Two highlighted how VGI and PGI may vary in their use of standardised terminology, frequency of surveying/resurveying areas and quality control (amongst others). However, from the perspective of the consumer-user, a distinction is not made between VGI and PGI, and they are instead seen as simply information. Here, the volunteer or professional originator has little impact on the consumer’s use and assessment of the information. While such a point was originally contested (Das and Kraak, 2011, Flanagin and Metzger, 2008, Keen, 2007), Study Three demonstrated how informing participants that their mashups contained data from amateur volunteers had a largely negligible (although positive) impact on user judgements. What was shown to have the greatest positive influence on user judgements was including VGI within the data set, irrespective of whether the user believed the mashups data to have been generated by professionals or volunteers. It is unlikely that this was the result of VGI simply offering more information, since the judgement dimension which was the greatest influenced by the inclusion of VGI alongside PGI was that of currency.

While providing more information may influence the judgements of credibility, trustworthiness or authority, currency judgements are not based on quantity. Instead, they are based on the ability to reflect current events, demonstrated by the way the information is written and presented (Alonso et al., 2007, Schilder and Habel, 2001). Therefore, consideration must be given to the characteristics
of the information which influences the user’s judgement, more so than the level of professionalism accredited to the contributor. This is supported by the work of Haklay et al. (2009, Haklay, 2010b) that when compared to professional information, volunteered information is already more than good enough. However, this is highly task dependant, and demonstrates how VGI can be more than good enough, rather than being demonstrably more than good enough.

Due to its standardised and well-documented approach, the creation of PGI is a well-understood field, with processes catalogued and discussed in detailed within the literature (Crone, 1968, Monmonier, 2006, Ordnance Survey, 2009a). However, the production of VGI is a more elusive and less understood subject, possibly due to its anarchic nature and it being a relatively recent phenomenon. Additionally, each VGI project takes a unique approach on crowd sourcing for its information data set, and therefore the search for a universal description of such a process is elusive. Goodchild (2007a) propositioned the use of the world’s six billion inhabitants as potential contributors of VGI, the implication being that anyone may be and could be a VGI contributor. However, as Study Two demonstrated, there currently exists a large gap between the use of VGI and the desire to generate VGI. In fact, many of those whose activities relied heavily on the anonymous contributions of others did not see the act of sharing their own experience as important. Within the framework of the scoping study, such attitudes were clearly different between those who belonged to Special Interest Mapping Groups (and were keen to contribute and develop GI) and those who were consumers of GI and had no interest in the development of the source. In general, the pervasion of smartphone and crowdsourcing in society has been gathering momentum since the mid 00’s (Alonso et al., 2008, Doan et al., 2011, Tapscott and Williams, 2008). However, Study Two demonstrated that the information originating from volunteers which has the greatest impact on the outcomes of user activities is that which may offer personal perspectives and opinions. This can contextualize complimentary information, which may be PGI. Therefore, the act of producing and contributing widely effective and useful VGI is the role of the purposeful individual who strives to do so for a possibly unspecified reason.
This thesis has highlighted how although volunteers can come from any location and background, it takes a certain motivation or desire in order to drive an individual to contribute. This is in line with the work of Rogers (2003), who showed how simply having knowledge and access to technology was not sufficient indicators for its adoption. Since VGI is a form of crowdsourcing (Goodchild and Glennon, 2010, Zook et al., 2010), consideration is needed as to 1) recruitment, 2) user motivation for engagement in the contribution process, 3) long term retainment of contributors and 4) the forms of tasks given to the contributors (Doan et al., 2011, Reeves and Sherwood, 2010). While the reasons why members of *Special Interest Groups* are engaged in VGI creation may be explained through these four perspectives, interesting issues arise from the consideration of consumer-users. The scoping study addressed this aspect, highlighting how at the core of their activities, consumers’ desire to achieve their goals, with no clear preference or consideration given to whether the data comes from volunteers or professionals. However, as highlighted through Study Two, the demonstrated desire to achieve interaction with appropriate data for their own needs presents a opportunities for collection of VGI by consumers. This is a position proposed by Goodchild (2007b). The fact that consumers were shown to be more reluctant towards data contribution than *Special Interest Groups* means that although their engagement in VGI creation is potentially lucrative (Goodchild, 2007b), such an effort may be limited. This may be due to the relative complexity of contributing data, the lack of communication from VGI to consumers that contributions are needed, or the lack of motivation for consumers to contribute to projects.

A final consideration relevant to this discussion is the role of mobile computing (e.g. smartphones, tablets) in VGI. Since the start of this thesis, the smartphone (and the ubiquity of third party apps to take advantage of the hardware and user interface) increased exponentially in pervasion (Alonso et al., 2008, Doan et al., 2011, Tapscott and Williams, 2008). Consequently, contribution of VGI has shifted from being a very technical, hands on event, requiring dedicated GPS devices and ability to upload their traces (see Chapter 5: Scoping Study, page 29).

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29 *Special Interest Group*: Individuals who come together to collaboratively achieve some shared goal (Coote and Rackham, 2008)
126) to a simple, and interactive event using third party apps. This has allowed the number of contributions to increase, and more specialist groups such as wheelchair users to volunteer their information; see Figure 9.1. Additionally, comparable websites such as AccessAdvisr (www.accessadvisr.net) have started collecting subjective VGI (e.g. how friendly were railway station staff) alongside subjective matters (e.g. does the railway station have stepped entrances).

![Figure 9.1 – Screen Shots of the Android WheelMap app (Sozialhelden, 2012)](image)

Consider this, it may be expected that future crowd sourced and VGI projects will fully embrace the subjective information which can only come from persons to whom the information relates to. Since this thesis has demonstrated that (within the contextual limitations of the studies) it is the qualitative and subjective information which is the greatest strength of VGI over PGI, then these projects look to become more prevalent, influential and important within society over the next few decades. However, such future gazing is outside the scope of this project.

### 9.2.2 Information judgements

The scoping study demonstrated that classifying users by their use of geographic information was an effective way to group individuals and organisations in order to understand their attitudes towards VGI. This stemmed from the categorisation system of Coote & Rackham (2008) that VGI users exist...
as Consumers, Special Interest Groups (SIG), Local Communities (LC) or Professionals. It was shown that the user’s use of mashups and information, requirements on accuracy, relationship to other users, and personal ideological bias can create unique perceptions towards VGI on a group-by-group basis. Therefore (within the limitations of the studies within this thesis) if a neogeographic product was produced to fit the user attitudes, requirements and interaction preferences of a SIG, it may be unsuitable for consumers, LCs or professionals. For example, the OpenStreetMap mapping platform JOSM has been at the centre of data contribution to the project from very early on, yet for all its advances over the years, remains largely inaccessible in terms of usability to anyone without the time or dedication to learn to use it. This may cause the product to be rejected outright as unfit for purpose by such user groups.

This philosophy of developing the product with the users, their characteristics and their needs is one of the most fundamental approaches and themes within Human Factors and Interaction Design (Burns and Vicente, 1996, Flach et al., 1998, Norman, 2005, Preece et al., 2002). Although the literature relating to VGI provides a relatively useful perspective on user needs (Goodchild, 2007a, Obermeyer, 2007), the users in the literature tend to be treated as a homogenous block (e.g. ‘the users’) rather than as separate and distinct groups (e.g. the consumer-user). Therefore a more detailed understanding of user perceptions related to VGI would allow for current and past work to be contextualised so that user centred design practice can be applied. A limitation to this thesis is how investigations following the scoping study investigated only the position of the consumer-user. An interesting outcome was how Study Two (Section 6.6.2.2 - Relevance Of Information Sources) hypothesised that the more knowledgeable and accurate an information source is (in the sense of reflecting the conditions of reality in line with how the information searcher will experience them), the more likely it is to be seen as authoritative and professional. It was also suggested that in this situation it is accuracy rather than a logo that may be emphasising professionalism. This is interesting since in Study Three, adding VGI to the mashup data (and presumably being assessed as knowledgeable and accurate data) did not increase perceptions of
authority or professionalism. However, these two studies focused on different tasks and use situations, to which the generalizability is currently unproven by complimentary studies. This difference between the two studies may be because the VGI included within the mashup did not contain the right attributes to be considered *more credible* than the PGI, when considered from the viewpoint of the user (Wilson, 1983). Alternatively, it may be that the VGI did not add sufficient increases in *usefulness, goodness, currency or accuracy* (Rieh, 2002) to cause an effect. It is clear that further research is required in order to better understand whether adding VGI to a data set increases its perceived authority based on the user having knowledge of the contributor(s) of the data. If such an experiment was to be conducted, a central theme must involve the self-selection of information. This is because it is possible that the participants in Study Two perceived VGI as being authoritative since they *chose* the VGI sources they talked about, whereas participants in Study Three had no choice over the information they had to consider.

### 9.3 An Appraisal Of The Framework Of VGI

While Section 9.2 (above) highlighted the differences between VGI and PGI from a human factors perspective, this section aims to discuss the Framework of VGI proposed within Chapter Four (see Figure 9.1). This can provide a framework with which to further understand the scope of VGI and its role in products.
The framework as presented above in Figure 9.1 proposes that the two most important factors when making the distinction between VGI and PGI projects is the objectivity and quality control as demonstrated in the data; discussed below.

The framework presented above shows both VGI and PGI together within a single framework – as opposed to producing two complimentary frameworks for VGI and PGI respectively. Doing so is in line with the findings within this thesis that demonstrated how consumers utilise VGI and PGI alongside each other with the same critical requirements. In particular, while telling users that their mashups contained VGI had almost negligible impact, improving the mashup data set with VGI generated noticeable and interesting influences on user judgements within Study Three. This is contrary to the standard practice within the literature, where VGI and PGI data sets are often referred to as two different and largely incompatible forms of information (Flanagin and Metzger, 2007b, Keen, 2007, Tsou, 2005, van Exel and Dias, 2011). However, Study Two demonstrated how consumer-users utilise both VGI and PGI sources alongside each other in order to manage the level of risk in their activity. Additionally the
degree of trust they placed in information was greater when coming from multiple sources being used together to converge on a truth. Importantly, the criteria used to assess their discovered information was the same for both VGI and PGI sources. This is complimentary to the outcome from the scoping study - that consumer-users require their information to aid them in their activities, irrespective of its volunteer or professional origins. However, it must be noted that the scoping study also demonstrated how each user group perceives VGI and PGI differently. Here, the higher their personal investment in an information source the more biased they are towards it; e.g., an OpenStreetMap contributor is biased towards OpenStreetMap. Therefore, while presenting VGI and PGI alongside each other within the framework can be considered sound from the perspective of the consumer-user, it may have limited applications in describing the way in which professionals, Special Interest Groups or local communities relate to VGI and PGI.

Objectivity and quality control are shown as the two-categorisation elements of the matrix. Within this thesis a broad definition of quality has been taken as the extent to which the product or service satisfies the technical or specific needs of an individual or organisation. This is different from the notion of Quality Control, being the processes of examining a product or system to determine whether or not it accomplishes was what was specified by the designer in the design (DeGarmo et al., 2003). However, quality control has been shown to influence the overall quality of GI, and is therefore a useful predictor of the user’s perception of the information’s quality (Bevan, 1999, DeGarmo et al., 2003). Viewing the rich picture of the scoping study (Figure 5.2, page 145) the key concerns of the users, while unique to each group, may be categorised as 1) concerns about the content of the maps relative to user needs and 2) concerns about trust, or the degree to which the information is correct. Under the definition as used in the thesis, these may be drawn together through the consideration of the information’s quality. Information of relatively high quality may be assumed by the user to have less issues associated with accuracy than that of low quality. Finally, in the literature quality has been discussed as a key issue which has yet to be mastered relative to VGI, but once done so shall
provide a useful and effective categoriser (Bishr and Mantelas, 2008, Goodchild, 2008a, Mummidi and Krumm, 2008).

At this point it is worth exploring the relation between quality control and findings of this thesis. As shown in Studies Two and Four, the inclusion of volunteered information in a mashup does not lower the quality or authority of neogeography, as was the concern of several authors (Flanagin and Metzger, 2007b, Keen, 2007, Tsou, 2005, van Exel and Dias, 2011). Additionally, Haklay et al. (2010) and Holone et al. (2007) both demonstrated that the more an instance of VGI is edited, the higher quality it becomes. This leads onto a question of how quality control may be introduced into a system that Raj Budhathoki et al. (2008) described as anarchic. The first point is that saturation of results in the data generation chapter supports the proposition of Haklay et al. (2010) that five participants editing an instance is sufficient to produce a quality data set. Secondly, Bishr and Mantelas (2008) showed that VGI comes in a degree of qualities and should be filtered to ensure high quality content is presented. Therefore, a simple metric could be constructed for a mashup where the map may be edited by any individual, yet the instance which is being edited would not be available to consumers until a minimum of five edits has been encountered. This may allow for group consensus to emerge through the anarchic scene of VGI, forming an effective although untraditional method of quality control. However, the drawback to such an approach would be counter to the principals of crowd sourcing engagement, which stresses instant visible feedback to the contributor as a reward (Mihalcea and Chklovski, 2003).

Objectivity is the second categorisation term within the framework. When users search for information that describes an area of interest to them in terms of good, bad, difficult (etc.), then subjective information is of most use. While not experimental or subjected to rigorous testing, the data generation chapter demonstrated various differences between VGI and PGI, with their levels of objectivity being an important and central outcome. This observation is supported by Study Two in how users sought a combination of subjective and objective information in order to converge on a truth about the environment relative to their needs. Additionally, Study Three showed how adding VGI alongside PGI increased with perceptions of quality and authority, most likely as
a result of the inclusion of subjective opinions (VGI) alongside objective statements (PGI).

It is therefore the conclusion of this section that the framework as presented within this thesis provides a potentially useful way to discuss neogeographic projects in relation to one another. However, while the suitability of its two dimensions are supported studies into information use (Study Two) and judgement (Study Three), it has not yet been utilised, tested and developed within a design context. Further discussion to this point is given in Chapter 10.

### 9.4 Unique Influences of VGI on the User

This thesis has shown how both VGI and PGI play particular roles within online information search. In particular, while PGI sources may effectively describe relatively static objects (e.g. trees, building locations, topography, etc.), VGI comes from a convergence of amateur sources, with each source describing specific points that are perceived by the author to be of interest to others. Additionally, VGI was shown to cover a wider range of topics than PGI, although it was of most use when describing niche subjects in detail far greater than achieved in PGI. However, it is important to note how this is limited in applicability to the tasks and contexts of the studies of this thesis.

An obvious importance of this is VGI being able to capture and produce data sets not possible under traditional cartographic means - as was highlighted by the *Special Interest Groups* within the scoping study. The impact of this convergence of multiple sources on a wider reaching *truth* as described in Study Two was measured and understood within Study Three. While the benefits as measured were not as profound as some of the current literature may have assumed (Grira et al., 2010, Ray and Ryder, 2003, Tapscott and Williams, 2008), including VGI alongside PGI had a definite and positive influence on the overall perception of the mashups *quality and authority* from the position of the user; particularly *currency*. While this is indicatory of a wider trend, such an outcome should only be applied with confidence to online mashups delivering transport accessibility information.

Although further research is required within experimental settings and different use contexts, Study Three demonstrated that VGI can positively influence the
information judgements of users. Further to this, the reason why VGI influences the judgements of users is its difference to PGI. Here, the PGI fills a need where this traditional form of information excels in to a lower degree; as shown within Study Two. Moreover, the influences of VGI as described within Study Three (above) are highly compatible with the concerns and tensions of consumer users presented within the scoping study. For example, the consumer concern for trust in the data provided to them may be addressed by the increased currency, credibility and usefulness of the data as derived from VGI. Therefore, this thesis has been able to describe the benefits of VGI (Study Two), the ways they influence user judgement (Study Three) and how they address the concerns and needs of consumer users (The Scoping Study).

9.5 Limitations Of VGI From A Human Factors Perspective

Human factors was broadly defined by Burns and Vicente (1996) as being concerned with the design of artefacts to be consistent with a human user's physical and psychological capabilities. More importantly, Norman (2005) wrote that “good behavioural design should be human-centred, focusing upon understanding and satisfying the needs of the people who actually use the product”. To take a human factors perspective is therefore to design what is best for the user in terms of their technological, personal (user), control or use requirements (Flach et al., 1998). While each of these design views offers different perspectives on the user-product relationship (helping the designer to produce highly functional products to their project’s specification), this thesis relies upon the framework of user centred design to generate research results that are relevant to future products/services incorporating VGI. Taking this angle directs focus away from the technological and physical limitations of VGI and its production, and towards to the relationship between the user and the amateur volunteered information.

Goodchild (2007a) commented that VGI is able to provide information at a faster rate than traditional methods, filling a long-standing gap in cartography (Crone, 1968, Wood, 2003). Such a proposition is supported by this thesis since the scoping study demonstrated the acceptance of VGI by users from consumer to professional, Study Two highlighted VGI’s great strength in providing current information, and Study Three showed how VGI may enhance
judgements of mashups being current, and of high quality and authority. Present literature has also highlighted that VGI may play an important role in fulfilling the call for more specialist maps (Crone, 1968, Goodchild, 2007b), or achieving a diversity in GIS previously not possible due to commercial viability (Goodchild, 2008a, Pultar et al., 2008). However, this thesis has been able to build upon much of the speculation and suggestion of previous research, demonstrating potential as well as placing limitations on the ability of VGI to be an information addition to neogeographic systems to enhance the user experience. The above may be given a deeper perspective by the outcome from the scoping study that consumers (those who primarily utilise) and Special Interest Groups (those who primarily contribute) are fundamentally different in their attitudes and relationship towards VGI products. Consequently, while almost anyone can contribute data (Goodchild, 2007b, Shirky, 2009), only a self-nominated minority will. This is mirrored within Study Two of this thesis, where in the context of outdoor recreation, people were more willing to view and receive information than actively share and disseminate their experiences to help others. However, the degree to which this impacts upon the utility of VGI is debatable, since small numbers of contributors may make large and effective data sets (Bishr and Kuhn, 2007, Haklay et al., 2010).

From a theoretical point of view, Petty and Cacioppo (1986) and Idris et al. (2011a) identified that people are not always motivated to scrutinise every message that they come across. Additionally Warnick (2004) demonstrated that over time the source of the information is decreasingly of use within determining information credibility. This may explain why presenting users with VGI had a greater impact on their information judgements than telling them that their mashups contained VGI. The benefits to the user are closer associated with the functionality of the data relative to the user needs, rather than the perceived image of the data author. This in turn relates to the concept of information value as being derived relative to the needs of the user (Badenoch et al., 1994), how it reduces uncertainty (Sheridan, 1995) and its ability to make a difference (Bateson, 1988, Koops, 2004, Stephens, 1989). From this it may be seen how if utilised in the correct fashion by a designer, VGI alongside PGI may increase
perceived value of a neogeographic product while producing greater usability; as defined by ISO 9241-11 (1998).

VGI is of most use when it describes the world in ways that PGI cannot. However, this is relative to the needs of the user, rather than a demonstrable geographic or cartographic specification. This therefore raises the question of the reusability of VGI outside the context it was created for. Unfortunately, this thesis does not explicitly tackle this issue. However, the wide variety of formal and informal sources described within Study Two suggests that while the further away from the intended contribution the VGI is used the less effective it is, VGI may be able to be effectively utilised within a number of contexts. A popular example of this is volunteer mapping projects such as Google Map Maker or OpenStreetMap producing the best maps for less economically developed countries where national mapping agencies are ill equipped to tackle the substantial cartographic challenge (Cooper et al., 2011, Zook et al., 2010). However, these map generation forms of VGI limit the user tasks to the contribution of largely objective information, and therefore limit the scope of their related perspectives to the wider field of VGI. Additionally, while Study Two highlighted VGI’s limited ability to describe large geographic areas to the precision and coverage to which PGI has traditionally excelled at. However, their suitability to this scale depends greatly on task which the user is searching information for in order to achieve. As value is derived from the use of data in specific contexts (Badenoch et al., 1994), the generation of theory to describe or predict such potential may be elusive. However an approach of such a theory could be that the more niche the object that the information describes, and the faster it alters its conditions, the less transferable that information is. While this may be a limitation in VGI, it also presents an opportunity since these are the conditions identified as opportunities for VGI to provide benefit to a specific user group.

9.6 Design Recommendations for Utilising VGI

Due to the limitations of this thesis as derived from the restricted number of user tasks considered through the research chapters, design guidelines in this section should be taken as indicatory rather than mandatory. As highlighted within the introduction of this thesis, at the time of submission there is a lack of
guidelines on how to develop and evaluate mashups (Idris et al., 2011a). It must however be understood that this thesis has centred on the consumer-user perspective. While design recommendations may be useful to all user groups, their allocation of non-consumer-users (e.g. Special Interest Groups) may be less effective than has been demonstrated within this work.

Drawing from the outcomes of this thesis and synthesis above, the following user centred design recommendations can be made:

- Cover the widest range of consumer-user information needs by combining VGI and PGI alongside each other in a neogeographic system or mashup.

- While judgements of quality, authority and credibility have been shown to be positively influenced by the inclusion of VGI within a mashup, neogeographic designers may need to find alternative ways of influencing the user’s holistic judgements of the online information, since the simply including VGI within a mashup will not alone create the killer app.

- To use information most appropriately, use PGI to describe general, permanent and objective features of the landscape (e.g. location of a castle), and VGI to describe specific features in depth related to the subjective opinions of the associated user group (e.g. ‘easy access’ to all areas of the castle for wheelchair users).

- To capture highly relevant experience from users and thus improve the VGI data set, seek to promote contribution of experiences and opinions as a natural and purposeful part of the neogeographic system.

- Take into account the activity within the VGI contributor community, and ensure that it is lively enough for erroneous or incorrect data to be corrected or updated by fellow contributors.

- Allow a clear and easily accessible comparison between multiple information sources (VGI and PGI) within the mashup to allow users to converge on a common truth and find the mashup more useful, effective
and satisfying. For example, if a developer was producing a mashup of accessibility information, a degree of benefit to the user would be found by collating professional information sources. However, by adding to this the voluntary contributions of amateurs (e.g. parents with prams, wheelchair users, etc) then the mashup would cover a wider spectrum of issues a user may face while navigating the built environment.

- Favour the use and utilisation of VGI and PGI information sources that take advantage of the pervasive data capture and representation inherent in Web 2.0 technologies. For example, the name of streets, places and shops form an important dimension to geographic information and provide a useful context within mashups and information delivery. However, rather than being static, they alter and change at a rate faster than traditional techniques can accommodate (Monmonier, 2006). Instead of treating such information as if it was a static geographic feature (such as a road) and instead allow Web 2.0 technologies to constantly update this frequently changing data would provide a wealth of additional accuracy and context to a mashup.
10 Thesis Conclusion

10.1 Introduction
This final short chapter concludes the thesis. It outlines the main contributions that have emerged from the thesis, and identifies further research issues that have arisen as a result. This section also indicated where results in the thesis have been published.

10.2 Contribution To Knowledge

10.2.1 Perceptions of the value in VGI being unique to each user group

The scoping study demonstrated that Volunteered Geographic Information (VGI) has huge potential for influencing the creation and use of geographic information systems. However, there is a wide range of individuals involved in this process, each with their own motivations for contributing and using volunteered data. This study investigated the range of stakeholders involved with VGI, their relationships and the main tensions and issues involved. The research was based on a series of detailed interviews and theory-driven coding of data. From this, a Rich Picture (Monk and Howard, 1998) was developed to graphically present stakeholder relationship information. The scoping study demonstrated that different groups of users (e.g. consumers, professionals, special interest groups and local communities) value VGI differently in terms of its emotional, functional, knowledge, legal, moral, price and social benefits. The findings have implications for how stakeholder groups may be described, and how VGI can lead to enhanced products and services, which are accepted by different user groups.

The framework of user relationships and their general value perceptions was presented at an academic conference, with publication in its proceedings:

10.2.2 How consumers perceive VGI and PGI in an outdoor pursuits context

Study Two explored how VGI and PGI can be used together in an outdoor recreation context. In particular, consideration was given to what makes each information source valuable to the user, and how this can be used to help developers of GIS provide more useful, usable and satisfying products. Using a multi-methods approach consisting of participatory observation and focus groups, the differences between VGI and PGI were investigated in relation to the characteristics which are the most, or least relevant to an end-user community. The assumption that VGI is inferior to PGI was shown to be unfounded, rather each has its own strengths in describing particular aspects of the user information landscape. Considering the opportunities to influence user activities, both VGI and PGI have a greater ability to influence the user in the planning phase than actually during the activity. The importance of the author of the information (volunteer or professional) was shown to be of less importance to the end-user than the characteristics that describe the information in terms of communication, frequency of updates and accessibility. The discussion amongst designers should not be whether to choose VGI or PGI as the information data set, but to consider which combination of VGI and PGI relating to different geographic features and task characteristics will best fit the user requirements. VGI is likely to be most relevant to the user when a geographic feature is dynamic rather than static in nature. These findings have implications for how different forms of information may be most effectively utilised within different usage situations. Above all, a case was presented for the implementation of User Centred Design principals when integrating VGI and PGI together in a single mashup based product to maximise benefit to the end user.

An overview of how the perceptions of consumers may perceive VGI as relative to PGI was presented at GISRUK 2011, and published in its proceedings.
Further outcomes from this study exploring the inter-relationship of consumers and their use of VGI were published in two peer-reviewed journals:


10.2.3 Influence of VGI on user perceptions of neogeography

Chapters Seven and Eight demonstrated the ways in which including volunteered information alongside professional information influenced the user’s information judgements. In particular, Study Three demonstrated that by including VGI within a mashup alongside PGI, the overall user perception of quality were noticeably increased; influenced by perceived the currency of the information. Additionally, Study Three demonstrated how users do not see VGI as inferior to PGI when told about the contents of their mashup (confirming the null hypothesis). VGI and PGI provided different ways of describing the environment, which when combined met the users requirements for objective and subjective description; converging on a truth. Consequently, the influence of VGI within neogeography has an impact on enhancing the usability of a GIS system, rather than simply being a faster or more cost effective way of sourcing GIS (Goodchild, 2009). This work suggests that it would be valuable to further research the influence of VGI alongside PGI upon the end users’ perception of the information environment.

An overview these findings was presented at the GISRUK 2012 conference and published in its proceedings.

10.2.4 Importance of VGI in Inclusive Service Design

While not the main focus of this thesis, the involvement of wheelchair users in Study Three allowed for the outcomes of the research to be applied to a wider audience than GIS professionals/designers. In particular, the ability for amateur volunteers to help enrich the data used by Service Designers in creating more inclusive, easily accessible and better transport solutions within the built environment.

An overview of the way in which VGI can offer service designers a new and rich perspective on understanding their users and the built environment was published within The Design Journal:


10.2.5 Usability in GIS

The author was involved in a multi-disciplinary research group regularly taking part in workshops to discuss the usability of GIS. This included the application of VGI and PGI within both professional and consumer fields. Discussion of the need to investigate VGI from a human factors perspective took place with key academics and business leaders, including Ordnance Survey, Nottingham University and University College London.

The first of the workshop sessions (Nottingham University 2009) led to the outcomes of the research group being presented at AGI GeoCommunity 2009:

Harding, J., Sharples, S., Haklay, M., Burnett, G., Dadashi, Y., Forrest, D., Maguire, M., Parker, C.J. & Ratcliff, L. 2009, "Usable geographic information – what does it mean to users?", Proceedings of the AGI GeoCommunity '09 Conference, AGI GeoCommunity,
Chapter 10: Thesis Conclusion

Following two further workshops sessions (London - UCL 2010 and Southampton – Ordnance Survey 2011), the views of the group were published in a special issue of Applied Ergonomics:


10.3 Further Work

10.3.1 Definition and framework of VGI

Within the Literature Review (Chapter Two) and Framework of VGI (Chapter Three) this thesis aimed to reduce the confusion (Crampton, 2008, Das and Kraak, 2011, Elwood, 2008a) which surrounds the nomenclature of neogeography, VGI and PGI. This was undertaken in addition to furthering the understanding of the nature of VGI as explored within studies two and three. However, further work has to be done to bring about an academic consensus to the nomenclature of VGI outside of this thesis. While there is no need to produce a new terminology, it is important that the terminology in current use is applied in a way which designers may be able to utilise to bring further understanding to the utility of VGI.

A need exists to help different VGI projects be evaluated in terms of their relative advantage to the user. Therefore, a method should be developed with which to assess VGI projects so that they may be discussed to a higher fidelity. One such framework that could allow for such a useful dialogue is the Framework of VGI; see Chapters Four and Nine. Doing so would lead to critical evaluation of the framework, and insight into its usefulness inside academia and the VGI developer community. From this, the relative advantages and disadvantages of the framework may be understood within a design context, with the framework developed appropriately. Additionally, such advances in
assessing neogeographic projects would fulﬁl the call for such a development made by Flanagin and Metzger (2008).

10.3.2 Theory development

There is a need to develop and validate a theoretical framework that can be used to develop VGI applications from a user centred design perspective, creating highly usable online experiences. These should be developed in context to the outcome of the scoping study that consumers do not tend to differentiate between VGI and PGI, but instead see it all as simply information. However, designers and professionals are aware of the difference and should be treated accordingly. While the ﬁeld of VGI is still in its infancy at the time of this thesis’ submission, various models have been presented to explain the differences between VGI and PGI, and their utility to the user (Bai et al., 2009, Cooper et al., 2011, Das and Kraak, 2011). However, these approaches focus on the technical speciﬁcation of the information and not on the utility to the end user, or the impact it may have on the user experience. Therefore, while of interest to the understanding of VGI, they do not offer much beneﬁt to a designer wishing to utilise VGI within neogeography for a non-professional user.

This thesis has provided the ﬁrst human factors centred perspective on understanding VGI and PGI within realistic situations. This is most evident in the framework of VGI (chapter three), description of user interactions (chapter ﬁve), relevance of VGI in use (chapter six) and demonstration of the intrinsic impact of including VGI within a mashup (chapter eight). While these studies have demonstrated useful ways in which to describe VGI from a human factors perspective, a need exists to take these outcomes and investigate their usefulness in developing neogeographic systems, and to demonstrate their beneﬁt in terms of enhancing the user experience. From this, the individual frameworks of understanding may be developed, tested, improved and reﬁned, not within the context of individual case studies (as within this thesis), but as a uniﬁed approach to solving a user need. For example, the value framework of the scoping study or the relevance framework of Study Two have been shown
to be effective, yet could they be modified to create a more VGI focused and applicable way of viewing user judgements?

### 10.3.3 Further understanding of different user groups

Both studies Two and Three investigated the use and judgement of VGI alongside PGI from the perspective of users within relatively high-risk situations. These were chosen since the element of risk management within an information search increases the requirement of critical information assessment in the user (Richins and Bloch, 1986). However, since the element of risk in the user’s activities increased their critical assessment of the information, it may be possible that the user judgements measured were an exaggeration relative to the general, non-risk centred population; in line with Mitra et al. (1999).

Testing the outcomes of Study Three with other user groups which exhibit a moderate level of risk in the built environment (e.g. parents with push chairs) would allow for deeper insights into the ability of VGI to influence society. Undertaking such an investigation would provide valuable insights to the designer on how VGI may or may not offer significant benefit within different situations. Further to this, understanding the relative effectiveness of different ways of telling participants that their mashups contain VGI would shed a great deal on light on the way VGI should be promoted within design and its influence on user judgement.

### 10.3.4 Design recommendations

It is important to link developments in theory and user understanding to the development of practical and useful design guidelines. An area not discussed within this thesis is that of visual design. While outside the remit of this thesis Idris et al. (2011a) demonstrated the important link between the visual presentation of VGI and user judgements in terms of the framework of Rieh (2002); used within Study Three. Further understanding of such visual impact relative to user perception of VGI is therefore needed.

### 10.4 Thesis Conclusion

The conclusion to this thesis is that greater emphasis needs to be placed on understanding the benefits of information derived from different sources.
Despite being a young and potentially underdeveloped form of information, VGI is useful in how it offers unique benefits to users above and beyond that attainable through traditional data collection and distribution techniques. Despite its various merits, it may be considered patchy, in that individuals or groups of volunteers focus on specific geographic regions for their contributions. Therefore, it is of most use when it is integrated with PGI within a mashup to provide a more complete representation of the world through information converging on a truth. Crucially, consumers do not necessarily care whether the data comes from professions or volunteers, as long as it fulfils their information needs.

This thesis has demonstrated that in use both VGI and PGI have the potential to enrich the user experience, with neither forms of information being superior or inferior to one another, just different. Each has their own strengths and weaknesses, which may be harnessed to increase the confidence the user has during their information search. However, simply placing VGI within a mashup alongside PGI cannot automatically guarantee benefit to the user. For this reason, understanding the user, their needs, their social interactions and the way they interact with information must be understood in order to develop such neogeographic systems.

Terms such as volunteered-generated and professional-generated are not necessarily the most useful, since within current literature the nature has been to use such terms as proxies for good and bad. This has particularly been undertaken with reference to the amount of quality, accuracy, trust or reliability within the information. Such polarisation can be taken as not being useful (or necessarily truthful) from a human factors perspective, since users tend to be more interested in how the information aids their activities than technical truth; e.g. its spatial accuracy.

Considering the above points, a future of interactive, customisable and fully engaging products and services based on neogeography exists. By utilising the principals of human factors alongside the advances in GIS, these products shall not only provide effective information delivery, but also be efficient and satisfying in their delivery and interaction. In creating such products, the
designer should consider VGI and PGI as complementary forms of data, which can be integrated to create enhanced user experiences.
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A Human Factors Perspective On Volunteered Geographic Information

Appendices
Chapter 5. Scoping Study

Appendix 5A Interview Question Sheet

The following table presents the questions used in each of the scoping study interviews. Here, white cells denote questions posed to the interviewee by the interviewer, and the grey cells possible follow up questions.

The interviews were semi structured by nature, with all the ‘white questions’ were asked as they are, with the exception that the system name would be changed to fit the interviewee (OpenStreetMap for an OpenStreetMap user, Google Maps for a Google Maps user etc). The ‘grey questions’ were picked on as and when needed, with some additional questions asked which are not on the sheet if necessary to the interview.

Table 5A.1 – The scoping study Interview Question Sheet

<table>
<thead>
<tr>
<th>Q1</th>
<th>In a few statements, please describe how you are involved in OpenStreetMap.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• What do you see as your contribution?</td>
</tr>
<tr>
<td>Q2</td>
<td>Could you please briefly explain a little about your interests and background relevant to your involvement in OpenStreetMap?</td>
</tr>
<tr>
<td></td>
<td>• How do you feel this has influenced your involvement with OpenStreetMap?</td>
</tr>
<tr>
<td></td>
<td>• How typical do you see yourself amongst OpenStreetMap users/members?</td>
</tr>
<tr>
<td>Q3</td>
<td>Please describe the timeline of your involvement in OpenStreetMap; from first hearing about the project right up to the present</td>
</tr>
<tr>
<td></td>
<td>• What was your original motivation to get involved with OpenStreetMap?</td>
</tr>
<tr>
<td></td>
<td>• What makes you want to continue with OpenStreetMap?</td>
</tr>
<tr>
<td></td>
<td>• Can you tell me more about any positive experiences you have had?</td>
</tr>
<tr>
<td></td>
<td>• Can you tell me more about any negative experiences you have had?</td>
</tr>
<tr>
<td>Q4</td>
<td>How do you feel your life has been influenced since you started with OpenStreetMap?</td>
</tr>
<tr>
<td></td>
<td>• How has your involvement in OpenStreetMap impacted your everyday life?</td>
</tr>
<tr>
<td></td>
<td>• Has this affected you on a personal level?</td>
</tr>
<tr>
<td></td>
<td>• Has this affected your professional life?</td>
</tr>
<tr>
<td>Q5</td>
<td>What role do others play in your involvement with OpenStreetMap?</td>
</tr>
</tbody>
</table>
- How important do you see these relationships?
- Are you aware of any tensions that exist in or around OpenStreetMap users/contributors?
- [Could you draw it/ can I draw it for you?]

Q6 How do you feel ‘The Completeness of the map’ has progressed since you started your involvement?

- Can you give any specific examples of developments relative to your involvement?

Q7 What do you feel about the concept of user-generated content within the context of OpenStreetMap?

- Can you think of any benefits of user-content in OpenStreetMap?
- Can you think of any negatives of user-content in OpenStreetMap?

Q8 What features/content do you think is lacking from the map?

- What would you like to see developed?
- What do you think prevents these features from being implemented?
- What do you think would enable this to happen?

Q9 Do you contribute information to any other VGI based projects?

- Why do you do this?
- Can you show me any examples?

Q10 What do you see as the key differences between OpenStreetMap and other forms of maps?

- How do these differences affect your use of the map and map based applications (e.g., mashups)
- Can you show me any examples?

Q11 Can you name any applications that make use of OpenStreetMap data?

- What is your involvement with these applications?
- Can you show me any examples?
- What kind of applications would you like to see in the future?

Q12 Do you know of any other contributors, developers or users of OpenStreetMap who might be interested in my project?

Q13 Are there any other comments regarding OpenStreetMap or volunteered information you would like to add?

Q14 Are there any questions you would like to ask me?
Appendix 5B  Coding Rational

Due to the exploratory nature of the scoping study which aims to focus future research and understand of the user base and not to generate theory, the highly methodical and detailed coding structures associated with grounded theory were considered over precise for the study. This is because Grounded theory exists to produce theory to “hold true for all of the evidence concerning the phenomena under study” (Corbin and Strauss, 1990), an activity not intended to be undertaken during the scoping study. Therefore despite the involvement of a second researcher to ratify the coding scheme (using it in parallel to the principal researcher, improving the coding scheme until a strong coding scheme which will provide the same outcome universally is produced) has been noted by King and Keohane et al. (1994) to greatly increase the scientific rigour of qualitative data, this processes was not conducted. Instead guidelines on open coding (Corbin and Strauss, 1990, Robson, 2002) appropriate for grounded theory were utilised.

5A.1 Coding Rules

- All interviews are transcribed and coded by the interviewer to ensure a reliable bias across all interviews.

- Ecological, background information was coded for possible later use, but not included in results as above.

- Positive and negative experience, emotions and opinions are coded

- Statements are generalised away from the specific quote (e.g. finding a local park I never knew existed was great) towards the general (e.g. exploration and discovery).

- Nodes based on statements are categorised into the super general terms which help describe the general terrain. For example moral, knowledge, ecological, emotional, function, legal, price and social enhancement, as described by TAM. These titles are not limited or mandatory, but help form the description of the nodes.
• All items, not just relating to VGI but also the general base map, system, community etc. are coded so not to exclude any information at an early stage.

• Phrases which mention more than two node subjects shall be coded twice (or more as appropriate) to reflect this.

• After all interviews are coded, a matrix is drawn up showing how many of which stakeholder groups have said which codes.

Nodes were selected from this matrix (produced during coding) based on direct relevance to VGI and supported by a frequency in the stakeholders which demonstrates an importance to the stakeholders as a whole, or as a niche group. This produces the results for the scoping study.

5A.2 Testing the coding rules

As put forward previously (King et al., 1994) the rules must be tested to ensure that the results being generated are not personal, and are scientific. This ensures reliability of information, and not just opinion.

When deciding on how transcripts shall be coded, and subsequently which nodes shall be selected as ‘important’, methodology is recorded as rules. These rules are thought through before coding or selection of nodes, and applied through the relevant processes. In this form, another researcher may follow the same methodology to similar results. The problem of personal perception is a limitation.

A key limitation is the items decided to be coded in a particular way are perceptual. Because of this one person may decide to code one phrase one way, while another person may code it in a different way. To address this, if one considers a phrase to be possibly two, three or more things, then it shall be coded as such; covering all possibilities.
Chapter 6. Study Two

Appendix 6A Potential Study Communities

The following communities were highlighted by the 2010 GeoVation Challenge (Ordnance Survey, 2010a) and drew from both concept ideas put forward by participants and actual ventures using GI.

<table>
<thead>
<tr>
<th>Community</th>
<th>Description</th>
<th>Highlighted By</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban drivers</td>
<td>Update a traffic map of a city based on live GPS data transmitted from public transport, stationary traffic points, CCTV, radio broadcasts and data from the traffic lights. It would show traffic hotspots, accidents and major events to avoid and suggest alternative routes. It would also show alternative means to get to your destination using public transport and estimated arrival times.</td>
<td>Ron Magee</td>
</tr>
<tr>
<td>Wheelchair Users/ Cyclists</td>
<td>There are plenty of mapping solutions for roads but there are none that highlight roads, paths or routes that are suitable for bicycles and/or wheelchairs - users are required to work out the best routes by trial and error. An interactive map would allow people to plan journeys which would comprise the safest cycle lanes/paths to get to their desired destination without needing to use busy and dangerous roads. The map would also act as a useful tool for local authorities to improve their provision of bicycle infrastructure and facilities.</td>
<td>Rich</td>
</tr>
<tr>
<td>Disabled</td>
<td>Allow people to upload text comments, photos, and videos about any location with regard to disabled facilities. So if a hotel, or any other building, describes itself as 'disabled friendly', users can get a precise view of what that means. Companies selling 'disability services' (e.g. ramps, hoists etc) could also use the site to advertise.</td>
<td>Rob Trent</td>
</tr>
<tr>
<td>Local Authorities</td>
<td>Gritting vehicles use preset routes around a local authority. The problem is that in some instances the vehicles are authorized to go down one way streets the wrong way, or grit car parks that are not on the plans available from the sat nav suppliers. My proposal is to use modified OpenStreetMap data loaded onto standard sat nav’s to allow routing up one way streets, through pedestrian zones or enhanced details of car parks. Existing open source software exists to convert OSM data to sat navs which can be used to modify the original data. This will not only provide a low cost solution for local authorities, but will create a requirement for the local authority to enhance OpenStreetMap, and the benefit the community. Further enhancements to the Sat Nav display could be to use OSM gritting tags to change the line style of gritting route and use waypoints to indicate positions to switch the salt on and off.</td>
<td>Andy Berry</td>
</tr>
<tr>
<td>Public Transport Users</td>
<td>Map all the bus stops within the city along with running times and fares. If possible update it based on GPS data transmitted from the busses in real time in order to give more accurate arrival/departure times based on live data. Map would allow me to type in start location, destination and it would provide me with all routes to my destination in graphical format showing my route and stops I would pass. It would also suggest if getting off ‘N’ stops before my destination and walking ‘X’ minutes would be quicker than travelling all the way on the bus to my destination. It would also provide fare information for this modification. It could also be rolled out across all public transport and provide options to trains, trams etc and could be implemented on the iPhone.</td>
<td>Ronan Magee</td>
</tr>
<tr>
<td>Surfers</td>
<td>I love surfing (in the water rather than electronically!) It would be great to have maps showing surf beeches along with live wave/swell height, tide state and sea conditions? I know that most beeches have free web cams too, maybe that could be used too ..?</td>
<td>Talltone</td>
</tr>
<tr>
<td>Mobility Scooter Users</td>
<td>To use mapping software to map mobility scooter routes for an individual user in there area or others to show all drop curbs/safe road crossing points best route to local hops/doctors/supermarkets location and distance to disabled toilets emergency location feature for emergency services gps tracking for vulnerable persons</td>
<td>Martin</td>
</tr>
</tbody>
</table>
### Pedestrians

My idea is as follows:

1. Map the location of CCTV cameras in urban areas.
2. Build a web-based routing engine that allows pedestrians to route "safe paths", i.e., paths that have continual CCTV coverage from origin to destination.

The potential benefits are:

1. Increase pedestrian safety.
2. Allow law enforcement officials to focus on areas that do not have CCTV coverage to further battle crime.

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### Astronomers

A map of light pollution, enabling amateur astronomers to find the best (and most convenient) places to find a nice dark sky for stargazing.

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### Cyclists

In order to get more people on their bikes, it's important to have clear cycle routes and for mapping to help with this. However, if you live somewhere very hilly, like Sheffield, one of the things which puts people off is not just the ease of route but also the hills. If a would-be cyclist could map their route with consideration of cycle routes, bus lanes etc and map it to the terrain this may help them to come up with an easier route to take, and may help more people to take the first steps to cycling to work.
Car Drivers
Submit places within a specified distance of a major road network, for stopping for a meal / other amenities. This would avoid the problem of getting stuck in a dire service station, when there is a nice pub just off the next junction. Allows a star rating and comments from users. Distance from nearest motorway junction/ trunk road is stated, or calculated.

Users can then query a route which they are travelling on the website to view recommendation of where to stop, they could perhaps specify a stop every X miles, or Y Hours, minimum star rating etc.

This could also be a mobile app / file for SatNav. E.g. query when driving, where is the nearest place to stop, does it have hot food, baby changing etc. If a mobile app, the ratings system could be also accessible in the app so you can rate it when you are there.

You would also need to be able to see when the information was last updated, to allow for users to decide on the currency of the information.

There are a few websites with motorway stop info, but not with this functionality and the ability to be used "on the go". They could perhaps assist with initial info to get the system up and running.

Fashion followers
Location based fashion tips for users, giving them new collection, styles based on location.

Occuranz

Urban Walkers
We can easily get (shortest, fastest) car or walking routes from variety of sources (Google, Yahoo, Bing Maps etc). But none of them give information what the (predicated) weather will be like at different points on the route. This service will take start and end points along with start time of journey. The returned map will show the route and as you move your mouse over the route it will show what the weather will be like for that location when you arrive there (calculated from start time and average speed).

Omair

Wheelchair users
Wheelchair and mobility scooter users, and even mothers with prams, often struggle getting from A to B via dropped kerbs, past poorly parked cars etc.
A map that allows users to enter where there are dropped or low kerbs, junctions/crossings that are not suitable for us etc could be extremely useful. I know of several ways from my own home into the town centre that if you use the wrong side of the road, you get to points that are impossible to pass, and you have to backtrack a considerable distance to get around the problem.

Martyn Hurt
**Local communities**

Someone who has recently moved to an area would be able to text words which include: Hospital, Dentist, Doctors along with their own postcode. The service will then tell them their nearest NHS Service that they had asked for along with it’s phone number. The service would cost 10p per text to cover the costs. This would help people with health problems be able to get to their closest service.

*Cameron Laird*

**Organic Food lovers**

Eating your five a day could be even better, If it was possible to locate Organic/Vegetable Box Scheme Organisations throughout the UK. I know of a couple in my home town of Nottingham. But I would imagine there were quite a few co-operatives that offered Organic Vegetables and Fruit within the UK in a box scheme.

*Kieran Fitzsimmons*

**Genealogists And Researchers**

Collecting monumental inscriptions is important as lettering fades, gravestones decay, fall and overgrow, or are removed. Inscriptions are also sought out by genealogists.

Attempts to establish a national record ([www.memorialinscriptions.org.uk](http://www.memorialinscriptions.org.uk)) seem to founder, but more success comes when inscriptions are gathered by local volunteers. See [www.sdths.org/Dormis.htm](http://www.sdths.org/Dormis.htm) for a typical result.

Most churches are already shown on the map. Names of churches etc can appear as roll-over information. Icons can show what sort of church or memorial it may be with web links on a pop-up (including to any photos in [www.geograph.org.uk](http://www.geograph.org.uk)).

For sites with no information the site could contain a method for uploading of inscriptions into a searchable database.

As well as mapping the location of ALL inscriptions for the first time, the site would enable historians to, for example, compare locations of birth and death to map migration to cities.

*Elaine Owen*
| **Local Food enthusiasts** | The idea is that all producers of foods for supermarkets have the location of their produce on a food source map. This map could be populated by producers, supermarkets, consumers or a combination of all three, a bit like Wikipedia, open and self policing (i.e. it is in the producers interest to correct inaccuracies). Consumers can then search the map for produce they buy and find out easily where exactly in the world it is grown/farmed etc. Maybe even put a whole shopping list into the map search and get it to work out things like food miles/uk or abroad/ethical or questionable and so on. This empowers the consumer to make more informed choices and gives producers a chance to have a voice on the map. The incentives for the producers/supermarket are marketing and consumer relations. |
| Charlie |
| As part of the scheme supermarkets could also be encouraged to put a 'tinyurl' on each food package label sold so that a consumer can put into a web browser when home. This would link directly to the producers location on the food source map. This link could also be online in supermarkets online shopping websites. |

| **Home food growers** | Produce a map of allotments and other available spaces and owned spaces on which various produce is grown. From this application it would be possible to trade different produce. For example I'll trade some of my apples for your red cabbage. |
| Chris Parker |
| Addresses a growing interest in locally produced food and produce. |

| **Birdwatchers** | Birds have regional accents. |
| Tim Waters |
| If we record enough birds and their locations we then should be able to listen to a bird and tell where you are. It's like Shazam (the mobile app that can identify music from hearing it) but for birds and maps. |
| I'm envisaging it as a mobile application |
| Other ideas include more general sound mapping and identification of similar places (see comments) |

<p>| <strong>Community Food</strong> | Much fruit gets wasted as the public aren't aware of what is available to pick locally. How about mapping the location of apples, blackberries etc, along with temporal data about harvest times to enable the public to harvest. Could provide recipe options and advice too. |
| Chris Parker |</p>
<table>
<thead>
<tr>
<th>Gay</th>
<th>Would be good to have a National Online Map of Gay Britain! Would be great to create a map in which you can zoom into locations of bars, restaurants and clubs. The map could give you directions on how to get to any bar or club and the site could also be rated by individuals - thereby giving their scores out of 10 for the bars and restaurants and clubs that they have visited. Would also be good to combine this with safe transport home again - so train stations, car parks and bus routes - all ensuring that everyone gets home safe after a good night out! Bars and restaurants could fight it out for the best in Britain!! Could also provide detailed maps for Pride events throughout the year - how to get to where the event is happening and mapping-out the Pride March route and the meeting points along the way!</th>
<th>Liz Ratcliffe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storm Chasers</td>
<td>I like storm chasing here in the UK... There are a number of real-time lightning sites that show where lightning is happening. What makes things tricky is to plot routes to drive and intercept storms. If you could show the lightning strikes as well as road systems that would be fantastic :D</td>
<td>Talltone</td>
</tr>
<tr>
<td>Urban Drivers</td>
<td>Map all the parking zones and pricing information for cities. Could be done with support of city councils or a open data project where people log their local parking information on a communal map. Would allow visitors to a city know the pricing and distribution of parking bays.</td>
<td>Tunde Cockshott</td>
</tr>
<tr>
<td>Motorcyclists</td>
<td>Generally parking for motorcycles is free provided they don’t take up a parked parking bay as its very difficult to display a parking ticket in a secure way. However many local authorities designate specific areas for motorcycles and will fine those parked in other areas. Information about designated parking spaces for motorcycles in local authority car parks is inconsistent. It would be better to have a common purpose built web site showing these locations. I see this being updated by the public and financed via targeted advertising.</td>
<td>Andy Berry</td>
</tr>
</tbody>
</table>
**Beach Visitors**

To map where CLEAN beaches are. Currently Britain is the dirty man of Europe as far as the quality of it's bathing waters go and the Blue Flag system is not reliable. Scientific studies have consistently highlighted that those using beaches, lakes or rivers for recreational water use are most at risk of falling sick from an illness associated with sewage polluted water. And it's just getting worse. With information from The Environment Agency, the water companies, Surfers Against Sewage and others we could provide beach users with data on water quality so they know what the risks are, plus info on car parking and charges, availability of toilets, life guard stations, cafes, shops etc.

**Surfbetty**

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**Special Interest**

**Walkers/ Tourists**

In the south west of Scotland; Burns' Country.

There have been Burns' Trails through the years, but what if small tourist attractions promoted each other and passed on information which would help them and their customers?

Burns' Corridor is an imaginary strip of land, 15 miles wide, stretching from Largs in Ayrshire to Gretna in Dumfriesshire. A strip of land in which Robert Burns was born, grew up, learned, loved, wrote, loved some more, farmed, married, drank, fathered, wrote even more, died and was buried.

Poets, writers, inventors, pioneers, shipbuilders, politicians, whatever you're interested in there would be someone to point you in the direction of a place of 'your' interest. The Corridor has doors to all worlds.

The spine of Burns' Corridor is the A76.

**Geoff Crolley**

---

**Walkers**

Walking is one of the best ways to experience the environment, also helps keep you fit, improves your sense of well-being and it free.

The Pathavisor web site will enable members of the public to report on the experience and condition of a footpath they have used. Also give some feedback on the suitability for other users and share their experience using photos, podcast or video and highlight Points of Interest.

Local authorities and other responsible for maintaining the Rights of Way network could pull the data to inform their Rights of Way improvement plans and also conduct user surveys etc.

**Ramblers Cymru**

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### Woodland Management
There are many reasons why we should encourage the sustainable management of all our woodlands; appropriate care of our woodland heritage; water quality and flood management; biodiversity; climate care; reduction in 'wood miles'; homegrown timber; and a source of sustainable energy.

MyForest aims to revive our wood culture by providing a free service to support woodland owners manage their woodlands sustainabley and for all interested in the sustainable forestry sector to communicate and work with each other.

### Car Share
Users plot on a map their journey to work (+ times), and their interests, passions, etc. Users with the same (Full/Part) route are then automatically linked up to correspond and perhaps agree to meet up and share their journey together.

### Fisherman
Another hobby of mine is fishing. Fishing is one of the most participated past times in the UK. It would be great to have a site that locates fishing lakes, rivers etc and gives details of recent catches, cost of fishing, tactics etc. maybe then link in where the nearest fishing tackle shops are or nearest shops to get supplies ...

### Hill Walkers
Walkers and other outdoors people venturing into Britain's wild places have long been recommended to create a route card, detailing their intended route and intended return time, and to leave this with a responsible person. My proposal is to bring this into the electronic age.

### Local History
This 'Mapping Oral History' venture would be an innovative, interactive, website that utilises digital mapping, such as google maps or similar, where users can tag locations and leave recorded messages / memories / stories about that area.

### Real Ale fans
BeerMap is a location based real ale & beer reviewing tool. It allows users to rate the beer they're drinking so that the next person to visit that area will have an idea about which beer is good and which beer to steer clear of.

### Cyclists
Give me the flattest way to get to work or any other place really.

Type in 2 post codes into a web site and view/print the flattest cycle route there and back using roads, paths, parks etc.

Also "nicest", "safest" and "quietest" route options will be supplied.

Offer a mobile option if required as well.
An application to show Surf beech's around the UK that is accessible via web browsers and portable devices. The idea is to keep the application simple, regularly update the information from accurate sources. (UK Hydrographic office, Met Office, Ordnance Survey/Google.

It should show mapping at a fixed scale (the actual scale will need to be investigated to ensure it is workable on small portable devices).

Speed, simplicity and accuracy is the key.
Appendix 6B  Focus Group Question Sheet

The following information was presented to the participants of Study Two B focus group. All material is based on research presented in the literature review.

Things to talk through:

- What a focus group is
  - Discussion between groups – conversation of ideas
  - Time: 60
  - Do you have anything on you which is used in planning of trips?

- Background information to the study,
  - Purpose - why it’s being done, to find out what?
  - Main theme = ‘Things to find out when kayaking’

- Ethics compliance – comply with form I signed

The following series of questions were presented to the participants during the focus group.
<table>
<thead>
<tr>
<th>Question Type</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Opening</strong></td>
<td>1. Could you tell us your name and what you enjoy most about canoeing and kayaking?</td>
</tr>
</tbody>
</table>
| **Introduction** | 2. Thinking back, what are the good and bad memories of canoe or kayak trips you have been on?  
| | o Keep short |
| **Transition** | 3. Have any of you planned a trip to an unfamiliar location?  
| | o If not why not?  
| | o How often do you go on trips?  
| | o Can you give me examples of what kind of places  
| | o STORIES and dialogue, particular examples |
| **Key** | 4. Thinking back to a particular trip when you have planned a visit to an unfamiliar stretch of water, discuss how you went about doing it.  
| | o Why did you go there? Goals and motivations.  
| | o Where does information about the trip come in?  
| | o What types of information do you use?  
| | o What do you look for in a new stretch of water?  
| | o What information might be considered *constantly changing*? |
| **Key** | 5. On the paper in front of you, jot down your thoughts about traditional/paper resources that you might use to help plan a canoe trip.  
| | o Good points  
| | o Bad points  
| | o What forms of *Professional Information* do you use? |
| **Key** | 6. Similarly, jot down your thoughts about local knowledge to help plan a canoe trip.  
| | o Good points  
| | o Bad points  
| | o What forms of *Volunteered Information* do you use? |
| **Key** | 7. Describe how the perfect trip would be and how would it be planned? |
| **Ending** | 8. Of all of the issues we discussed, which is the most important to you? |
| **Ending** | 9. Is there anything we should have talked about but didn't? |
Appendix 6C  Coding Rational

Due to the exploratory nature of Study Two B, which aims to focus future research and understand of the role of information to kayakers and not to generate theory, the highly methodical and detailed coding structures associated with grounded theory were considered over precise for the study. This is because Grounded theory exists to produce theory to “hold true for all of the evidence concerning the phenomena under study” (Corbin and Strauss, 1990), an activity not intended to be undertaken during the scoping study. Therefore despite the involvement of a second researcher to ratify the coding scheme (using it in parallel to the principal researcher, improving the coding scheme until a strong coding scheme which will provide the same outcome universally is produced) has been noted by King and Keohane et al. (1994) to greatly increase the scientific rigour of qualitative data, this processes was not conducted. Instead guidelines on open coding (Corbin and Strauss, 1990, Robson, 2002) appropriate for grounded theory were utilised.

Four main coding categories were produced to begin with, each category aimed at extracting information relating to the 4 aims of Study Two B, see Table 6B.1.

<table>
<thead>
<tr>
<th>Coding Category</th>
<th>Sub Category 1</th>
<th>Sub Category 2</th>
<th>Study Aim</th>
</tr>
</thead>
<tbody>
<tr>
<td>User Experience</td>
<td>Positive</td>
<td>-</td>
<td>1. The ‘kayak experience’ to recreational kayakers</td>
</tr>
<tr>
<td></td>
<td>Negative</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Planning process</td>
<td>-</td>
<td>-</td>
<td>2. The process of planning when preparing for a trip to a new, unknown location?</td>
</tr>
<tr>
<td>Information Use</td>
<td>Professional Sources 'Value'</td>
<td>-</td>
<td>3. The role of information to kayakers planning trips?</td>
</tr>
<tr>
<td></td>
<td>Volunteered Sources 'Value'</td>
<td>-</td>
<td>4. The current level of trust in professional and non-professional (volunteered) sources?</td>
</tr>
</tbody>
</table>

Table 6B.1 - Main coding categories
Appendix 6C

- All interviews are transcribed and coded by the interviewer to ensure a reliable bias across all interviews.

- Positive and negative experience, emotions and opinions relating to the user experience of canoeing/kayaking were open are coded.

- To be open to all the possible stages of planning recreational kayaking trip, no predetermined subcategory is used. Instead, the relevant text is free coded to draw out each stage in the order of occurrence.

- Thoughts and feelings towards professional and volunteered information is free coded. The relevant text is free coded and later brought together into logical categories within the subcategories of information sources (e.g. books, internet, local kayakers, etc.) and value of the information to the user (e.g. somewhat useful, highly important, unimportant, etc.).

- Statements are generalised away from the specific quote (e.g. finding a local park I never knew existed was great) towards the general (e.g. exploration and discovery).
  Phrases which mention more than two node subjects shall be coded twice (or more as appropriate) to reflect this.

- After all interviews are coded, a matrix was drawn up showing how many of which stakeholder groups have said which codes.

Nodes were selected from this matrix (produced during coding) based on direct relevance to the study aims and supported by a frequency in the participants which demonstrates an importance to the participants as a whole, or as a niche group. This produces the results for Study Two B.

As put forward previously (King et al., 1994) the rules must be tested to ensure that the results being generated are not personal, and are scientific. This ensures reliability of information, and not just opinion.

When deciding on how transcripts shall be coded, and subsequently which nodes shall be selected as ‘important’, methodology is recorded as rules. These rules are thought through before coding or selection of nodes, and applied through the relevant processes. In this form, another researcher may follow the
same methodology to similar results. The problem of personal perception is a limitation.
## Appendix 7A  Data Capture Sheet

**Figure 7A.1 – Data Capture Sheet for Participant Observation**

<table>
<thead>
<tr>
<th>Location</th>
<th>Time</th>
<th>Describe The Access Problem</th>
<th>How Did You Navigate It?</th>
<th>How Severe was It?</th>
</tr>
</thead>
<tbody>
<tr>
<td>London</td>
<td>11:00</td>
<td>Escalators going down to the underground</td>
<td>Found the lift to the right, had to find it first but easy to get to and went to the underground.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>14:00</td>
<td>Very narrow passageway and floor, “crawled”</td>
<td>“I almost had to go down on my knees and back to where I came from.”</td>
<td>2</td>
</tr>
<tr>
<td>Oxford</td>
<td>16:00</td>
<td>System</td>
<td>Light gate was broken, so couldn't get through.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

*Appendix 7A  Data Capture Sheet*
Appendix 7B  Participant Observations

The following sections present the individual observations of wheelchair users in London for the data generation chapter.

7B.1 Participants #3-01 and #3-02

The observations and experiences of participant #3-01 and #3-02 are presented in Table 7B.1

<table>
<thead>
<tr>
<th>Location</th>
<th>Describe The Access Problem</th>
<th>How Did You Navigate It?</th>
<th>How Severe was it?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Victoria tube station</td>
<td>No access to tube station – steps only, trying to get to waterloo station</td>
<td>Took bus after enquiring at the information point (no. 507 bus). Passengers boarded bus including the carer, then bus pulled up to let ramp out. The wheelchair user was waiting on the pavement to board the bus when the doors closed and the bus started pulling away, at this point the carer shouted at the driver. The reason for pulling “forward” was not apparent as there was ample room for the ramp to be let out at the first position. (12:33).</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td></td>
<td><strong>Good Point</strong> - Lots of drop kerbs around the station, getting to waiting points not an issue.</td>
<td>Had to alert driver to put out ramp to get off the bus despite requesting stop using the blue bell. He was on the phone as it was a stand point. Ramp system very good.</td>
<td></td>
</tr>
<tr>
<td>Waterloo Station</td>
<td>Took lift to underground, onto Stratford. Gap on platform, just small enough to stop front castors going between the platform and the train. Lift not working as signposted. Cover up signs indicating temporary closure?</td>
<td>Went to exist of main station which meant back tracking.</td>
<td>X</td>
</tr>
<tr>
<td>Stratford Station</td>
<td>Took 108 bus towards Lewisham. Bell on bus not in good position to request stop.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Location</td>
<td>Observation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>----------------------------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can’t read information display as back to it when seated in required position as indicated on the bus seating position for wheelchair users. This position is needed in an emergency stop.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never feel confident that ramps are going to be operated as no communication confirmation with driver.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feel anxious.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kerb near bus stop pedestrian crossing not a dropped kerb.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Bow Church Bus stop</strong></td>
<td><strong>Bus 205</strong> – again information board behind you. Bell not in good position.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Good point</strong> – Good room to manoeuvre chair on bus.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Angel Station</strong></td>
<td><strong>Map @ station has no indication of accessible station. No access, escalator only.</strong> Disabled sign on wide entry gate should be covered over as this is not an accessible station. Staff very helpful and understanding.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Bus #43</strong> – wheelchair space very tight. Not suitable for all chair types. Driver not helpful or cheerful.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Get #43 bus to London Bridge. Wheelchair already on bus, so had to wait for next one.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>London Bridge Station</strong></td>
<td><strong>Getting off bus not a lot of room for ramp with railings in the way. Could be a problem for a different chair type; i.e. – manual/ rear wheel drive.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Take 16:23 to Greenwich. Change of platform so told to take 16:38 which was on the platform we were on despite other passengers using altered platform.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>South-Eastern train service, no specific space for wheelchair, block doorway. No easy access</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Greenwich
DLR  | Lift very small, Lift to platform needed not operating. No information for disabled access on map display at DLR station. Staff not aware lift not working and gave wrong information. Signs not clear. No information giving alternative entrance to station, i.e. main entrance. | X

7B.2 Participant #3-03

The observations and experiences of participant #3-03 are presented in Table 7B.2.

Table 7B.2 – Observations and experiences of participant #3-03

<table>
<thead>
<tr>
<th>Location</th>
<th>Describe The Access Problem</th>
<th>How Did You Navigate It</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>London Victoria</td>
<td>No tube access so can’t get to Waterloo</td>
<td>Took the train to Clapham junction, changed there for Waterloo</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Couldn’t get the train we wanted, had to change platforms</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Had to wait for conductor to turn up at the second platform, didn’t feel in control</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>When the conductor arrived he talked to the researcher rather than the participant, even though the question was about wheelchair access.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Clapham Junction</td>
<td>The staff were helpful and the lifts were easy to use. Wondering why they hadn’t done this before.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Large step between the platform and the train, needed a push.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Waterloo</td>
<td>Conductor waiting at the train stop, easy access to the underground.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jubilee is step free between the platform and the train.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stratford</td>
<td>Easy to move around without any problems.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>The bus ramp was at a weird angle, worried that participant might not be able to get on the bus.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bow Church</td>
<td>Moving between bus stops, slight lip on the drop kerb making access slightly hard.</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lack of accessible toilet access</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Location</td>
<td>Description</td>
<td>Outcome</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>------------------------------------------------------------------------------</td>
<td>---------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>London Bridge</td>
<td>Stuck on bus when pulled into station, had to wait for 10 minutes for the bus to pull forward to let the ramp down. Inside the station moving to the train platform there is a very long and steep tunnel, which the participant needed help moving up it. Staff at the station not overly knowledgeable but helpful.</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greenwich</td>
<td>Lift broken but told by friendly staff how to get to the platform needed. Feeling tired to bad drop kerbs difficult to navigate Access onto the DLR no problem at all.</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Bus driver did not see the participant and drove off with the researcher on the bus! Did not seem bothered by this and grudgingly let the researcher off.
### 7B.3 Participant #3-04

The observations and experiences of participant #3-04 are presented in Table 7B.3.

#### Table 7B.3 – Observations and experiences of participant #3-04

<table>
<thead>
<tr>
<th>Location</th>
<th>Describe The Access Problem</th>
<th>How Did You Navigate It?</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jubilee Tube</td>
<td>Step between platform and the train a bit too big to be easy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Stratford Station</td>
<td>Had to work around the roadwork’s</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Between the bus stops</td>
<td>Drop kerb not enough for a manual wheelchair</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Angel Islington</td>
<td><strong>Good Point:</strong> All pretty accessible and easy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>London Bridge Station</td>
<td><strong>Good Point:</strong> Smooth with no problems and very helpful staff</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>General</td>
<td><strong>Good Point:</strong> Entire day is fine</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 7B.4 Participant #3-05

The observations and experiences of participant #3-05 are presented in Table 7B.4.

<table>
<thead>
<tr>
<th>Location</th>
<th>Describe The Access Problem</th>
<th>How Did You Navigate It?</th>
<th>How Severe was it?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>London Victoria station</strong></td>
<td>Lack of general Information at bus stands</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
| **Waterloo station – Jubilee tube line** | Gap and step between the train and the platform too large  
                                    | The tube was very loud                                                        |                           | X     |
| **Stratford Station – Jubilee tube line** | Step and gap off the train very good, wish that it was the same everywhere     |                           | X                 |
| **Stratford Station**           | Irregular surfaces                                                                         |                           | X                 |
| **Stratford Bus Stop**          | Steep ramp onto the bus                                                                      | Needed help for access     | X                 |
| **Bow Church**                  | Drop kerb not really a drop kerb                                                            | Needed help for access     | X                 |
| **Bow Street Station**          | Needs better route signage                                                                 |                           | X                 |
|                                 | Steep ramp onto the bus                                                                      | Needed help for access     | X                 |
|                                 | Not much time to apply chair brakes before setting off on the bus                          | Didn’t use breaks, not too much of a problem.                                | X                 |
| **Angel Islington Bus**         | No problems at all                                                                          |                           |                   |
| **London Bridge station**       | Lack of communication about ramp access                                                     |                           | X                 |
|                                 | The train was excellent                                                                     |                           |                   |
Chapter 8. Study Three

Appendix 8A  Likert Scale Survey

The questions below are those as presented to participants at the end of the Study Three experiment.

Terms and Conditions

Please read the terms and conditions for the experiment before you continue

1) 1. I understand that this study is designed to further scientific knowledge. All procedures have been approved by the Loughborough University Ethical Advisory Committee.

2. I have watched the information video and understand the nature of this experiment

3. I understand that I am under no obligation to take part in this study

4. I understand that I have the right to withdraw from this study at any stage for any reason, without my legal right being affected and that I will not be required to explain my reasons for withdrawing.

5. I understand that all the information I provide will be treated in the strictest of confidence

☐ I agree ☐ I do not agree

1/8 A Little About You

Because some groups of people perceive information differently (e.g. young 18 year olds compared to older 65 year olds) we need to know a little about who you are. This information is non-intrusive and is strictly confidential.

* 2) Sex:

☐ Male ☐ Female
3) Country of Origin?

☐ Australia  ☐ Canada  ☐ Ireland  ☐ New Zealand  ☐ UK  ☐ USA  ☐ Other

4) What kind of region do you live in?

☐ Rural  ☐ Town  ☐ City  ☐ Super City (e.g. London, New York, etc.)

5) How many days a week do you use a computer?

☐ Less than 1  ☐ 1-2  ☐ 3-4  ☐ 5-6  ☐ Every Day

6) How confident are you at using online maps (e.g. Google Maps, Bing Maps, MultiMap, etc.)?

☐ Very unconfident  ☐ Unconfident  ☐ Comfortable  ☐ Confident  ☐ Very confident

7) How confident do you feel when using public Transport AT THE MOMENT?

☐ Very Unconfident  ☐ Unconfident  ☐ Comfortable  ☐ Confident  ☐ Very Confident

Section 1

In the following section the questions are asked on a scale of 1 - 5. Here 1 = Strongly Disagree and 5 = Strongly Agree

2/8 Authority

8) After using the maps:
### Appendix 8A

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

I feel I can rely on the information to help me travel freely

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

I feel confident that the information provided is true

**9) I feel like the information provided on the maps:**

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

Was credible

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

 Came from sources that were knowledgeable

**10) I feel I:**

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

 can rely on the information to help me travel without encountering access issues

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

 Can depend on the information when I go traveling
**11) The maps should be considered:**

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>As presenting official information</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Worthy of inclusion on key tourist websites</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**12) The information the maps presented me with:**

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Felt authoritative</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Should be considered worthy of respect</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**13) The information provided by the maps:**

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did a good job at informing me about accessibility</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was perfect for my needs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**14) The content of the maps:**

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Was as accurate as I could hope for</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Should be considered right</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**15) The materials I engaged with on the maps:**

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reflected the current conditions well</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appeared to have been generated recently</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**16) I found the overall information presented through the maps:**

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Useful for my needs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Informative in its contents</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**17) The data presented to me through the maps:**
Appendix 8A

4/8 Usability

*18) Usefulness:

Would be important to me when planning future journeys

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Does not need to include any more information

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*19) Clarity:

The maps will be very useful to me

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

I can see a lot of possible ways of making use of these maps

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The layout of the information is clear

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The instructions and messages are

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
understandable

The maps seem to work in a logical way

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

**20) Efficiency:**

I feel I can achieve tasks quickly with the maps

I feel in control of the maps

I am able to move around the maps as I wish

**21) Satisfaction:**

The maps are interesting to use

I would like to learn more about the maps

Using the maps gives me a sense of achievement

Working with the
maps is enjoyable

Section 2

The next series of question have a different, reversed scale, so please take note. When you respond to the statements in the questions 1 = Strongly Agree and 2 = Strongly Disagree

5/8 Quality

22) The information provided by the maps:

<table>
<thead>
<tr>
<th>Strongly Agree 1</th>
<th>Agree 2</th>
<th>Neutral 3</th>
<th>Disagree 4</th>
<th>Strongly Disagree 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>May not have been the best possible</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Could have been better</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

23) The content of the maps:

<table>
<thead>
<tr>
<th>Strongly Agree 1</th>
<th>Agree 2</th>
<th>Neutral 3</th>
<th>Disagree 4</th>
<th>Strongly Disagree 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Was not always correct</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was not always as precise as I would want it to be</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

24) The materials I engaged with on the website
<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seemed to be old and out of date</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did not capture the timely importance of travel information</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*25) I found the overall maps

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Useless for what I needed to find out</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did not help me feel confident I could travel without problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*26) The data presented to me through the maps

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Would be unimportant to me when planning future journeys</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would require more diverse information</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
27) After using the maps:

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I do not believe it would help me travel without access issues</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I do not have faith in the quality of the content</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

28) I feel like the information provided:

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did not provide information from sources that were experienced in disabled travel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did not come from credible sauces</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

29) I feel I:

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>May need other forms of information to help</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Would rather use other forms of information when planning a trip

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

*30) The maps should be considered:

As secondary to official websites

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

As containing unofficial information

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

*31) The information I was presented with:

Is not respected in my mind

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

Did not feel like it embodied much authority

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

*32) Usefulness:
<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I do not see any advantage in using the maps</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>I would prefer to achieve the same task without the maps</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>The maps do not really do what I want</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**33) Clarity:**

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is not always obvious what to do next</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**34) Efficiency:**

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I cannot easily find the information I want</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>I have to go through a lot of irrelevant stages to get to the information I want</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
35) **Satisfaction:**

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

I would often get frustrated when using the maps

--

8/8 Win £150

So we can contact you when you win the £150 prize, please enter your contact details below. None of your data will be shared with any person at any time and will be deleted from the database after the study.

36) **Name**

---

37) **Email Address**

---

38) **Contact Phone Number (optional)**
Appendix 8B  Pre-Test and Piloting of Experimental Website

Screen Shots of the pre-test website for the experiment; originally branded Sky Traveller.
Appendix 8C Website Design

8C.1 Website Requirements

The website was a tool developed for the experiment to deliver the basic elements to the user:

- Information about the experiment
- Obtain consent to take part
- Split the participants into groups
- Provide instructions on how to take part in the experiment
- Present the variables and experiment materials to the participant
- Collect data in the form of a Likert Scale questionnaire.

The website was designed and built by the researcher using Adobe Flash to provide an enjoyable online user experience. To ensure all platforms may experience the site equally tests were run on all main browsers at the time; i.e. Internet Explorer, Firefox, Chrome and Safari. The website did not contain elements of Adobe Flash since some computer platforms are unable to read these animations, and its inclusion may have excluded potential participants.

8C.2 Overview of Components

Within the experiment, it was important to present the right information and materials to each user group in order to affect their judgements with the specified variables. For this, the website required a structure which could accommodate multiple user groups and conditions, yet appear simple to the user. The website structure is presented in Figure 8C.1.
Additionally, a series of videos were made to be embedded within the project website. These were to replace long lists of informative text, creating a more personal, enjoyable and accessible user experience. These videos have been publically archived at http://www.youtube.com/user/usergeneratedtalk

8C.3 Welcome Screen

A simple page that all participants see when visiting the website, designed to engage them into further participation. Included on the welcome page was a short video explaining the website and a providing a brief overview of the experiment.
8C.4 Project Overview Information

Before the visitors to the website began their participation, the purpose of the experiment and what they will be expected to do was clearly outlined through an embedded video. The criteria for participants was outlined and the participant asked to only proceed if they comply with those requirements.
8C.5 Assign Users To Groups

To create a statistical viability within the experimental data, it was important that participants were assigned to their experiment groups at random. Before they began their involvement in the research project they were asked to click on a button which would randomly assign them to one of four groups. In tests this embedded random number generator produced equal assignment to all groups; 25% group 1 - 25% group 2 - 25% group 3 - 25% group 4.
8C.6 Tutorial

As the experiment requires different groups to be told different things about the data they are presented with, two instructional videos were required. Video 1 (presented to groups A and C; informed users that all of the information within the mashup was produced by professionals working alongside Ordnance Survey. An explanation of the features of the mashup was shown followed by details of how the experiment is to be run. Finally, an example of a person using the mashup was shown the participant to ensure they were fully capable of executing their tasks.

Video 2 was identical to video 1, with the exception that participants were told that the information presented within the mashup was produced by professionals working alongside Ordnance Survey, and by volunteers contributing to the amateur information site Access Advisor.
8C.7 Mashups

The mashups developed within the data generation chapter are presented to the user via the page shown in Figure 8C.6.

8C.8 Participant Consent

In order to comply with the Loughborough University Ethics Guidelines it was necessary to ensure that the purpose of detail of the study has been explained
to the participants. For this, a short video was created and embedded within the page to deliver this information to the participant.

The terms of the experiment which the user must agree to in order to participate were presented with a simple form used to capture their acceptance.

![Image of survey form](image.png)

**Figure 8C.7 – Pre-Survey Consent Form**

### 8C.9 Participant Survey

Data was collected and stored using the online site [www.SurveyMonkey.com](http://www.SurveyMonkey.com). This removed the need for complex programming and specialised databases to be created inside the website. The survey was itself located within the website using an inline frame, making the experience seamless to the user.
Figure 8C.8 – Experimental Likert Scale Survey; Group 1
Appendix 8D Promotion of Invitation to Participate

Within this appendices are visual samples of the ways the Free Traveller Website was promoted to the wider wheelchair community.

Figure 8D.1 – Press Release Via the Loughborough University Website (Lboro, 2011)

Figure 8D.2 – Press Release Science Magazine (Parker et al., 2011b)
Figure 8D.3 – Facebook Fan Page for the Free Traveller Experiment
Appendix 8E  Website Usability Assessment

8E.1 Introduction

In order to allow for the experiment website to be tested for its appropriateness for use in the context of usability, a third set of Likert Scales on Usability was included in the survey. This was based on that developed by Maguire (1998) and has been demonstrated as being effective in assessing the usability of online information. The analysis of this data can be found in Appendix 8E.

8E.2 Method

Although the System Acceptance scale was used successfully by Clarke et al. (2005), no data are available on the internal consistency achieved during their research. In the current study, the Cronbach $\alpha$ coefficient was .91; suggesting exceptionally good internal consistency in the scale.

Table 8E.1 – Questions on the Judgement of Usability, score range 20 – 100; based on Maguire (1998)

<table>
<thead>
<tr>
<th>Values</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usefulness</td>
<td>The system will be very useful to me</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>I do not see any advantage in using the maps</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>I can see a lot of possible ways of making use of these maps</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>I would prefer to achieve the same task without the maps</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>The system does not really do what I want</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Clarity</td>
<td>The layout of the information is clear</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>The instructions and messages are understandable</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>It is not always obvious what to do next</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>The system seems to work in a logical way</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Efficiency</td>
<td>I feel I can achieve tasks quickly with the maps</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>I cannot easily find the information I want</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Appendix 8E</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel in control of the maps</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am able to move around the maps as I wish</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have to go through a lot of irrelevant stages to get to the information I want</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Satisfaction</strong></td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The maps are interesting to use</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I often get frustrated when using the maps</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would like to learn more about the maps</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using maps gives me a sense of achievement</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working with the system is enjoyable</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix 8E

8E.3 Results

12.1.1.1 Usability Assessment

Figure 8E.1 – Box plot representing participant judgements on the website’s usability (Y-axis = combined scores of usability, X-axis = usability dimensions)

12.1.1.2 Usability Variance Between Groups (Two-Way MANOVA)

A two-way between-group multivariate analysis was performed to investigate the inclusion of VGI alongside PGI within a mashup, and the influence of being told a mashup contains VGI alongside PGI on the user judgement of a mashup’s usability. Four dependent variables were used: usefulness, clarity, efficiency and satisfaction. The independent variables were: 1) belief that their map contained VGI alongside PGI and 2) whether their mashup contained VGI; irrespective of belief. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity or variance-covariance matrices, and multicollinearity, with no serious violations noted. In initial assessment of the experiment data relating to authority, a high correlation (.83) was found between the dependable variables of efficiency and clarity. To allow the data set to be appropriate for MANOVA assessment
(Pallant, 2010), and insight into the effect sizes of the dependable variables (Field, 2004), the decision was taken to remove the element of clarity since this was the most correlated user judgement in the data set. There was no statistically significant interactions between those who had been told their mashups contained PGI + VGI and those who had been told their mashups contained only PGI on the combined dependant variables, $F (3, 95) = 1.05, p = .376$; Wilks’ Lambda = .97; $\eta^2_p = .032$. No significant interactions were observed between those who were presented mashups containing PGI + VGI and those who’s mashups contained only PGI, $F (3, 95) = 1.95, p = .221$; Wilks’ Lambda = .96; $\eta^2_p = .045$. At no point was a statistically significant interaction between the fixed variables observed within this MANOVA test.

### 12.1.1.3 Sample Size Estimation

The dependable variables of efficiency and clarity were found to be significantly correlated, resulting in the removal of clarity from the data set. Therefore, clarity was not considered within this section. Importantly analysis of the data demonstrated that no statistical significance was found relating to the perceived authority.

By estimating the sample size to be $N = 303$, significant interactions were observed between those who’s mashups contained PGI + VGI and those who’s mashups contained only PGI. This was taking into account $F (3, 297) = 4.67, p = .003 > .00851$; Wilks’ Lambda = .96; $\eta^2_p = .045$.

Table 8E.2 demonstrates the estimated sample sizes for required for achieving statistical significance using MANOVA for each of the dependant variables found insignificant within the experimental data set; $N = 101$. 

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Table 8E.2 demonstrates the estimated sample sizes for required for achieving statistical significance using MANOVA for each of the dependant variables found insignificant within the experimental data set; $N = 101$. 

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Table 8E.2 – Sample Size Estimations for System Acceptance: Information Presented

<table>
<thead>
<tr>
<th>Dependant Variable</th>
<th>Estimated N</th>
<th>Target ( p )</th>
<th>( F )</th>
<th>( p )</th>
<th>( \eta^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usefulness</td>
<td>303</td>
<td>.02014</td>
<td>(1, 299) = 9.68</td>
<td>.002</td>
<td>.031</td>
</tr>
<tr>
<td>Efficiency</td>
<td>303</td>
<td>.02014</td>
<td>(1, 299) = 5.76</td>
<td>.017</td>
<td>.019</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Although estimation of sample size was increased to \( N = 606 \), no significance was found relating to satisfaction.

By estimating the sample size to be \( N = 404 \), significant interactions were observed between those who were told that their mashups contained PGI + VGI and those who were told that their mashups contained only PGI. This was taking into account \( F (3, 398) = 4.38, p = .005 > .00851 \); Wilks' Lambda = .97; \( \eta^2 = .032 \).

Table 8E.3 demonstrates the estimated sample sizes for required for achieving statistical significance using MANOVA for each of the dependant variables found insignificant within the experimental data set; \( N = 101 \).

Table 8E.3 – Sample Size Estimations for System Acceptance: Participants Told

<table>
<thead>
<tr>
<th>Dependant Variable</th>
<th>( Estimated N )</th>
<th>Target ( p )</th>
<th>( F )</th>
<th>( p )</th>
<th>( \eta^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usefulness</td>
<td>404</td>
<td>.02014</td>
<td>(1, 400) = 6.66</td>
<td>.010</td>
<td>.016</td>
</tr>
<tr>
<td>Efficiency</td>
<td>404</td>
<td>.02014</td>
<td>(1, 400) = 6.69</td>
<td>.010</td>
<td>.016</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>404</td>
<td>.02014</td>
<td>(1, 400) = 12.77</td>
<td>&lt;.001</td>
<td>.031</td>
</tr>
</tbody>
</table>

At no point was a statistically significant interaction between the fixed variables observed within these MANOVA tests.

8E.4 Discussion

12.1.1.4 Usefulness

Within this study presenting users with VGI alongside PGI was predicted to show a statistically significant influence on perceived usefulness. However this was achieved with a small effect size, yet one which was predicted to be large.
enough for consideration. Similarly, telling users that their mashups contained VGI was predicted to achieve a statistically significant and positive influence, yet with a very small effect size which may be considered negligible.

Usefulness (or utility) was described by Preece et al. (2002) as one of the key components of usability, being the “extent to which the system provides the right kind of functionality so that users can do what they need or want to do”. Considering this, the relatively low influence of VGI on usefulness in the context of system acceptance suggests a strong limitation to the potential of VGI to enhance a mashups usability. This is of course not regarding situations where VGI captures information which can only come from volunteers; see Study Two.

12.1.1.5 Efficiency

In both presenting users with PGI alongside VGI, and informing users that their mashups contained VGI, statistical significance was predicted by sample size estimation. However, both of these aspects only achieved a small effect size, meaning that VGI does increase the perceptions of efficiency from a usability perspective, but to a degree which may be considered negligible.

In outlining the key principals of usability design, Preece et al. (2002) defined efficiency as “the way a system supports users in carrying out their tasks”. Within the experimental mashups, user tasks may be considered as 1) navigating around the interface, 2) interacting with the features, and 3) considering the information presented as to confidence travelling around London. The first two of these points relate to the design of the interface itself, which may be considered equally good or bad from a user perspective for all user groups, and therefore irrelevant to this investigation. Therefore the only task which may be measured by the element of efficiency is that VGI enhancing the cognitive considerations of the user. While this is small, it is worth considering that within a user perceived value context, “any difference that makes a difference” enhances the overall worth of a system (Bateson, 1988).

Although current research has investigated the efficiency gains related to VGI as a fast, cheap and effective way of generating GI (Dunbar, 2010, Heipke, 2010), no comparable research has yet been published of usability-efficiency gains stemming from the inclusion of VGI from a cognitive/human factors
perspective. Therefore making further interpretations and comparisons with the data at this point in time is difficult.

12.1.1.6 Satisfaction

While only achieving a small effect size (and predicted to require over four hundred participants) the most interesting element of system acceptance being influenced by the information as told to the user was that of satisfaction. However, when informing participants that their mashup contained VGI alongside PGI, no statistically significant influence was observed.

In itself, satisfaction is a key component of usability and the delivery of great user experience (ISO 9241-11, 1998). Additionally, Rothbaum et al. (2008) proposed that the search criteria and requirements of the user are directly influential in the level of satisfaction which may be gained from an online information search. Therefore the increase in satisfaction as derived from the use of VGI is interesting in itself. The degree to which this increase may be observed does however have a profound impact on the potential of the information innovation. Due to the exploratory nature of this study, and the tendency for new areas of investigation to turn up significant outcomes with small effect sizes Cohen (1988), it is difficult to state with certainty if the effect sizes measured are due to an insensitive measure or are actually of low influence on the user experience. However, under the consideration of information value being relative to “any difference that makes a difference” (Bateson, 1988), an increase in user satisfaction which is measureable and influential may be seen as important. This is especially true when considered within a framework of innovation diffusion, which states that a product or service which has an enhanced sense of satisfaction (among other things) provides a relative advantage to its utilisation over other less satisfying items (Rogers, 2003). Therefore, an increase in satisfaction has a wide reaching influence on the potential for the website to be accepted by users and be useful in their information search behaviours.
Appendix 8F  Factor Analysis

To allow the reader to see if they agree with the decision to utilise a two component design, the Scree Plot (Figure 8F.1) and Unrotated Loadings relating to the factor analysis within Study Three are presented below.

Figure 8F.1 - Scree Plot of 1 – 10 Factor Solutions
Table 8F.1 – Unrotated Loadings: Component Matrix

<table>
<thead>
<tr>
<th>Component</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authority: Reliability</td>
<td>.900</td>
</tr>
<tr>
<td>Authority: Authoritative</td>
<td>.885</td>
</tr>
<tr>
<td>Authority: Authoritative</td>
<td>.883</td>
</tr>
<tr>
<td>Trustworthiness</td>
<td></td>
</tr>
<tr>
<td>Quality: Usefulness</td>
<td>.874</td>
</tr>
<tr>
<td>Quality: Goodness</td>
<td>.863</td>
</tr>
<tr>
<td>Quality: Importance</td>
<td>.835</td>
</tr>
<tr>
<td>Authority: Credibility</td>
<td>.827</td>
</tr>
<tr>
<td>Quality: Accuracy</td>
<td>.817</td>
</tr>
<tr>
<td>Quality: Currency</td>
<td>.776</td>
</tr>
<tr>
<td>Authority: Official</td>
<td>.768</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Component Analysis.
a. 1 components extracted.
Appendix 8G  MANOVA Assumption Testing

Table 8G highlights the assumptions required to be passed before the execution of a MANOVA test, and the ways in which this study has addressed them. As shown, there were no serious violations of the statistical assumptions within the Quality data set.

During preliminary assumption testing statistically high correlation between the Authority elements of Trustworthiness and Reliability (ρ = .846), the item trustworthiness was removed from the data set since of the pair it exhibited the highest level of correlation with other items. This was done to meet the assumptions of MANOVA (Pallant, 2010) and to allow insight into not only the statistical significance of dependable variables, but also their effect sizes (Field, 2004). Consequently, the summary of the assumption testing below represents how the data and variables as treated by the analysis passed the assumptions required of MANOVA.
Table 8G.1 – Testing of assumptions relating to quality required before proceeding with MANOVA (Field, 2004, Pallant, 2010)

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Test: Threshold Level</th>
<th>Value in Data Set</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sample Size</strong></td>
<td>MANOVA: Minimum cases required per cell (^{30}) = 10</td>
<td>Lowest sample size per cell = 22</td>
<td>Pass</td>
</tr>
<tr>
<td></td>
<td>Robustness: Minimum cases required per cell (^{31}) = 20</td>
<td>Lowest sample size per cell = 22</td>
<td>Pass</td>
</tr>
<tr>
<td><strong>Normality</strong></td>
<td>Parametric</td>
<td>See Figure 8G.</td>
<td>Pass</td>
</tr>
<tr>
<td></td>
<td>Largest acceptable(^{32}) Kolmogorov-Smirnov Sig. = .05</td>
<td>Largest calculated Kolmogorov-Smirnov Sig. = .009</td>
<td>Pass</td>
</tr>
<tr>
<td><strong>Outliers</strong></td>
<td>Maximum Mahalanobis Distance (^{33}) = 27.88</td>
<td>Calculated Mahalanobis Distance (Max) = 23.71</td>
<td>Pass</td>
</tr>
<tr>
<td><strong>Linearity</strong></td>
<td>No evidence on non-linearity found in the data set when analysed through scatterplot matrices.</td>
<td></td>
<td>Pass</td>
</tr>
<tr>
<td><strong>Homogeneity of regression</strong></td>
<td>Not applicable to this analysis</td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Multicollinearity and singularity(^{34})</strong></td>
<td>Largest acceptable Spearman ρ (^{35}) = .800</td>
<td>Largest Spearman ρ calculated = .768</td>
<td>Pass</td>
</tr>
<tr>
<td><strong>Homogeneity of variance-covariance matrices</strong></td>
<td>Minimum Equality of Covariance (^{36}) (p = .001)</td>
<td>Box’s Test of Equality of Covariance Matrices</td>
<td>Pass</td>
</tr>
</tbody>
</table>

The box plot in Figure 8G. demonstrates the degree of normality within the data set related to Quality & Authority perceptions.

\(^{30}\) (Pallant, 2010)

\(^{31}\) (Tabachnick and Fidell, 2007)

\(^{32}\) (Pallant, 2010)

\(^{33}\) (Pallant, 2010, Pearson and Hartley, 1958)

\(^{34}\) Due to the use of ordinal measures for the dependable variables in the data set, Spearman’s Rho (ρ) was selected (Pallant, 2010). This is a correlation coefficient defined as the product moment correlation coefficient between two sets of rankings of a collection of objects or individuals (O’Muircheartaigh and Pitt Francis, 1981).

\(^{35}\) (Pearson and Hartley, 1958)

\(^{36}\) (Pallant, 2010)
Figure 8G.1 - Box Plot Representing Normality and Outliers
This thesis is dedicated to my mother, who sadly passed away during the research period. Being a child with dyslexia, she helped me to read and write, encouraging me at every stage to achieve my full potential. Without her love and support through our time together, this thesis could not have been possible.

Susan Joy Parker