Design Principles for More-than-Data Walks

Louise Mullagh, MA MRes

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To Jamie and my family,
I got there eventually

Declaration

This thesis has not been submitted in support of an application for another degree at this or any other university. It is the result of my own work and includes nothing that is the outcome of work done in collaboration except where specifically indicated. Many of the ideas in this thesis were the product of discussion with my supervisors, Professor Nick Dunn, and Dr Lynne Blair.

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Abstract

With the rise of the data-driven society, there is a danger of losing insights of unique, nuanced, and complex dynamics that are critical to our understanding of and engagement with place. This research establishes how the use of walking reveals the concept of More-than-Data. This concept forms the basis of a series of design principles capable of engaging with complex, unique, and temporal placed-based data, information, knowledge, wisdom and lived experience. Our understanding and experience of the places we inhabit are being increasingly mediated by technologies, many of which are driven by quantitative, automatically gathered data. These types of data can provide us with huge amounts of information once processed and analysed, however this data-driven mediation of our spaces and places is but one way of understanding and experiencing the world in which we live.

Whilst these types of automatically gathered data enable us to gain valuable insights into our world, the reliance upon outsourcing our senses and collecting data are often illegible to many people who do not possess the skills or equipment to engage in these modes of quantifying and mapping place. Other, valuable types of data exist in place, but these are often latent within place or people and more difficult to access. Therefore, those who have much to contribute to increasing knowledge about our world, are often excluded.

This research explores the knowledge gap that exists in understanding how these data-driven and situated modes of understanding place might be synthesised and contributes to a growing body of research that explores how we might interrogate the data-driven society through the practice of walking. This nascent approach answers calls for critical approaches to understanding the impact of the data-driven society by moving through a place and exploring what data means in that location. Through the exploration of practices that are located within the data-driven realm the concept of More-than-Data emerged and is defined as “a heuristic guide that encourages and embeds the collection, conceptualisation, interrogation, storage and re-use of data, information, knowledge, wisdom and lived-experience in, from and through place.”

To explore how More-than-Data can be embedded within a practice, five walks were designed and carried out. The insights developed through the walks have been synthesised with findings from literature and interviews carried out, to form the basis for a set of design heuristics. The three key contributions to knowledge presented in this research are:

1. The concept of More-than-Data
2. A set of design principles that can be used by a wide range of people that embed More-than-Data in place.
3. The “Pathways Forward” Method that can be used to collate and make sense of emergent findings that brings together diverse types of research data and artefacts.

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If I have forgotten anyone, which I no doubt will have, apologies.

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1 Introduction

1.1 The Data-driven Society

The data-driven society proclaims data as the "new oil" that fires the engines of the Fourth Industrial Revolution, which is characterised by new technologies such as the embedding of sensors in our environments, the Internet of Things, artificial intelligence, and machine learning (Schwab, 2016, p.97). Vast quantities of predominantly quantitative data are collected from the places we inhabit with the view that the more data we collect, the better. The rhetoric surrounding this new material hails the potential of data to ameliorate complex societal and environmental problems. Data are described variously, in accounts of future visions as the new resource that will drive the economy and government through the creation of business insights, operate cities by rendering them smart, enable the empowerment of citizens and offer solutions to complex societal and environmental problems.

Society is permeated by data in multiple facets of our everyday lives and places in which we live and work but has only recently been subject to more critical appraisals that seek to balance the celebratory and utopian visions promised by technology companies, media, and some disciplines within the academy.

The concept of data is not new; it has existed in various forms since its first use in English in the 17th Century (Glass, 1964; Kitchin, 2014b; Rosenberg, 2013). The underlying concepts of data that relate to knowledge and argumentation date to the development of modernity (Rosenberg, 2013). However, during the 20th Century, the use of the term data became synonymous with and woven into technological systems such as Artificial Intelligence, Big Data, Open Data, and the Internet of Things.

Data are not only gathered from us as we move through cities and towns, or from the environment, but also from the vast connection of devices that transmit data constantly. The mobile and wearable devices we carry with us throughout our daily lives also serve as data transmitters and our homes are becoming equipped with "smart" devices that relay constant data streams to companies all over the world.

We now have more quantitative data than at any other point in history, causing what has been termed "information abundance" (Borgmann, 2017, p.93), "infoglut" (Andrejevic, 2013) and a data deluge (Bowker, 2013, p.171). However, as Bowker (2013) suggests, the increased data we have will not necessarily mean answers to the complex societal issues we now face. The result of this transmission of vast quantities of data means that databases used to store all this

data now handle petabytes of data; this is a quadrillion or a thousand trillion bytes. By 2021 the amount of data produced in the world reached 79 zettabytes and by 2025 the daily rate of data produced is estimated to reach 121 zettabytes (Statista, 2021). This is an increase of 77 zettabytes since 2010, and shows no sign of slowing down. This production of data will only grow as the number of internet users, mobile device owners and connected webs of sensors in our homes and places we inhabit increase. Much of this data resides in digital formats only to be accessed and re-used by those with the necessary skills and equipment. Whilst data has always required translation to transform it into information, knowledge, or wisdom, it was not locked away in black boxes, but in books, archives, or files. Gathering these amounts of data is having an environmental effect, as they require vast data storage centres (Reddy et al. 2018). These centres are often located in remote places, and we are unable to readily see them. The vast quantity of data being collected from devices and sensors enables us to predict, model, and gain a very particular understanding of the environment, one which is rooted in the tradition of positivism and quantitative data collection that tells only part of the story about what it is to be human (Kitchin, 2014b, p.145). At a point in history when more data is being gathered than ever before, often without real consideration for what it might be used for, or for the implications of increasing demands for data storage across the globe, it seems more necessary than ever to think critically about what we are collecting, how it is stored and made manifest in the world. As suggested by Kitchin, whilst quantitative approaches are useful in explaining and modelling instrumental systems "their limitations in understanding human life should be recognised and complemented with other approaches" (Kitchin 2014b, p.145).

Today we share our data without always considering the implications, often in return for "free" services, which then might be sold on as aggregated metadata for customised marketing or to enable insights into consumer behaviour and patterns (Van Dijck, 2014). Since the mid-2000s, largely influenced by the open-source movement (Kelty, 2008), datasets have been opened by governments around the world, often in the name of enabling transparency. This acknowledgement of the importance of making data available to citizens occurred alongside the Open Government movement (H.M Government, 1997), which was concerned with wider issues around governance (Davies, 2014). This opening up, which was largely driven by the potential for innovation and citizen engagement through the ability to re-use data in new applications and online services, paved the way for large amounts of data being made available on government data portals (e.g., www.data.gov.uk).

Throughout the 20th Century, what we understand as data underwent a transformation from analogue, where it was collected manually and took the form of counting or observations (e.g., censuses, weather forecasting) to being collected from automatic sensors. This latter includes data collection through our movements around the place as we use transportation and electronic payment systems, the mobile devices we carry everywhere with us, and through the

vast network of connected objects on the Internet of Things. We rely on our mobile devices to help us navigate around cities, to connect the various smart devices in our homes, connect across the globe online, and predict the weather, among other activities. As a result, how we understand and interact with the world around us is changing and is now often augmented and mediated through digital mobile devices.

The deluge of data driving this push toward the data-driven society is not, yet, accompanied by adequate methods or tools that enable a critical understanding of its impact on society. Until recently, most attention has been given to the technical realm of data, its production and analysis (Kitchin, 2014b), rather than a philosophical approach that is more nuanced and explores data practices and assemblages. However, challenges to the notion of "raw" or value-neutral data have started to emerge and the field of Critical Data Studies boyd and Crawford, 2012; Dalton et al. 2016) is gaining momentum in this area.

Data have been conceptualised as "raw," neutral, objective, and free of values, but this is not the case (Bowker and Leigh Star, 2000; boyd and Crawford, 2012; Kitchin, 2014b). There is an increasing body of academic literature relating to the critical and philosophical considerations of the impact of data upon society, to which this research seeks to add. There is a tendency within the rhetoric of data, particularly that pertaining to big data and within data science, to focus upon the considerations of the data lifecycle (including the collection, storage, distribution, analysis, and re-use of data), rather than the wider societal implications of the data journey. Data, and its collection through and embodiment in technological artefacts, results in a complexity of relationships, or entanglements, between data in the abstract and "worldly things" (Dourish, 2017; Taylor et al.2014). As a result, there is a need for a re-conceptualisation of data that "doesn't presume an intrinsic generality, or that we "look under" the data, as suggested by Gitelman and Jackson (2013).

In response to this call, more critical approaches toward data augment existing critical questions relating to technology in the philosophy of technology (Bates et al.2016; boyd and Crawford, 2012; Dalton et al.2016; Kitchin, 2014b; Taylor et al.2014). Dominant discourses of data studies relate to the operational aspects of the data lifecycle, rather than the more conceptual and philosophical issues raised (Kitchin, 2014). Recent controversies relating to abuse of data such as the Snowden whistleblowing case relating to the PRISM surveillance programme (Kumar, 2017), the Cambridge Analytica and Facebook scandal (Isaak and Hanna, 2018) and debates surrounding bias in algorithms (Mann and Matzner, 2019) highlight the need for critical responses in this area. This demonstrates the non-neutrality of data systems and algorithms in terms of values and their contextualisation within a "specific scientific approach" (Kitchin, 2014b, p.136).

The view that the more data collected the better to solve complex problems and drive society is becoming increasingly contested (Bowker, 2013 p.171; Halpern, 2014), both in terms of the potential versus the actual ability of data to be used in the solution of complex problems and the sheer quantity of data collected. Bowker calls for a more humanistic and hermeneutic approach to data which "enables us to envision new possible futures even as we risk being swamped in the data deluge" (Bowker, 2013 p.171). The collection of increased data also brings with it questions relating to the resources required to store and process it (Gitelman and Jackson, 2013). Much of the data collected sits in a nascent state in vast data centres that require increasingly vast resources to operate. The question as to whether we should collect such enormous quantities of data rarely gets asked. Instead, anything and everything is collected, without considering what it might be used for.

1.2 Understandings and mediation of place

All this data comes from somewhere, from physical as well as abstract digital locations. Data are not only collected from our online interactions, but also as we move around in our daily lives. Our movements are captured through our use of travel cards, card payments, when we log onto apps and stamp our location, the metadata in the photographs we take, when we move past CCTV (Closed circuit television) cameras, and increasingly through facial recognition. The mobile devices and sensors that capture our data trails have emerged from the concept of ubiquitous computing (Weiser, 2002), as devices have moved away from the stationary location of the office to inhabiting our environment, a phenomenon that might now be termed "Everyware" (Greenfield, 2006). As Bowker (2013, p.168) states,

> "it is now difficult to walk the streets of a major city without having one's progress captured by some hidden gatekeeping device. It is getting difficult for trees to fall in forests without non-humans present."

This reliance upon the collection and use of automated data, whether through sensors, smart cards or mobile applications is questioned by Offenhuber (2015), who writes

> "The argument goes like this: why should we attach sensors to every light pole, when each citizen already owns an array of intricate sensors? I am not referring to sensors in smartphones and gadgets but to the eyes, ears, and the local knowledge of everyone, for which the smartphone is just a conduit."

Today we rely far more on data that have been sensed through technological means, rather than on using our senses to understand the world.

As such, place is being increasingly mediated and understood through the collection of vast amounts of automatically collected and sensed data. Previous understandings of place were reliant upon our senses, or as Offenhuber refers to, on the local knowledge of individuals. Whilst the advent of data offers benefits in terms of collecting large data sets and understanding at scale, there is also a danger that we become disconnected from the places we inhabit and, as a result lose our "sense of" place. Places are "necessarily situated and partial" (Dalton and Thatcher, 2014) and whilst data can offer geographic insights through, for example, location tagging, social media posts or mobile devices, it is unable to offer deeper insights into the experiences people have with place through talking to them or personally experiencing it during fieldwork (Dalton and Thatcher, 2014).

Data are collected about us as we move through the landscape, whether urban or rural, and using data as mediated through mobile devices now feels second nature. However, our relationships with place are changing, both through our relationships with technologies that mediate place for us and our tendencies towards moving around more frequently and often inhabiting physical and digital places simultaneously. Today place is, as Massey (1994, p.5) suggested, "unfixed, contested and multiple … open and porous." As our engagement with digital technologies increases, particularly those which mediate place such as those we use for wayfinding and navigation, the reliance upon data that drives such technologies might supersede "other" ways of understanding place that enable us to engage more directly with it. Such engagement through other modes of understanding is particularly important as decreasing engagement with the natural world needs to be tackled, particularly at a time when we need to understand and engage with our world at a deeper level, (Fuller et al.2007; Miller, 2005) both to counteract the growing reliance upon the use of data-driven technologies and to engage directly with the world.

A changing sense of place is taking place which has seen the balance shift towards that which is often mediated by data and data-driven technologies. Our experience of place has of course been mediated prior to the rise in the data-driven society, for example Meyrowitz (1986) discussed the rise of new media technologies on our interactions with the "situational geography" of everyday life. For decades we have been able to be co-located in physical and digital space at the same time. However, this research explores how an increasing use of data is further changing our relationships with place, particularly through mobile technologies and the use of data-driven mobile applications or wearable devices that we take with us as we move through place. These devices, that we have on our person at almost all times, go with us as we move and not only enable us to use data driven apps to find our way or talk to others around the world, but also *gather* data about our movements and activities in place. We are no longer simply co-located through digital media, through communications or chatting on computers, but we carry these devices with us. It is this particular moment in time, where we

are tracked and have become mobile data generators, that is of interest in this research. The notion that we are coming to rely on data-driven applications to know what the weather will be like tomorrow, or to be warned of floods, or to guide us through a city without us looking up and engaging with that place, is of central interest in this research. The mobile and ubiquitous nature of data-driven technologies that mean we transmit rather than just consume data is what sets our current situation apart from previous considerations of mediation of place, as for example Meyrowitz (1986) explored. At that point in time, Weiser's notion of ubiquity (2002) had not come to fruition, and media technologies tended to be fixed in one location, such as televisions, or desktop computers. Today, sensors and devices permeate our lives and travel with us.

Technology and its relationships to and with space and place has been explored over recent years, but less so focussing upon data that are embodied within the technological systems. It has been acknowledged that the design of technologies often does not "explicitly consider the importance of gaining a full understanding of the human experience of space when designing technologies that will provide and become an integral part of our physical environment" (Ciolfi, 2004). The mediation of place and space through technological artefacts such as mobile phone applications, dashboards and visualisations, rely predominantly on data that are collected, stored, processed, and re-used through technological methods. As these artefacts pervade society and our everyday lives, the reliance upon data as material increases and fundamentally changes how we interact with our environments. Those environments we inhabit are becoming filled with vast amounts of information, some of which makes our lives easier (McCullough, 2013). However, much of it is often unnecessary and leads us to become increasingly reliant upon digital mediation of space, such as using mobile navigation. When moving through a town, city, or even rural areas we see more people walking around fixated on their mobile devices (McCullough, 2013). We are paying less attention to the world around us, as McCullough (2013, p.8) points out "As a flood of information pours into ever more aspects of life, your focus becomes vital. Attention has become something to guard and manage."

More qualitative knowledge systems of understanding place that are based upon intimate relationships with the environment are often considered ancillary modes of understanding, even though they offer empirical understandings and have much to offer. These ways of knowing counteract the data-driven, are embodied in approaches such as Traditional Environmental Knowledge (TEK) (Nelson and Shilling, 2018), are fundamentally rooted in place, and often exist outside of Western knowledge systems.

Understandings of place cultivated through long-term observations and lived experience offer engaging and situated insights that are often not collected, recorded, or re-used through technological means. Instead, they might be relayed through song, dance, storytelling,

imagery, or text (Borgmann, 2017; Nelson and Shilling, 2018; Pacey, 2001). Such systems, even though not rooted within Western positivist knowledge traditions, are still based upon empirical evidence such as observations of weather and how conditions and places change over time and can make valuable contributions to science and technology (UNESCO, 2017). Historically, information came from the world around us; we noted the cues in the landscape such as flora and fauna, looked up at the sky, and paid more attention to place and our lived experience (Borgmann, 2017, p.96). Such knowledge systems are often participatory (Pacey, 2001) and are born out of communities with skills specifically related to their landscape for hunting, gathering, growing food, and observing and understanding the weather. These ways of knowing and understanding place are also being increasingly recognised as offering key insights into how we might understand and tackle global wicked problems, such as climate change. Other ways of knowing that are rooted within the West but tend not to be classified in such a way include those of farmers, environmental stewards and even those who simply pay attention to and care about the place in which they live, who are not part of a formal group or community but have much to offer and contribute to developing more diverse and situated understandings of place that can strengthen the purely data driven.

1.3 Data practices

The rising tide of data being made available for re-use has led to the development of various practices that seek to transform the latent data into mobile applications, visualisations, dashboards, or physical objects. Together with a more critical approach to the data-driven world, a critical approach to those practices which embody and make manifest data should be explored. A key practice to have emerged alongside the proliferation and opening of data is the hackathon (or data jam) where participants gather for intense but short periods of time (usually between twelve and twenty-four hours) to develop designs or products using data. The organisers and participants of such events are influenced by the notion of hacking that grew up alongside the open-source movement. For many, the hacker movement was all about the ability to "create the possibility of new things entering the world. Not always great things, or even good things, but new things … in any production of knowledge where information can be extracted from it, and wherein that information new possibilities for the world are produced" (Wark, 2004, p.3-4). Today however the phenomenon of the hackathon does not always reflect the values and practices of the ideological hacker as outlined by Wark above, instead referring to a more general group of programmers who attend events where they spend intense periods of time developing new products from datasets.

The potential of data to be of great benefit is often limited by the practices through which it is processed, analysed, and re-used, particularly through practices such as the hackathon where many of the designs or prototypes never make it beyond the event itself (McKeon, 2013;

Porway, 2013) and often do not "solve" the issues they intend to tackle. The use of hackathons to re-purpose data is producing what Kitchin calls "rough and ready responses to an emerging phenomenon," in that events take place over twelve to twenty-four hours, during which time the entire process from analysis to design of artefacts or visualisations takes place (Kitchin, 2014b, p.64). Whilst programmers are highly proficient in the analysis and programming of data, they are less skilled in employing design methods to ensure their potential products engage with significant issues and stakeholders. Furthermore, the events draw a limited audience and the results do not engage with the complexities of the issues being tackled. The lack of diversity in both participants and the data available for use during these events is reflected in the products designed or created during the hack.

Furthermore, the sites of the events are often within towns and cities. The participants "believe that deep structural problems can be resolved by technological solutions" (Kitchin, 2014b, p. 64-65), an issue that will be explored further in this thesis, as it relates to wider issues with the rhetoric of data and its potential to ameliorate complex, sometimes wicked problems (Rittel and Webber, 1973).

Other practices have emerged alongside the proliferation of data into society. In addition to the hackathons, small tech start-ups often harness data to create websites and mobile applications, which embodies the desire for innovation and represents the concept of data as the "new oil" of the Fourth Industrial Revolution (Palmer, 2006; Schwab, 2016).

1.4 Walking

Walking has many positive benefits in understandings of and engagement with place and people and is a potentially useful way through which to develop a practice through which to engage a variety of people including data practitioners and those with lived experience of place. Much has been written about how walking enables contemplation and engagement with the immediate environment (Edensor, 2000; Edensor, 2010; Gros and Howe, 2014), as a research method within the social sciences (Bates and Rhys-Taylor, 2017) and in understanding the data-driven society (Masson et al.2020; Powell, 2019; van Es and de Lange, 2020). As a mode of movement that demands slowing down and noticing, of being grounded temporarily in a place, walking offers an act through which to contemplate and explore the features of that place outside. Walking also enables direct contact with the world, without the need to constantly engage with devices. This connection offers a counterpoint to the dominant approaches of data collection, which are presented in this chapter, as reiterated by Dunn (2016, p.21), who writes

> "At a period in human history when so much of our activity is uploaded, categorised, tagged, and compressed into moments, I contend that to sense

> a wider and deeper world candidly through first-hand encounter becomes more important than ever."

It is this wider, deeper connection this thesis seeks to explore, primarily through walking and map making, in order to reflect upon how we might utilise the positive benefits and insights of data, whilst fostering modes of engaging with the world that can add knowledge and wisdom to understandings of place.

1.5 Designing new situated data practices

Design is a process that can enable the envisioning of futures and might be considered as an activity or process that transforms an existing situation into a preferred one (Simon, 1969). Data assemblages are becoming enmeshed in our everyday lives, and it is essential that we understand the impact they have. Furthermore, it is important that products and services that use vast amounts of data are seen as a design material and that we explore how we might use design methods and processes in moulding them (Speed and Oberlander, 2016). Designers already engage with data, and this has been seen in the development of fields such as Human Computer Interaction (HCI) in which the embedding of data within new technologies, as well as its collection has been considered by a range of researchers (Feinberg, 2017). By using design to interrogate data, through both theory and practice, it might be possible to bring about a more balanced approach to different modes of knowing.

1.6 Key fields of knowledge this research contributes to

This research is fundamentally cross-disciplinary and therefore potentially contributes to a range of fields of knowledge across the broad fields of design and computing (and, in particular, data studies). There are further, more specific areas of knowledge this research can contribute to, including: Critical Data Studies (CDS) and critical understandings of data; practices of data (e.g., those wanting to organise hackathons or other data-driven events); Human Computer Interaction (HCI) and Human Data Interaction (HDI); Design Studies (with and for data); Human and Cultural Geography (e.g., understandings and mediation of place in the data-driven society); Data-driven society; Data-walking (theory and practice).

1.7 Thesis motivations and overview

1.7.1 Influence of my previous career on my research journey and values

I came to the Highwire PhD programme after working as a museum curator, having completed a BA in Fine Art and Practice, and then an MA in Museum and Gallery Studies. This expertise

has shaped my approach not only to the areas of research explored in this thesis, but also the ways in which I carried out and made sense of the research.

A curator has multiple roles, depending upon the context in which their practice is situated. As a curator in a local government museum in the UK, which housed historic collections (including the building itself), fine art and temporary exhibitions, I was what might be called a "generalist." Throughout my BA and MA, I primarily focussed on modern art and curatorial practices, exploring the context and development of curatorial practice throughout the 19th and 20th centuries. This theoretical underpinning gave me an interest in museum buildings and spaces, as well as the ways in which curatorial practices informed the communication of history and art. As a curator in a museum, my practice focused on engaging a wide range of audiences in historic houses, the collections they housed, and more contemporary art exhibitions. Throughout my practice I was interested in how, as curators, we shaped the experiences of audiences, and the ways in which we mediate and communicate knowledge. The curator is often bestowed with an authority, whether relating to historical artefacts or fine art, and are responsible for attempting to "construct and convey meaning" (Ferguson, Greenberg and Nairne, 1996).

Later in my curatorial career I became engaged in the development of new technologies within museums. Through working in a small art gallery and then a historic house which housed two art galleries, I became interested in how new technologies such as 3D printing and augmented reality might be used in these contexts. I developed an interest in how they not only offer benefits, but also challenges in terms of the experience of visitors and relationships to the space of the museums. This interest led me to explore wider understandings of, and through my PhD research, critical explorations of technologies.

The skills I developed during my curatorial training and career mean I can synthesise and translate a range of materials, from written to visual, to a range of audiences. I also developed skills in taking historical information, or that created by artists, and writing documents and texts for visitors. This has led to a continuing interest in synthesizing unusual ways of understanding, moving from art and history to place and technologies.

As a researcher I feel I have become a "curator of knowledge." My research practice always brings together different voices and experiences around a specific area or problem. I never work in isolation, as a lone researcher, rather I work with others to bring together distinct types of understanding of different themes. I feel it important to engage with these differing voices and experiences, through interviews or carrying out activities, such as the walks or workshops

My early training and career have had a significant impact on my sense making approach, which throughout the PhD process and now as a researcher is always visual. I always start by

presenting the "data," in this case a range of visual materials and text from interviews, on a large wall or surface. I then begin to make connections.

My own experiences and expertise as a curator implicitly influence my position in relation to the political dimensions of this research. During my curatorial career I sought to enable access to heritage and culture, to the opening up of archives and collections. This drove my interest in engaging with new technologies to enable those without sight to experience built heritage (using 3D scanning and printing to create models of ceilings that could not be seen by those with visual impairments). I also value bringing together differing expertise around a subject, in this case people with a range of experience and understandings of place to enable the "curation of knowledge." In challenging the current approaches of the data driven society, I feel this has been influenced by my background in art practice and theory. Part of my approach is to challenge and embody critical questioning, this time through research.

1.7.2 Research motivations

The fundamental motivation of this thesis is to galvanise and mobilise a wider audience than currently engage with data practices, particularly those who have lived experience of a place or specific issue, interested in developing understandings of place through practices such as walking, to embrace the myriad ways through which place can be understood. A key motivator to this research is an interest in exploring how we might balance the focus upon quantitative understandings of place with more qualitative, experiential, and situated understandings. Furthermore, the notion of "abundance" or indeed excess of data, and the entanglements of data in place, are important to this thesis. During the preliminary stages of the research, I developed a curiosity that led me to explore the relationships between not only data and the ways in which it is gathered and collected through sensing, but also other ways of gathering data that might aid understandings of place that seem to be increasingly ancillary. The relationships and entanglements between data, information, knowledge, wisdom, and place, and how we might reconcile differing approaches in order to engage deeply with place, are explored in this thesis

My own experience of Storm Desmond hitting Lancaster in December 2015 led to the theme of flooding being incorporated into two of the walks (these are presented in Chapter 6). The need to understand and connect with our environment has never been more urgent, as we face unprecedented changes in our climate. Whilst data enables us to understand and model the climate and the potential impact on our lives using vast datasets, our sense of wellbeing and connection with one's world that might trigger greater engagement and action occurs through direct experience of the natural environment (Fuller et al.2007). However, as more of us are living in towns and cities, these connections are decreasing and leading to a loss of connection to and engagement with nature (Fuller et al.2007).

This thesis seeks to explore how balance might be achieved between, on the one hand, data-driven modes of understanding place that are rooted in positivist, quantitative understandings and, on the other, more intuitive situated modes of understanding that are based upon lived experience and grounded in the world. Through engaging with these modes of knowing through literature, interviews and the design of walks, the thesis navigates a route through the rhetoric surrounding the data-driven society and the emerging critiques of such approaches.

The research is situated within critical approaches to data that simultaneously appreciate the potential for this mode of information and the assemblages that emerge from it, and engage critically with the relations between data, people and how we understand and experience place. The position I take throughout the thesis is that, while data and the technologies and assemblages in which it is embedded do have much to offer for ways in which to understand place, this must be done cautiously. Furthermore, the research explores creative methods of gathering and re-using data that offer accessible and engaging additions to current approaches that are embedded within technological philosophies and practices. This research began with an exploration of smart cities, a phenomenon that became of interest to me when exploring the emergence of urban technologies and wider notions of sense of place. It became apparent to me that there is an intangible and abstract nature to data throughout its whole lifecycle and ultimately in its manifestation in and mediation through digital technologies, such as mobile devices and dashboards, as well as when it is visualised. There is also seamlessness, or place-lessness conjured up in the visions of the data-driven smart city which gave me a sense of unease when exploring the literature during the initial stages of this research. The notion that data are the "new oil" of the fourth industrial revolution that fuels the smart city, and the technologically mediated environments also made me intrigued to explore this area in more depth. Whilst much of the discourse around such phenomena consists of rhetoric from technology companies involved in smart cities, it represents an approach to understanding of place that has only recently begun to attract more critical attention. The potential for exploring the modes of understanding places that are seemingly becoming "othered", that are rooted within the experience and real connection with the world, sparked an inquisitiveness and desire to explore this further.

Data are collected instrumentally, stored in databases all over the world, then analysed or developed into apps that utilise technologies developed globally and which ultimately enable navigation through or information about the place from which the data was originally gathered, but without offering any real connection to that place.

Through walking, I explore how being in a place and considering the myriad ways of understanding and developing a sense of place might somehow bring back into balance the data-driven approaches that are rooted in Modernity and emerge from the modes of knowledge and understanding developed during the Enlightenment, with situated, richer, and more

meaningful approaches to understanding place. Such understandings consider “more than” data, they also embrace knowledge and wisdom that are borne from situated knowledge and lived experience of place. There is significant utility and value in data and information but the rhetoric and hyperbole about it are creating an imbalance between, on the one hand, the data-driven world and, on the other, more intuitive ways of knowing that are rooted in lived experience.

This research will explore key data practices emerging from the data-driven world and from this seek to develop a new practice that explores the need to consider the design not only of the products created using data, but of its collection and storage. Furthermore, greater engagement with place and those who inhabit it through such practices will be explored.

In the context of this research, walking is explored in terms of its potential for creating connections between disparate understandings of place through action. As an experiential and primarily contingent mode of moving through a place, walking has been practised and written about by artists, writers (both fiction and non-fiction), philosophers, sociologists, anthropologists and more recently those interested in technology.

1.8 Research Aims and Questions

Based upon initial engagement with discourse and practices around data as it relates to how we understand the places we inhabit, the main research question for this thesis was developed. The initial insights highlighted that within what is termed the Data-driven Society there is often a focus placed upon data that are easy to gather, that is, data that are sensed and gathered automatically through sensors or through the wearable and mobile devices we carry with us as we move through space. Furthermore, when exploring how data are designed with, through practices such as the hackathon, Human Computer Interaction (HCI) and Human Data Interaction (HDI), there seemed to be few principles that aided not only those engaged in the collection and re-use of place-based data but also those who were not located within these practices. Therefore, the initial research question developed for this research sought to understand how the seemingly dominant gathering and re-use of predominantly quantitative data about place might be somehow synthesised or held in balance with more qualitative modes of gathering and re-using data. The development of principles for those not engaged in data practices, or those engaged perhaps more informally, became an important output of the research, as something tangible that might speak to a wider audience.

1.8.1 Research Questions

The research questions for this research were developed in two stages. The first, overarching research question (RQ1) results from a review of literature spanning a range of disciplines that explore the data-driven society and its impact on the ways in which we understand a place, in addition to a range of theoretical and practice-based approaches to understanding data. Furthermore, literature that is rooted in situated, place-based modes of understanding place is included in the survey, to develop an understanding of where any gaps lie between this and predominantly quantitative data-driven understandings.

RQ1: **How might data, information, knowledge, wisdom and lived experience be woven together to develop situated, engaging, and balanced understandings of the places we inhabit in our data-driven society**?

Research question	Chapter
RQ1.1: what do data-driven understandings of place look like in literature and practice?	2 and 4
RQ1.2: what do information, knowledge, wisdom, and lived-experience driven understandings of place look like in literature and practice?	2 and 5
RQ2: how might more-than-data be embedded into a new practice that uses walking?	6 and 7
RQ2.1: how might walks be designed to encourage a more-than-data approach to understanding place?	6
RQ2.2: how do the walks contribute to the more-than-data design process?	7
RQ3: what might design principles for more-than-data look like?	8

Table 1: Research questions and locations in the thesis

To address the over-arching research question (RQ1), it was broken down into sub-questions that explore its component parts. The sub-questions and their locations in the thesis are shown in Table 1 (above).

1.9 Structure of the Thesis

Chapter 2: Literature Survey situates methods of understanding place through the practice of walking. The survey presents the key literature relating to the data-driven society, key sites of data practice, including the hackathon, and critical approaches to the data-driven society. It explores ways in which we understand place through data-driven technologies, the nascent practice of data-walking, and situated practices and knowledge systems.

Chapter 3: Methodology brings together the different methodological approaches used in this research and presents the research methods used. It also highlights the key tensions

between action research and research through design, presenting the decisions made as to which methods to employ.

Chapter 4 - Data-driven practices in place: **the hackathon** explores how place is represented in, with and through data assemblages, specifically through the practice of the hackathon. Through carrying out interviews with participants at a one-day hackathon event, the insights are developed to form a series of Pathways Forward that can enhance the opportunities and tackle the challenges of this data-driven practice.

Chapter 5 – Situated data: people and place explores how situated knowledge is present in a place and is manifest in people who live and work in a particular context. Through carrying out interviews with people in the Calder Valley, Yorkshire, insights are developed that offer alternative insights to those presented in Chapter 4. A further series of Pathways Forward are developed that might offer balance to those developed in Chapter 4.

Chapter 6 –**Designing More-than-Data Walks** presents insights drawn from five walks that were designed and carried out to explore how More-than-Data, the concept developed in Chapter 5, might be embedded into a new practice. This chapter explores the practical and operational aspects of carrying out the walks.

Chapter 7 – Weaving More-than-Data into Practice forms part 2 of the findings from the five walks, and specifically explores the content and output of the walks, and consideration of post-walk activities. The insights have been developed by weaving together those developed in Chapters 4-6 and taking into consideration the Pathways Forward developed in Chapters 4 and 5.

Chapter 8 – Design Principles for More-Than Data Walks presents the two key contributions of this research, the concept of More-than-Data and a set of heuristics through which MtD might be embedded into practice.

Chapter 9 – Conclusions and Future Work concludes the research, presenting key contributions to knowledge, limitations of the work, and potential future work emerging.

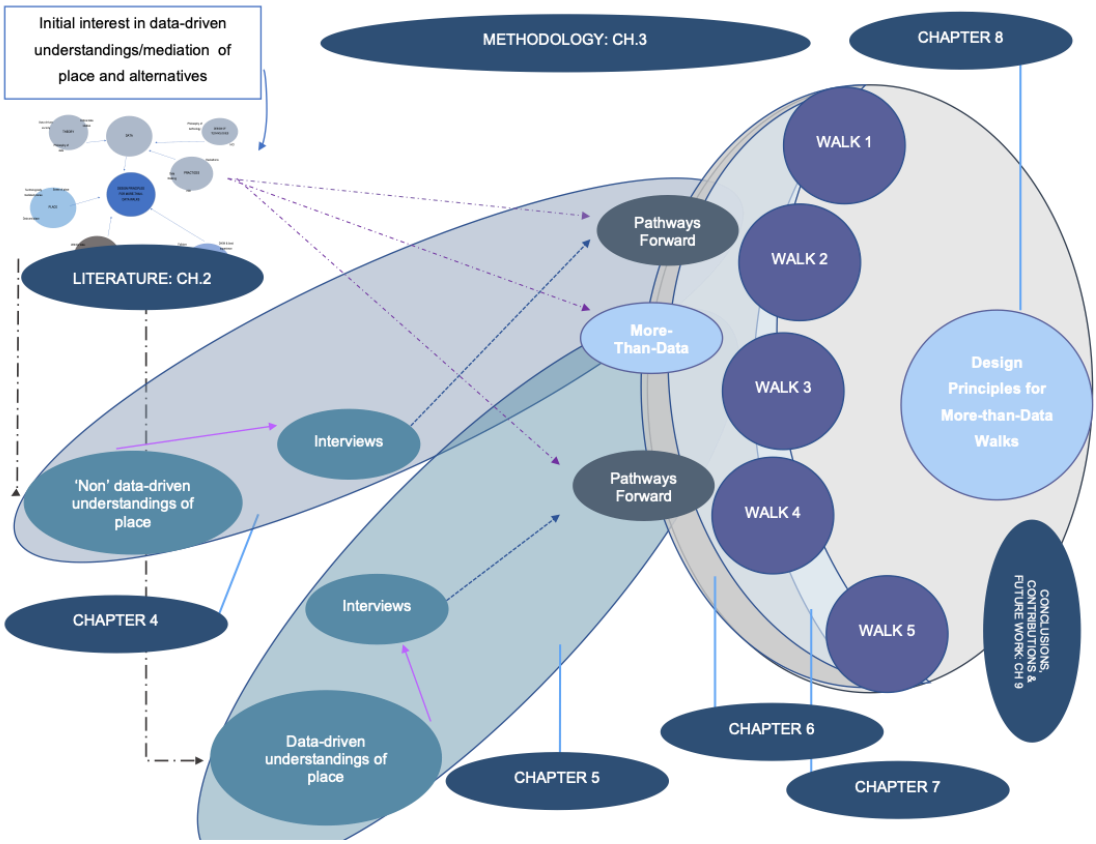

Figure 1: Map of the thesis showing the development of each chapter and research stage

2 Literature Survey

This chapter situates the research presented in this thesis within the context of existing academic literature, research, and relevant areas of practice. The chapter begins to address two research questions:

RQ1.1: What do data-driven understandings of place look like in literature and practice?

RQ1.2: What do information, knowledge, wisdom, and lived-experience driven understandings look like in literature and practice?

The literature that has been brought together and synthesised in this chapter underpins the cross-disciplinary research presented in this thesis and highlights key inter-relationships between the different subject areas. Figure 2 (p.20) visualises the key thematic areas explored in this chapter and the inter-relationships between them.

The key fields of knowledge this research contributes to include the following; data studies and practices (including "big" and "open data"); Critical Data Studies (CDS); Human Computer Interaction (HCI); practices of data (including hackathons and data walking); explorations of place in a data-driven society (including human and cultural geography, locative media, pervasive computing, digital civics, situated and local knowledge studies and practices, and intangible cultural heritage (ICH)); information studies; and design studies (including use of cultural probes, and Research through Design (RtD).

To understand how the data-driven society is impacting how we understand and make sense of the places which we inhabit, it is necessary to explore a range of literature that spans a range of disciplines. Through developing insights and understanding of the key areas and tensions within the discrete areas of literature, modes of understanding and making sense of place were explored; what might be termed "folk" and situated knowledge, such as TEK, folk and weather lore. Literature relating to how we understand and make sense of data, information, knowledge, and wisdom is included here, as this forms a key part of the following research. Bringing these types of "knowing" together, and de-constructing the DIKW pyramid, highlights the different modes of understanding that can be brought together to underpin a more varied and diverse system of knowing. Practices that embody and interrogate both the data-driven (the hackathon and data-walking) and the non-data-driven are explored to understand how DIKW is used and materialised in sense-making activities for place. The practice of design is introduced into the literature survey to explore how current practices do, or do not, embed principles and strategies in the use of data or wider DIKW frameworks. This then offers a basis for developing Design Principles in Chapter 8 of this thesis.

2.1 Defining Data

The use of the word "data" feels distinctly contemporary, inextricably linked to statistics, and embedded within technological systems. However, the term has been in use since the 17th Century (Kitchin and Lauriault, 2018; Rosenberg, 2013).

Societies have gathered, stored, and analysed data for millennia (Kitchin and Lauriault, 2018) to record and understand their lives. The earliest forms of data storage and analysis were tally sticks, thought to have been used by palaeolithic tribespeople who would mark notches into sticks to keep track of materials they traded and their supplies. The notches were used to predict the time their supplies would last. The first examples of historical big data include John Graunt's *Natural and Political Observations Made Upon Bills of Mortality* in the 17th century (Glass, 1964) in which he collected data regarding death rates, identified variations by subset, and developed the use of tables that began to predict mortality. The collection and collation of large data sets became a challenge with the introduction of censuses, which led to innovations in machinery to read punch cards and eventually to the first data processor, Colossus which was developed during World War II (Rosenberg, 2013).

The term *data* is the Latin plural of *datum* and is the past participle of *dare*, meaning "to give" which is translated into English as "something given" (Puschmann and Burgess, 2014; Rosenberg, 2013). Rosenberg (2013) charts the change in use during the 18th century from something widely accepted as given, granted, or generally known, to the result of experimentation, discovery, or collection (Puschmann and Burgess, 2014). During the 19th and 20th centuries, the use of the term *data* became embedded in the fields of science, administration, and business.

As a concept embedded within technology and computing, data emerged during the 20th Century and its emergence can be seen developing alongside modern concepts of knowledge from the Enlightenment before becoming fully entrenched within ideas fundamental to the scientific and positivist approaches to the world that flourished during Modernity (Rosenberg, 2013). The term data is now synonymous with technological systems, used to collect, store, analyse and re-use what is gathered. We now talk of different forms of data, predominantly "big" and "open" data, which have become embedded within myriad facets of our everyday lives. The following sections explore the development of these terms, followed by a review of how they have become embedded in the data-driven society.

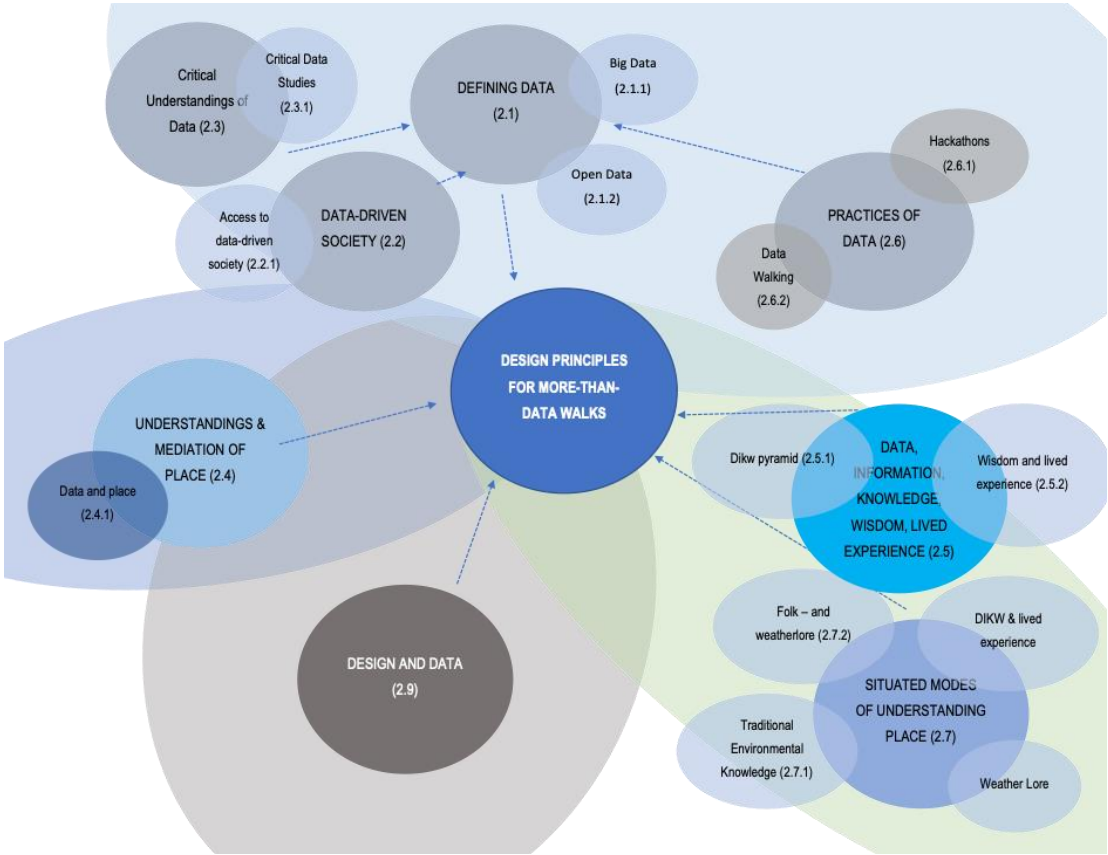

Figure 2: Literature map showing relevant sections and their relationships to each other

2.1.1 Big data

The use of the term big data started to proliferate in the worlds of business and computing in the 2010s when it became a buzzword often used in the business world and media (Kitchin, 2014b, p.67). Charting the development and usage of the term big data is beyond the remit of this research, but Diebold (2012) offers an interesting and useful history of the phenomenon. The term has become embedded in the world of business, particularly in its potential for driving innovations, insights, and business models. Big data was popularised in the media, with a key event being the launch of the Big Data Fund by the Accel Partners at Hadoop World in 2011 (Gage, 2011). At the event, Accel committed $100 million to start-ups using big data, generating big data, or offering solutions for big data analytics.

Big data is also prevalent in academic literature where, until recent years, the focus was predominantly placed upon technical aspects rather than approaches that explore its societal and critical impacts. boyd and Crawford (2010) note that big data discourse tends to invoke both utopian and dystopian visions of a data-driven future. The discourse surrounding big data in the media, grey literature, and academic literature often makes strong claims about its potential (Puschmann and Burgess, 2014). These claims are often illustrated by metaphors, where “big data is suggested to signal the arrival of a new epistemological framework … with

the potential to displace established models of knowledge creation" (Puschmann and Burgess, 2014). Big data also proclaimed the "end of theory," according to Anderson (2008) who stated in Wired that

> "This is a world where massive amounts of data and applied mathematics replace every other tool that might be brought to bear. Out with every theory of human behaviour, from linguistics to sociology … Who knows why people do what they do? … With enough data, the numbers speak for themselves."

This represented the new epistemological paradigm represented in what was becoming the data-driven society, where the collection of vast amounts of quantitative data, whether through user-generated or sensed methods, could drive new information and knowledge production.

Whilst there is no rigorous definition of big data (Kitchin, 2014a; Mayer-Schoenberger and Cukier, 2017), two commonly used reference points are Laney (2001) who refers to the Three Vs of Big Data. These are:

- Volume: data sets are huge in volume and consist of terabytes, or petabytes;
- Velocity: data sets are created in or near real-time;
- Variety: diverse types of data, consisting of structured or unstructured and can be temporally or spatially referenced.

Lycett (2013) adds in "value" to make four V's, stating that this is seen as a commodity where "doing something valuable with the data is important." Kitchin (2014b, p.152-153) adds "veracity" to the 3 V's, stating that it refers to the "authenticity of the data and the extent to which it accurately (precision) and faithfully (fidelity) represents what it is meant to." Khan et al. (2014) increases the Vs to seven, by adding in validity, volatility, and value.

In their seminal work "Critical questions for Big Data" (2012), boyd and Crawford define Big Data as a "cultural, technological, and scholarly phenomenon that rests on the interplay of:

1) *Technology:* maximizing computation power and algorithmic accuracy to gather, analyse, link, and compare large data sets,
2) *Analysis:* drawing on large data sets to identify patterns to make economic, social, technical, and legal claims,
3) *Mythology:* the widespread belief that large data sets offer a higher form of intelligence and knowledge that can generate insights that were previously impossible, with the aura of truth, objectivity, and accuracy.

Big data is fundamentally computational, from its collection, through to its analysis, storage, and re-use. Even more than a computational epistemology, Beer (2016) suggests that

> " ... Big Data is doing a lot of work, it is a persuasive presence in funding, management, decision making, 'human capital' and the everyday practices of production and consumption. The work that is being done by the concept of Big Data needs attention, particularly as it is frequently doing far more than the actual data itself."

As it has become embedded within a wide array of discourses and academic literature, big data has also permeated into our everyday lives, as Beer continues: "… the term Big Data can be used to reveal the type of thinking and the mode of reasoning that ushers data and metric-led processes into everyday organisational and social life." This metric-led mode of reasoning which requires computational power (Puschmann and Burgess, 2014) underpins the data-driven society (discussed in 2.2 below) and has become abstracted from the world in which we live. Big data, in contrast to the origins of the term "data" which could be manually processed and interpreted, requires specialised tools to be captured, stored, analysed, and interpreted. Importantly, "big data is more abstract than traditional data by virtue of its quantity, its mode of collection, and the requirements for its analysis, all of which require computational tools" (Puschmann and Burgess, 2014). The permeation of big data into our everyday lives is discussed by Halpern (2014), who writes

> "The fantasy of managing life itself by bandwidth, and the often-unquestioned assumption that data presents stability, wealth, and sensorial pleasure is not solely the privy of real estate speculators. Today "big data" is regularly touted as the solution to economic, social, political, and ecological problems; a new resource to extract in a world increasingly understood as resource constrained."

This refers to the notion that big data is the "new oil" driving the economy, where the use of vast amounts of data can be deployed in the tackling of complex societal issues. As big data has become embedded within societies around the world, the rhetoric, and large claims of the potential benefits of big data have given way to calls for both critical understandings of the phenomenon and a greater focus on the societal and social impacts of big data. Proposed tools to do so (Beer, 2016; boyd and Crawford, 2012; Dalton and Thatcher, 2014; Kitchin, 2014a)are explored in section 2.4 below.

2.1.2 Open data

Open data is included here in the exploration of the data-driven society as it is often used as a material through which to create new products and services. Furthermore, it is important to consider how open data has become integral to discourses and practices within our everyday lives. Open data, that which has been made open by Governments and institutions around the world, has driven increases in the amount of data available to be re-used for a vast array of purposes. It is important to consider the origins and emergence of open data to understand how it has become integral to the discourses and practices of the data-driven society (the concept of which is discussed in the following section 2.2). Whilst all aspects of open data including transparency of governance and increased accountability are of significant importance, for the purpose of this research the following section includes a brief overview of the genesis of open data and places greater emphasis upon the promise of data for the empowerment of citizens around the world.

Unlike big data, open data has been relatively clearly defined, with the Open Knowledge Foundation (2012) stating that "Open data is data that can be freely used, re-used and redistributed by anyone – subject only, at most, to the requirement to attribute and sharealike." One of the key purposes of opening-up data has been to "empower" citizens, make governments accountable, and enable greater access to and transparency of governance (Cabinet Office, 2014).

The idea of open data emerged from several sources, one of which is the meeting of thirty thinkers and activists engaged with the Internet which took place in Sebastopol in 2007. The participants of the meeting came from a range of backgrounds that included free software and open-source communities. At the meeting, a set of principles now known as the Sebastopol Principles were developed that, at their core, were founded on the concept that public data are common property and should be available to everyone (Chignard, 2013). This concept of opening data built upon the communal idea of providing public knowledge and software for good, as developed through the open-source movement (Kelty, 2008). The concept of opening data to public affairs was introduced at the Sebastopol meeting and gained traction, so much so that when he arrived in office in 2007, President Barack Obama signed presidential memos that open government, of which open data was one of the pillars.

In the UK, open data was also part of a move towards a more open and transparent government. This resulted partly from the government's agenda of being open by default, and partly in response to the Parliamentary Expenses scandal that emerged in 2009 (Larcinese, 2012). As a result of the scandal, and the global financial crisis of 2008, public trust in the government and the financial sectors was eroded leading to increased calls for greater transparency and more inclusive governance. One of the aims of opening data in the UK was

to enable greater transparency and to empower people to hold government and public services to account. This largely entailed publishing financial data.

The combination of technologists and open data activists with governments meant the open data movement began gaining momentum and emerged alongside the Open Government Movement (Davies, 2014). In the UK, 2012 marked a key turning point in the opening of data, with the amendment of the Freedom of Information Act and the government's publishing of *"The Right to Data"* report (Cabinet Office, 2012). The report stated that all non-personal data held by the public sector should be made available to the public for free. The report also stated that the lost value of re-selling data such as post-codes and maps would lose the government around £50 million a year, but that the benefits of offering the data for free would potentially earn billions of pounds for the economy. This was the first time the notion of inviting third party innovators to re-use public data for profit had been included in the burgeoning open data movement. The focus on open data in the UK government shifted towards the potential for economic and empowerment with the publishing of their Open Data White Paper in 2012 (Cabinet Office, 2012).

The G8 Open Data Charter was a key document that emerged from the summit of 2013, and stated "We have arrived at a tipping point, heralding a new era in which people can use open data to generate insights, ideas and services to create a better world for all" (2013). These motivations are like those of big data, as defined in the previous section, in that they are both heralded as being of significant use in driving insights, ideas and services and tackling complex issues.

Having opened data up, this form of data has become important in practices such as hackathons, or in civic hacking, which seek to develop public programmes and policies (Stepasiuk, 2014). When combined with big data, in addition to data that resides elsewhere, open data is now seen as driving many aspects of societies around the world.

This section has introduced the context in which data, as we come to associate it with technological systems has emerged and changed over time. It has highlighted the key claims that are made about the potential for big and open data to tackle complex issues in society and the challenges that have emerged in this area. Furthermore, the section has introduced the different types of data that come together in the data-driven society. The following section will place big and open data in the context of the data-driven society and interrogate issues that access to it faces.

2.2 The Data-Driven Society

The phenomena of big and open data have been embedded within societies around the world, where they are both considered to be instrumental in offering insights and being the material that fuels new businesses and solutions to complex challenges (boyd and Crawford, 2012). Terms such as "data-driven," "datafication," and "datafied" have become embedded in discourses surrounding how data have permeated our everyday lives. The huge amount of primarily quantitative data being gathered is being used to influence decisions, drive businesses, and inform policies (Cukier and Mayer-Schoenberger, 2017; Verhulst et al.2019; Victorelli et al.2020). To understand how these concepts are driving new understandings of place, it is important to understand how the terms have developed and what they mean. Discourse and literature around the gathering, processing, and re-use of vast amounts of quantitative data have, until recent years, been focused more on the technical aspects, such as how the data are gathered, processed, and stored, with less attention being paid to how it is re-used (Kitchin, 2014b). Data-driven practices have been part of the emerging information society since the nineteenth century (Schäfer and van Es, 2017, p.13), and are now commonplace in the information economy.

In the data-driven society, data are often "big" or "open." Datafication, datafied and the data-driven society are terms which have seen increases in use in recent years to refer to the role big data plays in many facets of our lives, however, they are described in a range of ways. Mayer-Schönberger and Cukier (2017, p.15) define "datafication" as

> "… taking information about all things under the sun – including ones we never used to think of as information at all, such as a person's location, the vibrations of an engine, the stress on a bridge – and transforming it into a data format to make it quantified. This allows us to use the information in new ways, such as predictive analysis … As a result, we can unlock the implicit, latent, value of the information."

Data are often spoken about in terms of value and how the "raw" data, which is a contested term (Gitelman, 2013), can be "extracted" to inform decision making (Elgendy and Elragal, 2016), and to build value and new business models in organisations (Mayer-Schoenberger and Cukier, 2017; Saggi and Jain, 2018).

The data-driven society relies upon the quantification of everyday life, of which Couldry and Powell (2014) state "Datafication refers to the process of rendering into data aspects of the world not previously quantified." The rise in wearable and mobile devices which gather data from us as we move around the places in which we live has added to the quantity of quantitative data that are gathered from all around us every day. The rise of the "quantified

self" movement came to prominence in 2007 when Wired Editors Wolf and Kelly launched their "Quantified Self" website (Wolf and Kelly, 2007). This movement is about "self-knowledge through numbers" (Quantified Self Institute, 2016). Whilst gathering data about us using wearable or mobile devices still relies upon quantitative data, it is different to being surveilled as we move through spaces in which sensors are embedded or cameras located. This capture of personal data is referred to by Lupton (2016, p.2) as "tracking the self", rather than "self-tracking." Data gathered by tracking the self is often restricted and not available to the subjects who are being monitored, and people often do not know who is gathering the data or how, where it is stored, and for what uses it may be deployed. Gathering data about our interactions online, using data analytics on social media or in our online shopping habits or about our behaviour is a fundamental component of the data-driven society. This is part of what Van Dijck (2014) refers to as an "accepted new paradigm for understanding sociality and social behaviour", which is another "value" extracted from big data that mirrors the espoused benefits for organisations and governments (Mayer-Schoenberger and Cukier, 2017). Lycett (2013) states that "datafication can be conceptualised via three innovative concepts that allow the logic of value creation to be rethought – dematerialisation, liquification and density."

Whilst definitions and terminology around the data-driven society have different components, quantitative data is a key similarity, particularly in academic literature spanning a wide array of disciplines. Within these definitions and understandings that focus on quantitative data, the gathering of metrics and measurement plays a vital role. Beer (2016) states that "metric-led measurement and organisation has now become interwoven into our everyday lives – much of which we do ourselves", referring back to how we "quantify" ourselves (Lupton, 2016). The importance of measurement is shared by Mattern (2013), who states that within our societies there is "the presumption that all meaningful flows can be sensed and measured." Furthermore, Bowker (2013, p.170) states "the interpretive work is done inside the computer and read out and acted on by humans", marking the shift from data being gathered and interpreted through human activity, to that of computational collection and interpretation. This notion is key to this research, which will go on to explore how we might make more use of our senses as we move around a place. This presumption that sensing means the use of technological devices, many of which are small and hidden from view and over-ride our own senses.

The questioning of the gathering of the vast amounts of quantitative data and a rise in critical approaches to the data-driven society will be explored further (2.4 below). These more critical challenges and understandings of the data-driven society are important to highlight, as they act as a counterpoint to the often celebratory, utopian visions of what big data can do for urban places that can be found in grey literature produced by large technology companies. In grey literature, discourse around big data, and academic literature, (though less so) data are described metaphorically as being the "new oil, of the fourth industrial revolution" (Andrus,

2017; Day, 2016; Kuneva, 2009; Palmer, 2006; Rotella, 2012; Titus, 2010). However, this metaphor has been contested, both regarding the impacts the previous industrial revolutions have had upon the world in terms of personal and environmental challenges, and because oil is a finite resource, whereas data are not. We see ever more data being gathered, stored, and processed, with the only challenges faced being in relation to how the data might be stored adequately (Marr, 2018; Schlosser, 2018). Where data are described as the new oil, or as driving new information economies (Schäfer and van Es, 2017, p.11), this is also considered a challenge and datafication is described as a fundamental component of contemporary capitalism, where data itself has become a new form of capital (Sadowski, 2019). As Mayer-Schoenberger and Cukier (2017, p.15-16) state

> "In the twentieth century, value has been shifted from physical infrastructures like land and factories, to intangibles such as brands and intellectual property. That is now expanding to data, which is becoming a significant corporate asset … It is the oil of the information economy."

One key component the definitions share is the notion of "quantification," which encompasses both the amount of data gathered and its nature as quantitative, rather than qualitative. A further common theme in definitions is the transformation of everyday life into data which is archived and used for a wide range of purposes, by governments, educational institutions, healthcare providers, and businesses of all kinds (Barassi, 2020). Whilst the definitions are varied, they all point towards the measurement and quantification of society, with the inclusion of new data that we once never even thought of as being of use. Data-driven society is the term that will be used in this research.

2.2.1 Access to the data-driven society

The discourses around open data suggest that it should be open to all. However, this is not the case. It is fundamentally only open to those who have access to the necessary hardware and skills. There are issues around data literacy, particularly in the realm of big and open data.

The digital divide is a well-known phenomenon and describes how people are excluded from the use of technologies (Vicente Cuervo and López Menéndez, 2006). This divide extends to the collection and re-use of data, often along geographical lines. Walker et. al (2020) identify key issues in what they call the "Open data gap", stating that "if the focus of data collection and its … re-use in technological artefacts in urban areas is prioritised, those who are not part of the data become invisible, and are subsequently ignored." Andrejevic (2014) refers to the "Big Data Divide" which describes the "asymmetric relationship between those who collect, store, and mine large quantities of data, and those whom data collection targets." Key to this issue was the call from Sir Tim Berners-Lee that all internet users have access to their own

personal data (Katz, 2012). One of the key issues highlighted by Andrejevic is that people are separated from their data and excluded from the process of putting it to use.

A geographical divide in access to the data-driven society is identified by Dix (2014), who discusses the issues relating to rural and remote locations and the infrastructural problems faced by such communities. Dix highlights the potential for rural and remote communities to contribute data and explores wider questions, such as the potential for such places to move from being "data subjects" to sharing data locally and globally. Furthermore, the notion of local knowledge is introduced, which can be easily lost or at best held in individual memories. This type of data is a community asset. However, due to infrastructural issues and such communities being seen as low priority, it is difficult for local communities to not only gather data but also to share it. Dix states the benefits of enabling rural and remote communities to engage in the data-driven society, however it is conceptualised, could include empowering the community through controlling information about the community and enhancing communication within and between communities, as well as the incorporation of local knowledge into wider conceptualisations of data. He suggests that these communities should be encouraged to collect, analyse, and re-use their own data.

A further factor that limits access to the data-driven society is that of data literacy, which "refers to the ability to understand and use data" (Frank et al. 2015). The issue of literacy is important to consider as we are expected to engage with data, but data is not information, as discussed by Frank et al. (2015). The authors state that for data to be useful people must be able to extract information from it. Furthermore, they state that "the ability to do this is rapidly becoming a requirement to participate in modern life – as fundamental as the ability to use a telephone or money." As data has been presented as having the potential to empower people (Johnson, 2013), the issues relating to literacy undermine this, ensuring that those already empowered continue to be so (Gurstein, 2011).

When combined, these infrastructural, societal, and geographical issues regarding access to the data-driven society exclude a wide range of people and their associated communities. These challenges also highlight the issues with discourses and rhetoric that claim big or open data have the potential to not only create new insights, products, and services, but also to tackle complex issues faced by society.

This section has introduced the notion of the data-driven society and presented key definitions and conceptualisations that define it. Furthermore, the section has highlighted key issues that are faced by those who are unable to access the data-driven society and the key reasons this occurs. The following section explores how more critical approaches to the data-driven society have emerged in recent years.

2.2.2 The History and Politics of Data (and place)

The collection and use of data are political. Coté et al. (2016, p.5) suggest that (Big) Data "is political in the same way in which identity, the body, gender, sexuality, race and ethnicity are political, that is, as sites of struggle over meaning, interpretations, and categorisations of lived experience." As data are used to make decisions relating to myriad aspects of our lives, it is important to remember that this has been the case since before the computational turn in data collection and re-use (Rosenberg, 2013, p.15).

Whilst use of the term "data" can be dated back to the seventeenth Century, Rosenberg (2013, p.15) states that it is not wrong to associate the emergence of the concept of data to that of modernity. "The rise of the concept in the seventeenth and eighteenth centuries is tightly linked to the development of modern concepts and argumentation" (Rosenberg, 2013 p.15).

Data collected from and about a place, even before the invention of mass collection through computational means, has enabled the division of land and its subsequent control and increasingly granulated data about people through census.

Scott (1998, p.11) talks of the control that resulted from the rise of census data, stating

> "Certain forms of knowledge and control require a narrowing of vision. The great advantage of such tunnel vision is that it brings into sharp focus certain limited aspects of an otherwise far more complex and unwieldy reality. This very simplification, in turn, makes the phenomenon at the centre of the field of vision more legible and hence more susceptible to careful measurement and calculation."

The "narrowing of vision" Scott refers to encapsulates the ways in which the data-driven society utilises that data which might benefit particular agendas and potentially give more power to those who already wield much. However, this wide-ranging and vast array of data gathered through computational means does not necessarily lead to equitable or apolitical methods of collection and use. Scott (1998, p.11) talks about a "synoptic" view of a selective reality, which makes possible a "high degree of schematic knowledge, control and manipulation." This synoptic view of place began when governments started gathering data about people through censuses and cadastral surveys, which enabled them to gather information about their populations, and who owned what packages of land. Furthermore, Scott talks about the nature of agriculture being a "radical reorganization and simplification of flora to suit man's goals" (1998, p.2).

There has been a rise in the development of algorithms through rigorous computation models. These have been used to try and understand complex social phenomena (Coté et al. 2016). This has led to big data being used in predictive future models, both at the individual and

organisational level. As a result of this, as Coté et al. (2016) state, “Big Data is thereby driven by a resolution of verisimilitude: not just faith but an actual resolve that if we just gather enough data, its finely granulated resolution will reveal in high definition all the world’s hidden truths.” Once we developed the tools to increase the data gathered, without having to rely upon that which was collected through analogue means, the rise in the sheer amount of data and the faith placed within this to see “hidden truths” became accepted within societies.

2.3 Practices of data

Data that are sensed and gathered from the locations which we inhabit are used in a wide range of ways, being processed using different software and then re-used through different practices. As a material, big data and data that are made open and published can be utilised to provide insights into different contexts, such as for businesses, or public organisations. These data once processed can also be re-shaped and developed into commercial or public applications, visualisations, and dashboards that form the basis of mobile applications. The act of re-using data can form part of a range of practices, some of which that are most relevant to understanding and mediation of place, are included here. Kitchin (2014b, p.64) states that

> “to date, attention has largely been focused on the supply-side of accessing data and creating open data initiatives, and there has been insufficient attention paid to the sustainability of initiatives and how data are being utilised and employed.”

Through exploring key practices in which data are either used as a material for designing new products and services (the hackathon) or critically interrogating data (the data walk), this section begins to address Kitchin’s assertion.

In particular the practice of the hackathon (a phenomenon which has seen a rapid rise over the last decade or so), Human Data Interaction (HDI) (Mortier et al. 2014) (which seeks to embody and make intangible data into physical objects), and data walking (a practice that engages critically with data), are explored here.

2.3.1 The hackathon

Hackathons are explored here as they represent a practice that uses data, including both big and open data. The events are considered by many as a method through which data can be re-used to benefit both private organisations and citizens, through the development of new products and services. Furthermore, as Kitchin (2014b, p.64) identifies, hackathons support and promote the opening of data, which is often done by enthusiasts and organisations with little experience in archiving data or the contextual use of the data being opened.

The hackathon has emerged over the last decade or so as an intensive event where datasets are presented and re-used, often to tackle specific issues, or to explore themes within a brief time frame, with prizes often awarded to winning participants (Olesen and Halskov, 2020). The format of hackathons, usually held as intensive events over short periods, mirror the traditional practice of the programmer or coder, who might work intensively to develop their code. This approach is also mirrored in tech companies that use the "sprint" as intensive work periods to complete projects. The format of the event finds its origins in the hackathons tied to the emergence of Silicon Valley in the late 1990s, where groups of enthusiastic programmers would assemble and prototype and problem-solve with and for technology companies (Olesen and Halskov, 2020). These events are defined in a range of ways; rapid design and development events at which volunteer participants come together to conceptualise, prototype, and make (mostly digital) products and services (Lodato and DiSalvo, 2016).

As Trainer et al. (2016) state, hackathons are, seemingly, everywhere. Alongside the emergence of this phenomenon, literature has begun to emerge that interrogates this practice, as it has become increasingly popular and used by both private and public organisations. The practice has also become embedded in technological education, with universities choosing this event format to encourage the development of programming and coding skills in practice (Porras et al.2018). Students and young participants are often encouraged to develop designs or solutions in return for prizes or to add to their portfolios, which is becoming increasingly important as the technology sector places greater emphasis upon portfolio careers. In response to this, Irani (2015) suggests that the hackathon promotes "entrepreneurial citizenship" which is celebrated in cultures that look towards Silicon Valley for models of social change.

A comprehensive literature review that covers ten years of hackathon practice by Olesen and Halskov (2020) offers insights into research *through* hackathons and research *on* hackathons over the last decade. The paper reviews the literature relating to hackathons (including research through and on the events) and presents key benefits and challenges that emerge. The summary is sorted according to three motivations: Structuring Learning (light grey), Structuring Process (grey) and Enabling Participation (dark grey). The benefits, whilst predominantly of use to participants and organisers, do not tend to have a bigger impact upon the wider world beyond the hackathon. Furthermore, the challenges tend to not only inhibit the products or designs that might be sent out into the world beyond the event, but also mean that the data gets "stuck" within the event. The authors also found that not all solutions are suitable to be developed in hackathon participation, to create more heterogeneous events and outcomes.

Hackathons are opportunities for participants to collocate and write code (Trainer et al.2016). The key benefits of events are forming social bonds and ties; however, these are created at the expense of the technical benefits of the events (Trainer et al. 2016). In a study of Philanthropic and issue-oriented hackathons, Porter et al. (2017) interviewed participants of the CHI4Good

Day of Service, a philanthropic hackathon which was aimed at those with technical skills from the CHI (Computer Human Interaction) community and non-profit organisations, to explore key issues they face. Based on their findings they suggest that "the hackathon genre might be productively restructured to benefit the breadth of stakeholders" and suggest several implications for the re-design of the philanthropic hackathon. These include organisers better supporting technical capacity building and expertise by providing templates that can be re-purposed, or design patterns for developing websites, and creating websites, or developing mobile applications. They also suggest organisers could better support the development of social networks, which is a key benefit of the hackathon, by introducing participants and making connections both before and after the event. Recognising the importance of the design process in the hackathon process, to ensure meaningful interactions and events for participants, the authors suggest organisers "might offer non-profit representatives step-by-step guidance through a flexible design process, producing user needs' assessments and workflows before attendance at the event." Finally, they suggest organisers build in reflectivity during the event, to enable participants to reflect on their process and engage in creative activities.

The hackathon tends not to be a practice where organisers or participants are encouraged to engage in critiques of big data or to interrogate underlying and inherent issues. Whilst these events do have the potential to bring together highly skilled participants to tackle complex issues, they obscure the politics of data, and underpin rather than challenge existing power relations and politics (Thornham and Cruz, 2016).

In their research on what they term "issue-oriented hackathons," Lodato and DiSalvo (2016) suggest a hackathon can be labelled as such "when it is motivated by and organised around a specific set of conditions and consequences with the intention of addressing those conditions and consequences." The authors suggest that these types of hackathons are sites of material participation through the making of things, which include databases, application programming interfaces (APIs), interfaces, visualisations, maps, and apps, amongst other things (Lodato and DiSalvo, 2016).

Kitchin (2014b, p.64-65) states that a further issue, also identified by McKeon (2013) and Porway (2013), is that hackathons promote and reproduce many of the issues inherent in opening datasets, such as lack of experience in organisations which lead to websites with poor data access and lack of clean and useable data. As a result of these issues, Kitchin, McKeon and Porway suggest that hackathons can be of little benefit. Whilst one of the key benefits of attending the events is of developing social ties, as highlighted above (Porras et al.2018), participants tend not to have deep contextual knowledge relating to the data, or what it refers to (Kitchin, 2014b). A further key challenge of the hackathon as identified in the literature relates to the lack of continuity in the design and development of ideas once the event ends,

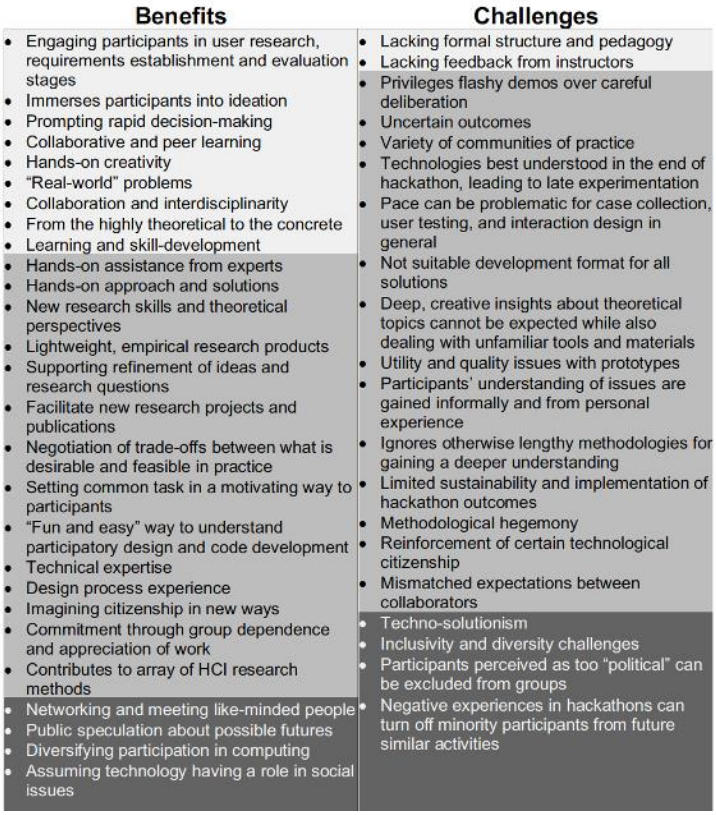

Figure 3: Summary of benefits and challenges of hackathons Olesen and Halskov, 2020)

which limits the access to and visibility of data (Kitchin, 2014b; Kitsios and Kamariotou, 2019).

Furthermore, the participants often belong to a particular demographic that is not diverse and does not represent a wider society. Kitchin states that participants tend to be young, educated and tech oriented (Kitchin, 2014b) and that the tendency is toward believing that "deep structural problems can be resolved by technological solutions" (Kitchin, 2014b), echoing the notion of technological solutionism.

The use of design, and design processes within hackathons has not been explored as extensively as the more socio-technological and technical facets (Olesen et al. 2018). One key paper which does explore the design process in hackathons is based upon research by Olesen et al. (2018), who explored the factors that inform design judgements at hackathons (within the context of HCI) and found four key contributions. They state that whilst research relating to hackathons has increased, most of it explores *what* they do, but little research has explored *how* they unfold, and the creative processes found in the practice. This is a key area to explore, as the design process used in the re-design of data has an impact on future products and the

how these designs often do not make it beyond the event. The authors recognise that design judgements at these events are impacted by the tight period and limited resources, and this differentiates the design process from other contexts.

The four factors identified by the researchers are

1. The hackathon format: Frames and imposes certain elements to the design process. Prompts prioritizing of resources.
2. Tools and materials: Played a significant role in idea generation since the design process depends on what tools and materials are available.
3. Domain knowledge: The main driver for idea generation and user insights. Sought internally and highly dependent on the composition of team members.
4. Technical knowledge: The team depends on their internal technical knowledge and what is realizable within the team.

The authors note that within design processes, it is common to experience constraints on time and resources (Löwgren and Stolterman, 2004). However, they noticed that this was particularly pervasive in the hackathon, where little thought was given to changing the situation or the world as is often the aim of design. This echoes the assertion made by Kitchin (2014b), that designs, or prototypes are rarely developed beyond the event. The researchers also discovered that at the hackathon, the design process was limited by the hackathon situation, and not "the world outside." This lies in opposition to Löwgren and Stolterman (2004), who describe the designer as one who "simultaneously works with the vision, the operative image, and the specifications of design work while taking into account how the world will be changed by their design ideas and decisions." By referring only to the world within the hackathon, and relying upon group members to inform use decisions, rather than referring to user groups or stakeholders, as design tends to do, the hackathon does inhibit the potential of potential designs. This lack of continuity, the researchers suggest, aims to create a design space, but they state that within this space "the focus and development is very short-sighted and limited to the time of prototype presentation and demonstration" (Olesen et al.2018).

Hackathons use datasets that have been gathered from places or people, whether using sensors, or humans with mobile devices. These events tend not to interrogate the data itself or the systems through which they are collected and used or the relationships between these socio-technical entanglements and the places in which they are situated. The following section explores a practice that is emergent and situated, and that offers the basis for an alternative practice to hackathons that can address the "methodological hegemony" identified by Olesen and Halskov (2020, above).

2.3.2 Data Walking

In recent years data walking has emerged as a practice that uses walking to engage with and interrogate data as it relates to place. As it is a nascent practice, most often embedded within academic research and practice, there has only been a small amount of literature produced in this realm. The practice was first written about by Greenfield and Kim (Greenfield and Kim, 2011) as the walkshop, where technological phenomena could be interrogated in place. The walkshop is a "learning experience that's equal parts urban walking tour, group discussion, and spontaneous exploration" and explores the presence of networked computation in cities. Greenfield and Kim's guide to developing a walkshop was made available on their website.

Data walking is located within critical approaches to data, within the field of Critical Data Studies (Masson et al. 2020), critical interrogations of big data (Powell, 2019) and highlights issues relating to data literacy and community engagement (Hunter, 2020). A recent evaluation of data walking carried out by Masson et al. (2020) offers useful insights into this nascent area and the different types of walks, and included five different types and format of walk carried out by different researchers. One of the key reflections the authors make is the relationship between several of the walks and Critical Data Studies (CDS), in that they engage with data infrastructures and dig down into critical understandings of data in a location. The authors also highlight how the walks engage with issues around data literacy.

Data walking was first introduced into academic practice by Powell (2019), who has carried out and subsequently written about different walks with a range of participants. The main concern in Powell's walks is big data, in particular exploring how it might be made from the bottom up (Powell, 2019, p.212). In *"The data walkshop and radical bottom-up data knowledge"* Powell explores

> "strategies for examining public matters of concern in relation to data production, following from and developing from previous efforts at surfacing and valorising situated knowledge in particular urban contexts, and identifying how "bottom-up" data subjectivity could become collaborative and collective using participatory meaning-making processes."

The data walk approach developed by Powell interrogates big data by asking questions about it, which prompts participants to explore how data becomes "big," who asks the questions that make the data big, and how we might begin to ask diverse kinds of questions (2019, p.212). Data walks were initially designed by Powell for pedagogical activities, to introduce students to the concept of "situated knowledge" (this is defined in 2.7, below). During the walks, participants observe, discuss and record connections between the data they see, as well as the

infrastructure, and data that are missing from the location. Participants create responses in a participatory, non-hierarchical way, and they sometimes confront the unknowability of data assemblages, with some creating their own data in response to these issues on some walks (Powell, 2019, p.223-225).

Powell's data walks were based upon a proposal for "flashmob ethnography" which was intended to create more participatory forms of ethnographic practice. The "data" gathered through the walk is considered by Powell to be ethnographic data, which has been gathered through observing and interacting with and in place. The aim is for participants to use that data to "produce (future) interventions in the city spaces they observed" (p.217). Critical making is highlighted by Powell as one approach that can be utilised in exploring the interventions.

van Es and de Lange (2020) explore data walking (which they term "datawalking") through the lens of a research method that studies the computational turn in media and communication studies. The authors highlight the current nascent state of the practice, which has descriptive accounts of how walks were carried out and what resulted. They also point out that there are no methodologies or frameworks that guide those wanting to carry walks out. As such, the authors suggest the development of data walks as a "modular methodology," stating (p.287)

> "By methodology, we mean the design and discussion of a research strategy, outlining the methods used and reflecting on that approach (pros/cons, biases etc.), and its relation to the research question and the theory. To address various research aims and a wide range of contexts, we go to create hands-on modular datawalks that can be easily tailored."

The survey carried out by Masson et al. (2020) offers a starting point to the development of a methodology by evaluating current approaches and drawing out key benefits and challenges therein. The research explores how data walking might be used effectively in a pedagogical setting and intends to develop walks further.

The practice of design has been explored through Data Walking, as Hunter (2020) explores in the "Data Walking" project. This project seeks to "explore the potential of walking to gather data on the urban environment and then through multiple walks and visualisations build a rich picture of that area, acknowledging the plural understandings and experiences of the urban environment." As with Powell's Data Walks, Hunter highlights the participatory and collaborative nature of the walks. However, Hunter's walks differ in that they are used to gather data and use it as a material with which to design, through visualisations. Data are gathered while walking using Arduinos, which include sensors that capture the data as participants walk, or using analogue methods including object collection, floor rubbings or hand-sketched charts. Data sets are made available after walks and shared online to enable collaboration and the development of visualisations. The walks explore 4 Es; exploring,

experimenting, engaging, and empowering, and specifically address issues relating to data literacy within communities. Furthermore, the aims of the walks include exposing designers and participants to data gathering processes, for participants to learn about data literacy, and understand the fallibility of sensors, technology, and processes (Hunter, 2019, p.15).

The development of data walking practices represents a positive and engaging move towards understanding data and bringing a wider range of people into the conversations around these key issues. Those who have previously been excluded due to a lack of understanding or connection to data here have an opportunity to become engaged through a different route. However, the data walks highlighted here tend to take place in urban environments. These locations are of course primary sites of potential interaction with a range of data issues and offer opportunities for accessible walks. However, carrying out such walks only in urban locations excludes a wide number of individuals and communities, who are left off the map due to infrastructural, social, or economic issues (0). Carrying out walks in urban locations is practical and as they are most often organised by academic institutions, whether participants are academics, activists or members of the public, the ease of organising a walk in such a location is preferable. There is an opportunity to develop walks that not only explore where data are but perhaps where data are not. Remote and rural locations still offer opportunities to engage with data. As Dix (2014) explores in his white paper, rural and remote communities such as those on the Scottish island of Tiree face different challenges than those in urban locations but can still benefit from exploring how they may contribute to the discourses and practices around data and the assemblages that pervade our everyday lives, or not, as may be the case on islands.

Data walks offer a bridge between the data-driven society and situated modes of understanding place and generating data that are situated.

This section introduced two key practices that explore data in diverse ways, one seeking to use data (the hackathon) and the other seeking to interrogate data (data walks). Key literature was introduced, and challenges and opportunities of each practice was presented.

The following section introduces the notion of situatedness, particularly as it relates to place, and practices that are engaged different in understanding place.

2.4 Move towards critical understanding of data

As the data-driven society has come to embody the measurement and quantification of myriad aspects of our daily lives, the often utopian and hubristic claims made for the assemblages fuelling the dominance of computationally gathered and processed data have been challenged.

Within academic literature and beyond, in popular media, there has been an increase in research that explores not only the tools that gather and process data, but also the societal and structural impacts that have resulted. This section highlights the key literature that challenges the data-driven society and draws out potential approaches to be embedded further in this research.

2.4.1 Critical Data Studies

Having identified challenges embedded within not only the methods of collection but also the processing and re-use of data, whilst also recognising the inherent benefits of collecting large sets of data, it is possible to engage critically with this area. Critical Data Studies (CDS), which explores critical understandings of the data-driven society and the development of tools for getting underneath the data have been increasing over recent years (boyd and Crawford, 2012; Burns et al.2018; Dalton and Thatcher, 2014; Kitchin, 2014). Iliadis and Russo (2016, p.2) referred to the field of Critical Data Studies (CDS) in their 2016 paper as a nascent field and

> "a formal attempt at naming the types of research that interrogate all forms of potentially depoliticised data science and to track how data are generated, curated, and how they permeate and exert power on all manner of forms of life."

One of the key early papers CDS referred to was the seminal paper by boyd and Crawford (2012, p.665-675) which presented six provocations for Big Data:

1. Big Data changes the definition of knowledge;
2. Claims to objectivity and accuracy are misleading;
3. Bigger data are not always better data;
4. Taken out of context, Big Data loses its meaning;
5. Just because it is accessible does not make it right;
6. Limited access to Big Data creates new digital divides;

When written in 2012, the critiques of the data-driven society had not coalesced into a specific area of inquiry, although boyd and Crawford concluded in their paper that "it is important that we start questioning the assumptions, values and biases of this new wave of [big data] research."

Following on from this call by boyd and Crawford (2012), further researchers identified the need to not only critique "big data" and its role in society, but also to develop methods and tools to do so. Building on the momentum in developing a more formalised approach to "big data," Dalton and Thatcher (2014) introduced the concept of Critical Data Studies (CDS). The

authors state “As the public discourse around data turns from hubristic claims to existing, empirical results, it’s become nearly as easy to bash “big data” as to hype it.” Whilst Dalton and Thatcher ask questions of “big data” as it relates to concepts of space, within the context of geography, their work is applicable more widely.

Critical Data Studies aligns with other critical approaches to technology, which in turn relate to the wider field of the philosophy of technology. In particular, the work by Feenberg (1991, 1999; 2002; 2008) and the Critical Theory of Technology. Grimes and Feenberg (2013, p.123) state the Critical Theory of Technology

> “… argues that while technologies materialise in socially determined ways depending on the contexts, people and practices involved, they also have larger normative implications that demand critical attention. Foremost among these implications are the enduring issues of power raised by substantivist philosophy and by political theories of modernity.”

Dalton and Thatcher (2014) build upon this and state, “As with all technologies, it [big data] recedes from our attention as it saturates and structures our everyday lives.” They call for an examination of “big data” that asks critically who it speaks for and why, before it disappears from consideration. Kitchin and Lauriault (2018) offered an answer to Dalton and Thatcher’s provocation (2014) “what does a critical data studies look like?” by suggesting CDS should study “data assemblages.” This term refers to the “technological, political, social and economic apparatuses and elements that constitutes and frames the generation, circulation and deployment of data” (Kitchin and Lauriault, 2018). Kitchin and Lauriault also pose questions relating to the nature of data, how they are being produced, organise, analysed, and employed, and how best to make sense of them and the work they do. Kitchin’s previous work (Kitchin, 2014) had called for tools and methods through which to understand the re-use of big data, which he then goes on to develop within the context of CDS.

One of the vital considerations of CDS that is important in this research is the quantification of life and the attempts to reduce our experiences into data. Dalton and Thatcher (2014) address this, stating

> “As the fullness of human experience in the world is reduced to a sequence of bytes, we should not limit our concern to how much better those bytes function vis-à-vis their counterparts. Rather, we must ask what it means to be quantified in such a manner, what possible experiences have been opened and which have been closed off.”

Couldry (2017, p.237) identifies an issue in how we are able to process the value of outputs from big data, stating that “such processing is, of course, beyond the capacity of human interpreters. The issue is how we interpret the value of the outputs of such processing.” One

of the key issues identified in the processing of vast amounts of data is that it marks a different order of knowledge production and making sense of it. It also represents a "step change in human self-understanding that precisely bypasses humans' meagre attempts at self-understanding through interpreting the local details of what they think, say and do." This concept implies that we are essentially outsourcing our own self-understanding to data that are gathered about us. Importantly, Couldry (2017, p.237) also talks about the de-valuing of other forms of "social knowledge",

> "resulting from the overall celebration of social knowledge achieved through automated, processing and, by contrast, the devaluing – even the attempted decommissioning, - of other forms of social knowledge that until fairly recently, were taken seriously."

Couldry relates this loss of social knowledge to what Nikolai Gogol called "dead souls," which are human entities that have financial value that are not alive, not at least in the sense we have always known human beings to be alive (2017, p.237). This out-sourcing of knowledge to automatic collection and analysis has been questioned by Offenhuber (2015) who wonders why we no longer use our own senses. This observation leads onto questions of how we sense our own environments and places in the Data-driven Society, which will be explored further in the following section.

This section has introduced key literature that forms the critical interrogation of data that emerged in recent years. These views seek to balance and navigate through the often utopian and dystopian visions of the future data-driven society. The following section aims to draw out key literature about place, to embed the notion of the data-driven society in this context.

2.5 Understandings and mediation of place

This sub-section presents a selection of understandings of place, to provide context to this research, which explores data in place, and to draw out key principles that are of use to this research. While not an in-depth review of how place has been conceptualised through history, it is useful to briefly pay attention to how the concept has changed over time.

2.5.1 Sense of Place

Place is an interdisciplinary issue and has been considered in fields such as art, architecture, literature, history, and anthropology, amongst others (Cresswell, 2004, p.23). Within geography, place is a concept that "expressed an attitude to the world that emphasised subjectivity and experience rather than the cool, hard logic of spatial space" (Cresswell, 2004, p.24). This concept of place was explored deeply by Tuan (1974) and Relph (1976). Tuan's "*Topophilia*" (1974, p.4) refers to the "affective bond between people and place." This

experiential understanding, as understood by Tuan, is embedded sense of place within phenomenology, with Tuan stating that we get to know the world through places, through human perception and experience. Distinguishing between "space" and "place," Tuan refers to space as an "open arena of action and movement, while place is about stopping and resting and becoming involved." Importantly for this research, this notion of space is open and amenable to the abstraction of spatial science, whereas place is open to discussions of concepts such as "value" and "belonging." Relph (1976) was more explicit about the links between his concept of space and place, and phenomenology, writing about our practical experience of places. Cresswell (2004, p.38) summarises the concept of place by stating "place is … a pre-scientific fact of life – based on the way we experience the world."

The notion of place is considered contingent, and ever changing, constructed by "objects and processes from outside" (Cresswell, 2014, p.71). Lippard (1997, p.7) discusses place in terms of layering, stating that

> "Place is latitudinal and longitudinal within the map of a person's life. It is temporal and spatial, personal and political. A layered location replete with human histories and memories, place has width as well as depth. It is about connections, what surrounds it, what formed it, what happened there, what will happen there."

This concept of place demonstrates that identities of place are, as Massey (1994, p.5) writes

> "always unfixed, contested and multiple. And the particularity of any place, in these terms, constructed not by placing boundaries around it and defining its identities through counter-position to what lies beyond, but precisely (in part) through the specificity of the mix of links and interconnections that go 'beyond.' Places viewed this way are open and porous."

Massey's concept of place as ever moving and of being profoundly changed by mobilities and, as Lippard (1997) refers to as "us moving about a lot", challenges the modes of place as outlined by Tuan (1974) and Relph (1976). The "bounded" notion of place, that we need to spend time in a place to get a "sense" of it, is perhaps outdated and does not consider the vast connections to places "beyond" those in which we live, as Massey suggests above. In Massey's seminal "*A global sense of place*" (Massey, 2008) place is considered to be "open and hybrid."

2.5.2 Hybrid Place

In recent years, accounts of how technologies have become entangled in place have emerged across a wide range of disciplines, including geography, human geography, and technology studies. The concept of "augmented place" is one such way of understanding the proliferation

of technologies into place. Creswell states "Our phones … know where we are. They are linked to data that knows where other people or things are too. They provide a level of information about place" (Cresswell, 2014, p.14). Data, code, and technologies are located in the places we inhabit, but are often invisible (Kitchin and Dodge, 2011). Amin (2006) refers to the "software code, timetable, traffic signals, zoning patterns, lists, databases, grids" as the "hidden hand" within the city, which gathers data and then channels it into new forms of activity and control within the urban realm.

The notion of "hybrid place" is also important to consider in understanding place in the data-driven society. In *"City of Bits"*, written in 1996, Mitchell talks of "public cyberspace" (1996, p.128). During the 1990s the notion of cyberspace was essentially anchored to one's home computer, before Weiser's concept of ubiquitous computing was developed in 2002. For Mitchell, in the exploration of the different "spaces" that existed online and their connection to the offline world, it was important to consider the ways in which people used online space and how that was similar to, or differed from, physical space. He wrote (1996, p.128)

> "For designers and planners, the task of the twenty-first century will be to build the bitsphere – a worldwide, electronically mediated environment in which networks are everywhere, and most of the artifacts that function within it (at every scale, from nano to global) have intelligence and telecommunications capabilities."

Mitchell foresaw what is now best known as hybrid-space, where we use our mobile devices as we move around, and no longer have to be sat at a home computer to access the internet or the spaces within it. A more contemporary notion of hybrid space encompasses the ways in which digital space permeates our physical space. This has been defined by De Souza a Silva (2006, p.262) as

> "mobile spaces, created by the constant movement of users who carry portable devices continuously connected to the Internet and to other users. A hybrid space is conceptually different from what has been termed mixed reality, augmented reality, augmented virtuality, or virtual reality … The possibility of an "always-on" connection when one moves through a city transforms our experience of space by enfolding remote context inside the present context."

The key concept highlighted by De Souza a Silva is that of "always-on connection," which has, since the article was published in 2006, become even more prescient. We now move through space with more than mobile devices connected to the internet, as we have wearable devices (e.g., smart watches or bracelets), we use smart cards for travel, and there are also myriad sensors in our environment. Therefore, space has become even more hybrid, as sensors

are now part of our everyday lives. Our mobile technologies reconfigure our own notions of space, as De Souza a Silva (2006, p.273) writes "Changing our experience of space means not only interacting in new ways with other people but also redefining the space in which we live." We no longer rely solely on analogue maps for navigation, or walk around a town or city untraced, but refer to our devices as we move, connect with others virtually online or through messaging, and can be connected to anywhere in the world.

Conceptualisations of place can no longer be static and consist of bounded geographical locations. Rather, place has become entangled and amorphous, being shaped continuously not only by inhabitants, architecture, and infrastructure, but also by the data that are gathered and embedded back into the fabric or invisible technological systems. Ciolfi (2013, p.169) argues that

> "Considering the physical world as a continuously negotiated compound of structure and experience is essential when studying and/or designing digital technology: in the same way as technology needs to be thought of in terms of human needs and activities, so the physical setting it occupies in an increasingly pervasive way needs to be examined from a human-centred perspective."

Following from this, it is therefore important to consider physical space when exploring and designing data collection and use of products and services.

The literature explored above highlights the split between the Cartesian notion of place, seen from above, through to the embodied sense of place that is experiential, contingent, and always being re-made. This complex entanglement of place, people and things forms the context for this research. As Crang (1998) states, in paraphrasing Husserl "Places are not just a set of accumulated data, but also involve human intention and are shaped by the way we approach them."

2.5.3 The Politics of Place

Notions of space and place, as understood in this research, are political. As considered above (2.6.1) the notion of place has various meanings, which are complex, in today's data-driven society. For this research, the two most relevant figures dealing with politics and place are De Certeau, in *"The Practice of Everyday Life"* (1988) and Lefebvre's *"The Production of Space"* (1991).

For De Certeau, the ways in which places, or specifically the city, is understood depends upon the position taken. Walking in the city and the notion of this as a "tactic" through which we can understand and challenge the politics of place was explored in "*The Practice of Everyday*

Life" (1988). De Certeau talks of being elevated to the top of the World Trade Centre, which "allows one to read it [the city], to be a Solar eye, looking down like a God" (p.92). The urban planner, architect and cartographer remain "aloof," seeing the city from above and as a whole, whereas the "ordinary practitioners" of the city "live down below." This is an important concept which might be transposed onto today's "smart city," where the data are gathered and re-used by those who have a view from the top, to try and understand the city as a whole. Those who are beginning to unpick data as it exists in place are the "ordinary practitioners," and this is where the practice of data walking (2.4.4) is important in this understanding of place.

For Lefebvre, the notion and construction of space is rooted in Marxist politics (Lefebvre, 1991). Lefebvre argues that space is not an inert, neutral and a pre-existing given, but is rather an ongoing production of spatial relations. Ruppert (2017, p.206) states that Lefebvre wrote of three registers involved in the production of space:

Conceived: conceived spaces are rendered by objectifying practices that code, re-code, present and re-present space to make it legible and intelligible.

Perceived: perceived spaces are symbolic representations that guide imaginative relations to space.

Lived: lived spaces are those that we inhabit through the things we do in or by living and are spaces through which we act.

In exploring the inextricable relationships between space and society, Lefebvre stated "social space is not a thing among other things, nor a product among other products: rather, it subsumes things produced and encompasses their interrelationships in their coexistence and simultaneity – their (relative) order and/or (relative) disorder" (1991, p.73). The Cartesian model of space, which separates "ideal" space from "real space" was rejected by Lefebvre. Rather, he considered space to be a product of something that is produced materially while at the same time "operate[s] … on processes from which it cannot separate itself because it is a product of them" (1991, p.66).

A further notion developed by Lefebvre that is pertinent to this research is that of "abstract space." This has been described by Wilson (2013): "technocratic rationality's emphasis on abstraction and quantification, exemplified by Cartesian notions of time and space as homogenous and infinitely divisible, is a representational expression of capitalist society's domination by the logic of the commodity." The anti-Cartesian notion relating to space and place is of particular interest in this research, where we see big-data and the data-driven society being divided along similar lines. We find ourselves once again attempting to understand how we might "dig underneath" the technocratic move towards cities being quantifiable and commodified through the division of private and public space.

Lefebvre also highlighted the ways in which "the abstractions of technocratic rationality are not only alienated but are also *alienating* in terms of the instrumental role they play in the material abstraction of lived experience" (Wilson, 2013). Within the data-driven society the "technocratic" approach to understanding place overtakes that of the lived experience. This notion is particularly relevant to those places in which we see data being re-used, such as the hackathon (section 2.4.3) and might be considered as "abstract space."

It is important to understand these political concepts of space, as this is the context in which place-based data are gathered and reified. The rejection of space and place as neutral and inert mirrors the notions of data that are "raw" or neutral. If space, place, and data are not neutral and inert, then it is important to draw attention to the ways in which the political, non-neutral production of space and data are made, and to explore these "from below," as De Certeau (1988) suggests. This view from below is similar to the calls for "looking under the data" (Gitelman and Jackson, 2013) and responds to the emergence of Critical Data Studies, where the political and spatial implications of data are considered.

2.5.4 Data and place

Data as it relates to place has been explored in several pieces of research located within the field of Human Computer Interaction (HCI). Little work exists that explores data and situatedness (see 2.7 for an explanation of situatedness). Taylor et al. (2014; 2015) explore what data means to the "person in the street" in their yearlong research project, *"The Tenison Road Project."* The project consisted of the researchers engaging with residents of one street and was based on understanding both how data are generated, analysed, and used, and how it becomes entangled and settled in place. Through asking residents to complete data notebooks, carrying out data surveys on local plants and wildlife, installing and managing data technologies, and interactions with the residents and the research team, a wide range of data were collected. Two archives, one physical and one digital were created, to foster a sense of community and ownership of the data that was gathered. A local resident, who was a trained archivist curated the physical archive, and the digital archive was built by the research team and could be added to and seen by anyone with access to the internet. Interestingly, the physical archive was added to more frequently than the digital archive.

Engaging with the notion of place is important in Taylor's research, particularly as it remains "on the ground" and situated within the street. The engagement with the residents and their evolving and developing understandings of the potential use of and issues with data led the researchers to believe there are new possibilities for designing data-oriented tools and systems. Furthermore, the researchers found that this engagement of data through its materiality, whether through digital or tangible data, "makes its presence felt when situated in real-world

places and, simultaneously, the tensions that can arise when we inhabit those places together" (Taylor et al. 2015, p.2864).

Through exploring and seeing the resident's emerging understanding of data that was collected about them, and issues arising with privacy and ethics, the researchers call for the design of data systems that should be either more accessible for non-technical users, or that embed sustained technical support. This issue relates back to the ways in which people are excluded from the data-driven society (0) and offers tangible examples which might form the basis of innovative designs and design methods for engaging communities in not only the collection of data, but also in the design of systems that collect and use data. The researchers also highlighted that the notion of data-in-place has implications for "a design approach that accommodates the always emerging assemblies of place, community, and data, and at the same time one that enables specific and unique configurations to flourish" (Taylor et al. 2015, p.2869). This finding is important, as it highlights the need to synthesise the ecosystems of heterogeneous data in a place, rather than focussing solely on either the technical tools of gathering the data or the ways in which it might be used. Essentially, this offers a situated approach to the collection, storage, and use of data.

This section has introduced key literature relating to place and key theories that are of importance in this research. The notion of data, as it relates to place has also been introduced. The following section introduces different definitions and understandings of data, information, knowledge, wisdom and lived experience, that embed these understandings in this research.

2.6 Data, Information, Knowledge, Wisdom and Lived Experience

The terms "data", "information" and "knowledge" are often used interchangeably, with a range of differing definitions and relationships. Wisdom is not easily defined, even though we might recognise it when we see it enacted (Mulgan, 2021). The notion of lived experience is challenging to define and often used without a definition offered (McIntosh and Wright, 2019).

Disciplines dedicated to information science (Borko, 1968; Brookes, 1980), the philosophy of information (Floridi, 2010) and the theory of knowledge (epistemology) exist, and an in-depth study of these specific areas is beyond the scope of this research. However, an understanding of the terms and the ways in which they are conceptualised and represented in literature is important to this research. Whilst this thesis does not study these areas of understanding in depth, it is important to understand how they relate to different modes of understanding place (as discussed in 2.5.3 above and 2.7 below).

2.6.1 The Data, Information, Knowledge, Wisdom pyramid hierarchy

One of the key points of reference in understanding data, information, knowledge, and wisdom is the Data, Information, Knowledge, Wisdom (DIKW) pyramid. Whilst the origins of the pyramid are not fully apparent, it seems to stem from Ackoff's seminal paper [1] *"From Data to Wisdom"* (1989). The hierarchy has been described as forming the canon of information science (Frické, 2008), but has also been critiqued, with various other revisions offered.

The traditional DIKW pyramid as used by Ackoff (1989) describes the components as follows:

Data: basic, discrete objective facts about something such as who, what, when, where.

Information: data that are related to each other through a context such that it provides a useful story; as an example, the linking of who, what, when, where data to describe a specific person at a specific time.

Knowledge: information that has been culturally understood such that it explains the how and the why about something or provides insight and understanding into something.

Wisdom: placing knowledge into a framework or nomological net that allows the knowledge to be applied to different and not necessarily intuitive situations.

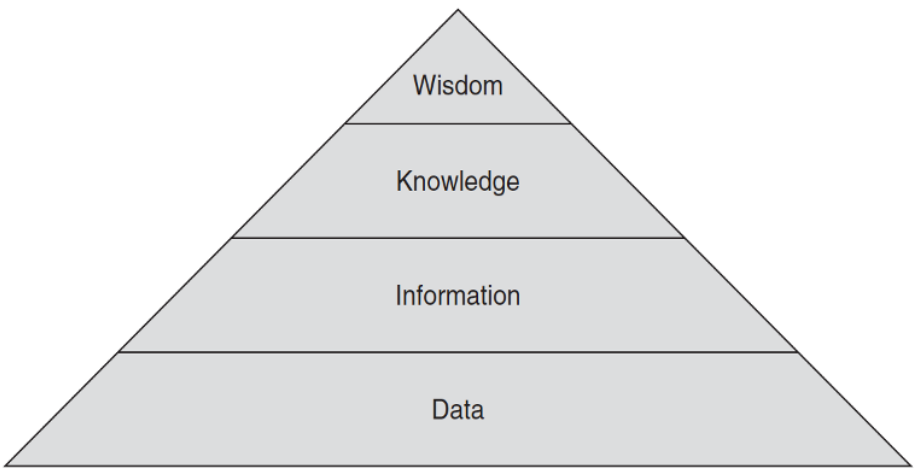

Figure 4: Data, Information, Knowledge, Wisdom Pyramid - from Fricke (2008, p.132)

The notion of the DIKW pyramid and hierarchy has been contested, particularly in the fields of information management and knowledge management. Here the critiques are important as

[1] Ackoff's paper originated as a presidential address given to the ISGSR in in 1988, which was then published as a paper "From Data to Wisdom" (see reference above)

they offer potential frameworks and definitions of DIKW that will be useful within this research. In particular, the notion of the hierarchy of DIKW is important, as this research seeks to re-balance the concept of the data-driven society, which in essence mirrors Ackoff's conceptualisation, with data being the building block upon which information, knowledge and wisdom is derived. The de-construction this hierarchy has been explored by Tuomi (2000, p.5) who states that

> "data is not the building block for information, knowledge, and wisdom as data is not observed, collected, or recorded in a vacuum. Rather, our understanding of the world through our wisdom and knowledge drives us to collect specific information and data to support our use of our knowledge and wisdom."

This understanding of DIKW is useful for this research, as it acknowledges the inter-relationships between these ways of knowing. A further revision of the DIKW pyramid proposed by Jennex (2005) illustrates that data, information, knowledge, and wisdom exist in a broader context, in that we are always gathering and processing data into information, knowledge, and wisdom. However, the data gathered and processed is not all that is available and is limited by the abilities of our sensors (human or mechanical sensors) to detect, interpret, and capture data (Jennex, 2017). Frické critiques the DIKW pyramid, and therefore the hierarchy, stating that the theory is "reminiscent of an inductivist growth-by-accretion model of science." In the critique, Frické explores the ontological concept of data and notions of truth, which, while of interest, are beyond the scope of this research. The critiques of the DIKW hierarchy constitute an important and extensive debate within the fields of information and knowledge management. For the purpose of this research, the hierarchy is essentially flattened, to bring about and encourage a balance of DIKW, with the addition of lived experience. It is accepted that there are relationships between DIKW, and these will be explored through practice in Chapters 6 and 7 of the thesis.

Beyond the concept of DIKW and the debates around hierarchies, exploring how we derive our understandings of the places we inhabit and how those have changed over time is also of interest. Borgmann (2017, p.96) describes the nature of the means through which information has been conveyed and the difference that has made to the ways in which we engage with it.

He writes that

> "information, like food, was once woven into the texture of everyday life; it was accessible and intelligible to all. Information came from nature, from the clouds that warned of rain, from the blossoms that foretold berries, from the tracks that pointed to game. It came from the stories of the elders, from the reports of those returning from gathering or hunting, and from the news conveyed by a member of the neighbouring tribe."

What Borgmann describes here is akin to Traditional Environmental Knowledge systems (see 2.7.2), which rely upon observing and gathering data, information, and knowledge from the environment. Importantly, he continues by charting the changes information underwent when it required specialised instruction to be understood, usually through visual forms such as the making of notches on sticks, blazes on trees and cairns on hilltops. This was then followed by writing and the expert knowledge held by scribes, and the literate communities that came as a result of the printing press. He argues that reading and writing is accessible, that it gives people the opportunity to enter the realm of information that was tangible on paper. However, when the telegraph came along, Borgmann argues that an information machinery developed that "became ever less intelligible as it became more powerful" (2017, p. 96). Many people did not understand how sound came from their radio, or pictures appeared on their televisions. This has become amplified today, now that "the machinery of computers and information links is incomprehensible to most users … the growing size and sophistication of the machinery have greatly increased the quantity and variety of information" (2017, p.97). Here the issue of accessing information is raised, as we have moved from visual forms of communication within the environment, through to modes of information that required more specialist skills, to now where information has disappeared into the machinery of computers. This is also true of data, which are gathered and then not experienced by those who contributed it until it is delivered back to us in the form of visualisations in mobile applications or websites.

2.6.2 Wisdom and lived experience

The notions of wisdom and lived experience are important to consider here, as they both have much to contribute to our understandings of the places we inhabit. Today the concepts of data, information, knowledge, and wisdom appear to be almost in conflict with one another, or at least, out of balance with one another. However, this is not necessarily a contemporary issue, as Ackoff (1989) referred to T.S Elliot's *"The Rock"* from 1934,

> "The endless cycle of idea and action, Endless invention, endless experiment, brings knowledge of motion, but not of stillness; Knowledge

> of speech, but not of silence; […] Where is the wisdom that we have lost in knowledge? Where is the knowledge that we have lost in information?"

Wisdom is one of the concepts which does not appear to be as contested as data, information, and knowledge within the DIKW hierarchy discourse (Frické, 2008). Of wisdom Ackoff (1989, p.2) states,

> "…although we are able to develop computerised information- knowledge, and understanding-generating systems, we will never be able to generate wisdom by such systems. It may well be that wisdom – which is essential for the pursuit of ideals or ultimately valued ends – is the characteristic that differentiates man from machines."

Within the data-driven society, where insights are increasingly driven by big data, including wisdom within the understandings of place developed in this thesis offers the opportunity to re-balance. In the context of the data-driven society, the importance of considering and embedding wisdom seems particularly timely. Of this, Mulgan (2021, p.5) states:

> "We … live in societies that are far richer in data and knowledge than ever before. But it's not obvious that we have become wiser. Indeed, the recent explosion of data and information may have diminished rather than amplified wisdom. Too much information can amplify noise rather than useful signals."

Lived experience is a concept that has a wide range of definitions, dependent upon the academic discipline. Within the context of qualitative research lived experience is defined as "a representation and understanding of a research or research subject's human experiences, choices, and options and how those factors influence one's perception of knowledge" (Given, 2008, p.489).

The sense that we now live in a world where we have abundant data and knowledge, but less wisdom, suggests bringing these different modes of conceptualising the world back into balance. However, it is perhaps the prioritisation of these modes of understanding that need to be balanced, rather than privileging one over another. Whilst Ackoff (1989) suggests that computers can not generate wisdom, we are still able to do that ourselves, and we are able to use innovative technologies to enable the production of data, information, and knowledge.

Data, information, knowledge, wisdom and lived experience all have complex definitions and conceptualisations across many research disciplines. However, it is also important to consider the terms for this research, to explore how more balanced understandings of place might be developed, through developing new practices of data.

This section has introduced the framework for this thesis embedded in concepts of data, information, knowledge, wisdom and lived experience. Differing definitions and issues with these terms have been highlighted, that seek to offer clarity in the use of the terms throughout this research.

The following section introduces two approaches of understanding place that engage with data practices, both of which take different approaches.

2.7 Situated modes of understanding place

Situatedness is a term used in a range of disciplines, including sociology, anthropology, cultural psychology, and behavioural science to describe the "close relation between an individual and its environment, and the influence of this relation on the nature and development of the individual itself" (Rehm et al.2003, p.133). Differentiating between situation and context, Rehm et al. (2003, p.134), state "A situation consists of the spatiotemporal ordering of objects and agents alongside physically given constraints or characteristics, like gravitational force or light intensity."

2.7.1 Situated and local knowledge

A key text that explores the notion of situatedness is Haraway's seminal *"Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective"* (Haraway, 1988). The paper criticizes theories of "disembodied scientific objectivity" and argues that the perception of a situation is a matter of an embodied, located subject, and their geographically and historically contingent perspective, which is constantly structured and restructured by current conditions (Antonopolou, 2017). A key concept that relates to this research is that situated knowledge relates to knowledge specific to a particular location and is often embedded in language, culture, or traditions, echoing the embedded and embodied knowledge of TEK. This approach to knowledge also sits in opposition to the "gaze from nowhere," which is prevalent within the data-driven society and notions of objectivity. Papacharissi (2015, p.1097) observes that situated knowledges "help us to be part of a better world and more meaningful communities."

Scott (1998, p.318) talks of situated and local knowledge, stating that "We might reasonably think of situated, local knowledge as being *partisan* knowledge as opposed to generic knowledge." This places knowledge within a place, but also ties it together with personal values and motivations; that the person has a "passionate" interest, or a personal stake. Scott also talks of "generic formulas," in discussion of the drive towards the collection of data through censuses and the division of land. In particular, he discusses the notion of the translation of "crude general understandings," which were developed through the gathering

and aggregation of large-scale data (prior to computation). This generalisation is problematic, in that the local application of such knowledge, that which is not situated, must require greater translation to be locally successful. In the era of big data this approach is also problematic in relation to situated or local knowledge.

This understanding of place offers one which might start to synthesise, or at least foreground, the tensions between the data-driven, embedded within positivist paradigms of objectivity and neutrality, with more subjective, yet still empirical understandings of place, as explored further in the rest of this section.

2.7.2 Traditional Environmental and Local Knowledge

In seeking to explore a range of understandings of place that are embedded within and beyond the data-driven society, this literature survey now turns to modes of understanding that are essentially situated and comprise heterogeneous ways of knowing.

There is no universally accepted definition of Traditional Environmental (or Ecological) Knowledge (TEK), as the terms "traditional" and "ecological" knowledge are themselves ambiguous (Berkes, 2018, p.3). Therefore, it is defined in several ways, but tends to refer, as Berkes et al. (2018, p.3) suggest, a

> "… cumulative body of knowledge, belief and practice, evolving by accumulation of TEK and handed down through generations through traditional songs, stories and beliefs. [It concerns] the relationship of living beings [including human] with their traditional groups and the environment."

Wall-Kimmerer (2002) defines TEK in similar terms, referring to Berkes (2000), stating that TEK (using "ecological") refers to the "knowledge, practice and belief concerning the relationship of living beings to one another and to the physical environment." Furthermore, Wall-Kimmerer (2000, p.5) states TEK is "born of long intimacy and attentiveness to a homeland and can arise wherever people are materially and spiritually integrated with their landscape." Of importance here is the notion of long intimacy and attentiveness, which is central to practices of TEK.

The fundamental components of TEK and Local Knowledge are the way in which knowledge is passed through communities, often through narrative means, and the heterogeneous nature of the types of knowledge captured within this context. Explanations and accounts of TEK tend to focus on the fundamentally opposing epistemologies embodied in this approach, and the approach of Western science. Knowledge is fundamentally based upon qualitative understandings, which create a diachronic database, described by Wall-Kimmerer (2002) as a record of observations from a single locale over an extended period. TEK has been described

by Berry (1988) as an "enchanted" world that science is discovering, that was part of the natural mind for most of human history. This view is described by Berkes (2018, p.2) as a "departure from the static, mechanical, disembodied view of the world formulated by Descartes, Newton, and other thinkers of the age of the Age of Enlightenment which has dominated our thinking." Wall-Kimmerer also refers to the differences between TEK and Western science and seeks to incorporate the more qualitative approach into biological education (Wall-Kimmerer, 2002).

In TEK concepts of place were, and continue to be, understood in quite diverse ways compared to those data-driven methods we experience today in the West. For example, navigation techniques for non-western peoples often required elevated levels of skill, whether finding their way in trackless deserts, snowy planes or at sea. Navigation techniques depended upon integrating several kinds of sense experience relating to winds, waves, seabirds, the smell of distant land, the apparent colour of water over reefs, and the sun and stars. Waves and swell patterns could provide clues to the locations of islands and were recorded using "stick maps" formed by tying thin sticks together in complex patterns (Pacey, 2001). In *"Meaning in Technology"*, (2001, p.109) Pacey talks about pre-scientific peoples in all parts of the world requiring knowledge and skill related to the landscapes in which they lived, and states,

> "inevitably, this knowledge was of a participatory kind. It was the knowledge needed for hunting, gathering, or growing food and for obtaining other necessities: materials for making shelters, fibres for ropes and clothing, herbs for medicinal use. And it was knowledge that could be gained only by experience of the most practical, involved kind."

Today however, Pacey states, the landscape is rationalised, and separated from the place, "abstracting from it only those things that can be measured and calculated" (Pacey, 2001, p. 109). Today we do find participatory knowledge systems, but those that contribute to the "hive mind," where knowledge can be crowd-sourced on platforms such as Wikipedia.

Whilst it is useful to consider how TEK and Local Knowledges offer alternative modes of knowledge collection and communication, there are issues with the ways in which these systems have been understood and utilised in the West. The discourse of TEK and Local Knowledge, particularly in the fields of environmental development, sees these modes of knowing and those rooted within the positivist paradigm as dichotomies. This can be seen in the quotes by Berry (1998) and Berkes (2018), who place them in opposition to one another. Nygren (1999) discusses the differing approaches, within the context of environmental development and located within anthropology. Nygren describes the two opposing archetypes, with Western science characterised as reductionist and theoretical, while non-Western knowledge was considered as holistic and practice based. Between these two polarised ways

of knowing, it is implied, there is little exchange of information (Nygren, 1999). The importance of seeing both types of knowing as legitimate and seeing them not as mutually exclusive, but as complementary, derives from Lyotard (1979). The concept is discussed in the context of traditional knowledge (relating to climate change) by Lejano et al. (2013) who suggest that traditional and modern knowledge, and other legitimate ways of knowing are not mutually exclusive but are complementary.

Within the promotion of alternative knowledges there has also been an assumption that all domination can be removed by replacing hierarchies with alternative, "bottom up" approaches. This approach is problematic, as it further contributes to the "them" and "us" position and this approach is not always the best. Nygren calls for the analysis of local knowledges as "heterogeneous ways of knowing that emerge out of a multidimensional reality in which diverse cultural, environmental, economic and socio-political factors intersect." Furthermore, it is impossible to work with clear boundaries "between people's science and scientists' science."

TEK and Local Knowledge systems are not static, they morph and adapt. This is illustrated by a UNESCO report (2017, p.41), in which the example of Tongan farmers is used. The farmers use their own traditional calendar to decide when to plant, but today weather conditions have shifted in relation to that calendar. As a result, they have adapted their planning and activities. The report states that "This detail knowledge of local-level change and adaptation is invaluable for understanding climate change impacts and policy responses" (UNESCO, 2017, p.41). Adaptation of Local Knowledge systems also result from encounters in which local and global, and traditional and modern, are intricately intermingled (Nygren, 1999). It is also important to bring attention to the ways in which local knowledge exists within the global, and the ways in which knowledge and power exist in this context. Local knowledges are not static, they expand and transform, through connections within and beyond the local context. Of this Nygren (1999, p.283) states

> "In today's highly interconnected world, local people find themselves tied into social, scientific and technical networks which extend far beyond their locality and, consequently, there is an increasing need to recognise the ongoing hybridization of knowledges."

Whilst TEK offers valuable insights into methods that engage deeply with place, it should be recognised that there are significant ethical and moral considerations when exploring these modes of understanding place. In recent years, the realisation that TEK can offer longitudinal, quantitative, and qualitative empirical data has led to Western scientists extracting what is "of use" to their work and leaving.

In the UK, the term TEK is not widely used, instead the terms Local Knowledge or Lay Knowledge are more common. Two dominating modes of gathering data and information about a place, in the context of flood mitigation, are through environmental data and through expert knowledge, which this leaves a gap of the lived experience and local, or lay knowledge of those who live and work in that place. This is being recognised, and research is being carried out into the benefits, potential, and challenge in addressing this gap, particularly in the realm of flooding mitigation and resilience in communities (Forrest et al. 2019; Lane, 2010; McEwen et al.2017). Furthermore, the importance of knowledge within communities is being recognised by organisations such as the UK Government who state (Cabinet Office 2008, p.350),

> "Experts involved in emergency response should not ignore the skills, energy, and ingenuity … latent in most communities; in preparing for an emergency, communities have important shared local knowledge and can harness local resources and expertise."

For this research in particular, this gap represents a rich seam of understanding place that has much to add to the data-driven representations of place, as presented in Chapter 4. However, the ways of understanding place located in local and lay knowledge are not without their own challenges, particularly in terms of gathering those which are stored within people, place, and other living beings. Furthermore, the reliability, storage, and representation of a more heterogeneous system of place-based understanding presents challenges that need to be addressed.

Whilst this is not a call to return to pre-technological, pre-data-driven times (although one could argue that stick maps could be defined in the broader context of technologies), the methods through which TEK engages with place can offer insights and potential for richer, more situated understandings and mediations of place.

The implication of understanding local knowledge for this research lies within the synthesis of heterogeneous ways of knowing and seeing these as existing within a world where the data-driven can exist, but that these different approaches are not dichotomies. It is also important that the notion of local, or TEK knowledge not be romanticised, or seen as the "other" that is in opposition, nor to reject the potential benefits of data.

2.7.3 Folk- and weather-lore

Two traditional modes of understanding the places we inhabit are folk- and weather-lore. Folklore is a way in which we understand the world and "the medium through which we make our understandings available and legible to others … There is never a world for us except the one we sing and, singing make" (Ryden, 1993, p.10). In an exploration of future folklore,

Maxwell et al. (2016) refer to beekeeping folklore, such as "Telling the Bees", where bee colonies would be told of deaths in their beekeeper's family to prevent them swarming or getting sick. One form of folklore is the very localised etiological tale, which explain natural phenomena and contain universalised, written, and scientific explanations. Knowledge and cultural traditions can be encapsulated in oral histories or folktales (Olson and Torrance, 1996; Zipes, 1983).

The UK Meteorological Office defines Weather Lore as "the body of informal folklore relating to predicting the weather" (Met Office, ND). Weather-lore are predictive sayings that long before the advent of meteorology, dating back to the Ancient Greeks, provided useful indications and recommendations for activities that were strongly dependent on the weather, including farming, sailing, animal breeding, travelling and military campaigns (Diaconu, 2017; Inwards, 1893). The sayings often relate to signs of change from plants to animals, while others relate to astronomy, astrology, and clouds. Inwards (1983) states that these observations have been embedded in proverbs, others in the form of rhymes, while many still "float about, unclaimed and unregistered, but passed from mouth to mouth, as mere records of facts, varying in verbal form according to local idioms, but owning a common origin."

One of the most accurate examples of Weather Lore is the "Shepherd of Banbury's Rules to judge the changes of weather" (1670). The book includes a version of "Red Sky at Night" which does have a sound evidence base in meteorology. These "folk" ways of knowing, whilst not to be utilised on their own in our understandings of place, offer a rich historical mode that can be told through narratives and stories. They offer potential for being used in conjunction with other, more contemporary modes of understanding place.

2.7.4 Permaculture Design Principles

A contemporary situated practice that engages deeply with place, and in essence embodies the relationships between place and living beings, is Permaculture. The ecological approach was developed in the 1970s by Mollinson and Holmgren (1990), who defined it as "an integrated, evolving system of perennial or self-perpetuating plant and animal species useful to man [kind]." Holmgren took the definitions further and re-presented the more contemporary definition of Permaculture as "Consciously designed landscapes which mimic the patterns and relationships found in nature, while yielding an abundance of food, fibre and energy for provision of local needs" (Holmgren, 2020, p.3).

Holmgren considers Permaculture to be the use of systems thinking and design principles (Figure 5) that provide an organizing framework for implementing the vision (below, p.57). The petal model demonstrates the inter-related elements of the principles and the spiral path, beginning with ethics and principles, suggests that the domains are knitted together.

Permaculture has become a movement worldwide, including the Transition movement (Hopkins, 2008), with many groups adopting the definition and principles beyond engagement with the environment. For this research, this wider phenomenon is not explored, rather it deals with the design principles developed by Mollison and Holmgren (Holmgren, 2020). The design principles of permaculture reflect components of TEK, in that there is a complementary focus upon practice and understanding, with the development of knowledge over time.

This section has introduced key understandings of place that are situated and seemingly lie in opposition to Western, positivist modes of knowing a place. The different examples offer opportunities to explore how, as some authors suggest, a more balanced approached, rather than a dichotomous approach will be of benefit.

The following section explores walking as a situated practice and seeks to understand how this practice might be used in future understandings of place.

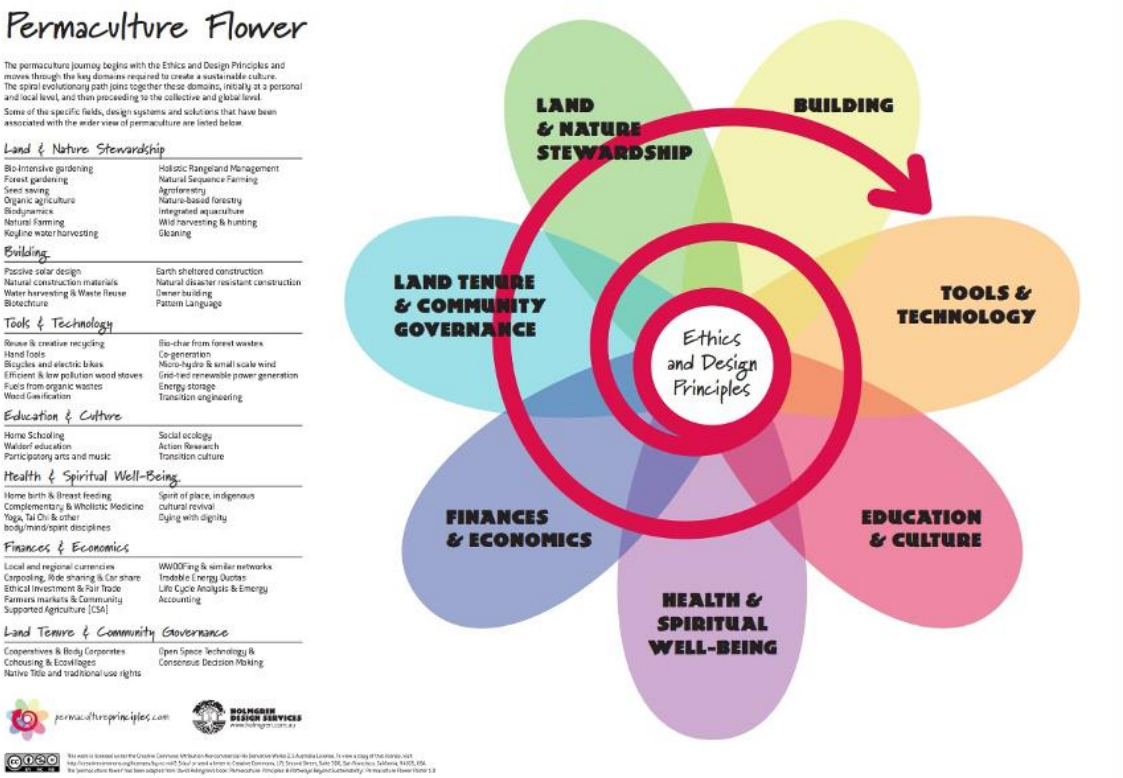

Figure 5: Permaculture Design Principles by Holmgren (2020)

2.8 Walking as situated practice

This section explores how walking enables and encourages being in a place, engaging with it and slowing down. As explored in 2.3.2 above), walking is being deployed in critical interrogations of the data-driven society. As such, this section delves into the practice of walking to provide context for this research and to understand how the practice can contribute.

Two strands of walking related literature exist, according to Bates and Rhys-Taylor (2017, p. 1). The first relates to walking and its relationship to the production of philosophical knowledge, and the second relates to theorising the world through consideration of the everyday pedestrian practices of others. Between these two strands sits the work of Walter Benjamin who, drawing upon Baudelaire's "flaneur," who used walking as both a tool to develop and process one's inner thoughts *and* a way of surveying others and the worlds in which they live. This section deals predominantly with the first strand, touching upon the second, which is explored in more depth in 3.4.4.

2.8.1 The Derivé and Pyschogeography

The derivé, developed by the Situationists, was a way in which the city might be experienced through walking and was led by Guy Debord. The practice was explained by Debord (1956) "the study of the precise laws and specific effects of the geographical environment, consciously organised or not, on the emotion and behaviour of individuals." The practice itself was not clearly defined, with chance playing a key role in the routes taken by the "drifters." Debord's closest attempt of defining the structure of the derive states,

> "One or more people during a certain period take a break from their relations, work and usual motives for movement and action. They let themselves be drawn by the attractions of the terrain and the encounters they find there. Chance is a less important factor in this activity than one might think. In this latter regard, ecological science – despite the narrow social space to which it limits itself – provides psychogeography with abundant data."

This new practice was a first attempt toward the development of an urban praxis, and of understanding the city from alternative views, as opposed to those presented officially. A fundamental aim of the Situationists within the city was to engage in playful, reconstructive behaviour. They also presented critiques of the commodified consumer behaviour that became prevalent in the 1950s. Described as a "technique of rapid passage through varied ambiences" based in urban environments, the practice was to be experienced as a playful act that embodies constructive behaviour and awareness of psychogeographical effects, quite different from the

notion of journeys or strolls. It is not an act of leaving point A in order to arrive at point B, with a pre-defined purpose or with clear objectives, but an act of curious exploration.

Walking in the city was also central to De Certeau's *"Practice of Everyday Life"* (1988), in which he talks about urban walking, considering urban walkers to be "practitioners of the city" for the city is made to be walked. He stated (1988, p.45) "A city is a language, a repository of possibilities, and walking is the act of speaking that language, of selecting those possibilities." Just as language limits what can be said, architecture limits where one can walk, but the walker invents other ways to go, "since the crossing, drifting away, or improvisation of walking privilege, transform or abandon spatial elements."

One aim of this research is to understand how we might synthesise or at least bring into balance understandings of place that come from automatic sensing, that are embedded in the data-driven society, and understandings that result from using our own senses. Two key themes represented in literature about walking relate to the notion of situatedness and embodiment which engage with our senses, and to moving through a place as the act of building knowledge.

The practice of walking is deeply sensorial and somatic and is represented across a range of literature and practice-based research, particularly in anthropology, human geography, and place studies. Rose (2017, p.26) refers to walking as "a sensual, multi-sensory and somatic practice which can illicit an emotional understanding of place." In addition to engaging senses, Rose refers to the bodily engagement in walking through a place. Similarly, Edensor (2000, p.82) refers to the "sensual perception" and experience of moving through place, stating,

> "As a geographically and historically located practical knowledge, walking articulates a relationship between pedestrian and place, a relationship which is a complex imbrication of the material organisation and shape of the landscape, its symbolic meaning, and the ongoing sensual perception and experience of moving through place."

Ingold (2011) also talks about "senses", this time relating to touch, stating "… it is surely through our feet, in contact with the ground (albeit mediated through footwear) that we are the most fundamentally and continually "in touch" with our surroundings" (Ingold, 2011). Clearly the sensory experience of walking is important and offers a counterpoint to the nature of automatic sensing of data. The engagement between senses and the environments we move through also inform our notion of "being" in the world. Csordas (1994) suggests that "the body is the means through which we experience and feel the world; the senses act to inform presence and engagement to constitute a "being in the world." This view further highlights the ways in which walking offers a whole-body experience of place, which can build situated knowledge.

Walking is also referred to as being "embodied." In their work on data walking, van Es and de Lange (2020) refer to walking as "embodied, situated and generative." Benesch and Specq

(2016, pp.v-ix) specifically refer to this, stating "While walking body and mind join to interact with the environment, and to provide a panoply of ways – intellectual, emotional, bodily – to "take in" and make sense of the world "out there."

The creation and building of knowledge through walking is also of significance here. Ingold (2011, p.149) states that,

> "By becoming knowledgeable I mean that knowledge is grown along the myriad paths we take as we make our ways through the world in the course of everyday activities, rather than assembled from information obtained from numerous fixed locations. Thus, it is by walking along from place to place, and not by building up from local particulars, that we come to know what we do … It is therefore critical to the relation between bodily movement and the formation of knowledge."

The idea that gaining knowledge and understanding through a landscape that moves, rather than through a series of static viewpoints, is articulated by Rendell (2006, p.188) who states "Walking along … provides a way of understanding sites in flux … When we walk, we encounter sites in motion and in relation to one another, suggesting that things seem different depending on whether we are "coming to" or "going from." Pink (2010) refers to learning through walking, stating that "we cannot but learn and come to know in new ways as we walk." One of the challenges inherent in the practice of walking is understanding the extent to which people learn or build knowledge as they walk, as measuring or quantifying this creates tensions and undermines the sensorial and contingent nature of the practice.

The act of walking is and always has been mediated (Laurier et al. 2016). Wandering around the city or hiking in the mountains requires basic technologies such as adequate footwear, backpacks, maps, and a compass. Digital technologies have also become woven into the practice of walking, with GPS (Global Positioning Systems) devices, mobile devices, and fitness trackers playing a role in route planning or tracking, thereby bringing this mode of movement into the quantified self-paradigm. Wherever we travel we now leave digital traces.

The bringing together of walking and data, as highlighted in 2.3.2 (above) is one example of how the interrogation of technologies we encounter in the places we inhabit is occurring.

Ingold (2011, p.149) suggests that city dwellers walking through a place leave no traces, stating that,

> "People, as they walk the streets, leave no trace of their movements, no record of their having passed by. It is as if they have never been. There is, then, the same detachment, of persons from the ground, that runs … like a leitmotif through the recent history of western societies."

However, one might disagree with this statement in 2021, where it seems virtually impossible to not leave a trace digitally when moving through cities, or indeed non-cities. We leave data-traces; of locations, journeys, whether through GPS trails or logged using smart travel cards, photographs taken and stored, "check ins" on social media, SMS messages, calls, chats, emails, or location logs collected through mobile applications. However, unlike physical traces, the data traces are invisible to us, collected through devices we carry, or through the systems we pass through, then stored and shared, often thousands of miles away.

Walking is rather akin to putting your hand in flowing water: you can never do it the exact same way twice because of the variables (time, weather, mood etc.), which are contingent. It is these relative and situated qualities that make this act so rich for exploring data. However, as explored further in Chapter 3 (3.4.6), walking also presents some challenges.

This section introduced walking as a situated practice and presented a range of literature that explores how this practice engages with place and builds knowledge. The following section brings this together with the practice of design and explores existing practices that explore data in this way.

2.9 Making Maps

Maps have long since been used as tools for making sense of the world, enabling people across cultures to understand a universal visual language. Therefore, the practice of mapmaking is explored here as one of the fundamental tools used by humans to understand place.

Maps are embedded within a history of practice that has encouraged colonisation and the exercising of power (Monmonier, 1996; Dodge et al. 2001; Corner, 2002; Harley, 1988a). However, maps also have the power to uncover, "maps make the invisible visible" (Jacob, 1996) and while they may not organise society in a hierarchical manner, they do reveal power structures and the organisation of society (Corner, 2002). The act of map making can be creative (Corner, 2002) and used as a tool of discovery, anarchy, and artistic expression (Crampton and Krygier, 2006; Collective and Dalton, 2012; Pinder, 2005).

Cartographers have traditionally been experts; creating maps for people as unquestioned territory. However, maps are never value free and so they instil in maps their own biases and world views (Harley, 1988). Maps are also universal and whilst the Western tradition has been to map tangible territories, other traditions have mapped more abstract phenomena, such as the Tibetan tradition of spiritual mapping (Jacob, 1996). They are also culturally specific and primarily communicate in visual significations; "a striking feature of a map is the way it carries many layers of signification" (Jacob, 1996). However, making maps is no longer the domain of the cartographer or geographer, with the rise in technologies that enable GPS logging, where all that needs to be done is pressing "start" on a mobile device

application and our movements are recorded. However, mapping movements and traces is not map making in its purer form, as the territory is already provided in digital format. Traces are not maps, but data now is often placed on maps automatically, as a black box process. Maps are no longer just the province of geographers; many new and previously inaccessible physical domains are being mapped, while many "known" territories are being re-explored and mapped all over again in novel ways (Hall, 2004, p.17).

Monmonier critiques the rise of personal computers being used for map making, as far back as 1991. He suggests that making maps became too easy as a result of "user friendly" mapping software and that we should be wary of the "hacker-cartographers" who might manipulate data visualisation either through error or furthering of their own agendas (Monmonier, 1991 p.123-124).

We all make our own personal maps, whether we make them into tangible objects or not. We might do it unknowingly, forgetting to turn off GPS applications on our phone, so that our movements are recorded as we move, or enable apps to know our location at all times, making our movements visible to unknown people, often for unknown reasons. That data trail is removed from sight, enclosed in black boxes, where our personal maps are beyond our view.

2.9.1 Community mapping

The field of community cartography is not a clearly defined methodology but demonstrates the potential of maps to uncover previously hidden realities and information through collective acts. It is described as "local mapping, produced collaboratively, by local people and often incorporating alternative local knowledge" (Perkins, 2007). Map making was, until recently, seen largely as a practice carried out by experts; individuals rarely made maps even though they used them. However, all human beings can make maps and have natural map making abilities (Blaut, 2003). With the development of technologies such as GIS (Geospatial Information Systems) over the last few decades, map making has started to become democratised. It is considered that people now have their own tools to make maps (Perkins, 2003), leading to an egalitarianism in map making.

A notable example of community map making was the "*Parish Maps Project*" (Common Ground, n.d) the aim of which was to "support local distinctiveness." The website states:

> "Parish Maps are a starting point for local action, they are demonstrative, subjective statements made by and for a community, exploring and showing what it cares about in its locality. They offer a way of communicating creatively and socially how rich everyday places are, and what importance seemingly ordinary things have to everyone. All kinds of people old and young, from varied cultural backgrounds, by sharing their

> ideas and knowledge, begin to cherish their locality more and often become involved directly in its care. Parish Maps can be made by anyone, in any way, of any place."

Through creating maps with local people, the aim of the Parish Map Project was to gather knowledge relating to the local area, ostensibly through its culture. The explanation above implicitly describes a way in which mapping enables a plurality of values and subjective experiences of place to be represented cartographically. As visual artefacts the maps were generally representations of important places, rather than more abstract representations of values or experience of place, nevertheless they provide an interesting insight into how collective cartographies can be created. Perkins does point out that, as with many mapping processes, dominant voices came to the fore, with many maps created by local groups, taking their representation from the point of view of that group, such as a Historical Society. The project was "predominantly English, quintessentially local, invariably defined by the largely backwards-looking spatial frame of the ecclesiastical parish and, despite the initial wishes of Common Ground, mainly rural" (Perkins, 2007). This mapping project might not be considered "radical" and did not uncover any political or value-based abstractions but is worth considering in terms of communal actions and participatory methods of cartographic practice.

2.9.2 Locative Media

Understanding place has also developed through the use of digital technologies that enable mapping through the use of GPS (Global Positioning Systems) and devices including mobile phones and laptops. This area is of interest for this research, as it offers possible ways forward to incorporate both that which is digital and the analogue, whilst enabling an interrogation of place and the data encountered therein. Locative media has been adopted by artists, who have used GPS systems to interrogate how people move around and experience places. Described by Hemment (2006) as "art of mobile and wireless systems", the rise of locative media "signals a convergence of geographical and data space that comes about as soon as computing becomes mobile or ambient, reversing the trend toward the view of digital content as placeless." The Urban Tapestries project by Proboscis (Lane et al. 2005) sought to understand how people "inhabit urban space once the physical topography of the city could be overlaid with an invisible data landscape accessed by mobile devices." This merging of the geographical and the digital to interrogate space explored a person-centred approach to map and share local knowledge and experience in particular locations, with the project led by a cultural organisation, rather than being solely tech-focussed. The aim of the project was to explore how "the convergence of geographic information systems with mobile technologies could be harnessed to create new opportunities for individuals and communities to share their knowledge, memories and experiences of the places they live and work in" (Proboscis, 2005).

The results were used to inform policy locally, based on two prototypes built in London during 2003-2004. As with Lefebvre's approach to space (discussed above in 2.6.2), Proboscis challenge the "abstract and conceptual Cartesian division of location into the grid of longitude and latitude, and the subjective, negotiated social spaces of lived experience" (Lane et al. 2005). This rejection highlights the potential for bringing together lived experience that is interrogated through place, in this case using mobile technologies to do so.

The integration of people's emotional responses to a place, that brings together different forms of understanding, was explored in the Biomapping project (Nold, 2004). Nold describes the project as "a critical reaction towards the currently dominant concept of pervasive technology, which aims for computer "intelligence" to be integrated everywhere, including our everyday lives and even bodies" (p.3). The Bio Mapping device built by Nold is a portable and wearable tool that records data from two technologies: a biometric sensor that measures skin response, similar to a lie detector, and a GPS sensor. The purpose of the device was to measure the emotional response to a particular location, which then sent the data to Google Earth (or other mapping technologies) to visualise it. This mapping of personal data onto maps highlights and critiques the pervasive and often un-challenged collection of our own data. Nold (2006, p.5) wrote,

> "Bio Mapping functions as a total inversion of the lie-detector, which supposes that the body tells the truth, while we lie with spoken words. With Bio Mapping, people's interpretation … of their own data becomes the true and meaningful record of their experience. Talking about their data in this way, they are generating a new type of knowledge combining the "objective" biometric data and geographical position, with the "subjective story" as a new kind of psychogeography."

This approach to locative media highlights *other* forms of experience of place and can build a picture that uncovers diverse types of meaning. As with the Urban Tapestries project, the Cartesian approach to place is rejected, in favour of uncovering subjective understandings and experiences.

The 34 North 118 West project (Knowlton et al. 2006) used GPS and a tablet pc to take walkers on a journey through downtown Los Angeles. The GPS tracked the walkers' location which determined how the story unfolded, telling tales of the "history and myth of the Railroad to the present day, sounds and voices drift in and out as you walk" (Knowlton et al. 2006). This approach uses storytelling to uncover a place, where the walkers do not contribute to a map or to a body of knowledge but take with them their experience, which changes their own experience and view of a location. Rather than

passively listening to music or podcasts on a device, the walker is engaged in that place, with their experience influenced by whichever route they decide to take.

These approaches to engaging with place offer examples of anti-Cartesian approaches to location, through gathering knowledge, lived experience, and personal data which is then used to interrogate both that place and the underlying developments of using technologies to experience place.

2.10 Design Studies

2.10.1 Cultural Probes

Cultural probes (Gaver et al. 1999, p.22) were used in a project that sought to explore technologies to increase the presence of the elderly in their local communities. The probes are described as being designed "to provoke inspirational responses from elderly people in diverse communities … The probes were part of a strategy of pursuing experimental design in a responsive way" (p.25). Kits included postcards, maps, a camera and photo album and media diary. The materials were sent out to research participants, who were able to engage with the materials as they liked, with no prescriptive directions. This method of gathering data engages directly with experience, with the materials offering creative frameworks for capturing the responses of participants. The authors stated that they could have used more traditional research methods such as ethnography, interviews, or questionnaires, but their rejection of such techniques stemmed from their approach to doing research through design. The authors reflect on their approach to research, taking the position of "artist-designers," and concentrating on aesthetic control, the cultural implications of their designs and ways to open new spaces for design. The artist-designer key approach taken is openly subjective, only partly guided by an "objective" problem statement. Rather than gathering objective, more scientific data the researchers went after what they termed "inspirational data … to stimulate our imaginations rather than define a set of problems … We weren't trying to reach an objective view of the elders' needs through the probes, but instead a more impressionistic account of their beliefs and desires, their aesthetic preferences and cultural concerns" (p.25). This approach of using design in the tools for gathering data is fundamental to this research and guides the design of the specific outputs by the researchers.

The work was inspired by the Situationists, and the derivé in particular, where psychogeographical maps were developed to capture different topologies of the city (this is explored in section 2.9). Gaver et al. (1999) borrowed the technique of the derivé for their cultural probes and they borrowed the Situationist's more general approach of using artistic

strategies to critique what they termed the "Spectacle" which they saw as being an all-encompassing, media fuelled show.

The authors reflect that the probes enabled them to familiarise themselves with the context and sites in which they were researching and to provide a "rich and varied set of materials that both inspired our designs and let us ground them in the detailed textures of the local cultures." They also reflect upon the learning of the elders; in that they enabled the groups to think about their own experiences and to establish conversations with the groups. The cultural probes could be adapted to a wide variety of design projects, but the materials they had designed were specific to that project, the people, and the environments.

This mode of designing for a particular context and that engages with place and diverse types of data is of pertinence to exploring data and place.

2.10.2 Research through Design

Research through Design (RTD) has been described as "practice-based inquiry that generates transferrable knowledge" (Durrant et al. 2017, p.3) and has been used in a range of disciplines, including HCI (Human Computer Interaction). RTD is not a formal, methodological approach, but rather a "foundational concept for approaching inquiry through the *practice* of design" (Durrant et al. 2017). In recent years, the use of RTD has increased in the research community, to explore *how* design can create knowledge. The creation of the RTD conference, where designers and researchers present tangible examples, encourages discursive engagement.

One of the cornerstones of RTD is the practice of research through making, where the insights generated through the process are important, as is the process of reflection on both the process and any artefacts produced. Ingold (discussed in relation to walking in section 2.9, above), attended the RTD 2015 conference, where he gave a provocation based on his work with lines. He fixed lengths of string across the auditorium., and invited delegates to attend to "individual experience and the making of design research in terms of materials and movement." Through manipulating the lengths of string, Ingold highlighted how making things and working materials is "*constitutive* of knowing and understanding" (Durrant et al. 2017, p.5). Through doing so he emphasised how design is fundamentally processual and relational in a practice of "gathering" and transforming materials.

Notions of emergence and explorations are also embedded within RTD. As Blythe (2014) writes, "The work is usually an exploration but if it does not explore then it will: consider, discuss, investigate or reflect." This approach can be seen in the Cultural Probes (Gaver et al. 1999, discussed above), where the materials used to gather data sought to explore ways in which to engage with experiences of research participants and to reflect upon the outcomes.

The production of new knowledge is embedded within RTD, as is the much-cited work by Frayling (2002) of research into, through and for art, that has been re-defined for design by multiple authors. As highlighted above, and with the work of Gaver et al. (1999), the knowledge that is produced might be rich, and take myriad forms.

Within this research, the process of making and thinking, of gathering data through creative means, and through the use of walking, brings together the concept of cultural probes with RTD. The gathering of "inspirational data" is in itself of key importance for this work and sits in opposition to the data that are gathered within the data-driven society.

2.10.3 Design and data

Understanding how design is present within data assemblages, whether implicitly or explicitly embedded, or difficult to identify (for example in the hackathon process), can enable a more reflective and engaged approach in the collection, storage, and re-use of data. By applying design methods or processes within the practices of data, it is possible to bring about a more balanced approach to both quantitative and qualitative data. As we see with the wide array of data visualisations that take quantitative data as their design material, this area has become highly aestheticised.

Design itself, and design research, is an expansive field that has emerged over the last fifty or so years (Cooper, 2019). Whilst it is beyond the scope of this research to offer an in-depth review of how design has become manifest in research and practice, it is important to note that design plays an important role. It has been recognised that design has played a significant role in our understanding of data assemblages (Speed and Oberlander, 2016). Design has also become embedded in the materiality and exploration of data within research, particularly in HCI (Bogers et al.2018), the design of interactive systems (Noortman, 2021) and data visualisation (Kennedy and Hill, 2017).

Designers have explored and made significant contributions to more user-centred design of products and services using data (Speed and Oberlander, 2016). Design becomes important in the development of data collection devices, through to its storage, processing and ultimately the creation of new products and services resulting from that which is collected. Utilising design both to understand and visualise the complexities of data attempts to make sense of the vast amounts we are presented with in our lives. Through making data tangible and visible through products and visualisations, designers and researchers consider data to be a design material (Feinberg, 2017). However, the entanglements and complexities of the ways in which data are produced and situated within our societies offers challenges in understanding our roles in the shaping of data and ensuing designs. Feinberg (2017) offers a framework, situated within the field of HCI (Human Computer Interaction) for "describing our own roles in shaping data",

and explores the role of design in data infrastructure, data collection and data aggregation. It is important to consider the implications of design in these processes, making explicit the potential processes for the role of design. Feinberg asks "What are we doing *to* data when we are doing things *with* it? … When we are defining, collecting, and aggregating data, how are we redesigning it?" (2017). These questions are important to consider, to understand how the entire process, or lifecycle, of data are designed sensitively. For example, vast amounts of data are gathered, often without a clear purpose for how it might be used (Gitelman, 2013). This consideration is echoed by Speed and Oberlander (2016) who recognise that "… designers play a vital role in the design of future systems in which people, things and computers co-exist in the production of data." These complex systems that gather, produce and re-use data in all its forms have significant impact upon our lives, and therefore should be considered carefully. The authors also recognise the lack of consideration as to how the sheer quantity of data can be made sense of through design, stating, (2016, p.1)

> "…whilst the methods for gathering data have grown to reflect research through design approaches, there has been little classification of the kinds of data that we are encountering in an age of big data, nor to frame how we design alongside it."

Based upon insights gained from carrying out a range of design experiments, the Ablative Framework is intended to "recognise how existing and emerging research methods address the increasing performativity of data" (p.9). The framework uses the ablative case in Latin, where an agent, instrument, or source within a relationship is expressed by "by," "with" or "from."

Design **from** data: when systems are designed by people, where they are inspired by measurable features of humans, computers, things, and their contexts. Data are gathered "from" settings before being analysed and used to inform subsequent design decisions.

Design **with** data: when systems are designed by people, where they consider the flows of data through systems, and the need to sustain and enhance human values. Acknowledges that data is not a cold resource to be taken back to the studio for examination, but a condition in which designers should anticipate the disruptive potential that is produced from streams of live data from networked artefacts.

Design **by** data: when systems are designed by other systems, largely autonomously, where new products and services can be synthesised via the data-intensive analysis of existing combinations of humans, computers, things, and contexts. Suggests that as algorithms become faster and better at identifying new opportunities to sustain or add value to products and services, it will not be long before data-driven objects begin to become designers within our lives.

The framework foregrounds a range of situations in which designers might be working "alongside" data, and that each three components of the framework will interact within design research. Based upon the framework, a series of questions have been developed that can form the basis of tools to engage with data.

As it has been noted above, the use of design can enable the foregrounding of relationships within ecosystems of data, and it is important that those designing alongside data, information, knowledge, wisdom, and lived experience develop frameworks, principles and processes that can be shared amongst the design and design research communities.

2.10.4 Further areas of interest

This research is fundamentally cross-disciplinary and, as such, a wide range of literatures are potentially relevant. The following areas of research and practice are of particular interest for future research but are not explored in depth in this particular study; Socially engaged Art, Intangible Cultural Heritage studies, Pervasive Computing, Somatic Design, Digital Civics.

2.11 Expertise and experiential impact on motivations and research aims

As I discussed in Chapter 1. my previous training as a museum curator influenced the journey to this research. This experience and expertise also had a strong influence upon the way in which I approached the literature survey. In pulling together a diverse array of literature from different disciplines to understand the key challenges posed by my research questions, the approach I utilised when curating exhibitions or displays was deployed. By starting with a theme (in the case of exhibitions or displays), or in this case, a research question, I looked for key areas of literature that would enable me to make sense of the issues presented in the research questions (1.8.1). In a sense, this literature survey demonstrates the "curation" of knowledge and a desire to foreground differing types of expertise. In this case, the differing ontological approaches of big data and technological understandings of place which rely upon qualitative data are brought together alongside situated and embodied, qualitative understandings of place. Whilst this approach of synthesizing differing ontologies is challenging in terms of offering a coherent narrative, it was vital in building the foundations of this research. However, as a curator there is a tendency to "neaten" the narrative, to make an exhibition or display and the accompanying texts coherent, whether thematically or chronologically, and this can hide the messiness and complexity of the findings or literature.

My research aims and motivations are fundamentally shaped by my desire to bring together a wide range of understandings in exploring a particular theme or issue, as one might approach curating an exhibition or display. As what some might call a "generalist" curator, my driving

motivation was to bring together differing understandings of history, or of art, and to present this to a range of audiences. However, as a researcher, I now gather "knowledge" or "experience" from a range of sources. In the case of this research, I have gathered literatures, data from interviews and from walking, from a range of perspectives. I then present those perspectives through the medium of this thesis, rather than an exhibition. The motivation for carrying out my research in this manner is to offer insights that are both interesting and informative, and to engage in balanced debate around a particular issue or research question.

2.12 Chapter Summary

This chapter has sought to address the following research questions

RQ1.1: What do data-driven understandings of place look like in literature and practice?

RQ1.2: What do information, knowledge, wisdom, and lived-experience driven understandings look like in literature and practice?

Weaving together seemingly opposite forms of understanding place, through data-driven and situated understandings, the practices that enable the production of DIKW and new products that mediate our experiences of place is complex. However, the insights produced from this literature survey provides one way of approaching the apparent gap in literature that synthesises and explores how we might bring together DIKW in a place and to not focus solely on either data-driven or non-data-driven modes of understanding place.

This chapter has surveyed literature relating to the data-driven society, highlighting the potential benefits to be found in the quantification of many facets of lives. However, the dominance of this approach in the discourses of understanding place, which tend to be prioritised over more qualitative knowledge systems (2.5) should be considered critically. New tools and methodologies can make contributions in this area. Issues relating to the exclusion of diverse groups from the data-driven society were also established. By bringing these issues to the fore and exploring possible ways of ensuring the barriers are removed, a wider section of society will be able to get involved in not only using data, but in collecting and contributing their own.

The calls for more critical approaches to the data-driven society have been answered by the development of Critical Data Studies, and by research and practices that engage in place and data assemblages, such as the Data in Place project and data walking. However, these methodologies and tools are still nascent and require development.

Place is explored here to understand how different conceptualisations rely upon different "types" of knowing and experiencing. As highlighted above, the notion of place is "unfixed,

contested, and multiple" (Massey, 2008) and layers created in place result in what Cresswell (2004, p.72) describes as "the layering of histories which sediment in place and become the bedrock for future action." By seeing place through data alone, the potential for these rich, moving, and contingent understandings is removed.

Foregrounding definitions of data, information, knowledge, wisdom and lived experience is not a simple task, as there are many competing understandings and disciplines to contend with. However, by exploring how these methods of understanding might be brought together there are opportunities to find balances between the data- and non-data driven modes of experiencing and being in place. Whilst critical approaches to data are becoming more commonplace, we need to consider the place for wisdom in our data-driven societies. There appears to be less literature that suggests it is possible to find a balance between data, information, knowledge, and wisdom, not forgetting the importance of lived-experience, in our understandings of place. Both Ackoff (1989) and Mulgan (2021) talk about the lack of wisdom in our societies, and the surge of information and noise that might drown it out. The literature presented in this chapter suggests that by approaching this facet of datafication, and its impact upon the way in which we make sense of our spaces and places in a critical, yet curious manner, there is a course to be charted that is realistic, pragmatic, and hopeful.

By exploring practices which use data (hackathons), the chapter highlighted key issues and benefits of these events, which revolve around the format of the event, issues with design methods used (or not used), and participation by a limited range of people. However, those events that engage with philanthropic issues or wider society issues and have a clear focus do have the potential to ensure data are used more equitably and have a greater impact on the wider world beyond the hackathon.

The data walk, which interrogates data in place, is an example of a practice that engages with place and enables a collective opportunity to explore data with others. However, at present there are few guidelines or principles that enable a wider audience than academics to develop walks. Whilst a singular methodology might constrain the practice and remove the creative and engaging nature of the walks, a range of methods, described by van Es and de Lange (2020) as "modular" would be of use to developing this method further and engaging with wider participants.

Exploring and embedding the notion of situatedness in this research offers a counterpoint to the prevalence of "objective" understandings of place gathered through and mediated by data-driven technologies. By using the term "situated" or "situatedness" within this research, attention is paid to the wider contexts not only in which DIKW are gathered, but also to those who are doing the gathering and re-using.

A dichotomy between situated knowledge systems, which embody non-positivist modes of understanding and utilise qualitative knowledge, and the positivist modes of understanding, was identified in the literature relating to TEK and Local Knowledge. The tendency has been for the consideration of TEK to be seen as an "alternative" to Western knowledge systems, which might be considered romantic and perhaps outdated. This binary either/or, where we either go all-in and place our trust in the data-driven or eschew this in favour of more traditional ways of knowing, is not necessary. Both approaches bring with them opportunities and challenges, as explored in this chapter. Seeing them in synthesis rather than in opposition offers opportunities for innovative and more rounded ecologies of DIKW in place, by bringing together heterogeneous understandings and lived experience of place. This synthesised approach also brings with it challenges, in terms of bringing together two fundamentally opposing epistemologies, that of bringing Western science and positivism together with non-Western subjective and situated approaches. It is important to consider both ways of understanding as complementary, rather than either/or, as Wall-Kimmerer (2017) explores through embedding TEK in biology.

With all of this data, and the complex inter-relationships and entanglements between data, information, knowledge, wisdom, lived experience, people and place, it is important to consider how the systems that collect it all and re-use it are designed thoughtfully and equitably. Design has been explored in relation to data, predominantly in HCI and through data visualisations. However, there is still more work to be done in the development of tools and processes in this field. Frameworks such as Speed and Oberlander's *Ablative Framework* (2016) offer excellent starting points for these tools to develop, which can help designers to understand how they might create products and services.

This chapter has highlighted the complex challenges we face in making sense of the data-driven society and attempting to ensure that we maintain more situated modes of understanding the places which we inhabit. While data offers opportunities to gather and process vast amounts of insights, it is vital that we think about the practices that surround the data-driven society and how we might support and synthesise, through designing new practices, situated modes of understanding place.

3 Methodology

This chapter presents the methodology adopted and methods used during each stage of the research.

This research was carried out as part of the Highwire Doctoral Training Centre (DTC), funded by the EPSRC (Engineering and Physical Sciences Research Council), under the Digital Economy theme. The DTC was fundamentally cross-disciplinary, with PhD candidates carrying out research across management, design, and computing (two of which were chosen). The very nature of working across disciplines shaped this research profoundly. The intersections between computing, in particular the ways in which data proliferate our lives, and the design of practices, products, and systems in collecting, storing, and re-using data both offered potential for engaging cross-disciplinary research. Navigating the course of cross-disciplinary research has afforded opportunities to understand and synthesise nascent areas, such as data and walking. One conceptualisation of cross-disciplinary research is, as Wilson (1998) states, "the jumping together of knowledge across disciplines to create a common groundwork of explanation." The promise of this approach is considered to be that it "… provides an answer regarding how to address the most complex problems that our globalised society faces today" (Graham Bertolini et al. 2019). Whilst this approach does offer the potential for synthesising research areas, it can also cause tensions. These might stem from a sense that researchers might engage in more breadth than depth in their work, or the adoption of competing philosophies and methodologies (Aagaard-Hansen, 2007). Some researchers also face issues relating to crossing and entering academic silos (Lindgreen et al.2020), which can place limitations upon the progress of a solo researcher. Fortunately, the culture within the Highwire programme and academic staff involved in the three faculties and disciplines were open to working across disciplines and this approach was fostered in this research. Bringing together computing (in this case specifically exploring the wider societal implications of data science), and design was not a challenging task pragmatically, as they share cross-disciplinary research areas such as Human Computer Interaction (HCI) and the design of interactive systems, to name but two.

3.1 Research approach

Selecting research methodologies across disciplines can also be challenging, or bewildering, with a wide array to choose from (Crotty, 2014). Setting out on this research and crossing boundaries felt as though it was an exploration, or as Pullin (2015, p.60) suggests, "a journey into the unknown, or not-yet-known." I found Moses and Knutsen's (2007) definition of methodology as "a bridge that connects the research problem with the research method" to be

valuable in developing a picture of the research I would carry out. An exploration of the "research problem" was carried out initially through an initial literature survey relating to how we gather and use data to understand the places in which we live. This eventually led to the identification of the "research problem" and the initial research question:

Q1: How might data, information, wisdom, knowledge, and lived experience be woven together to develop situated, engaging, and balanced understandings of the places we inhabit in our data-driven society?

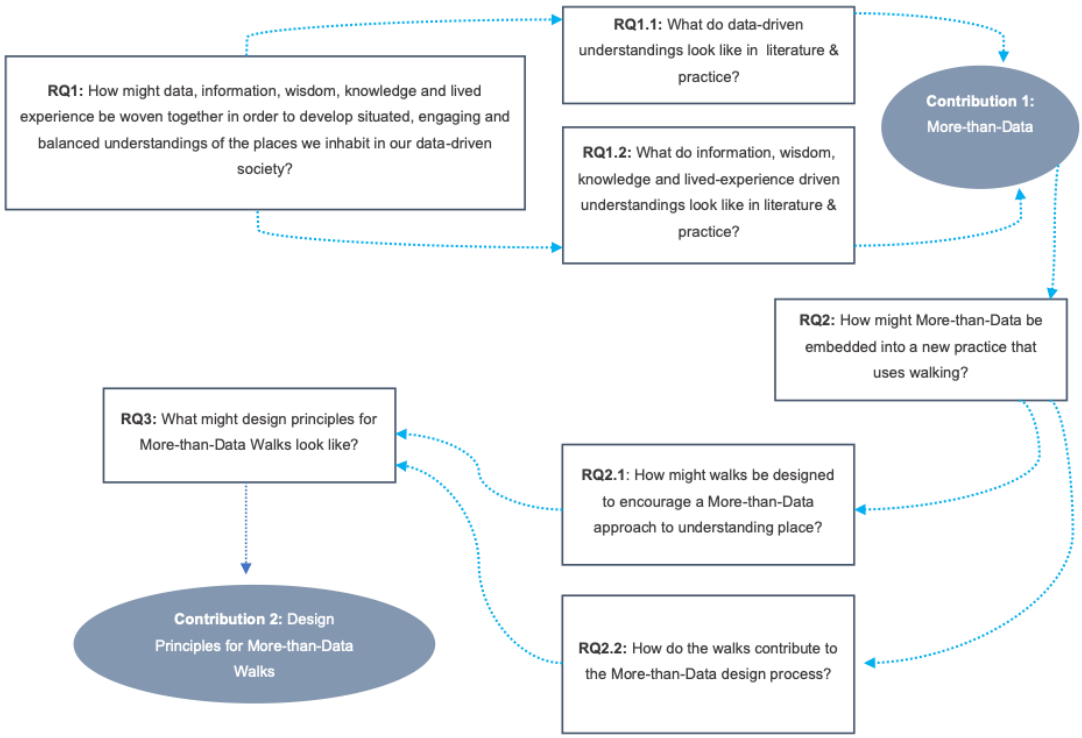

Figure 6: Research question development, showing points at which contributions emerged

3.1.1 How my expertise and experience informed the research

As outlined in section 3, my research took place in the Highwire Doctoral Training Centre. Through working in museums, I had accrued experience of curating a wide range of artefacts, displays and exhibitions, and the process of carrying out the research was always the most satisfying part for me. However, working in a local government museum meant becoming more of a building manager, responsible for facilities as well as exhibitions. After completing my MA in Museum Studies, I wanted to gain experience and put into practice what I had learned, but I also had ambitions to return to university to complete a PhD. I thought my

doctoral research would be situated in the context of museums, and as my career as a curator progressed, I became interested in the intersection of modern technologies and curatorship. During the latter part of my curating career, I began thinking more about how modern technologies were being deployed in museums and heritage. My own practice had moved towards using technologies such as 3D scanning and printing to enable greater access to built heritage (e.g., historic houses) and museum collections, as well as exploring how the early manifestation of virtual reality might be employed in museums and historic environments. Within the confines of my role at the time, this exploration was not possible and, combined with pressures on local authority museums and impending redundancies, I took the decision to take a short career break to look for PhD opportunities.

I came across the Highwire programme through a contact and initially did not think the programme would be suitable for me. My background did not include management, design, or computing, although my curatorial practice had started engaging with emerging heritage technologies. A conversation with the programme director, during which I was encouraged to put together a proposal around the use of digital technologies in museums, led to me applying to the programme. The combination of computing (encompassing a diverse range of approaches from HCI through to data science) and design (in particular design research as an approach) attracted me to the programme. Whilst I did not have experience in these fields, the 1 + 3 model, which included an MRes (Master of Research) in the first year, would enable me to take a deep dive into the three disciplines. Thrown into a new world of academia, which had changed significantly since the completion of my MA over a decade earlier, I was out of my comfort zone and surrounded by a cohort with a wide range of experiences and skills.

The immersion into the disciplines of computing and design enabled me to begin to think critically about the use of technologies, beginning in museums, but then widening to their societal impacts. My original proposal which planned to explore the potential for digital technologies in the design of virtual museums was of interest, but I quickly became interested in the more critical aspects of computing and the ways in which design could make the tensions in this area tangible. Furthermore, by developing practice-based research, the programme would enable me to explore cross-disciplinary research in new areas. Whilst my expertise in art history, practice, and museum studies did not at first seem relevant to the programme, I discovered that my *approach* to research that had been formed through this experience fit well within Highwire. The support offered during the programme also enabled me to find my way through new areas of research; with the freedom to explore, but a scaffolding of support provided by my supervisors, fellow cohort members, and researchers across design and computing.

My background as a curator and art historian enabled me to bring together and synthesise knowledge and approaches, as this was a core skill of putting together exhibitions and displays.

As a museum "generalist," I was able to assimilate a range of materials across different formats, including historic artefacts, narratives, and exhibitions. This deeply affected my approach to the research I carried out, but it also enabled me to work across disciplines, particularly in computing and in design. I had not previously been encumbered by disciplinary silos, and I feel this was a strength as I set out on my research journey.

3.1.2 Design Research

There is no single definition of design, or of design research, with many definitions being suggested over many decades and often being contradictory (Frankel and Racine, 2010; Saikaly, 2005). Several key understandings of design still resonate today, particularly those articulated by Simon (1969) who referred to design as an act which transferred a current situation into a preferred one, or Cross (1982, 2001) who refers to "designerly ways of knowing." Design has also been conceived of as a "third order," which is concerned with "the making and doing aspects of human activity" (Archer, 1979). Frankel and Racine (2010) offer a definition of design in their review of design research, as "an activity for planning and implementing new products, which includes the by-products of the processes involved such as drawings, models, plans, or manufactured objects." A deep dive into the history and development of design research is beyond the scope of this research. There are useful reviews which bring together and explore the history of design research (Cooper, 2019; Cross, 2001; Frankel and Racine, 2010) and build upon previous overviews of the development of the field by Archer (1995), Buchanan (2001), Cross (2001) and Frayling (1993), amongst others.

As design moved away from the notion of a "design science" (Cross, 2001), practitioners such as Alexander (1982) and Schön (1983) called for a more reflective approach. Of this, Schön (1983, p.68) stated

> "… practitioners themselves often reveal a capacity for reflection on their intuitive knowing in the midst of action and sometimes use this capacity to cope with the unique, uncertain, and conflicted situations of practice."

This notion of reflection highlighted by Schön, combined with the possibility of practitioners to cope with uncertainty within practice, points towards a methodological flexibility within design research, that is key to those who engage with it. Cross (2007) spoke specifically of methods in design research, stating that method "may be vital to the practice of science … but not to the practice of design (where results do not have to be repeatable, and in most cases, must not be repeated, or copied." Furthermore Cross (1999) presents a taxonomy of design research based on the focus of the investigation, not solely on the method of research. To Cross, it is knowledge that resides in people, processes or products that is key.

It is within the context of design research that this research sits, with an embedded model of reflection and action. More specifically, the research is carried out using Research *through* Design, which is explored further in Section 3.2.2 (below).

3.1.3 A practice-based approach

Practice-led research is not confined to one primary discipline and has been defined as "research in which the professional and/or creative practices of art, design or architecture play an instrumental part in an inquiry" (Mottram and Rust, 2007). Methodological approaches in practice-led inquiry are heterogeneous, with no one prescribed approach (Mottram and Rust, 2007). Glanville (2015, p.14) distinguishes between theory and practice stating "… theory is created by an observer standing outside the system to describe it, while practice, being something done, necessarily involves the observer acting within (as part of) the system." Saikaly (2005) refers to the "practice-based" approach to design research, where the development of design projects was considered "not as the objective of the research, but as an integral part of the process." Furthermore, flexibility is central to this approach, where a "path of discovery through design practice was followed in seeking new understanding." Practice-based design research, according to Sangiorgi and Scott (2015, p.115) "uses design projects as a research strategy to enable exploratory investigations of indeterminate … research problems or multivariate … situations where specific research questions emerge only as the practice work develops." The notion of practice-based research being exploratory is recognised by Durling et al. (2002), who state it is "a study where practice is used as an interrogative process."

Within this research, practice plays a significant role in the research, through designing and carrying out the five walks, in addition to producing a range of tools and materials used within them. Within this research the "something done" constitutes the walks, through designing them and taking part in them. Furthermore, the research process was both exploratory (Sangiorgi and Scott, 2015), in trying to understand how walks could be designed and the thematic explorations of data, information, knowledge, and wisdom in place; and interrogative (Durling et al.2002).

The research process was split into two key phases of data collection, the first being carried out through a survey of literature and interviews (3.4.1), the second through designing and carrying out five walks (3.4.4). This dual approach was selected as interviews offered a method through which to engage with people and understand their lived experience as relating to different practices and places, which could feed into and offer a framework for designing the walks. When designing the research at the start of the PhD process, having arrived at the idea of exploring how we might design more balanced understandings of place, the concept of walking both as a method of data collection as a process through which a series of principles

could be developed was adopted. Whilst it would have been possible to develop design principles based upon insights developed through literature and interviews, carrying out walks and exploring a practice-based approach enabled me to gain insights not only into the relationships between data and place, but also in understanding how to design and carry out walks. A practice-based approach, where I went on walks *with* people felt like the most engaging both as a researcher and potentially for participants. It was also important that I carried out a series of walks, to enable me to learn through reflection and explore a range of locations, themes and engage diverse groups of participants.

3.2 Methodology: Action Research or Research through Design

When carrying out practice-based research, the two methodologies of Action Research and Research through Design both offer opportunities for engaging in reflective, cyclical processes. Both methodologies deal with the production of knowledge through qualitative research processes and can encompass a wide range of data collection and synthesis methods (Bradbury, 2015; Swann, 2002). For the purpose of this research, it was important to engage with both methodologies in order to ensure the best fit. However, as I discovered during the research, both offered a rich array of opportunities for gathering and analysing the data I would collect. The following two sub-sections explore both methodologies and their opportunities and challenges for this research. They are then followed by a rationale of how and why the eventual methodology was selected and then applied in this research.

3.2.1 Action Research

Action Research (AR) is a methodology, or a "call to inquiry" (Reason and Bradbury, 2007, p.1), that is embedded within social science research and has developed since its original incarnation as described by Lewin (1946) when it was a challenge to the positivist world views that dominated research around that time (Brydon-Miller et al.2003). The challenge was to the approach of positivist research that research ought to be neutral and value free; Action Research sought instead to "embrace the notion of knowledge as socially constructed, ... recognizing that all research is embedded within a system of values and promotes some model of human interaction" (Brydon-Miller et al.2003). The methodology considers the whole complex ecosystem in which the research is placed, rather than focussing upon a single variable, and considers experimentation within the realm of the "real" world, in opposition to the natural sciences (Gray, 2009, p.313).

The methodology has a complex history due to its cross-disciplinary nature that has emerged from a wide range of fields, including both research and practice (Brydon-Miller et al. 2003) and, as such, comprises a wide array of methods. AR traditionally placed the researcher "in

charge" of the research (Chisholm and Elden, 1993), but its development since has placed greater emphasis upon the participatory nature of AR (Reason and Bradbury, 2007). Furthermore, AR seeks to research *with*, rather than *on* people and is a democratic and pragmatic family of research approaches (Bradbury, 2015, p.1; Coghlan and Brydon-Miller, 2014; Reason and Bradbury, 2007). Through engaging theory and practice, action and reflection, AR also seeks to improve situations and to be of service to human flourishing (Reason and Bradbury, 2007, p.1). AR also seeks to attain change and to ask of a situation "What can I do about it?" (Gray, 2009, p.312).

While AR does not have a coherent set of research approaches, strategies or methods, a key heuristic often produced is a variation on the Action Research Cycle. This consists of cycles (see below) with reflection and action being key components. Swann (2002) referring to Kember and Kelly (1993) identifies three criteria that must be met for AR:

1) Its subject matter normally is situated in a social practice that needs to be changed;

2) It is a participatory activity where the researchers work in equitable collaboration;

Zuber-Skerritt (1992) talks about a spiral of cycles of action and research which consist of four major moments: plan, which includes problem analysis and a strategic plan; action, referring to the implementation of the strategic plan; observation, including an evaluation of the action by appropriate methods and techniques; and reflect, which involves reflecting on the result of the evaluation and on the whole action and research process, which may lead to the identification of new problems and to a new cycle (as can been seen in Figure 7, p.80).

Reason and Bradbury (2007) also talk of a cycle of "action and reflection: in action phases coresearchers test practices and gather evidence; in reflection stages they make sense together and plan further actions." Like the AR cycle taken from Gray (2009), Swann's conceptualisation of the cycle is similar, and the author draws parallels with the design process of problem/research-analysis-synthesis-evaluation.

AR offers a methodology for this research that seeks change and does so within a particular working in a cycle of reflection, action, and observation. The "action" or "change" that is sought in this research is the re-conceptualisation of data in how we understand place, from the current dominant paradigm to being more balanced with other forms of understanding that are currently under-represented. The vehicle of change is the Design Principles that not only encourage the mobilisation of those currently under-represented and not engaging in the data-driven society, but also to engage physically with a place by walking through it with others.

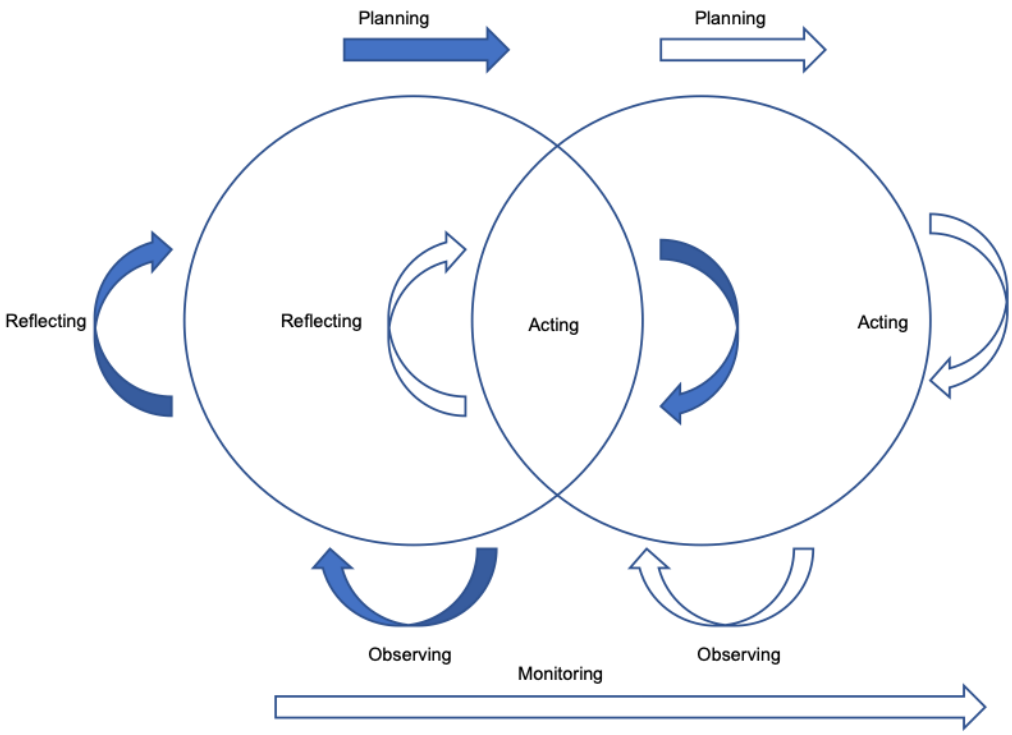

Figure 7: Action Research Cycle (from Gray, 2009)

3.2.2 Research through Design

As with "design" and "design research," there is no one definition of Research through Design. The phrase emerged from Frayling's somewhat ambiguous description of research *into, through* and *for* art and design (Frayling, 1993) and from Archer's "*Research through Practice*" (Archer, 1995). These terms have been the source of much discussion in design research where definitions have been developed and augmented (Frankel and Racine, 2010). Frankel and Racine's paper *"The Complex Field of Research for Design, through Design, and about Design"* (2010) synthesises some of these discussions in the context of Design Research. The authors categorise the three areas into Design Research Strategies of:

Clinical - Research *for* Design: an area which "provides the information, implications, and data that designers can apply to achieve an end-result in their design projects" (Downton, 2003; Forlizzi et al.2009).

Applied – Research *through* Design: The emphasis is on the research objective of creating design knowledge, not the project solution. It may combine a practice-based approach of practitioners with reflection and a research question that explores more than the product being researched (Schneider, 2007). The most important aspect of research through design is that it

seeks to provide an explanation or theory within a broader context, which is referred to by Buchanan as a "Dialectic Strategy" (2007).

Basic – Research *about* Design: Also referred to as "design inquiry" by Buchanan, who considers it to be searching for an explanation "in the experience of designers and those who use products" (2007, p.58) and by Cross (2007) as an area which addresses "the nature of design activity, design behaviour, and design cognition."

The definition I have found to be most useful in exploring RtD is from Blythe (2014), who states,

> "… Research Through Design often describes: an approach, a practice, a process, a framework, a method, or a technique. It is usually developed for: a community, a group, participants or people. It frequently describes: a product, an application, a system, a technology or an interface and these are likely to be – multi-media, smart, new, unexamined or emergent. The work is usually an exploration but if it does not explore then it will: consider, discuss, investigate, or reflect."

Blythe's comments illustrate the movement away from the design of products that has been seen over the last fifty or so years (Cooper, 2019). Storni (2015, p.74) suggests that RtD deals primarily with knowledge, stating "…design plays an essential part, but only in so far as it is instrumental to the study of something else – a resource for the production of new knowledge." The production of new knowledge, primarily through designerly ways of thinking, are key components of the various understandings and definitions of RtD, and it is these which relate to this research, as will be explored more in 3.2.5 (below).

These explanations offer a glimpse into the array of different and often contested notions and attempts to define research *for*, *through* and *about* design. This research does not seek to offer a comprehensive survey of these differing approaches, but instead will explore further the area of research *through* design, or RtD.

Like AR, while there are suggestions that those engaging in RtD share a similar set of values and span paradigms and practices (Edwards, 2019; Gaver, 2012), there is no overarching set of methods or procedures (Zimmerman et al. 2010). Whilst designers and researchers engaging in RtD may not share a defined set of theories and methods, Gaver (2012, p.942) states that "… we already share many of the attributes of a research paradigm and seeking to reduce diversity its cutting edge will just inhibit progress." The lack of methodological standards of RtD has been raised within HCI, with calls for "actionable metrics for bringing rigour in critique of design research" (Forlizzi et al. 2011). This is reminiscent of the emergence of design research in the 1960s and the call for a "design science" (Cross, 2001) and seeks to find a replicable and more objective approach to design. Furthermore, Gaver (2012) points towards

the suggestion from some members of the HCI community that design contributions should be extensible and verifiable (Gaver, 2012). However, this move, which lies in opposition to what Gaver values about RtD, that is, its "ability to continually and creatively challenge status quo thinking" might lead to "self-policing," and to restrictions being placed upon this approach.

The work of Zimmerman et al. (2007; 2010; 2014) locates RtD within the field of Human Computer Interaction (HCI). The definition of RtD used in this context is described as "the process of iteratively designing artefacts as a creative way of investigating what a potential future might be (Zimmerman et al. 2010). Zimmerman et al. (2007) also discuss two forms of design research: "theory for design", i.e., conceptual frameworks, guiding philosophies or design implications and "theory on design", i.e., knowledge on the design process itself. However, tensions arise in discussions around how that theory might be verified, or not. Gaver (2012) states that "… instead of being extensible and verifiable, theory produced by research through design tends to be provisional, contingent and aspirational." In place of verifiable results, RtD, and design practice in general, "embodies designers' judgements about valid ways to address the problems implicit in such situations" (Gaver, 2012). It is not suggested that researchers do not carry out rigorous research, based upon empirical methods and data collection, rather that researchers reflect on the results, which "allow a range of topical, procedural, pragmatic and conceptual insights to be articulated" (Gaver, 2012). As will be discussed in 3.2.5, the methods used in this research embody RtD, and are based upon empirical evidence drawn from literature and from interviews.

3.2.3Parallels between Action Research and Research through Design

AR and RtD have been considered to be similar approaches in recent years (Swann, 2002), with Pollastri (2017) synthesising the two approaches into "Action Research through Design." Drawing parallels to AR and RtD, Pollastri highlights the similarities of the two approaches as follows: AR is context bound, responding to situations in which it is conducted and producing knowledge relevant to that context; AR is participatory, developing a "community of inquiry" (Chisholm and Elden, 1993); values and judgements matter in AR, and it rejects objective, value free approaches to knowledge; methods and theoretical outputs of AR are almost always emergent, resulting from it being impossible to know in advance the exact type of data that will emerge (Dick, 2007). Archer also discusses the relationship between AR and design, describing it as "Action Research: Systematic Investigation through practical action calculated to devise or test new information, ideas, forms or procedures and to produce communicable knowledge." As AR is also context specific, Archer states that the products of the research should exist within and apply for that context, and that the results cannot be generalised (Archer, 1995).

One of the key similarities between RtD and AR is the nature of dealing with or exploring uncertainty. Of design, Swann (2002, p.51) states "Design deals in human interactions with artifacts and situations that contain a great deal of uncertainty." Furthermore, Swann continues that design "derives creative energy from the ambiguities of an intuitive understanding of phenomena." The similarities between the "emergent" nature of the data being collected and the uncertainties inherent in that approach, and the nature of design exploring and engaging with uncertainty forms a key underpinning of this research.

3.2.4 Selection of and tensions between methodology

When selecting a methodology, I felt tension between AR and RtD, in that I have not been trained as a designer, nor was the only output of the research a set of artefacts or other design related products. Furthermore, while I was engaging with participants during the walks, going along with them, and the final output of the research was a set of principles designed to enact change, I felt uneasy adopting AR. One of the key concepts of AR is of enacting change, and of carrying out projects or case studies that explored the same theme or issue (Reason and Bradbury, 2007). However, the walks all explored various locations, with different themes and mostly different participants, which did not seem to sit well within AR. AR and RtD are strongly linked, with the former utilised by design researchers, as well as within other disciplines, to develop design projects and carry out research (Swann, 2002)

One of the key tensions when reflecting upon the best approach for this research lay in the outputs and products of this research, in that the contributions are essentially frameworks; More-than-Data as a framework for gathering data, information, knowledge, wisdom and lived experience, and the Design Principles which set out a loose and adaptable framework for embedding MtD in a practice (in this case walking). The use of walking as both a mode of data gathering (see 3.2.3 and 3.3.2, below), reflection and potentially a design exercise is also novel within the field of Research through Design

Pulling together the different strands of this research, and attempting to bring together two diametrically opposing epistemologies, that of the data-driven society, which is inherently positivist, and more situated understandings which are inherently anti-positivist, was challenging. Working with these opposing epistemologies caused tensions in my methodological approach, which I did not resolve through this work, but intend to explore in my future research. My work has been guided by phenomenology, post phenomenology, human geography, technologies, feminism and "more-than-human" modes of understanding the world. These challenging strands permeate my research through wanting to understand people's experiences of the world, as opposed to abstract meanings and conceptualisations. The realm of the data-driven society can often be intangible, and as a researcher I struggled to find my way into researching this area. However, once I thought about tangible places, and

how we might extract data, information, knowledge and wisdom from them, this mode of research felt like the correct path.

My work relating to walking, mapping, and understanding what data, information, knowledge, and wisdom is present in people and place has been influenced by human geography. The turn towards the use of phenomenology as expressed by human geographers such as Tuan, Relph and later Massey influenced this research in terms of understandings of place. Their use of phenomenology was fundamentally a reaction against the Euclidian, positivist geography that dealt with space. Tuan (1971) understood phenomenology as the description and clarifying of phenomena, stating he understood the term to mean "a philosophical perspective, one which suspends, in so far that it is possible, the presuppositions and method of official science in order to describe the world as the world of intentionality and meaning." This mode of understanding the world resonates with my own research, which seeks to understand and engage with place through phenomena and people's experiences. Beyond human geography, phenomenology has also been used by philosophers such as Heidegger to explore technology (this sits in a broader realm of the philosophy of technology). This version of phenomenology is contested by the post-phenomenologists who, while influenced by the fundamental concepts of experiencing the world, contest the examination of technology by their predecessors as somewhat abstract. The work of post-phenomenologists, such as Rosenberger and Verbeek (2015) and Ihde (1990, 1993), are situated in the realm of exploring and understanding technologies, which is a vital area of my work. They take the view that work of phenomenologists, in particular Heidegger, in their exploration of technologies was somewhat abstract and romantic (Rosenberger and Verbeek, 2015 p.10). Critiques of post-phenomenology by critical theorists suggest that there is a disregard for the political implication of technology, or "for not coming to terms with the power of technology" (Feenberg, 2009). My research seems to sit between the two, in that I seek to engage with less abstract technologies (as relating to data), but simultaneously bring to the fore political elements of the collection and re-use of data in the world.

Post-structuralism, which is concerned with human beings, the world, and the practice of making and reproducing meanings (Belsey, 2013, p.6) can be seen to be relevant to my research. Where the exploration of the data-driven society is concerned, and my own explorations of data and place, there are similarities with poststructuralism, particularly where meaning of place and data are made explicit. However, whilst I recognise this is one possible theoretical approach my work may draw upon, I did not consider it the best approach to my own research.

The influence of Haraway, particularly the notion of "situated knowledge" (Haraway 1988) locates my work in challenging the objective nature of the data-driven society, that a view from nowhere exists. Also, Haraway's work on the Chthulucene (Haraway, 2016), which

seeks to break down hierarchies between the human and non-human worlds and considering "More-than human" approaches to understanding the world are important in underpinning my own epistemological position. This influenced the development of "More-than Data," to explore how we break down hierarchies between the positivist world view of the data-driven society and that which are situated and embodied in the world.

This tension is messy and highlights the epistemological challenges in carrying out cross-disciplinary research which also seeks to somehow understand two opposing modes of understanding the world. The work of social scientist John Law, and in particular his notion of "messiness" in social science research has influenced my own approach to research (Law, 2004). Therefore, I use the term "weaving" throughout my work, to signify the various ontological and epistemological strands I used to make sense of the world I was exploring. Perhaps though, weaving suggests something more coherent and less "messy" than Law suggests. It did however feel like a suitable metaphor, particularly in understanding that the separate threads, as well as the warp and the weft exist together in a piece of woven cloth, but they remain themselves, whilst ultimately creating something new in the world.

Law (2004, p.2) states that "simple clear descriptions don't work if what they are describing is not itself very coherent." Therefore, offering a simple description of my own methodology is challenging. He also talks about "situated inquiry": "Perhaps we will need to rethink how far whatever it is that we know travels and whether it still makes sense in other locations, and if so how. This would be knowing as situated inquiry" (Law, 2004 p.3). This concept is key to my own research, which sought to take the concept of MtD and explore it in distinct locations, with different participants.

3.2.5 Application of Research through Design

Gaver (2012, p.937) refers to insights from RtD that are developed from results of the design process as being "topical, procedural, pragmatic and conceptual." The insights developed from the walks based upon four key stages of thinking, designing, doing, and reflecting which were then synthesised into the Design Principles, embody Gaver's categories and illustrates where this occurred.

The Design Principles (Chapter 8) are one of the two key contributions of this research and are the culmination of this research. The principles can be a product, or artifact that has been designed. Through the process of cyclical reflection and action and interaction with places and people, the principles can be seen as having a primary function that is "to build an account of practice to be pursued in the future" (Gaver and Martin, 2000). This approach is echoed by Press (1995), who states that "A designed artifact is a researched proposition for changing reality" Gaver (2012) states that manifestos are a form of theory often produced as a part of

RtD practice. He refers to Sengers et al.'s *"Reflective Design"*, in which they suggest that "reflection on unconscious values embedded in computing and practices that it supports can and should be a core principles of technology design." Gaver states that manifestos will describe design practice to illustrate their approach, and theories to justify it, but their primary function is to build an account of a practice to be pursued in the future. Design Principles were chosen over use of the term manifesto purely because they are intended to act as a framework for design. Manifestos are traditionally found in politics (e.g., Marx's Communist Manifesto or political party manifestos), art, and more recently within design. There are examples from within design, with perhaps the most famous being Gropius's Bauhaus Manifesto (Trimingham, 2019), with more recent examples in the fields of ethical design of technologies (Mulvenna et al. 2017), urban design (Appleyard and Jacobs, 2013), sustainable design of technologies (Becker et al. 2015) and the Sustainable Design of the Internet of Things (Stead et al. 2019). Manifestos can be ideological in nature, acting as a published declaration of policies or aims, or a mission statement. It is somewhat difficult to find literature relating to how to design a manifesto, or what the fundamental components or characteristics are.

Design principles are perhaps more clearly defined than the manifesto. The definition embedded within this research defines a design principle as "A fundamental rule or law, derived inductively from extensive experience and/or empirical evidence, which provides design process guidance to increase the chance of reaching a successful solution" (Fu et al. 2015). This definition is suited to the methodology of this research, due to its inductive nature. Inductive research "moves from fragmentary details to a connected view of a situation," which sit in opposition to deductive research, which "begins with a universal view of a situation and works back to the particulars" (Gray, 2013, p.14).

The "actions" in Figure 8 (below, p.88) are speculative and result from the engagement of people with the Design Principles. Through designing the principles, based upon the findings of this work, it is intended that they could be taken and used by a wide range of people. Whilst the scope of this research did not cover the exploration of the Design Principles through use cases, this could form part of the future work based upon this research (9.6).

The vehicle for change lies in the contributions of the research: of More-than-Data, and the Design Principles for More-than-Data Walks. These contributions both have embedded within them the opportunity to envision, conceptualise and materialise, using design, what is currently designated the data-driven society. Current data-driven modes of understanding place do not encourage the assimilation or synthesis of any other forms of understanding, which may take the form of lived experience that encompasses wisdom, information, and knowledge about a place. The purpose of More-than-Data and the Design Principles is to provide a supporting scaffold and set of guiding principles that can encourage a re-balancing of understanding place that does not rely predominantly on the data-driven. Therefore, during this research, I did

change my own perceptions, but did not change an organisation, groups, or individuals. Rather, the outputs of the research, based upon the insights developed throughout, are the vehicle for change in the world. Ideally, the efficacy of these contributions and their actual value would be developed into a longer term and wider research project (this is explored in Future Work, 9.6).

3.3 Ethical Process

All research must be approved by the University's ethics committees. As the research methods and activities developed and emerged throughout the process, I submitted different applications for various stages. The first stage of the research which required approval was the interviews that took place at the hackathon (Appendix 1). A further application was then submitted for the interviews carried out in Todmorden, as the interview location, participants and questions were guided by the literature and the previous hackathon interviews. The walks were applied for through a separate application, with the first two walks being applied for first, and then the Todmorden and Mill Race walks applied for separately. This was done as the participants and locations were both different, and when I applied for the Todmorden walk, I did not anticipate carrying out the Mill Race walk. The applications also included risk assessments as they took place in public places.

3.4 Methods

The following section describes the research methods used in this research and the rationale for these choices. The research methods used in the research were interviews held in two parts, observations, and five walks. Figure 9 (p.94) illustrates where the research methods are located in the development of the research questions, in addition to the type of research data produced through the use of each method.

By using two main research methods of interviewing and walking, the research took a multi-method approach. Mixed-methods tends to refer to the combination of qualitative and quantitative research methods, which can be used to answer a question, or questions (Hesse-Biber, 2014). A multi-method approach, according to Lewis-Beck et al. (2003) entails "the application of two or more sources of data or research methods to the investigation of a research question or to different but highly linked research questions." Whereas mixed methods tend to bring together qualitative and quantitative data, using different data collection techniques, multi methods can consist of qualitative or quantitative data that have been gathered using different data collection techniques.

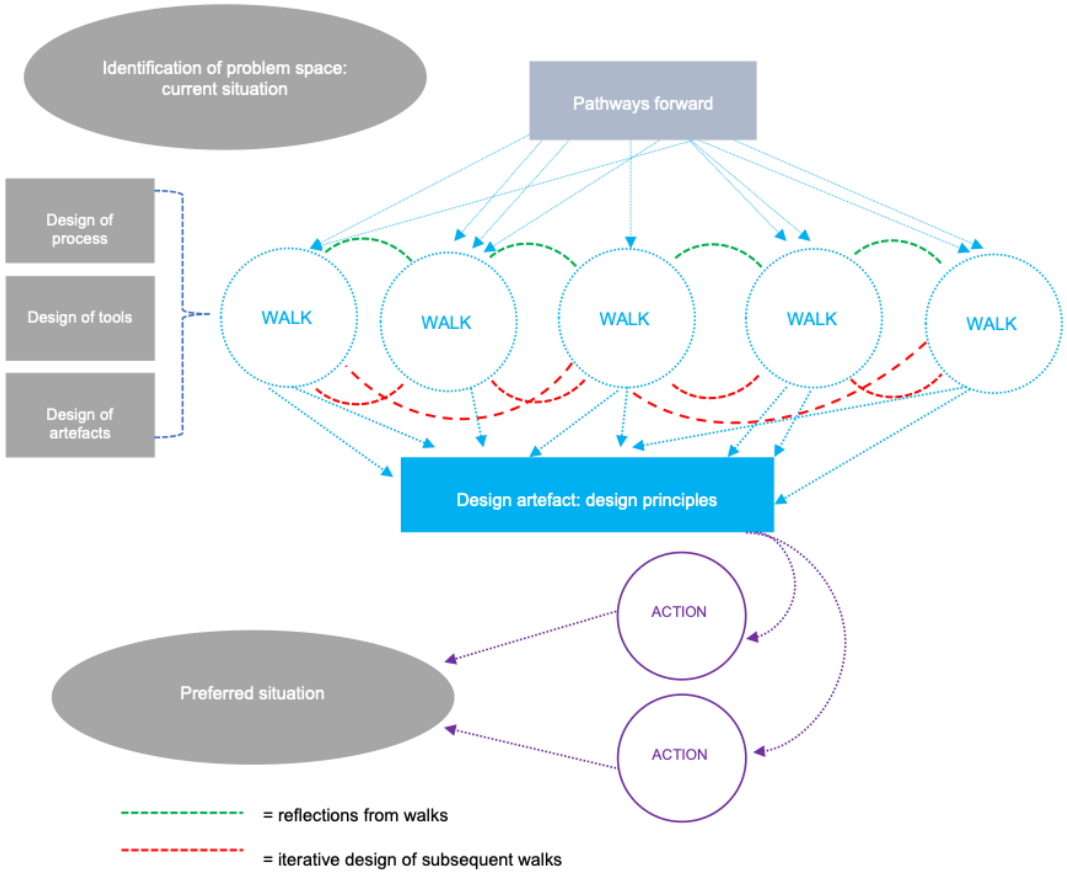

Figure 8: Process of Research through design that has been carried out within this research. The diagram shows the cyclical nature of the walks, with the designed products highlighted to the left

3.4.1 Interviews

Interviews are a common method of qualitative primary data collection (Gray, 2009). This method was chosen for the first exploratory stage of the research as interviews can be useful to examine feelings or attitudes effectively (Gray, 2009). The key purpose of carrying out interviews was to gain insights that augmented the literature survey (Chapter 2) and form the basis of insights that informed the design of the walks. Patton (2015, p.278) states that the purpose of interviewing is "to find out what is in and on a person's mind … to access the perspective of the person being interviewed … to find out from them things that we cannot directly observe." This qualitative mode of data collection is a way of "uncovering and exploring the meanings that underpin people's lives, routines, behaviours, feelings etc.," (Rubin and Rubin, 1995) and of "exploring the stories and perspectives of informants" (Knight and Arksey, 2012). Interviews were chosen over surveys and questionnaires as it was important to engage directly with not only the interviewees, but the places in which they are located. This research explores how data-driven and non-data-driven understandings of place

PHASE	ACTIVITY
Thinking – based on the literature survey and interviews – (topical, procedural, pragmatic)	What are they key themes to be explored?
	How might the walk be carried out?
	Who will be the participants?
	Where will it be carried out?
Designing – (procedural, pragmatic, conceptual)	Developing the theme and designing the plan of the walk based on literature and interviews
	Making the artefacts for the walk
	Designing artefacts for the walk – e.g., wearable maps, maps, cards, prompts
	Designing for the post-walk session
	Designing with the artefacts/MtD gathered
	Presenting the artefacts/MtD gathered – e.g., at the data publics conference
	Designing the design principles – taking the data gathered through literature, interviews, and walks and synthesising it
Doing – (procedural, pragmatic)	Doing the walks – gathering data through fieldnotes and sketches, taking photographs
	Making the post-walk displays and artefacts (film, physical display, Aurasma interactive)
Reflecting – (topical, procedural, pragmatic, and conceptual)	After each walk taking the data gathered and developing insights – for the next walks, and also to embed in the research and in the design principles
	Designing the following walk – based on insights – both theoretical and practical
SYNTHESIS	

Table 2: Phases and activities of the walks

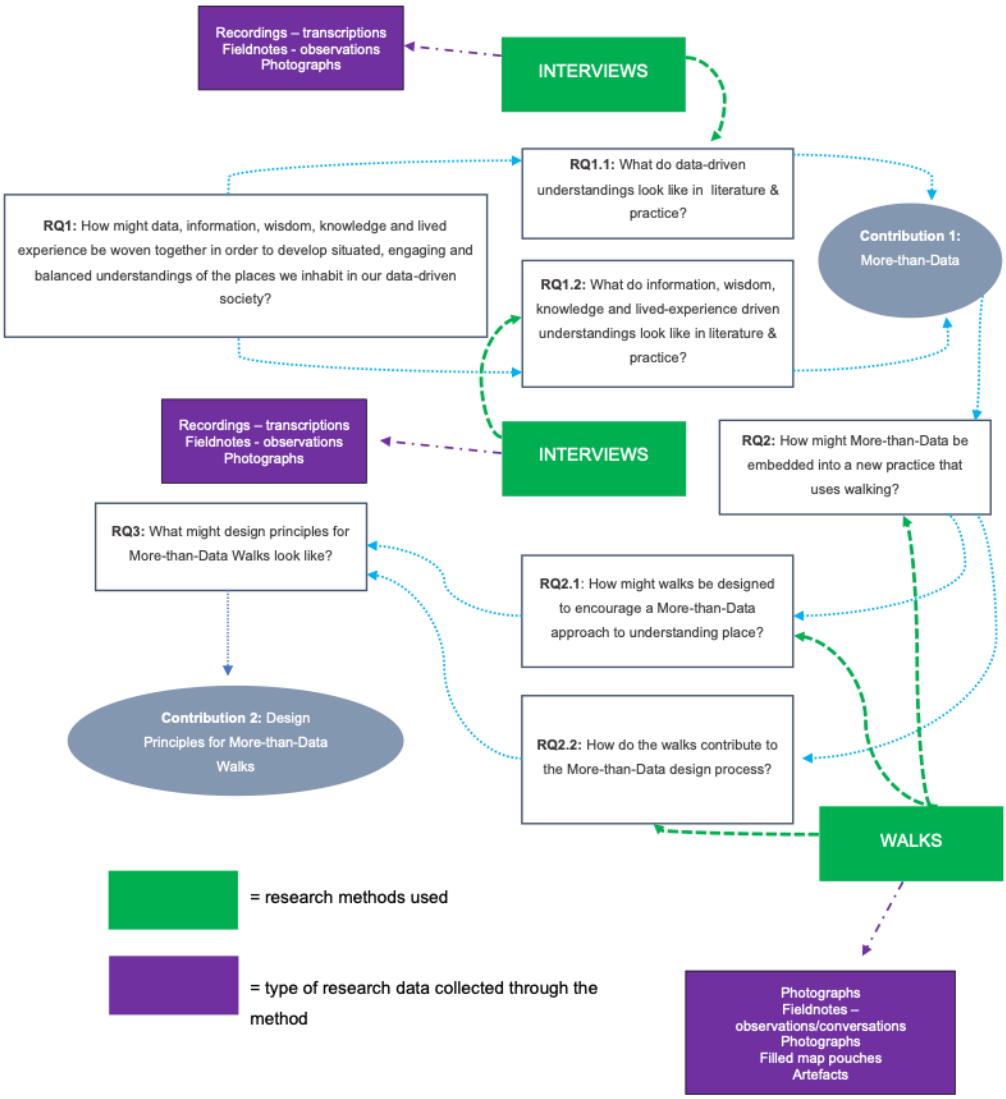

Figure 9: Development of research questions, with method shown in green and the resultant data in purple

might be woven together and therefore the place itself and the practices within which the interviewees place themselves was important in setting the context.

Two sites of practice were chosen that represent contrasting modes of understanding place. The hackathon which is predominantly driven by data represents what might be considered to be a "decontextualised" approach to re-using data, that is not rooted in a particular place. This approach might be considered to take place in a "non-place" and seeks to tackle complex societal issues. In order to complement this decontextualised approach to solving issues, I chose a location where people are using situated knowledges and experience to tackle issues (particularly relating to flooding). Both sets of interviews were situated in the two separate

places, they both took place “in” the locations (the location of the hackathon event, during the event, and in the Calder Valley). It was important that I visit and carry out interviews in the place, so that I could see how participants engage with the place and activities being explored. Furthermore, through being situated in that place myself, I was able to understand the context my own research was taking place in.

The interviews did not seek to be representational of a large population, but rather were a small sample. For the hackathon interviews I used purposive sampling, where the researcher deliberately selects the subjects against one or more traits (Gray, 2009, p.152). The trait was that the interviewees were attending the event, as the questions were designed around their experiences of other hackathons, as well as the current event.

The interviews in the Calder Valley used both purposive and snowball sampling, where the researcher identifies a small number of subjects who, in turn, identify others in the population (Gray, 2009, p.153). I began by meeting IV1 at a Highwire seminar, where he gave a talk about permaculture. He then introduced me to IV2, who owns a farm in the Calder Valley. I met IV3 through exploring community groups who engaged with flooding through natural flood management online and contacting her. IV4 was working in the community outreach centre for the flood charity located in the Calder Valley which I came across when going to interview IV3. IV4 then introduced me to her colleague, IV5. Whilst some of these interviewees seem to have been engaged in a somewhat random manner, they did fit within a specific criterion, which was that they either lived or worked in the Calder Valley and were involved in flooding in some way (reasons for exploring flooding as a theme are explained in Chapter 5).

As illustrated above, the interviews carried out underpinned the whole research process and, in addition to the literature, were referred to throughout the process of the walk design, implementation and reflection processes. Both sets of interviews consisted of semi-structured interviews, which are defined as having main questions and scripts which are fixed, but interviewers can improvise follow-up questions and to explore meanings and areas of interest that emerge (Knight and Arksey, 2012, p.7). The interviews were all partly interviewer-led and partly informant-led, particularly the walk-along interviews carried out in the Calder Valley.

PARTICIPANT	METHOD OF RECRUITMENT
Hackathon event	
All participants	Identification of suitable event carried out by online search. Contact between myself and organiser. Participants of event asked to take part before start of event
Calder Valley	
IV1	Met at seminar at Lancaster University
IV2	Suggested by IV1
IV3	Identified through exploring community groups in the Calder Valley and made contact
IV4	Identified shop where charity was located when visiting town to interview IV3
IV5	Colleague of IV4

Table 3: Interviewee recruitment details

The literature survey dealt with two main fields of enquiry: understandings of place that are predominantly quantitative and data-driven, and those which are more situated and qualitative. As such, the interviews were developed along the same lines, with two separate locations chosen which would enable me to gather data in two comparative areas.

3.4.2 Limitations of interviews

The interviews carried out for the first stage of this research formed the basis of the insights that led to the design of the five walks. One of the key difficulties when conducting qualitative research through interviews, particularly where a small sample is used, is one of reliability and establishing validity. Whilst the two sets of interviews were not intended to offer a representational and generalizable set of findings, it is important to note that reliability and rigour was still an important consideration. As Knight and Arksey (2012, p.54) point out, "the assumptions that underpin qualitative research mean that classic concepts of reliability do not sit very well with this approach." Furthermore, they state that "the quest for situational and conditional understanding is quite different from the quest of positivist social science."

3.4.3 Participant Observation

When designing the walks, a key consideration was whether to audio record conversations between participants. I decided not to do this, concluding rather that observing participants would enable me to collect relevant data for this study. Guest et al. (2017, p.75) state

participant observations are “in some ways both the most natural and the most challenging of qualitative data collection methods.” Direct Observation is used to explicitly “count the frequency and/or intensity of specific behaviours or events or mapping the social composition and action of a particular scene” Guest et al. (2017, p.78). This method was not relevant to my research and so I used Participant Observation which is an interactive and “relatively unstructured” (2017, p.78). Furthermore, Participant Observation is associated with exploratory research. This method is used to gather rich data about how people interact with one another and their environments. This was particularly useful during the walks and felt less invasive than audio or video recording would have done. I was aware that recording participants might change their experience and behaviour, which I did not see as a positive effect.

Whilst observing participants on the walks felt very natural, as I was able to observe what they were collecting, see how they used the tools and hear what they talked about, taking notes and photographs at the same time was sometimes challenging. I also had conversations with participants during the walks about what they were experiencing and gathering. These conversations also helped me to build rapport with participants, which Guest et al. (2017, p77) state allows participants to “be themselves” in front of the researcher. This helped both in terms of engaging with participants and making their experiences positive and building relationships which encouraged them to take part in further walks.

This method provided me with rich data, in the form of field notes (which I wrote during the walks and while reflecting afterwards) about the processes and tools, and experiences of the participants. However, this was also challenging as I was a sole researcher and had to take notes, photographs, and observations which meant sometimes I was not able to participate fully. For the walks where a guide was used, I was able to carry out more detailed observations of the walks.

3.4.4 Walking

When I began the PhD research, I had established walking as a way through which to try and unpick issues and questions that had emerged during the MRes year prior to this. By walking to understand my own thoughts, I began to explore how walking might be used in understanding data and its relationship to place. Attending a seminar by an academic who had started carrying out data walks around that time (Powell, 2019) encouraged the development of embedding walking as a possible practice through to explore the emerging critical approaches to data that I encountered around this time.

When designing the research, I planned to carry out a minimum of three, and a maximum of five walks during the research. This would offer me opportunities to develop the method of

the walks, any tools required, and provide enough data and artefacts to develop suitable findings that would feed into the design principles. The first walk, as discussed in Chapter 6 (6.2.1) acted as an exploratory walk, where I was able to consider and develop how to design walks to be carried out with a range of people in separate locations. In total I carried out five walks, the maximum I anticipated. Through securing some funding for walks 4 and 5 (6.2.4, 6.2.5) I was able to carry them out in locations away from Lancaster (walk 4) and to develop materials and have resources to invite members of the public (walk 5).

Walking is explored in this research in two ways, that are understood by Bates and Rhys-Taylor (2017) (see Chapter 2.8) as a practice through which to engage with and develop philosophical thought, and through which we might observe the pedestrian activities of others. Between these two strands they suggest sits the work of Baudelaire, whose *flaneur* "used walking as both a tool to develop and process one's inner thoughts *and* a way of surveying others and the worlds in which they live." This research sits between the two strands, but in addition to surveying others and the worlds in which they live, I explore the world of data, information, knowledge, wisdom and lived experience, and the relationships to place, as encountered and produced through people.

The use of walking as a research method (WRM) has risen in recent years, and the overarching principle behind this practice is to "observe social or spatial phenomena in a given space using walking practice" (Kowalewski and Bartłomiejski, 2020). The walking interview, or "go-along" has been deployed by researchers as a mode of not only exploring a place, but also specific issues embedded within the person and that location (Carpiano, 2009; Kusenbach, 2003; Rose, 2017). The "go-along" interview is a hybrid of interviewing and participant observation, where the researcher walks with interviewees as they go about their daily lives, asking them questions along the way. Kusenbach (2016) suggests that go-alongs can capture the sometimes hidden or un-noticed habitual relations with place and the environment because it tends to highlight environmental perception, spatial practices, biographies, social architecture, and social realms in the data gathered. One of the key benefits of this method is, as Ingold and Vergunst (2008) suggest, that walking with interviewees "encourages a sense of connection with the environment, which allows researchers to understand how, for example, places are created by the routes people take." "Walking affords an experience of embodiment to the extent that it is grounded in an inherently sociable engagement between self and environment" (Lee, 2006, p. 67). Finlay and Bowman (2017) identify five strengths of the mobile interview method; the ability to produce spatially grounded and place-specific data; to access subtler and more complex meanings of place; to create opportunities for flexible and collaborative conversation with participants in situ; to build rapport and adjust participant-researcher power dynamics, and to effectively produce rich geographical data.

The walking interview is one example of a WRM, and at least four different approaches to walking in the social sciences have been identified by Kowalewski and Bartłomiejski (2020);

1. Walking interview as a separate and rigorous research practice, referring to observable spatial phenomena.
2. A walk itself (i.e., without interview), including geospatial research (GIS), observation, and/or auto-ethnography … walking is used to locate and map the collected data. This approach brings together the positivist gathering of data using technologies, and the nonpositivist act of walking, which is embedded in practices that engage with place and often subvert it (e.g., Benjamin's Flaneur and Debord's Situationists).
3. Research walking as a supporting technique, involving all kinds of common moves of the participant and/or the researcher; using WRMs as a supporting technique for studies into walkability in urban areas, or in the field of pedagogy. This can include the use of visual methodologies/visual ethnography where walking is in support of the data collection, not the primary purpose.
4. Research walking as an artistic, experimental act. Walking research is in this case a sociological performance, introducing new social relations and revealing novel issues to be researched or discussed. The main idea of the project is to explore walking as an interdisciplinary, experimental, and innovative research practice.

Using the four categories above, the walks carried out in this research are a combination of 2, a walk itself and 4, research walking. Data for this research was gathered *about* walking, this fed into the Design Principles which were developed through Chapters 6 and 7; and walking was also carried out to explore issues, and indeed reveal current issues and was cross- rather than interdisciplinary. Springgay and Truman (2019, p.204) point out that "we need to shift from thinking about methods as process of gathering data toward methods as becoming entangled in relations." This was the case in the walks carried out for this research, where the method itself became entangled in the gathering of data in a range of ways, to different themes, a range of participants and places.

3.4.5 Walk recruitment

A range of recruitment methods were used for the walks, that were like those used in the interview recruitment. It was important at the beginning of the research when designing the walks that a range of participants took part, in order to not only gather a range of data to develop the Design Principles, but also to explore and understand the procedural and technical aspects of planning walks. Table 4 details the participants and recruitment methods used. The most challenging recruitment process was that of the public walks (walk 5), which involved

working with the university communications team in writing and sending out press releases to local news outlets.

The walk was also advertised on the university website and social media, all of which gained interest. Places on the public walk were limited, but we could have carried out more with greater resources.

3.4.6 Limitations of the walks

Walking offered an engaging and rich data collection method, which formed the basis of the insights presented in Chapters 6 and 7. The design and carrying out of the walks offered an excellent opportunity to develop research and organisational skills that will be invaluable in my future research career. I did however encounter some limitations, the insights from which will be useful in developing future walks.

One of the key limitations was found in asking people to hand-write on the maps, or on small slips of paper placed within the map pouches. It is challenging to write when walking, even when stopped, without a firm surface to lean on. This issue was tackled in Walk 5 through the provision of hard clipboards, but these were not practical on the earlier walks. When interpreting and transcribing the artefacts from the walks, trying to decipher handwriting produced on-the-go was challenging, and sometimes inferences had to be made as to what participants had written. This issue might be rectified using technology, such as mobile devices, which require typing rather than writing, but as discussed in Chapters 6 and 7, it is not always suitable to use digital technologies during walks. The issue can form part of the future research based upon the work presented here and be explored further, in terms of legibility and design.

A further limitation was that the walks were not recorded and therefore accurate voice recordings were not available. Whilst audio recording is of use and valuable in go-along or walking interviews (Kusenbach, 2003; Rose, 2017), I decided not to record the walks using audio devices. My concern was that the recording of the walks would change the nature of the engagement between the participants and the place. If participants were aware they were being recorded, this could affect their engagement with the tools and prompts they were asked to create during the walks. Recording what participants said and having a record of the conversations was not the main point of the walk, but rather for them to gather and engage with the concept of DIKW and to produce the artefacts that would form the materiality of the walks and the data for the research. Instead of audio recordings, fieldnotes and photographs were taken. It was challenging to achieve a balance between gathering data for the research through observing, and recording participants engagement. One of the key benefits of walking,

WALK	PARTICIPANTS	RECRUITMENT
2	PhD students from DEN project, participants of Tiree Techwave, Tiree residents	Attendees at Techwave invited to take part Tiree residents attended Techwave social event and were invited to take part
3	Academics and students from SCC (School of Computing and Communications) Lancaster Artists, writers, Design academics and PhD students	Email sent to staff and students in SCC Lancaster – invited to bring along other participants Artists & writers were part of wider Ensemble research project and were invited Design academics and PhD students known to researcher and invited
4	Flood charity volunteers, natural flood management specialist, permaculture designer Design academics, PhD students (computing & design), data scientists, computing academics- Ensemble Project Writer in residence – Ensemble Project	Took part in interviews and were invited by researcher Collaborators of researcher and invited Email sent to SCC and Imagination PhD students Invited Invited Invited
5	Members of public Retired engineer from City Council Flood modeller – Ensemble Project design academics, computer science academics – Ensemble Project Permaculturalist - Interviewee & participant in Walk 3 Farm owner (Calder Valley) - Interviewee & participant in Walk 3 Writer	News article in local paper, university website. Could book a place Met in café prior to first public walk – invited Invited Invited Invited Invited

Table 4: Walk recruitment details

as Edensor (2000) highlights is the benefits of walking for stimulating reflexivity. However, once practical conventions are introduced, there is potential for obscuring what he terms “the difference … the contingent, the decentred, the fleeting and the unrepresentable.” Attempting to give participants the freedom to engage with other walkers, with the tools and the landscape, meant I was keen to not record every interaction. Recordings would be of use at specific locations, where participants might explore specific questions. One viable way of tackling this issue would be to just record at specific sections of the walk and to ask participants to take part in advance.

3.5 Data Analysis

The research process consisted of two main data gathering phases. The first phase consisted of the interviews carried out at hackathons and in Yorkshire, and the second consisted of the five walks. The choice of gathering these two types of research data was made to enable me to firstly dig more deeply into different modes of understanding place, and secondly to explore place through a practice-based approach. As the data I gathered would be qualitative, this guided my approach to the research design and the analysis methods.

3.5.1 Thematic analysis

The potential methods for analysing qualitative data are plentiful and offer many different modes of making sense of data. The key requirement for analysing the data collected through the interviews and walks carried out in this research was to enable flexible and open coding that could be developed into overall themes. In order to make sense of the diverse types of data collected through this research I chose to use thematic analysis, which Braun and Clarke (2006) describe as "a method for identifying, analysing, and reporting patterns (themes) within data. It minimally organises and describes your data set in (rich) detail." This approach has often been open to interpretation and few guides to carrying out the process have been developed. A useful framework to guide the use of thematic analysis has been developed by Braun and Clarke (2006), who offer a six-phase guide for carrying out thematic analysis

Step 1: Become familiar with the data

Step 2: Generate initial codes

Step 3: Search for themes

Step 4: Review themes

Step 5: Define themes

Step 6: Write up

A theme is described by Braun and Clarke (2006) as capturing "something important about the data in relation to the research question and represents some level of *patterned* response or meaning within the data set." Whilst these phases are distinct and have clear steps of development, it is also possible to move backwards and forwards between the stages.

Interviews: The interview recordings were transcribed into Microsoft Word, during which I became familiar with the data and began to make basic memos and notes (Stage 1 of the TA process). Once I had transcribed the data, I uploaded it to Atlas.Ti, which is software that enables qualitative analysis of text. I chose this process, rather than using analogue methods,

to enable me to explore both locations of interviews simultaneously (those presented in Chapters 4 and 5). Through generating initial codes in the transcripts (Stage 2), I was able to begin to see themes emerging across the interviews, as well as key differences between the two different data sets. The software generated a code book, which I then used to develop themes within each of the interview sets (Stage 3). I then went back and forth between the codes and developing themes within each interview set, and then between the interviews, to understand the key themes emerging overall. Once I had developed the themes, I printed them and stuck them on a wall to sort them, and these then began to form the Pathways Forward (this process is described in Section 3.4).

3.5.2 Thematic analysis through annotated portfolios

Carrying out thematic analysis for the interviews enabled me to gain insights as to how this process works well for qualitative research. The generation of themes from the interviews helped to develop the design of the walks and worked well to synthesise data across the two different sets of interviews. Familiarity with this process of analysis led me to using it for the generation of themes from the walks as well. However, the nature of the data collected from the five walks went beyond transcriptions. The generation of different formats of data, including text from field notes, artefacts including the map pouches and contents, and photographs taken during the walks, necessitated an adapted approach to thematic analysis.

The use of visual material as research data has been explored as part of the research process itself, through methods such as photo elicitation (Glaw et al. 2017., Harper, 2002) which seek to generate and spark discussion between researchers and participants. However, my own use of photographs was to document both the research process (walks) and artefacts generated through the research itself.

A useful method for analysing visual methods is the annotated portfolio, as described by Gaver and Bowers (2012) and Bowers (2012). Located within the field of Human Computer Interaction (HCI) the annotated portfolio is described as “a means for explicating design thinking that retains an intimate indexical connection with artifacts themselves while addressing broader concerns in the research community” (Gaver and Bowers, 2012, p.70). The authors discuss the nature of design artefacts and the various differing viewpoints and interpretations that can be extrapolated from looking at or interacting with the design or object. They also enable the collecting of designed artifacts into one portfolio and bring together individual artefacts as a systematic body of work. The portfolio can “capture family resemblances between designs in a mesh of similarities and differences” (Gaver and Bower, 2012, p.45). One of the key benefits of annotated portfolios is the communication of design research. However, the way in which I explored annotated portfolios different in several ways to Gaver and Bower’s conceptualisations.

The key benefit I drew from annotated portfolios, and that I found when developing them, was the bringing together of different designed artefacts, which in this case were the walks, into a systematic body of work. Each walk was analysed after it was completed, with the same method used each time. As each of the walks took place in a different location, with a different theme, different tools, and a range of participants, capturing themes across the walks was facilitated through using this method. My method for creating the portfolios was to pin all images (including of data and artefacts, notes, and images of the walks) to a large wall. Each walk was contained within its own area, and I initially drew themes from individual walks. This process essentially took the same process as thematic analysis, of becoming familiar with the data through sifting and sorting it, then pinning it, generating initial codes by adding sticky notes to the images, searching for themes across these (e.g., the process of designing the walks and tools), reviewing them and then defining them. Once I had carried this out for each individual walk, I re-visited the themes across all of the walks to make sense of wider themes and to develop and refine the themes that then made it into the writing up of this thesis.

The process of creating and indeed the final use of the annotated portfolios of walk data was not carried out to communicate design research, but to make sense of my own research data. This is where my method departs from Gaver and Bowers (2012), in addition to the portfolios consisting of an activity and resultant data, rather than a designed object. What this does demonstrate however, is the flexibility of this method for analysis, when used in conjunction with a flexible and reflexive method such as thematic analysis.

3.6 Development of Pathways Forward

The process of using thematic analysis for the interview and walk data generated a considerable number of themes. As the research was exploratory and each stage emerged from the former as it developed, it was useful to start thinking about how the insights gained from each stage could be woven into the proceeding stages. For example, the insights gathered from the interviews could form the basis for designing the walks. Then each walk informed the other, but not always in a linear way. I began developing the insights and noting them down, then identifying which would be of use to develop further and embed in the subsequent sections. At first these seemed to be themes, which emerged from the thematic analysis. However, as the insights began to accrue, this seemed to be a method through which I could make sense of what I had found, and explore how they might be developed, or could tackle the challenges I had found (for example issues at the hackathon that were then developed). These might be considered similar to patterns in architecture (Alexander, 1977) which can be described as describing a problem and then offering a solution, or a response to an occurring problem in software engineering (Smith and Williams, 2000). While these are both useful methods to gather problems and address them, the approach was not quite right for this

research. Not all of the insights drawn from the research data were problems, and they did not always repeat.

The aim of developing insights throughout each stage of the research (from interviews to walks) was to inform the design principles that are presented in Chapter 8. Through recording them as they emerged and reflecting upon them after each stage of the research and throughout the analysis, it became clear that some form of organisation was required. I initially used the term “insights” but this did not feel adequate. After considering a range of terms, that of “Pathway Forward” emerged as one that embodied a positive response to challenges, and of leading to the design principles. This term fit with the use of walking in this research, and the building of insights throughout the research. The use of the term and the recording of the Pathways Forward enabled me to make sense of the insights that built up throughout the stages of the research. This framework also enabled me to present the insights and suggestions coherently and to enable me to develop the design principles.

In Chapters 4 and 5 I took the insights from the interviews and developed the Pathways Forward, which were essentially themes. I wrote a short paragraph for each PF, and these were then summarised at the end of the chapter. This summary then acted as a starting point for the next stage of the research, which built upon and was informed by the last (although exploring different research questions). For Chapters 6 and 7 I started to build in the PFs to the design of the walks and the materials, and to enable clarity and continuity, I summarised the PFs into a table. For each of the key themes I identified in Chapters 6 and 7, I then linked them to the PF’s forward, which acted in a similar fashion to Alexander’s Patterns. Each PF was numbered, so that it could be easily referred to and summarised in the finding's sections of Chapters 6 and 7. This method assisted the sense-making process, of embedding the findings from the interviews and literature into the walks, and to ultimately develop the Design Principles, as presented in Chapter 8.

The method of Pathways Forward lies between thematic analysis (the presentation and further development of themes), and pattern languages, and can help with sense-making for research processes.

3.7 Chapter Summary

This chapter has presented the research methodologies considered and then selected for this research, as well as the methods used. The methodologies of Action Research and Research through Design were explored as the consideration of them both, as well as the synergies between them, was instrumental in the design of the research and the methods chosen.

Whilst Action Research offers a methodology that encourages participation and democratic research, the focus upon change as part of the research was problematic for my own work. The

aim of this research is to develop a set of Design Principles that can be used to enact change. However, deploying the principles and then observing change enacted, or not, was not within the remit of this research and therefore the use of AR became difficult. The next stage of deploying the Design Principles forms part of the future of this research and would explore the impact of the principles, embedding reflection and iteration into the process. Research through Design offered a way of navigating the research in an exploratory manner, whilst not limiting potential research methods.

The use of walking within RtD is novel, in terms of the design of the process, the activities and the artefacts produced for and from the walks. This research offers an example of how RtD can be utilised in developing innovative research methods, and walking. The chapter also described the research methods used, interviews and walking, which are both useful in the collection of qualitative data.

4 Data-driven practices in place: the hackathon

This chapter explores how place is represented in, with and through data assemblages, specifically through the practice of the hackathon. This chapter explores the following research question:

RQ1.1. What do data-driven understandings of place look like in literature and practice?

The aim of this chapter is to build upon the literature relating to practices of data, in particular the hackathon (2.3.1) in order to understand the ways in which data are re-used and the relation of the data used, and products created, to place. The aims are achieved through carrying out interviews and observations with participants of a hackathon who use data relating to place. The purpose and key findings of the interviews and observations from the hackathon are presented and then discussed to identify opportunities and limitations of this approach. In Chapter 5, " Situated data: People and place", the results of a contrasting set of interviews carried out with people who gather and utilise place-based data, information, knowledge, and wisdom will be presented. The findings of Chapters 4 and 5 are then discussed and synthesised at the end of Chapter 5. The similarities and differences between the two approaches presented in these two chapters form the basis of Chapters 6 and 7.

By exploring and developing insights into a practice of data use that represents the data-driven society, and that re-uses data specifically relating to place, the hackathon is a site that is useful to study. The empirical research carried out in this chapter aligns with the underpinning of post-phenomenology, seeking to understand and explore in more depth the impact of particular technologies in a tangible way. By attending the event, talking to participants, and observing their designs, I was able to get "underneath" the data that are often presented online as the outcomes of events and gain deeper insights into what drives participants.

Semi-structured interviews were carried out with eleven participants at a day-long hackathon. The primary purpose of this data gathering exercise was to augment the literature that was reviewed in Chapter 2 (2.3.1) relating to the opportunities and challenges of the hackathon as a practice of data. The data from the interviews presented here and in Chapter 5 serve as the material from which I develop the research, which is presented in Chapter 6, and ultimately the design principles presented in Chapter 8.

4.1 Hackathon Interviews

Hackathons are but one of a range of bounded data practices through which data are re-used and made manifest (Chapter 2, 2.3.1) and often take a similar format. The events are often held in urban areas, last between 12- and 48 -hours, focus on technological practices (e.g., software engineering, programming) and seek to "imagine new possibilities for technology" (Taylor and Clarke, 2018).

The choice to focus on the hackathon in the preliminary stages of this research was made as these events are an example of a bounded data practice that largely follow a similar format, namely the utilisation of open data, which are datasets that have been made open and available to re-use (2.1.2). In recent years, hackathons have become the subject of research (2.3.1), spanning a range of disciplines, such as; Human Computer Interaction (HCI), (Jordan, 2013; Taylor and Clarke, 2018), new media technologies (Richterich, 2018); Science and Technology Studies (STS) (Irani, 2015a) and the design of interactive systems (DIS) (Olesen and Halskov, 2020). Accounts of hackathons are also found in grey literature such as blogs, magazine articles and hackathon websites, which offer insights into the practice, the issues explored, and products designed.

While it is possible to gain an understanding of the issues surrounding these events and examples of their organisation from academic and grey literature, to gain deeper insights into not only the practices and organisation of the hackathon, but also the people who attend them, it was important for me to attend a hackathon. Through observing participants at an event throughout the day and talking to them about their motivations, experience, and engagement with hackathons I gained an understanding of this practice that was not possible to acquire through literature alone. There are limitations with carrying out interviews with participants at one event, rather than a number (see Chapter 3.4.1). However, the aim was not to gather data of a large sample, but instead to gain an understanding of the events that complemented the literature in this field. The focus of research during Chapters 4 and 5 was the exploration of two different understandings of place; the data-driven as represented by the practices of the hackathon (as one example of data and place) and that which is derived from lived experience of being in and engaging with a particular place.

The event I attended was a one-day hackathon in the city of Bath in the Southwest of England, which was organised by a group who met regularly and organised such events. The group held regular events such as 12-hour hack days and longer 24- or 48- hour hackathons which often had specific themes based upon open data from the city and surrounding areas. I found the event through searching online for hack events that were using place-based data, i.e., that which pertains specifically to place.

At the start of the day, I asked for volunteers from the attendees and eleven participants agreed to take part, amongst whom were two attendees who were not programmers. These two attendees went along on the day to see if they could make contacts with software developers who might be able to assist them in a project idea they wanted to develop. During the day, I carried out semi-structured interviews (see Chapter 3 for further details on methodology) which were based around a set of questions that were asked to all interviewees, but some questions were elaborated upon where the interviewee offered more information or gave an answer of interest that prompted further explanation. The questions were developed to explore the specific research questions (Section 5) and sought to draw out interviewee's motivations for attending the event, their background experience, experiences of attending similar events, the benefits and limitations of the events and their interest in designing for issues and/or stakeholders. Participants were anonymised using the numbers P1-P11. The themes that emerged from the interview: data, people, practice, place, and products, are presented below and are illustrated by key quotes from the interviews. In order to understand how the data from the interviews and field notes related, the themes were mapped onto each set of coding to see where synergies and differences occurred.

4.2 Data collection and analysis processes

The process of data collection, processing and analysis described here were also used in the research described in Chapter 5.

Sampling strategy and participant recruitment

The sampling strategy of choosing the hackathon and of the interviewees was purposive and theory based. This strategy was chosen as the interviews were not intended to generate a wide range of data that could be generalisable, but instead that could be used to understand the relations between literature about hackathons and the practice as it occurs. Patton argues the logic and power of purposive sampling "lie in selecting information-rich cases for study in depth … those [cases] from which one can learn a great deal about issues of central importance to the purpose of the inquiry" (Patton, 2002, p.230). When choosing a hackathon to visit it was important that the event was using data that was open and collected from and about a particular place. The event also needed to be located within the UK, due to logistical constraints. The organisers of the event also needed to be comfortable with me attending and interviewing participants. I found the Bath Hacked event and it matched the requirements for this part of the study and the organisers were both keen to understand the research and comfortable with me attending to interview participants. The data being used on the day had been gathered from the city of Bath and had been made available to participants on an open data platform, and so these both matched my requirements.

At the start of the day, I spoke to attendees all together, explained the research and asked for participants who would be interviewed during the day. Eleven attendees volunteered.

Data collection, processes, and storage

I asked the interviewees semi-structured questions (see Table 5) and used a voice recorder to capture the conversations. The processes and storage of data followed the university requirements. The interviews were uploaded to my computer at the end of the day and secured on the password protected device. After the event I transcribed the interviews by hand and the transcripts were stored on my computer using the university cloud storage as required by the ethics process. The interview analysis was kept on the university storage and the transcripts were anonymised (all interviewees were given a number).

Analytic methods of working with the data

The interviews were transcribed by myself and as I did so I made memos and notes, using an open coding system as I went. When I had completed all of the transcriptions, I uploaded them to the Atlas.TI software. Using the memos and notes I had made on the transcriptions (Word documents), I began to code the data using thematic analysis (described in Chapter 3.1). The use of open coding was important, as I wanted to explore the data and build codes from the ground up. Through firstly coding the transcripts in Atlas.TI, I was able to develop a code book, which I then printed and used to carry out further thematic analysis, to develop the main themes as presented in sections 4.3 to 4.6. When using thematic analysis, it is important to either get somebody else to carry out coding, or to have a conversation with others to explain your codes and gather feedback. I did this through having a session with two other researchers from the Highwire programme and added the feedback into my themes.

4.3 Practices and People

Participants were asked about their experience and background in programming, software development or engineering to understand the types of skills found at such events. Of the eleven interviewees, nine identified as having skills in this area; specifically, they identified as computer programmers, application developers, software engineers and software architects, whether formally or informally taught (with two interviewees being self-taught). The two interviewees who did not possess skills in this area attended to find participants to help them develop a mobile application based upon data they were able to access.

The attendees of the event reflected the composition of many hack events (Porras et al.2018), with backgrounds in programming, whether formally or informally taught. More recently there has been an attempt to diversify these events, not only in terms of gender and age, but also in expertise (Taylor and Clarke, 2018). Calls that encourage participants who do not have

backgrounds in technical data handling or programming have sought to widen the range of designs and approaches produced (Taylor and Clarke, 2018; Taylor et al.2017).

4.3.1 Motivations

To understand the reasons why participants attended the event they were asked about their main motivation for attending the event. This question sought to elicit general reasons to gain insights into how these events attract participants and what they gain in turn.

The interviews demonstrated that participants were motivated predominantly by the social, career development and fun aspects of such events, where they often work collaboratively in teams. A key motivation for attendance was the social aspect, such as meeting new people or connecting with people who have similar interests, where participants were able to meet before the event started and form teams with others who shared their approach or perhaps an interest in a specific dataset.

All interviewees mentioned the social element of attending the event, seeing it as an opportunity to meet up and spend time with people they already knew, or to meet new people. For example, interviewee P8 stated "it's a way of getting to know a few people" and this was echoed by interviewee P9 who said "[the reason I attended] was first to get to know people in the same developer community … I didn't know many people outside of work at the start." Those participants who did not know anyone at the event quickly found collaborators over drinks prior to the event beginning.

Sense of shared purpose: I observed that a sense of community was quickly established between participants and was evident throughout the day, with a keen sense of shared purpose amongst them. After the event began, they quickly got to work in small teams and there was a powerful sense of conviviality throughout the day, particularly at break times and at the post-event prize giving. This sense of community harks back to what both Himanen and Wark (Himanen, 2001; Wark, 2004, p.109) refer to as existing in the early days of hacking, where programmers shared an intense sense of purpose and shared values.

Sense of fun and enjoyment: In addition to social motivation, interviewees spoke of attending for fun and enjoyment, as participants stated: "I enjoy the environment and the atmosphere" (P9), "[I attended] to win and have fun" (P4), "[I attended to] work on something fun and meet new other people who have similar interests" (P7), and "[I attended for] the selfish reason, which is fun to do" (P6). One participant went further than suggesting he attended for fun, saying it was an "opportunity to show off" (P4), which relates to the desire to demonstrate skills and the ability to produce something of value within the timeframe. The participants' enjoyment was evident throughout the day, which could be observed in their enthusiasm for attending and working with their teams on their designs. This enjoyment echoes Torvalds, who

states that, for the hacker "the computer itself is entertainment," (Torvalds, 2001) that the hacker programmes because he finds the act intrinsically rewarding.

Challenge of working within tight time constraints: Interviewees were also motivated by the challenge of working within tight time constraints and with new datasets, stating for example that "I fancied a challenge outside of work. I fancied something completely new and interesting to work with … it's picking up an open-ended problem and trying to build something interesting with it" (P7). Finding insights within the data through analysis was also important to this interviewee, who said "We have a whole load of data that's pretty disparate, so there is a challenge in drawing lines between pieces of data and developing some kind of insight" (P7).

Seeking help with a problem: The interviewees who were not programmers, P1 and P2, told me they attended "Because they're all computer people here and we're looking for someone who has the ability to produce something that we're after … we're hoping someone here will be able to help us with that." They had a specific idea that motivated them to attend and seek help with the idea.

Career and skill development: When asked the question "What was the main reason for you attending today" interviewees spoke of the event being an opportunity to develop their career and skills. This is increasingly important in an industry where there is high demand for jobs, and employers expect applicants to take part in extra-curricular activities and programmers/engineers to have portfolio careers (Irani, 2015). I found that participants considered this to be important, with six of out the eleven interviewees citing career development as a key motivation for their attending the event. By taking part in events outside of work time, participants can not only further their skills, but also to add their participation and success to their CVs. Participants told me "… in the back of my mind I thought it'd look good on a CV" (P10), and "primarily it is to do local career development as much as anything else" (P4). In a highly competitive job-market, participants see attendance at such events as an opportunity to demonstrate their skills and creativity; as one interviewee told me: "It's increasingly likely that when looking for jobs people like to see things you've done in your spare time, so hack events are a good opportunity to come up with good ideas and put [them] up online to show people what you've done" (P6).

Hackathons are good opportunities to develop skills, through working and collaborating with peers. It also offers participants the chance to challenge their skills and work through issues relating to creating something from a data set. This was echoed by interviewees who stated "I fancied a challenge outside of work. I fancied something completely new and interesting to work with" (P7). The importance of the challenge was also mentioned by another interviewee, who said "I quite like a challenge, so picking up an open-ended problem and trying to build

something interesting with it is fantastic … there is a challenge in drawing lines between pieces of data and developing some kind of insight" (P7). Hackathons produce prototypes or products such as mobile phone apps or web-based dashboards, however as demonstrated by P7, in addition to making something, the process of gaining insights from the data can offer participants satisfaction, often through "mashing" together different datasets they have found within the data made available for the event.

4.3.2 Diversity of Participants

Participants at hackathon events are often young people, often male (only two out of the ten participants at the event I attended were female), who are developing a career in programming, software engineering and related professions (Irani, 2015; Jones et al.2015; Kitchin, 2014). The hacker is often predominantly male, young and has completed, or is completing undergraduate or post-graduate degrees in software related fields (Kitchin, 2014, p.63) and it has been recognised that there are issues with gender inclusivity at hackathons (Briscoe, 2014). More recently, hackathons have attempted to attract a more diverse array of participants, such as those from different professions, often those that are more "creative" (Taylor and Clarke, 2018). By attracting a more diverse array of participants there is greater potential for a greater breadth of outputs from such events. The event I attended sought to attract a diverse range of participants, which was demonstrated on a blog written prior to the event, which stated "We need: developers, designers, artists and creatives, data analysts, public sector staff, charity, and community workers. Not every team turns up to compete, and not every team has a hack idea. That is why we'll be running icebreakers and a matching board to help you find the right people to work with" (Anonymous, 2005). However, from the examples I encountered the desired participants (e.g., artists, musicians, and another example) did not attend and therefore the events lack the diversity that could potentially lead to more engaging designs emerging from the hack.

If many hackathons attract similar participants this potentially reflects only a very narrow range of experiences, which, coupled with the scarcity of wider lived experience or stakeholders, potentially limits the diversity of solutions or prototypes created at these events. At the event I attended, two attendees who were not programmers did have an issue they sought to explore but were unable to connect with any other participants to work on their idea. They approached me after the lunch break to tell me that over food they had talked to a participant who was interested in working with them on their ideas, but that time had been lost during the morning so it was unlikely they would be able to start immediately. This also reflects the time-constraints that can work for and against the development of worthwhile artefacts. A key benefit of holding an event over 12-48 hours is that participants can work intensely, tackle a challenge, develop their skills, and then leave. This practice is discussed in

more depth in section 5.4.1 below. The opportunity for participants who do not possess technical skills was not taken up at the event I attended, but by exploring different formats that encourage a wider range of participants there is rich potential for bringing together a range of people to explore complex issues over a defined period. There was a wide range and depth of technical skill available in the room, with the potential to offer valuable insights into the available data and its potential re-use, but this was not combined with a range and depth of other experience and knowledge.

Issues with participant diversity resulting from the hackathon practice and format: The hackathon has become an accepted practice, in that many events follow similar formats, through which data are re-imagined and re-purposed into new technological artefacts, including applications, dashboards and visualisations. Events tend to be organised and held using similar formats, which has resulted in what might be considered a "methodological hegemony" (Olesen and Halskov, 2020), where participants know what to expect and are able to get on with the challenge presented unimpeded for intense periods of time.

As discussed above in Section 4.3.2, hackathons tend to attract young people who can spend intense periods of time at an event, without familial responsibilities (Olesen and Halskov, 2020). By attracting only young people, who may have a lot of energy and enthusiasm, other types of lived experience are excluded (as defined in Chapter 2, 2.3.1). Older people are also excluded from hackathons due to their format. Attempts have been made to hold events for older people, although these have been carried out as part of academic research (Kopeć et al.2018). This event took place between normal working hours (began at 9am and ended at around 6pm), which many of the interviewees had found to be a more suitable time as they were able to find childcare and did not have to forego sleep. The intensity of the hackathon gives participants the opportunity to work on one project without distractions and to share enjoyable time with their peers. Whilst this is advantageous to the development of solutions at events, it means that only those able to forgo sleep, or are without familial responsibilities to attend, therefore constricting the potential diversity of such events.

One interviewee told me that a key issue with 24- or 48- hour events was organising childcare, telling me that "Family life … to do these things I'm going to have to plan ahead … so my wife then looks after the child" (P4). The lack of sleep is also an issue for some, as is the need for those managing the event to remain with participants, as interviewee (P4) told me, "I don't work that way [without sleep]" and "… the problem is you have the 48 [hour events] … you get some crazy guy who wants to code all night, so then you need an organiser to sit there all-night babysitting." Another interviewee told me "I didn't work through the night as I think that's counter-productive" (P8). Furthermore, (P6) said "Some people perceive it that you

Theme	Question	Section
Practice of hackathons	1. Have you attended an event like this before?	4.3.2
	2. Have you taken part in a 24- or 48-hour hackathon?	4.3.2
	3. What do you perceive to be the benefits and/or drawbacks of 24- hour and 48-hour hackathons?	4.3.2
Design of products	4. Do you define yourself as a computer programmer/software developer/software engineer/software architect, or other?	4.3
	5. Do you have a specific community in mind when designing your product during the event?	
Motivations for attending	6. Has anything you have designed at an event gone on to be prototyped and/or deployed after an event?	4.4
	7. What was the main reason for you attending today?	4.3.1
	8. From the following list, please choose the motivations for attending the event today (all that apply): Passion, openness, activity, freedom, creativity, caring, social worth, prizes/competition	4.3.1
Collaboration	9. If you are working in a group, how did you come together to work today?	4.3.3
	10. Did you know any of the other people prior to this event?	

Table 5: Questions asked at hackathon and relationship to themes

should just carry on without sleep, but I don' think that's very useful for anyone … There's no point in depriving yourself of sleep for its not truly competitive" which was echoed by (P7), who said "The 24-hour ones I've been to have kind of fallen apart overnight, the ones who have kids are the ones slinking out and coming back in the morning." Whilst these experiences were limited to the interviewees attending this event, their views highlighted potential issues facing hackathons, where only those participants willing to forego sleep and able to arrange childcare or cover other caring responsibilities can take part. Furthermore, those with health

issues are easily excluded from this activity, and therefore from taking part in the design of data-driven products and services, or even accessing data that are made open.

4.3.3 Collaboration and solidarity

Hackathons offer participants the opportunity to work with peers over a short but intense period. During the event I attended I observed that participants were deeply focussed on the task and completely absorbed in what they were doing. Groups formed at the beginning of the day over coffee, with many of the participants not knowing others and joining together over shared ideas as to what they might do with the data available.

Issues with time constraints: With a limited amount of time in which to develop an idea for the presentations at the end of the day, where prizes were given, participants quickly arrived at ideas and set about their tasks. When asked what they felt the benefits of the hackathon were, several interviewees spoke about the notion of working collaboratively. P5 told me "Adversity breeds solidarity, people develop a sense of solidarity when they struggle … together. It also creates a novelty, there's something about being tired and sort of pushing yourself that makes it feel not normal, that is novel and exciting." However, this is not always the case, and the notion of the tortured creative is somewhat mythical (Burkus, 2014). The interviewee also said "… the thing about hacks is there's limitless potential and there's a real sense of you're actually looking for the best solutions for stuff, you're not looking to meet the bureaucracies, there's a space, there's a culture." This notion of spending intense periods of time tackling challenges and coding reflects the original notions of the hack (Irani, 2015) where participants gathered in a comparable manner. The time constraints and intensity apparent at hackathons enable participants to collaborate and develop a sense of "solidarity," as described by P5 above. However, time constraints can be counterproductive (Thome et al. 2016) and holding events over an intense period can exclude those with families or health issues.

There is also an understanding between participants that they will create something interesting, as P5 told me, there is a "tacit understanding that the goal is to make something as cool as you can." The intense focus of participants was highlighted by P11, who said "I always think with these things that pressure can be a good motivator, but also it really has got to make you focus on what you want … what you want to get out of it by the end, which I think is a good thing." Furthermore, P5 told me that "People here are all on the side of competition and collaboration", which again

speaks to the supportive nature of events where participants can work with their peers.

4.3.4 Pathways forward

Hackathons present opportunities for participants to engage in an enjoyable activity that also enables them to develop their skills and potential careers. These events also offer the opportunity for a number of highly skilled, passionate, and engaged people to get into a room. However, these opportunities often do not deliver the promise of solutions to intractable problems or engage as widely as they might with those experiencing those problems or with knowledge that would be invaluable when combined with technical expertise. Some hackathons have sought to tackle this gap (Taylor and Clarke, 2018) through engaging with communities beyond programmers and engineers, however these cases are less common.

Create a public around a problem or design challenge: The opportunity to capitalise upon the expertise and enthusiasm of participants by ensuring a range of people with technical, lived, and expert knowledge around a particular problem might be made manifest by considering assembling a "public" (Lodato and Disalvo, 2016). This essentially brings together those who understand the data and the problem with those who can provide the technical knowledge and practice (Porway, 2013). Engaging different people in the genesis, design, and development of an event also has the potential for bringing about a wider range of values, where the motivations and values of organisers currently differ to those of participants.

Pre- and post- event engagement with data and issues: As hackathons often take place during short periods of time, participants must rapidly familiarise themselves with other participants, tackle technical challenges, explore, and possibly analyse the data, design an artefact, perhaps prototype it and then put together a presentation for the final. This intense scheduling means possible avenues for innovation are not explored, nor is wider engagement with wider stakeholders or those with lived experience of an issue or problem. McKeon (McKeon, 2013 in Kitchin, 2014, p.65) suggests holding pre-event sessions where planning can occur and having post-event mentorship which might make the outcome more sustainable and develop a longer-term community. As Porter et al. (2017) suggest in their research on philanthropic hackathons, engagement with participants pre- and post- event can encourage greater interaction between participants to build social networks, which, as demonstrated in this research, is important to those attending. Through developing longer-term relationships participants can build working relationships with others within and beyond their realm of expertise, which would also enhance their experience and bolster their CV's. The lack of time might also be mitigated through using multi-media, such as videos, posters, artwork, or music created by people in that place to both market the event but also as a means of understanding the people who live there and to represent the more diverse range of people hackathons have increasingly been aiming to attract.

Consider different formats to encourage wider participation: The participants at the event I attended had a clear idea but were unable to connect with others to explore it during that particular timeframe. This was limited by the need to get working very quickly and to work

intensely on an idea to present at the end of the day. Longer events, held over 24- 48- hours offer longer periods of development time, but as reflected upon by the interviewees at the event, this format poses issues in terms of lack of sleep and inability to organise adequate childcare. Simple changes in format, such as having events over several weeks, or considering employing distributed sessions for part of the event, might encourage a wider range of participants. As with the suggestion above, where pre- and post- event sessions are organised, using distributed technologies such as websites, or even enabling participants to engage in an analogue way before and after the event might encourage wider participation. The term "hackathon" immediately conjures an image of an event dominated by those with the requisite technical skills and are prepared to forgo sleep to work intensely. Exploring other names for events that challenge this perception might encourage other participants to engage and attend.

Harness the sense of collaboration and solidarity: The interviews carried out and observations made at the hackathon demonstrate the sense of solidarity at these events, the shared experience and pride in presenting an idea at the end of the event. Collaboration is important in ensuring a range of creative designs at these events, but as there are often few participants who are not programmers this can limit the type of solution or design produced.

4.4 Re-use of data

In the lifecycle of data, which is often considered to be the collection/gathering, storage, analysis, and re-use of data (van Veestra, 2013) the hackathon is a practice that deals predominantly with data re-use. It is this practice and the ways in which data are considered within a design process that the following section explores.

4.4.1 Lack of clearly defined design process

A fundamental point of a hackathon is to develop or prototype innovative designs based upon the data provided at the event. Some private organisations hold events to specifically create new innovations in a brief period of time, whereas other public organisations (particularly in the realm of Civic Hacking) hold events where new innovations and designs might contribute to the city or government (Irani, 2015). However, it is often the case that designs go no further than the event itself (Kitchin, 2014) and the claims made by those organising hackathons in their calls for participation to tackle complex and prominent issues are often not supported in the results at the end of the event, or indeed their development after the event. Hackathons are sometimes held to tackle specific issues, such as flooding, healthcare, or social issues, which Lodato and Disalvo call "Issue Oriented Hackathons" (2016). Whilst the activity of the hackathon can be worthwhile for participants (4.3.1 above), they often do not solve the issue they set out to, as these issues, such as flooding, or hurricanes are complex and perhaps

intractable (Detar, 2013). Such complex issues require a joined-up approach by a wide range of people, and the consideration of needs and design solutions, which can often take time and requires more than one 12- or 24- hour event. The rush towards creating something innovative and novel at the hack often results in little or no work being carried out to the design post-event. This approach, resulting from limited time and lack of understanding of design processes could go some way towards explaining why the ideas generated at hackathons may tend toward the spectacular or novel, in that sometimes they respond to a problem that does not exist. Where participants are less diverse, there are potentially fewer rich and different experiences represented, leading participants instead to explore issues they face themselves, or to design something based upon the data available to them at the event. Whilst the interviewees I spoke to did not rank the winning of prizes as their most important value, the excitement of collaborating with their peers within a tight timeframe and developing an idea to present at the end of the day was important to them. Creating and developing an artefact that was at least prototyped at the end of the event, that they might continue afterwards, did not seem as high a priority to interviewees. Only one of the interviewees at the event had developed a product beyond the hackathon previously which was in use at the time of the interviews. After the hackathon ended some of the artefacts were available online for a brief period of time, but the websites have since been taken down or re-directed.

The issue-oriented hackathon is an event where issues are clearly defined (Lodato and Disalvo, 2016), however these more focused events are but one of many. Where hackathons do not present a clear design brief the issue may be ill defined or participants respond to a general theme (e.g., “flooding”), resulting in participants choosing an issue they face themselves, rather than one that might genuinely add value to life in a particular place. The competitive element, where many hackathons result in prizes, also leads to the products presenting ideas that are more exciting than the strategies that might address actual everyday issues. Whilst the interviewees I spoke to did not rank the winning of prizes as their most important value, the excitement of collaborating with their peers within a tight timeframe and developing an idea to present at the end of the day was important to them. Creating and developing an artefact that was at least prototyped at the end of the event which they might continue afterwards did not seem as high a priority to interviewees. Only one of the interviewees at the event had developed a product beyond the hackathon, which was in use at the time of the interviews. After the hackathon ended some of the artefacts were available online for a fleeting period of time, but the websites have since been taken down or are re- directed. This lack of continuity and longevity is an issue, where resources are put into an event but thoughts as to how they may work in future are not developed. As I spoke to participants throughout the day their artefacts were at various stages of development. At the end of the day, they presented their

designs and prototypes, which were judged, and prizes awarded. The products created are detailed in Section 4.4.4.

Availability and infrastructure of data: the data available at the event was presented via an online data store that participants were able to assess prior to and after the event. The data store has now been developed and is accessible to anyone who wishes to re-use that data. Data in the data store is themed by category and type, with areas such as economy, education, environment, government and society, health (see Figure 10) as well as by the data type and format. This format mirrors that of the UK government Open Data portal.

Participants can only use data they are provided with on the day and often the timing doesn't enable them to sort through and format data, or search for new data. McKeon (2013), Porway (2013) and Kitchin (2014, p.64) highlight the issues with open data sets and accessibility as one of the key limiting factors with the lack of development of products when the hackathon ends. There are issues with not only the amount and type of data available, but the way in which it is made available on portals. Portals, such as the UK Government's Open Data Portal (Figure 10) are structured thematically, so users must identify the subject of the data they are searching for. Structuring data portals by place, so that it is possible to see the kinds of data available in a particular location may encourage a different approach to the re-use of data, rather than using datasets within similar thematic parameters. On such portals there is no sense of what other types of data are available, nor of information, knowledge, or wisdom about a place.

4.4.2 Lack of diversity in data

The hackathon, literature relating to it and observation of data portals suggests that data lacks diversity (Olesen and Halskov, 2020; Porras et al.2018). In this context this means the sources and types of data used at hackathons. The data are predominantly sourced from open data portals, such as the UK government data portal (www.data.gov.uk). More recently the term "heterogeneous data" has been used to refer to a variety of data sources, types, and formats (Cammarano et al.2007), but this still refers to data that are available in digital formats. At hackathons, for example, participants do not have access to data such as archives, or analogue data and time constraints would make this difficult to access and analyse. However, by exploring the nature of heterogeneity in a wider sense, that encompasses other formats of data that might be found in a place, there is potential to redefine what the term means in the context of data and place.

Some hack events encourage participants who are not programmers to take part so that different skill sets are represented, and a more diverse array of participants could engender a more diverse array of creative designs to tackle issues. However, the participants (P1 & P2) who attended the hack event represented stakeholders, or people experiencing a particular issue, who had ideas as to not only what the key issues were in that domain, but also where significant data might reside and how other people experiencing the same issues might make use of the data. To have stakeholders at events, as well as participants from a wider range of backgrounds, might bring about a more diverse approach to the re-use of data. Stakeholders could also unlock different data, information, knowledge, or wisdom that could be significant.

4.4.3 Tools and techniques

The artefacts created during the event were typical of those created at hackathons and reflect the tools and techniques utilised at this type of event. The products developed or prototyped were typical of those produced at hackathons more generally, with the datasets being "mashed up" and plotted onto Google maps, developed into a mobile application, presented visually via a dashboard or interactive website. Six out of the nine artefacts visualised data by plotting it onto digital maps to either demonstrate the location of crime to plot routes avoiding them, visualise the relationships house price and energy, see historic buildings around the city plotted by location and road traffic accident data. These visualisations all take a "view from above" the place (Lindtner et al.2016). From these artefacts the participants take on a bird's eye view, or drone's eye view that is distanced from the terrain of the place itself. Whilst this Cartesian "view from above" offers a sense of objectivity and clarity in exploring the data and the 2-

Artefact	Type of data
Historic City Mobile/web application Figure 10 and 11	Flickr photos, maps – images and map
Visualisation Figure 12	Weather and air quality data (Kabana and Elastic Search)
Dashboard Figure 13	Air quality data
Visualisation Figure 14	House prices and energy use - map
Python Library Figure 15	LIDAR[2] – environment agency data – map
People in places mobile application	Census data
Visualisation - Data mashup	Road traffic accident data and Google routing API[3]- map
Dashboard	Census data - map
Interactive map	Crime data - map

Table 6: List of designs developed during the hackathon

dimensional domain, participants might miss valuable data, or insights that are located "on the ground" and might add a third dimension to their designs. This technologically, distanced experience has grown through collaborative gaming environment (particularly using Virtual Reality), widespread use of drone footage and images (Cureton, 2020).

The tools used to plot these data onto maps limit the ways in which the data might be used and the focus on technological solutions at hackathons has been discussed in terms of technological determinism. The participant becomes omnipotent, taking an overview of place as it relates only to specific datasets and then codes the data into a visualisation representing the data and

[2] Lidar (Light detection and ranging) is a method of making hi-resolution maps by measuring distance by illuminating the target area with laser light and measuring the reflection with a sensor

[3] API – Application programming interface enabling functionality between different interface

its relationship to other data only, not to the terrain or those who inhabit it. Whilst this overview enables viewers to see a representation of data and form relationships between those datasets, they become self-referential, rather than referring to any other factors within that place. For example, the crime stats visualisation that enables people to plot their way through areas, or avoid such areas, does not give any context such as the type of crime there or any measures that have been taken to tackle it. Nor does it offer context into the materiality of the place, such as the lighting or architecture, both of which might engender a sense of fear or safety. The house price and energy efficiency data-mash up offer a visualisation of the location of properties according to these two metrics, but does not consider the condition of the property, or any other metrics that cannot be represented by digital data.

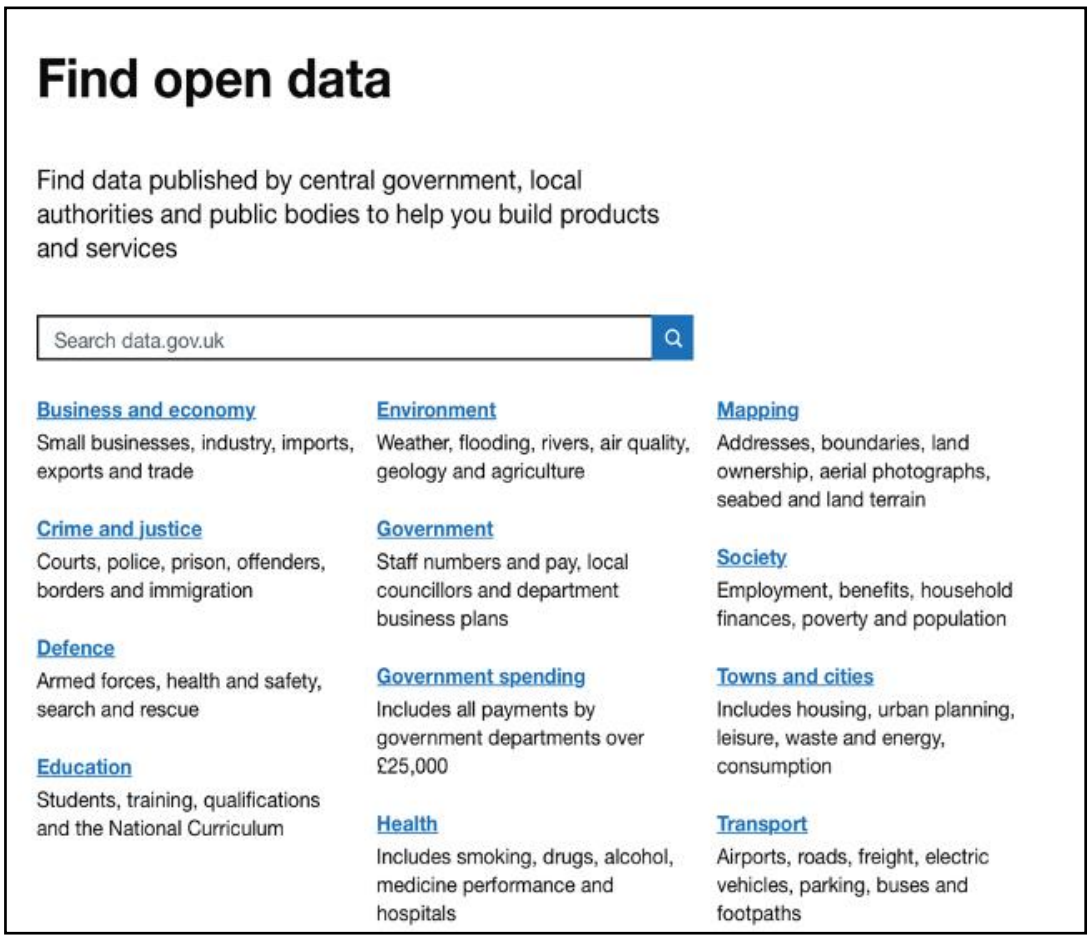

Figure 10: UK Government data portal, showing the thematic search options

The use of programming tools to interpret and re-use data are inherent in the hackathon and the constitution of the hackathon's participants affects the tools used at such events and the nature of diversity in what is produced. The tools also direct the creation of the artefacts, in that there are only a finite number of programmes that can be used to analyse, interpret, and then visualise the data or build dashboards or mobile/web applications which appears

somewhat deterministic (this is discussed in Chapter 2 2.4). This toolkit offers the ability to create sophisticated visualisations, interactive dashboards, and mobile applications, which can be useful in providing an overview of data and enables interaction with the data. There are various programmes that can visualise data now, such as Tableau, which have democratised the visualisation process. However, careful consideration needs to be given to what data are being visualised and the relationships between datasets (Kennedy et al.2016).

4.4.4 Creation of artefacts for use and level of completion

The concept of prototyping, designing, or making artefacts from the data available that might be useful became apparent in my observations and interviews at the hackathon. Whilst a lot of energy and enthusiasm is generated in the exploration of the data and ways in which it might be re-used, less is given to the consideration of how the artefact might be useful and to whom. The notion of usefulness is contested (Rai, 2016) and changes according to context, users and the nature of the artefact itself and the question as to whether artefacts resulting from hackathons need to be useful is important to consider here.

A key issue relating to the notion of usefulness is the level of completion of the artefacts at the end of a hackathon. Much energy is spent in the analysis of the data, or transforming it into visualisations, but the endpoint of the event is usually a presentation where a winner is chosen and prizes received, rather than the development of a fully functioning prototype or artefact (Decker et al.2015; Jones et al.2015; Kitchin, 2014; McKeon, 2013; Olesen and Halskov, 2020). During the observations I made during the hackathon it was clear that participants focussed on the end presentation and having something to show that represented at least their concept, rather than a fully formed artefact, remaining at version 1.0, and rarely worked upon after the event (Gama, 2017; Kitchin, 2014). This lack of completion is not necessarily problematic where there are no claims made as to the event producing solutions to a particular issue. However, where hackathons suggest they are issue oriented (Lodato and Disalvo, 2016) and seek to solve issues, that are intractable and complex, this level of completion suggests the aims of the event are not met (Detar, 2013). It follows that if the end results of a hackathon are either incomplete or not continued after the event, they cannot be considered useful, or of use. This lack of completion at the event was represented in the reflections by the interviewees, who told me “What usually happens is a good 90% of the projects die off after the hackathon event, so even today there will be nice presentations … but most things will just die off and

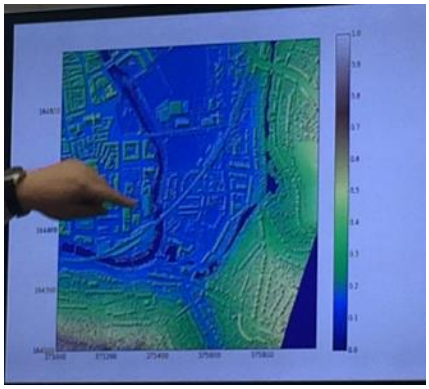

Figure 11: Lidar Map (left)

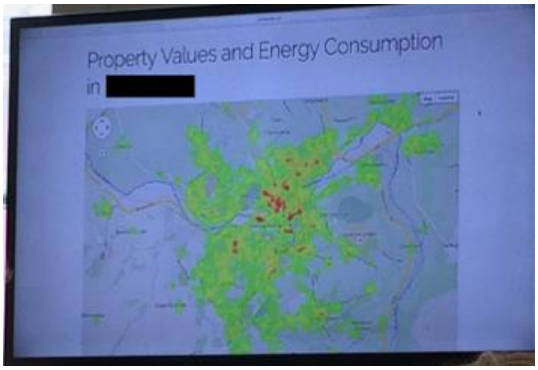

Figure 12: House price and energy consumption data 'mashup'

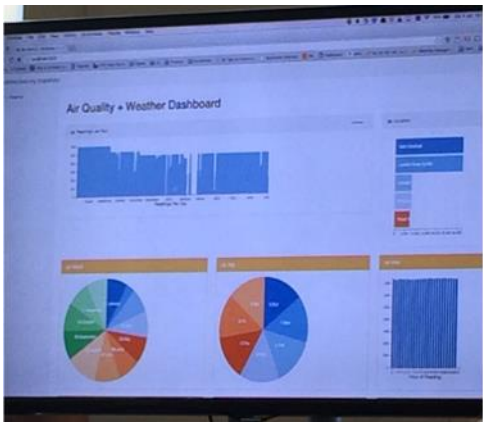

Figure 13: Dashboard (left)

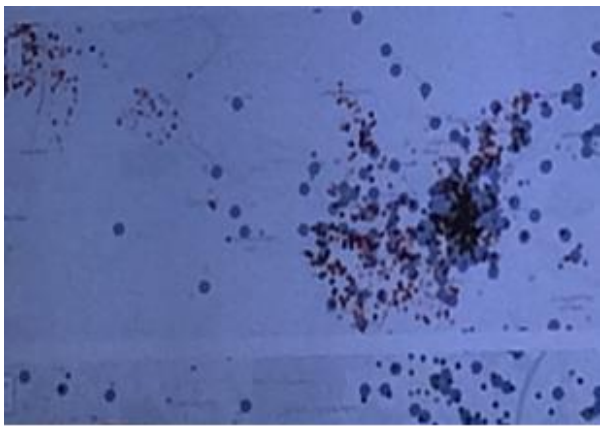

Figure 14: Traffic data visualisation

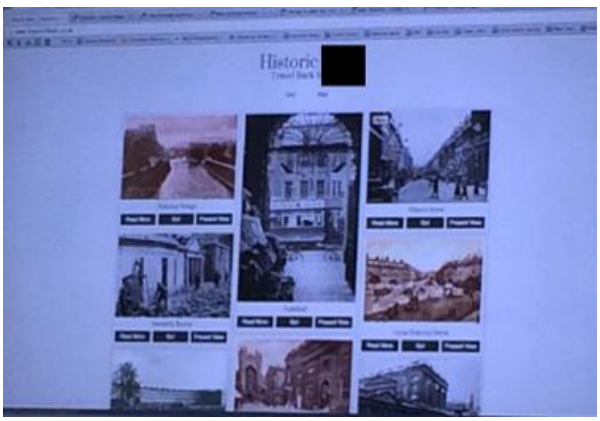

Figure 15: Historic city map application (left)

Figure 16: Historic city map application (2)

never be used again. In such a short timespan there's not much you can do … to bring it forward, so I think that's the biggest limitation" P9. This was echoed by P11, who told me "I think for longer term research engagement or exploratory pieces … it's better to dedicate a bit more time to the process of doing it and explore all the options."

4.4.5 Data-up approaches to artefacts

To make an artefact that is useful, it is important to consider to whom it might be of use. However, many hackathons (except those which have clearly defined briefs) do not define the issue or theme clearly enough to identify clear potential users or stakeholders. At the event interviewees were asked if they had users or a target group in mind when they started to design their artefact or explore the data. Spending between 12- and 48- hours intensely exploring the data means participants gain insights into the data itself, but it is here and the final presentation where energy is expended, rather than the consideration of the problem and its owners and stakeholders. In this respect, the artefacts are "built by a micro-community of casual volunteers, not by people with a deep stake in seeing the project succeed" (McKeon 2013, in Kitchin, 2014, p.65).

Being led by the data that are available makes it difficult to make meaningful design decisions that lead to "solutions" or products that offer tangible approaches to such issues. For example, one team developed a dashboard that mashed together house size and energy use. The team did not begin with an issue, but because the participants thought it might be interesting to see what they could do with the two different datasets. This is an example of "mashing data," where two different available datasets are combined in order to gain insights. Or the location-based application that took a Google map and location accidents on roads or areas. This did not arise from a specific issue, but instead from some data that the participant found and from the popular act of plotting data onto Google maps. Where there was an issue, with the interviewees who wanted to tackle problems relating to patient's experiences with organ donation in the NHS, which they had access to data for, no participants were available to engage and bring their expertise to an existing issue.

When I asked interviewees whether they were aiming to create something for a particular user or problem owner there was a range of responses, on the one hand that signified the activity and the data were of primary importance, and on the other hand that participants wished to develop something that might be of use in the world. Interviewees did show an interest in creating something of value, with P5 stating "I feel personally … a sense of being responsible … to engage with projects and processes I think can make a difference*."* This was echoed by P7 who said *"*… it does feel like you're doing some good, there's a chance you'll do some good. I'm not going to change the world or anything, but it's nice to think you are donating time to a cause*."* However, this view was countered by an interviewee P4 who responded *"*Do

I care about something valuable for other people? No. I want to do something interesting; I want to do something clever … It really is the act of programming and the … social interaction between the different groups of people."

The interviewees are well-meaning and have a desire to help people, but they are constrained in doing so partly by the tools and techniques they use at hackathons and by a lack of understanding of issues as experienced by those who might use such an artefact. Interviewee P3 told me "No, today I came with no specific ideas … because it's my first time here, so mainly its" for me to explore" and P6 who told me "You usually try to think of something you feel isn't being addressed now and wonder whether anybody would care whether this is addressed or not … First you have to look at what's available …." This response suggests innovation or creating something that has not been done before is important, rather than creating something of use to somebody.

The notion of the data being interesting was repeated by several interviewees. For example, P7 told me "I didn't come with an idea … I think I just kind of stumbled into some data we're playing with that was just interesting I think … so I didn't have a kind of target, not a target audience but a social goal in mind. It was more like "these are interesting things, and we could get an interesting insight out of that." This was echoed by P8 who said "… when I'd gone through the data store … I'd found data sets that were interesting to use and I though that's an interesting data set … so I came with an idea based on choosing data, by looking at what's available." Furthermore, P9 told me "When I first approach events like this one I don't have any end goal in mind, so it's basically whatever comes up in my mind of the day … what I try and create, it can even be for the sole purpose of the day and amusing people in the group … but I don't necessarily have the target audience in mind before having the idea, so usually I would look at the data … I would see if there's something that does look useful that hasn't been done before then basically the audience comes because of that" and P10 said "It [the users] would depend on the product. Obviously, I wouldn't always aim to say, for example, elderly people for example, it depends on what I decide to do." These responses suggest that participants approach the task of creating an artefact based upon the data available, rather than for a specific audience, group of users or specific use. Furthermore, interviewees seemed to focus upon data and the building of artefacts that are of more interest for them, that enable them to gain more out of the event in terms of skills or working collaboratively with others. A key factor in this approach is the nature of the brief given at the event itself, where participants can develop ideas from a place of understanding a specific set of issues, or a theme to explore. This approach can lead to confirmation bias, as the data directs the pathways that follow this data, rather than the place. This might have some serious issues that are not evident in the data available e.g., the use of crime statistics might not include context or details.

Data-driven does not always include information, knowledge, or wisdom: Enabling space for the inclusion of information, knowledge, and wisdom into the development of artefacts that enrich the data that are used at such events. This would require the inclusion of a wider range of participants, who bring with them not only their own lived experience, but also potentially knowledge of the location of wider information sources and connections with wider networks of information, knowledge, and wisdom. As I observed at the hackathon the participants used only data that was available on the day, or supplementary data available from open data portals. Information was utilised by some of the participants in their artefacts, such as the Historic City app (Figure 15 and 16 above, p.125) that brought together historic images of the city with information.

4.4.6 Pathways Forward

Expansion of hackathon toolboxes: This Pathway Forward is reliant upon the diversification of hackathon participants, who would bring with them a range of tools that could expand the current range. Rather than reliance upon tools and methods that are rooted within the creation of technologies and shaped by specific software systems, thinking beyond these, and focusing upon tools that fit the issue and the audience would bring about greater diversity in what is produced. Whilst hackathons have explored these (Taylor et al.2017), many events still rely upon tools and techniques that offer specific and specialist outputs, such as those seen produced at the hackathon I attended. Thinking in terms of design processes and exploring design methods, such as the ablative framework devised by Speed (2016) or adopting a more "designerly approach" to designing with data (Wolff et al.2016), could enable organisers and participants to take a considered approach not only to the designs produced, but also the tools that are used. Data do not necessarily need to be placed within a digital framework, as demonstrated with the Dear Data project (Posavec, 2016), which used analogue creative methods to visualise and explore a range of distinct types of data.

Think about data as a component of tackling an issue, rather than the whole solution: Practices of data, such as the hackathon, explore only the data that are made available, the format and useability of which can be inhibited due to poor presentation. Furthermore, hackathons sometimes tend towards being solutionist, presuming that only technology can solve a particular, often wide ranging and intractable societal problem. Thinking about a problem with a range of participants and engaging with a wide range of resources that include data, but do not focus solely on data can open potential designs and develop a more inclusive and representational design approach to issues.

Harness the well-meaning nature of participants: It was clear from the event I attended and reinforced in the literature that a key purpose of attending hackathons for participants is the social networking in person and chance to develop bonds that often outlast the event itself.

Participants also often want to do something good and useful, but the ways in which events are framed and organised often inhibits this. By placing greater emphasis upon the potential outcomes beyond prizes and the chance to work with a range of data, and bringing together a wider range of people, there is potential for simultaneously enabling social networking, but across wider networks which may be beneficial to participants. This can also increase the opportunities for developing projects that have greater longevity than the dominant approach which sees designs and prototypes go no further after an event.

Digging down into other data-sources: By using only data that are provided during an event, participants have a reduced range of materials with which to tackle the issue or theme they are exploring. Organisers could think about diverse types of data, and preferably beyond, or "more than" data, to include a range of information, or to signpost to distinct types. There are limits to data that have been opened, which relies upon greater access to better prepared data and this rests with large organisations and governments to enable.

Use tools guided by the issue being or theme being explored: Rather than jumping straight to the tool, such as a piece of software or programming a mobile application, the consideration of the suitability for the specific theme could be explored. The right tool might not always be digital, but within the framework of the hackathon tools tend to follow this route.

Taking a view from the ground up: to consider other data forms and potential tools. Stakeholders or those experiencing issues being tackled at the hack embody knowledge and lived experience of that issue and might be able to communicate this effectively. This might be done through the creation of stakeholder cards that are circulated prior to the event, where participants are able to read or see graphically represented, the key issues faced by stakeholders. By offering this information prior to the event, participants would be able to match their own experience and ideas with someone who has knowledge or lived experience. This approach would enable the participants to simultaneously work within the time constraints and gain a deeper understanding of key issues.

4.5 Place: sites and locations of data collection and re-use

Here place is considered both as a *site* of data collection and a *location* in which hackathons are held, where data are interrogated and re-used. Notions of space and place are explored in Chapter 2 (2.5) in order to understand the contexts from which data are extracted and locations in which hackathons are held. It is important to consider both.

The data re-used at the hackathon related to place in separate ways, from environmental data such as air quality and weather, to census data about people from that place, house price data,

images taken in a place, traffic accident and crime data. Use of GIS[4] data as the material for mobile applications such as Google Maps and applications such as Foursquare, what Cresswell (2015) calls "augmented" place that provide "*a level* of information" about place, but that are mostly one dimensional. Chapter 2 (2.5) contains a discussion on distinct types of mediation of place.

The participants were not asked about the location in which the event took place, but I observed the location, the data used on the day and the way in which participants related to place. Both the data sets used, and the participants were detached from place during the event. The participants did not leave the building during the day to engage with the places in which they were developed their prototypes. This approach reinforces the disengagement from place that Cresswell talks about and is "augmented." By engaging with a place, by getting out and exploring participants might experience serendipitous connections or encounters, which can add a different and more unexpected account of a location.

4.5.1 Place as sites of data collection

Software developers and programmers are engaging in place, often in profound ways, some of which are sinister (Cresswell, 2015, p.3). Cresswell states "Politicians want to know about place to finely target their funds or swing voters. Supermarkets want to know about our shopping habits so they can encourage us to buy more. Police forces and security services want to know about the links between crime and place so that they can more effectively discipline and survey. Google Maps purport to tell us about the places around us in objective ways but, in fact, is filtering place for us – directing us towards businesses that have engineered their appearance on the first page of a Google search" (2015, p.3). Whilst this use of data has clear benefits, such as enabling navigation around unfamiliar terrain, if we come to rely on our mobile devices for direction and forget to look up occasionally, we not only risk losing our abilities to read maps and our environments, but also the surprises and serendipitous experiences that we can experience in unfamiliar locations.

It is also important to consider locations that do not have access to the infrastructure of a data-driven place. Unlike the city I visited to interview hackathon participants, the island of Tiree, in the Inner Hebrides, where I visited to take part in the Tiree Techwave (6.2) has poor infrastructure and so does not have the "deluge" of data being collected and produced. By carrying out data practices in urban environments, which is also seen in the practice of the data walk (2.3.2) where there is ready access to infrastructure, we risk excluding those who might still benefit from being part of the conversation around data, and in designing products and

[4] GIS – Geographic Information System is a computer system for capturing, storing, checking and displaying data related to positions on Earth's surface

services for data-scarce locations. There is a presumption that everywhere has access to mobile signals and high-speed broadband, particularly if events are hosted in urban locations, little consideration will be given to locations without such ready access. There is also an abundance of data in urban locations, whether sensed or gathered from mobile or wearable devices, or through the collection of cctv or mobility data (e.g., that which are collected from the use of travel cards such as the Oyster Card).

4.5.2 Hackathons as location of data interrogation and re-use

Hackathon events predominantly take place in cities in what seems akin to Lefebvre's notion of "Abstract Space" (1991) such as office buildings. One participant stated, "It's incredibly difficult to book overnight spaces in cities." It is important for participants at hackathons to have access to spaces in which they can work comfortably from between 12 and 48 hours, with broadband and electricity." Whilst these spaces afford the practice of the hackathon, which requires access to power, internet and facilities for comfort, the places are often generic, sterile, and bland, rather than specific, situated and located. This might enable participants to focus on the task at hand and their technical requirements, but means little attention is paid to the location in which they are carrying the task out.

The nature of the hackathon taking place in generic and homogeneous spaces with urban locations also coincides with what Lodato and DiSalvo (2016) discuss in relation to the hackathon exposing "trends in global innovation, capitalism and labour under neoliberalism." These spaces enable participants to work unencumbered and focus on their task under time pressure, without the connotations or distractions that might arise from working in places that are full of other people or in grand locations. However, they are removed from social action and their locations, often away from genuine issues faced in the urban locations in which the data they use are extracted from.

The issue of the hack using location-based data from a point of remove, in abstract spaces is complex. On the one hand the spaces, often offices in towns and cities, offer the required technical specifications of the event and the ability for participants to focus on the task, whilst on the other inhabiting these spaces emphasise the point of remove from the place, both spatially and bodily, through datasets. The hackathons and therefore their participants inhabit *space* rather than *place* and consequently do not explore opportunities to uncover data that are not present in the datasets provide beyond the physical boundaries of the venue. These spaces are often generic, uninspiring (Taylor and Clarke, 2018) and could be anywhere, they are sterile and bland rather than specific, situated and located.

The choice of such locations for hacks are based around availability, as was pointed out by several of the interviewees when discussing the benefits and drawbacks of the events, who

told me they require specific infrastructure and requirements of participants for access to internet and power. They also provide a safe and often comfortable environment in which participants can simply focus on the activities.

Participants at the event relied on digital maps to understand the location and the use of location-based data on the day, rather than going out to look at the place. A wide array of information, knowledge, and wisdom, as well as lived experience resides in a place, and would add a richness to augment the data used at hackathon events. Archives, museums, galleries, and film and music made in the location, often about the location would add to the understandings of place available. These could potentially be gathered by organisers and participants prior to an event, or resources made available during the event, much like the data stores, that point participants towards available resources. These additional resources could represent those people the event was aiming to attract, such as older people or a more diverse mix of participants.

4.5.3 Pathways Forward

Situatedness: Consider what types of data might be located within a place and that might be specific to the area of interest or issue being explored. Think about what data means in the context of the location, how they are collected and what this means. Is there more data available than that which have been gathered and made available?

Exploration of what a specific, situated and located space or place might be in relation to the specific event being organised: Thinking about what would a specific, situated and located space or place be and why might that be important in this context. E.g., what might happen if organisers were to choose locations that embody the place, perhaps its historic origins and architecture, or a small community centre at the heart of a place in which a particular issue is being tackled? Or even outside, where participants can engage directly with the place and those who are situated within it. Whilst there are logistical issues inherent in taking a hack beyond their usual spaces, it might be that events are split and include time for participants to venture outside or into different locations surrounding the event. The creation of a new space for events such as hackathons, that moves between places in which the participants can be "on the ground" and inhabit embodied, situated experiences might encourage greater social action. Descending to the ground from the elevated view that deals with space from a Cartesian viewpoint taken in the hack, where locations are reduced to digital maps, might encourage participants to discover hitherto undiscovered data within a place, that encompasses other types, such as analogue.

Encourage leaving the space (go outside): Getting outside and walking or moving around the location in which events are held is important in understanding the context, even where

the issue or area of interest may not be directly located there. Walking not only encourages creativity but can also bring about greater engagement with other participants and uncover features or concepts latent within a location.

Range of venues that are not always non- or generic- places, that support the technical requirements: The location in which hackathons are held are essentially driven by the technical requirements. Hack events tend to be held in urban locations, which is due to the technical requirements. However, other locations beyond towns and cities offer potentially engaging and interesting sites that might encourage more diverse participants and bring about creative and innovative designs or products. Consider venues and locations that are not urban and tailor events to the context.

Consideration of data from, in, through place: Understanding how data are collected, stored, analysed, and re-used is important in developing products and services that will be of use to people. Breaking down collection of data *from* a location, *in* a location and *through* a location, whether through digital or technological methods, or physically, offers the potential for a wider range of diverse data, in addition to information, knowledge, wisdom and lived experience. A reliance upon only the data which are made open limits the potential for designing innovative and engaging products and services.

Consideration of theming data by place: The current open data dashboards tend to present data by theme rather than by a location. An exploration of gathering data together to build an "ontology" of place would be interesting to consider as a wider "data store," where there is a repository of a wide range of materials about a specific place. It would be interesting to explore how digital and analogue data, information, knowledge, and wisdom might be collated and stored, then accessed to enable participants to access more about a place.

4.6 Chapter Summary

This chapter has explored the following research question:

RQ1.1. What do data-driven understandings of place look like in literature and practice?

Hackathons represent one mode of re-assembling and re-using data that have been made open and available. Their prominence and the move towards organisations jumping straight to holding a hackathon, rather than thinking about other practices that might be more suitable for a given situation or issue, can inhibit the potential for talented programmers to contribute to the intractable problems we face today. As Rittel and Webber (1973) stated "Social problems are never solved. At best they are only re-solved, over, and over again." Through taking the example of the hackathon, exploring the growing body of cross-disciplinary literature encompassing research "with" and "on" hackathons, and carrying out interviews and

observing an event myself, a tangible example of a practice that re-uses data has been interrogated. A further practice, that of the data walk will be explored through a practice-based approach later in this research (Chapters 6 and 7) to understand how a practice that might take and embed the benefits of events such as hackathons, as outlined in this chapter, whilst acknowledging and addressing the challenges.

This chapter has explored how place is represented in, with and through data assemblages, specifically through the practice of the hackathon. The literature discussed in Chapter 2 enabled me to develop a deeper understanding of both the benefits and challenges of data practices, in particular the hackathon. Through carrying out interviews with participants at an event these findings were contextualised and explored in greater depth.

The findings from the interviews match much of what was expounded in the literature, in particular the issues relating to a lack of diversity in participants and the lack of continuity with designs after the event ends (2.3.1) Furthermore, the findings from this chapter articulate existing and potential benefits of hackathon events that might be strengthened further if carefully considered by not only organisers, but those making data open, commissioning such events and attendees, or potential attendees.

What might an alternative practice of data look like?

From the insights developed in this chapter and the Pathways Forward (Table 7) it is possible to begin sketching out what a practice of place-based data, that also includes information, knowledge, wisdom and lived experience might look like. One of the key benefits of the hackathon is the potential for bringing together individuals with a range of skills and interests, but at present this is inhibited by the reach of the practice, which tends not to be inclusive or representative of different segments of society. Basic considerations such as thinking about the types of design processes that might be used, and enabling participants to utilise some form of guide or principles to think through and then develop ideas and prototypes that go beyond data,

Theme	Pathways Forward
Practices and people	Create a public around a problem or design challenge
	Pre- and post- event engagement with data and issues
	Consider different formats to encourage wider participation
	Harness the sense of collaboration and solidarity
Data-driven products and artefacts	Expansion of hackathon toolboxes
	Think about data as a component of tackling an issue, rather than the whole solution
	Harness the well-meaning nature of participants
	Digging down into other data-sources

	Use tools guided by the issue or theme being explored
	Take a view from the ground up to consider other data forms and potential tools
Place: Sites and locations of data collection and re-use	Exploration of what a specific, situated and located space or place might be in relation to the specific event being organised
	Encourage leaving the space (go outside)
	Range of venues that are not always non- or generic- spaces/places, that support the technical requirements
	Consideration of data from, in and through place
	Consider theming data by place

Table 7: Summary of Pathways Forward developed in this chapter

could bring about more engaging and possibly more "useful" prototypes that could be developed beyond the event. A key alternative to the current practice would be the consideration of the location in which the event or activity is held, whether that is urban or rural and whether it is outside, or partially outside, or inside. By getting out into a location, with others, and exploring it, participants are opened to serendipitous experiences, that enable them to develop more situated designs. Engaging with people who experience the issue being explored, or from the location, who hold situated and embodied experience, rather than relying upon those who will attend for the activity of programming is also important. The hackathon, or data-based activity could form one component of a series of events, which take place in various locations, or engage with a range of data, information, knowledge, wisdom and lived experience (DIKW). The Pathways Forward in Table 5 offer a starting point to thinking about designing a new practice, based upon the interviews carried out in this chapter and the literature explored in Chapter 2. This chapter has demonstrated

4.6.1 Key Findings from the Hackathon

The key findings from this chapter are that hackathons, which represent a practice that seeks to materialise data assemblages through bringing people together, does have the potential to "do good" and engage with place. However, the ways in which they are organised, often to a similar format, inhibits the potential of their engagement with a wider community and wider, more situated modes of understanding place. Relying upon data that have been gathered from a location alone is not a suitable approach to tackling the complex issues of our time, nor does it enable those currently excluded, whether through infrastructural, economic, or social barriers to access and engage with the data-driven society.

These findings inform the next steps in this research through acting as a base from which to develop alternative modes of understanding place that weave in the positive aspects of the hackathon (e.g., bringing people together around a problem) and through considering data as a useful component to understanding place. The findings presented here are embedded within

the interviews in the following chapter, that when synthesised in Chapters 6 and 7 inform a new practice of More-than-Data through walking.

The Pathways Forward developed in this chapter will form the basis of further Pathways Forward that will be developed from a separate set of interviews with participants who engage with place in a different, more situated way in Chapter 5. By bringing the two together and synthesising the findings, the Pathways Forward will form the basis for developing and testing a new practice, which is presented in Chapters 6 and 7.

5 Situated data: People and place

This chapter explores how situated knowledges are present in a place and is manifest by people who live and work in a particular context. These understandings of place offer alternative insights, opportunities, and challenges to those presented in Chapter 4. The chapter explores the following research question:

RQ1.2: What do information, knowledge, wisdom and lived experience understandings of place look like in literature and practice?

Chapter 2 explored literature relating to information, knowledge, wisdom and lived experience, and this chapter augments it by carrying out interviews with a range of people in a bounded location.

The aims of this chapter are achieved through carrying out interviews with five people who live and work in and around a small market town in the Calder Valley in Yorkshire. The purpose and key findings of the interviews and field notes made during the visits are presented and then discussed, to identify opportunities and limitations of their experience and understanding of that place. These interviews are then synthesised with the findings from Chapter 4, and similarities and differences between the two approaches are presented at the end of this chapter. The insights then form the basis of a set of research questions to be explored in Chapters 6 and 7.

The interviews presented in this chapter have been called "situated" to reflect not only that they took place in the location being explored, but also that those interviewed live and work in that place and have in-depth lived experience of the location and of flooding. The notion of situated knowledges was previously explored in Chapter 2 to offer an underpinning for the ways in which place might be understood in alternative methods than those that are predominantly data-driven.

By carrying out these interviews in a place and interviewing participants about their experiences with data in that place and the ways in which they engage with data-driven technologies, I was engaging with post-phenomenology. Exploring the key factors relating to specific technologies and developing an understanding of how they relate to people and place underpins the empirical research carried out in this section.

5.1 Data collection and analysis processes

The data collection processes, types of data collected, and analytic method described in Chapter 4 also apply to this chapter (4.2). As with the interviews carried out in Chapter 4, the sampling method used for the interviews presented here was purposive. However, the strategy used in this chapter was snowball/chain referral (Guest, Namey and Mitchell, 2017, p.48). This strategy uses participants' social networks to identify other participants and asks participants to refer others based on criteria (Guest, Namey and Mitchell, 2017, p.48).

5.2 Situated Interviews

The focus of interviews carried out in this chapter emerged from the insights developed in Chapter 4 and took place after the interviews at the hackathon. The themes identified in Chapter 4: Practices and People; Data-driven artefacts; Place: sites and locations of data collection and re-use, formed the broad basis for the next interviews. Different questions were developed for the interviews in this chapter, as the context of the interviews was different and explored not only data, but also the notions of information, knowledge and wisdom as represented in place and those who inhabit it. The locations of this research were rural and semi-rural and were chosen to offer a counterpoint to the urban focussed data-driven approaches highlighted in Chapter 4. As urban locations are often the location in which data are considered and re-used (Chapter 2.5) by exploring rural and semi-rural locations of DIKW we might come to understand the affordances and challenges of a wide range of places for the practices of data to occur.

As with the hackathon interviews (Chapter 4), the intention with the interviews in this chapter was to gather focussed information to gain deeper insights into key areas that would augment the literature surveyed in Chapter 2. The interviewees do not represent a wide range of people working and living in the Calder Valley but offer insights that are situated in place which offer a counterpoint to the nature of data and its abstraction from place, as explored in Chapter 4.

Flooding as a key focus: Semi-structured interviews used the lens of flooding to understand the relationships of interviewees and the data, knowledge, information, and wisdom (DIKW) they encounter in their daily lives and ways in which they use these ways of knowing. While flooding was chosen in this instance, the following exploration of DIKW in place might be situated around challenges faced, whether in towns, cities, islands, or rural locations.

The Calder, the river that runs through the Calder Valley and its larger catchment area is often the cause of significant and severe flooding and has caused widespread damage over many decades (Forrest et al. 2018; Eye on Calderdale, n.d). This area is an interesting location,

particularly in terms of its geography and history of flooding. As a result of the frequent flooding

CODE	DETAILS
IV1	Permaculture specialist who works predominantly in the north-west of England. Has been working with IV2 in designing ways in which to work "with water" on his land.
IV2	Owner of farm (non-livestock) in the Calder Valley. Interested in the use of permaculture methods and natural management of land to work with, rather than against water.
IV3	Environmental activist and member of several groups in the Calder Valley who campaign for environmental causes, design, and implement natural flood management projects and work with local and national agencies in wider flood management initiatives.
IV4	Works for a charity in the small town in the Calder Valley who fundraise and distribute funds for local businesses for recovery from and development of resiliency from flooding.
IV5	As IV5 but is also a designer who has carried out place-based projects. Also, a cyclist in the local area.

Table 8: Details of interview participants

a range of community-based action groups have been set up in the area, who work with the local and county councils and the environment agency. Flooding is an increasingly important societal issue that will get worse in the future (Forrest et al. 2018) and one area in which data are used to understand and mitigate the effects of such events, through modelling and the use of weather and flood prediction applications. The notion of "learning to live with water" is now high on UK and international research and policy agendas (McEwen et al. 2016) and one area in which data is considered as a vital component to understanding how this might be done. However, it is also being recognised that data are not the only material needed to learn how to live with water and the collection of local, or lay, knowledge is being seen as vital to understanding how we might become more resilient in this area in the future.

5.3 Practices and people

Interviewees were asked about their experiences of flooding in the town and how their work explores this issue. Three of the interviewees live and work in the town (IV3, IV4 and IV5), one lives in a nearby town (IV1) but has carried out work in the Calder Valley and one lives around 5 miles outside of the town in a hamlet in the Calder Valley (IV2).

5.3.1 Motivations and values

To understand why the interviewees, carry out work around flooding, they were asked about their motivations and more generally about the kind of work they do. All the interviewees engage in one way or another with water, whether through designing interventions to live with water, through being a member of a range of groups who seek to find solutions to flooding and are engaged in environmental activism or working for a charitable organisation that supports members of the community who have suffered because of flooding. All the interviewees demonstrate a care for their local environment through their engagement with not only dealing with the aftermath of flooding, but in their work to prevent it where possible.

Collaboration of groups in the community: Interviewees communicated different motivations, however they largely related to care for the environment and care for their local community. For example, IV3's work relating to flooding involves natural flood management, such as the planting of trees and creation of leaky dams, but also extends to the contentious issue of the grouse moors above the Calder Valley and the impact their burning has upon the flooding of the town below. One of her key aims is to increase involvement of local people in preventing flooding and the wider issues of climate change but does so through action and long- term projects in the area. She also placed emphasis on the need to work with a wide range of groups, telling me "We've got the wildlife group. The rivers stewardship group, Moors for the Future, all those people liaising with each other and working together … it's helped us develop philosophically … we wanted to think about flooding, carbon, habitats, all that side of stuff … we turned it into integrated catchment management as well." This demonstrates a need for collaboration beyond a particular specialism and the variety of data, information, knowledge, and wisdom that would be required to solve particularly complex issues at a catchment level. Here we can see those solutions to complex issues such as flooding cannot be solved in the data-up methods used in Chapter 4. Collaboration in the context of situated understandings of place require groups of people to form around a particular issue and to bring a wide range of experience and expertise to an issue.

Diversity of community groups and activists: Collaboration amongst those living within and beyond the town increased after the floods on Boxing Day 2015, as IV3 told me "After Boxing Day there was this huge new impetus and everybody wanted to get involved and actually it's a good thing, so they joined our partnership." When asked about the constituent

members of groups and their diversity, IV3 told me that whilst there was a wide range of experiences and expertise, the age of members tended to be more towards the middle age and retired, but with a reasonably representative gender split. This tendency towards members of such groups being those who have time on their hands due to being retired does not represent diversity of age and experience, with perhaps younger people in the community tending to join such groups less. In his white paper "*Open Data Islands and Communities*" (2014), which explores the potential contributions of and limitations of using open data for communities in rural and isolated locations, Dix also recognises that activists involved in projects are "often retirees who may not be IT (Information Technology) literate."

In the context of the Calder Valley and the interviewees, there is a desire to be involved in mitigating and dealing with flooding, but a wide range of knowledge, wisdom and lived experience might be missing if only local community groups were to be involved in its contribution. Furthermore, skills required for understanding and engaging with data might also be lacking, as Dix states (2014). There are also wider issues relating to issues around lack of infrastructure and the digital divide in rural and isolated communities (see 5.3.1) that lead to a gap and potential lack of diversity.

5.3.2 Collaboration and community

Interviewees featured in Chapter 4, who take part in hackathons, give up their spare time to attend the events and the activity is carried out in addition to their paid work. Similarly, the interviewees in the Calder Valley are also largely amateurs (except for IV1 whose profession is permaculture). One interviewee has learned about the location in which he now lives and works through experience and working with another interviewee; an environmental activist and has been involved in a wide range of flood action groups but in a voluntary capacity; a volunteer flood warden and works for the charity and a designer by profession and carries out much work on a voluntary basis. The considerable number of community groups working in the area of flooding in the Calder Valley consist of volunteers, but this does not mean that there is no knowledge or experience present within these groups. As with the hackathon attendees, there is a deep level of understanding and skill that has been developed. However, the experience and knowledge built up in the flood group members has often accrued through lived experience and is very much situated within that place.

Not enough people from the community were interviewed to gain a deep understanding of who does what and the sense of community in the town and surrounding area, but accounts from the interviewees suggested that during and after the flood events suffered locally, people work together.

Working together: When I met IV4 and IV5 for the first time they asked if I knew anyone doing any work relating to flooding and managing water, so I told them about IV1and IV2. As a result of this IV4 and IV5 went to see IV2 and discussed ways in which they might collaborate in pooling the DIKW they both shared about the local area. One discussion they had focussed on the potential for allowing certain fields to flood, which would mean close working with farmers in the area who owned or managed the land. They also talked about natural flood management and its growth in popularity in recent years, and the potential for people to just go out and plant the wrong trees in the wrong place, which have an impact upon the ways in which water flows and might cause more issues in other places. IV4 said "this area is massively political. There's loads of stuff going on … There are loads of people trying to do their own thing … It's a bit chaotic. You've got the natural flood management people coming together and doing something to feel like they are actually doing something, and then you've got the modelling people who are trying to put all of this data into models, but they can't because it doesn't work at such a small scale. Then you have things like porous stone, permeable paving, so people are starting to use that, and how do the modellers include that on such a scale?"

Further down the valley, IV2 told me there was not really a sense of community when flooding occurred, but that the local people united around the poor state of the road that runs through their section of the valley. These accounts demonstrate that understanding what is being done around a particular issue, even in a relatively small geographical area, can be complex with many distinct groups and individuals involved. Identifying the motivations and values of such a complex ecosystem of people is challenging and they are often conflicting, as IV2 suggested.

Challenges of connecting distributed and disconnected people: Connecting people who are interested in working on a particular issue can be challenging in urban locations, as well as those places which are rural or isolated. In locations such as the Calder Valley there are small hamlets with only a few houses, small villages, and small towns, all of which are separated by challenging terrain and often poor transport and road links. I found when carrying out the fieldwork that even though IV2 lived only around 5 miles from the small market town in which I met IV3, IV4 and IV5, both locations felt particularly isolated due to the geography of the valley, with its steep sides and challenging roads.

Here, technology can have a role to play in connecting people who are separated geographically, and the use of social media has increased during flood events. The local flood action Facebook group is well-used and regularly updated, particularly when flood warnings have been issued. This provides communities with methods of communication that are informal but relies upon consistent infrastructure and regular use by a key number of people.

5.3.3 Tensions: practices and values

Tensions between different communities of practice: Whilst interviewee IV3 suggested community groups worked together and shared information between them, IV4 had a different view on sharing of information between organisations and individuals and told me "There's a lot of people who are very precious [about sharing information] … There are a lot of different responsibilities and pressures on organisations." IV4 spoke of difficulties with the flood container they must access as part of their role as flood warden and the inability to work quickly and responsively due to the constraints of organisations.

Where there are different constraints and pressures on groups working together, often with organisations (in this case the Environment Agency, local and county councils, and Government) there are frictions which result in delays and slow working. While small, community led groups form around an issue and can respond quickly (as was seen in the community itself when flooding occurs), larger organisations are often not able to respond as quickly or dynamically due to their structures and procedures.

This is essentially in opposition of the speed and agility of the hackathon, as explored in Chapter 4, with the safeguards and policies in place that might lead to delays in acting.

Conflicting values: Causes of flooding and the consideration of the most suitable solutions for a specific place are contested. Furthermore, the complexities of both place and people, with their conflicting values makes negotiating suitable responses an intricate and complicated process.

I found that in the interview with one interviewee that their role as both an environmental activist and member of different flood groups a range of issues were raised. They communicated a lot of information and knowledge about local issues, such as the burning of grouse moors locally and the benefits and issues of tree planting to slow the flow of water. This is a political issue, that plays out in different contexts that are also bound spatially. For example, the grouse moors on the hills above the valley are privately owned and managed, providing a livelihood for people in the area, but simultaneously encompasses tourism, where people visit the area to take part in grouse shooting. The conflicts between which DIKW are chosen to represent or utilise by each group are enacted by the values of the different parties; the flood groups, environmental activists, organisations such as Natural England and the Environment Agency, landowners, their employees, and visitors. This choice of what is done in this area, based upon DIKW about that location between the potential benefits of leaving the moors unburnt, meaning they would absorb more water, and the impact this would have upon the local economy due to the lack of tourism for shooting.

The spatial bounding of land, between public and private also affects the availability of data, e.g., it is not possible to access the place as it is private and so only those with access are able to gather and share this data. Open data relies upon a shared concept of making data available to everyone on accessible platforms. Land which is available to everyone is a site where DIKW can be gathered, but this relies upon access and then sharing of the data.

Useful practices of sharing DIKW: In the interview with IV1, I asked how the groups she is involved with have engaged with communities and organisations, in order to understand the kind of practices that occur in the gathering and sharing of data regarding flooding. Workshops tend to be the key way in which researchers and organisations (e.g., local councils and the Environment Agency) have engaged with communities who have experienced flooding. However IV1 suggested that there have been too many workshops, listing the different events that had been held "First there was the Friends of the Earth who did an initial response, then there was the Flood Commission and they've had workshops up and down the valley, then there was the flood event done by the Science Group, then we had the Environment Agency events … the local MP had a meeting, plus there have been the usual group meetings … then before the last floods we had a series of learning events about flooding, and we also had a PhD student who did 6 workshops on flooding … So, we are utterly workshopped out … Then next week there's the next flood meeting and a new flood workshop next month held by the local council … There's loads going on and everybody has their own little patches and trying to bring them all together is quite complicated." This demonstrates that while there is a lot happening in the local area and a lot of activity, there is perhaps a lack of joined-up thinking, where workshops or other potentially more engaging activities might be organised by different organisations. This might ensure that there is greater cohesion locally. The substantial number of workshops does not necessarily equate to meaningful action being taken and the results and outcomes of such events might be diluted. IV3 also confirmed that there is a lot going on in the area, and that this sometimes resulted in efforts being "chaotic." If groups tend to be made up of those with time on their hands (section 5.2.2) the same people will attend workshops and events, leading to the production of DIKW from a more homogeneous group of people.

This considerable number of activities and workshops is similar to the sheer number of hackathon events dealing with similar issues in dispersed locations and often replicating effort. Furthermore, workshops tend to be held indoors and, as with the hackathon might be limited in terms of understanding place and exploring potential solutions and approaches that are situated beyond the walls of community centres and other civic buildings.

5.3.4 Pathways Forward

Bringing people together around a specific issue: The interviewees suggested that there is a strong community spirit in the area, which was reinforced by reports published after the

floods and manifest in the Facebook page dedicated to the local area. However, this does not necessarily mean that wider members of the community are involved. Much like the interviewees demonstrated in Chapter 4, a community can grow around an issue, or around a specific event as with hackathons, but that community may not be diverse and may represent only a narrow range of experiences and therefore information, knowledge, and wisdom. In Chapter 4 a key way forward, based upon the issue of a "data-up" approach (section 4.x.x) was to bring people together around a specific issue. The interviewees in the current chapter demonstrate that focussing on a specific issue can enable deeper understandings of that issue. However, the interviews and observations from the Calder Valley also demonstrate that there are often a range of "publics" in a place, resulting in a complex ecosystem of actors who all approach the issue in unusual ways. Dix (2014) suggests compiling metadata to understand what kind of data and local knowledge is available in a place, which would go some way to capturing the complexities of place and those actively engaged in communities. It might also aid in identifying gaps in DIKW and in communities, where further action might be taken to ensure a more comprehensive range of DIKW in a place.

Understand the diverse and complex nature of communities: The hackathons explored in Chapter 4 lacked diversity in terms of age and perhaps backgrounds (in that participants tend to be young and predominantly from a programming background), whilst the participants and the communities of practice they belong to tend towards being older and perhaps middle class. Whilst the latter demonstrates a more diverse array of backgrounds and expertise, there is still not a diverse representation. A community is heterogeneous and it is important, when tackling complex issues, to understand how communities are made-up and where there may be gaps in age, gender, background, and experience.

Explore and articulate the common and conflicting values and politics: Within communities, whether they are constituted geographically, or around shared interests, a range of personal values and politics exist. Understanding these is vital in developing activities and bringing together DIKW in a place. It is not necessary to reconcile these conflicts but foregrounding them can bring about understanding. Walking side by side has been shown to encourage resolution in conflicts (Webb, 2017), and this is an activity which could encourage the revealing of values and politics and an opportunity to explore them.

Understand tensions between different communities of practice: As with the PF above, it is important to foreground any tensions between separate groups. Communities of practice might be, for example, natural flood management groups, designers, or flood activists. These groups all have values, that is, priorities and things that are important to them. They also have practices that they are embedded within. For example, a natural flood management group may have views or practices that are in tension with data scientists and flood modellers. However, there may be points of interest, in that they share a common aim of dealing with flooding.

Exploring and getting underneath these tensions can enable the development of a wider cross-disciplinary community of practice, that holds at its core a shared aim.

This section has introduced findings that relate to how different people relate to one another within a community, which has drawn out insights into potential areas of conflict, and areas that offer positive and beneficial areas of collaboration. The following section explores how different people understand and use data-driven technologies.

5.4 Data-driven technologies in place

5.4.1 Critical infrastructures

During significant events such as flooding, a collapse of infrastructure (as seen in Lancaster, see Interlude #3) is possible whether in urban or rural locations, for example mobile masts losing power due to widespread power outages. Where effort is placed on creating mobile applications for issues such as flooding, it is vital to consider whether the data being re-used and the materialities into which they are formed will be of any practical use during such events. When I asked IV4 and IV5 of their experiences of using mobile phones during the Boxing Day floods of 2015 they both told me that widespread issues with power outages and mobile signals had led to communities relying on analogue methods such as using landlines (many of which were also out of use due to their reliance upon electricity) and that people were mostly outside so shared information that way. Furthermore, they told me in the town and the wider valley visited for the interviews there are elderly populations who do not have access to the internet or smart phones. IV4 told me "We appreciate … there is a proportion of people who either choose to or are unable to go online. Some have a phone they can use to receive warning text messages. We have provided guidance and information for those communities." In the last flood they had pockets in the valley where mobile reception went down.

It is also important to consider that such outages, where people are not using their mobile or wearable devices lead to "data black-holes," where no data are produced or captured during these events. Instead, during such events, people are focussed upon dealing with the emergency, often only stopping to reflect after the event.

5.4.2 Mobile applications for flood prediction

Use of flood prediction applications: Hackathons often produce technological artefacts, such as mobile applications, dashboards and visualisations that are data-driven. In recent years issue-focussed hackathons have been held that specifically aim to tackle flooding, such as the 2015, UK Government funded Floodhack which was organised in response to the flooding caused by Storm Desmond. The ODI (Open Data Institute) in Leeds also organised a series of hack days to explore data-driven solutions for flooding. Most designs from the two events

were prediction and warning applications, using river levels from gauges and weather data, or communication applications that run on 2G networks. When speaking to IV4, they told me that they had been developing a local flood application with their partner and told me "People use it … what we do is, when the weather is looking bad and river levels are starting to rise, we would put out a post on Facebook and Twitter, so people start sharing that the app is there. There's people that regularly use it in [the town] and you get a spike checking river levels, what we want to do is use the MET Office's API (application programming interfaces) to bring in weather data too. When I asked whether they had considered how people who don't have access to smartphones might access this data and flood warnings they told me they had not really considered that. Residents in the town and other areas of the Calder Valley that flood regularly are warned by sirens and flood wardens (see section 5.4.3). Therefore, the real use of an application that shows only river levels taking data from the gauges, which do have gaps in coverage, might not be of significant use to a wide range of people in the area

5.4.3 Use of social media to map changes in the environment

In the interview with the representatives from the flood charity (IV4 and IV5) I asked whether they look for changes in their environment, through flooding or prior to a flood.

IV5 showed me some photographs on their mobile phone from cycling trips on the hills in the Calder Valley he had made over the last five years, to show how he had noticed the ground conditions change over time. He told me that he had asked for photos from other cyclists and walkers on Facebook to try and see how the area and the condition of the ground had changed over time. "Cyclists love taking photos of where they are, and walkers" … "Mountain bikers talk to each other, there is a strong community of them around here and online" which could potentially offer a rich archive of how place changes over time. The group noticed there had been no frost that winter and that the ground had remained largely water-logged. IV4 and IV5 also discussed Instagram, where they both publish images from the charity and for the flooding app, and IV4 said "I use the [app] Instagram page and whenever we go anywhere that's near water, I always take some photos because people only use the app when it is going to be flooding, so I want to make it more interesting.

IV2 told me about his use of YouTube to get information, knowledge, and wisdom, and uses an online allotment diary to see when others are planting vegetables.

Warnings in place: Areas prone to regular flooding often have an emergency siren which sounds when there is an imminent threat to enable residents to prepare and evacuate their properties if necessary. Residents in flood—prone areas such as in the Calder Valley get warnings through different means, such as the audible siren. Text message, telephone, email, and these are issued when properties are likely to flood. Flood wardens are issued with radios

and physically visit houses to ensure residents are aware of the warnings. These measures are used regularly and mean that there is provision should infrastructure be damaged. Therefore, many applications for mobile phones, that are driven by data, such as flood warning applications aren't of that much use to people experiencing flooding, which further highlights the need to think about what else, other than mobile applications, could be done with the vast amounts of data being collected and then re-used at events such as the hackathon. Such warnings do not require residents to have mobile devices or access to the internet, which is vital, particularly in areas with a high proportion of elderly people or those without access to mobile devices or the internet.

5.4.4 Pathways Forward

Tangible data, information, and knowledge about flooding in support of mobile applications: Data-driven mobile applications, such as flood prediction apps, do serve a purpose, but often provide a reductive approach to predicting flooding due to the metrics they use. Often flooding results from a complex set of interacting events, including complex catchment issues, surface water flooding, and features in the landscape that cause issues. Those with lived experience of flooding and volunteers such as flood wardens are accustomed to dealing with these events and often know what to look out for in their environment. A reliance upon technology is fallible, as seen in examples such as Lancaster in 2015, where infrastructure failure can lead to not only a lack of data being used through devices such as mobile phones, but gaps in data being collected.

Consider potential usefulness of using particular technologies in which data are embedded: Not all technologies afford useful solutions to complex issues, as explored in Chapter 4. The interviews in this chapter have demonstrated that data are of use, but as part of a constellation or ecosystem of DIKW, rather than being the main source. In remote or rural locations, it can be difficult to use mobile applications due to lack of mobile signal. Adapting the use of technology here is important, perhaps by developing, where suitable, a mobile application that can be run using 3G signal. For example, Dix (2014) developed a mobile application called FRASAN for the isle of Tiree, which either signposted people to locations on the island, or websites, and was designed specifically for use on a 3G signal. Understanding the limitations of a location prior to developing a technological solution is vital.

This section has explored the diverse ways in which data are embedded in technologies used in places to predict weather and flooding. A series of Pathways Forward have been developed that point towards understanding the potential benefits and challenges of using data-driven technologies in these areas.

5.5 Place: sites and locations of DIKW collection and re-use

Understanding the different facets of a location in which a range of data, information, knowledge, and wisdom can be gathered from and re-used in is explored in this section. Different modes of understanding, using data in the form of mobile applications, alongside more situated knowledge, such as observations of the weather over time offer deeper insights into the place itself.

5.5.1 Knowledge systems for understanding place

Local and lay knowledge, including lived experience: The floods in the Calder Valley have been recorded through a range of methods, which are stored publicly (open data, books, writing, art, products, research, oral history and archival materials, social media posts), personally (personal memories, photographs) and privately (research, unpublished work), in place (e.g., damage done to natural and built environment). Folklore and weatherlore are also often representations of local knowledge that have been passed from generation to generation, such as "Red sky at night, shepherds delight, red sky in the morning, shepherds warning." Such lore is rooted in scientific observation and can add richer layers to how we might understand and communicate DIKW in a place.

All interviewees collect data, whether using social media (e.g., cyclist's photographs on Facebook, IV5) or the use of environmental modelling (IV3), to the logging of water levels in both analogue and digital methods IV2, IV4, IV5). However, through their long-term involvement in place, they have also gathered a depth of information, which they apply through knowledge and wisdom. This is done through the adaptation of land to deal with flooding (e.g., IV1, IV2 and IV3) or watching the land to understand when flooding might occur and act in the local community (IV4 and IV5).

The growing significance and accrual of local and lay knowledge in the field of flood research, particularly that which relates to the resilience of communities has led to the concept of "sustainable flood memories" (McEwen, 2016), which draw upon narratives, oral and archived histories, physical marks, artefacts and material practices in the landscape, and media representing floods, comprising folk memories, autobiographical accounts, personal stories and anecdotes of previous floods, and their impacts. Local and Lay knowledges can be manifest through the experiential, observational, hobbyist, cultural, intergenerational, archival and are variously accrued by individuals and groups (McEwen, 2016).

In the interviews with all interviewees in this chapter I found the communication of knowledge found in place that constitute both local and lay knowledge, through their communication of their own memories and experiences of flooding, as well as anecdotal accounts. Traditional

environmental knowledge was present, but perhaps less so. IV2 also told me about the Rush Cart festival held on his farm every year. This festival began with the Pope in the 10th century and now theirs is one of only a few that occur annually. The detailed origins of the festival are not known but are thought to be connected to the harvesting of rushes and their transportation to churches, where they would line the floor.

Another example of local, or lay knowledge was relayed by IV4 and IV5, who told me "There is a woman who lives in my village who is 96 and she has lived there since she was 5. The house had a driveway and had fields going up onto the valley and it was always wet. Water would come over the tops, but their houses were safe. Every autumn the village would get together, the men would dig ditches and the women would make tea and sandwiches, and that was what they did every year to keep the land and houses safe. Then it stopped happening. Then you look at how people are tarmacking their drives and there is less land to soak the water up."

I also encountered traditional ecological knowledge relating to the burning of the grouse moors in the valley, which occurs on privately owned land. IV3 is involved in campaigning for the burning to stop as some modelling commissioned by one of the groups, they are involved in suggested there would have been a 10% reduction in the flow of water into the town during the 2015 floods, which would have had a significant impact on the damage done. The burning of the heather on moorland is a contentious issue throughout the UK, with issues such as ecosystem degradation outbreaks of wildfires (Davies et al. 2008) and its impact upon flooding. Much of the practice of burning is based upon traditional practice and existing knowledge of the heather regeneration. Key to keeping the moorland's complex ecosystem intact is sphagnum moss, which was largely damaged from pollution during the Industrial Revolution. When the moorlands began to be used for grouse hunting bogs were drained to dry the land. IV3 told me they have been out on the moorland with representatives from various agencies and encountered a gamekeeper who was involved in burning the heather and who told them they were carrying out work designated as "stewardship" ad carrying out restoration burning. IV3 also spoke of farmers, some of whom continue to use traditional knowledge systems[5] (Rebanks, 2016), telling me that "another aspect which is important in flooding is the farmers and the commoners … and to a certain extent the funding regime. So, it's not in a farmer's economic interest to do the natural flood management … there has been an increase in sheep farming over the last century but they [farmers] still see it as a traditional livelihood and somehow people think that because it has been going on for three generations

[5] Recently the Cumbrian farmer James Rebanks has written about the traditional methods of farming he still uses and how much of his knowledge of the local area and traditional methods have been passed down through generations of his family.

that it is kind of traditional." These values also demonstrate clashes, but where there is potentially useful DIKW to be gained from the farming community who have lived and worked in the area and have been witness to and experienced flooding.

As discussed in section 5.3.1, there a differences and clashes in values where place is concerned and, moreover, clashes of information and knowledge, particularly in contested and political areas. This makes it difficult to ascertain which pieces of DIKW to utilise and the choices are fundamentally subjective and shaped by whoever is making use of them. The gathering of DIKW in such contested places is challenging and objectivity is not always possible. However, if such DIKW were collected and assigned meta-data, it would be possible to reveal and document the values of the methods of collection and potential in re-use.

Use of data: When asked about whether they make use of data, IV4 told me that the local Facebook flood group was set after 2015 and people used it for giving out information and advice. They also told me that the Environment Agency have done a lot of that as well, saying "They have gone into areas to meetings and collected knowledge from people that have lived in the houses that have flooded regularly, people living there for 50 years, sometimes longer …They know the [flood] triggers and the weak points in the town." IV4 also told me "I have tried to find open data in this area, I've asked various people before if we can look at it [open data] and they said "Yes, you can look at it, but it won't mean anything to you" … I mean, it's all good saying you have all this open data, but if it isn't in a format, you can understand it isn't much use." This issue relates to the issue of data literacy and accessibility that was explored in Chapter 4, section x, specifically that open data are only worthwhile to those who have the skills to process and analyse it. IV4 is interested in accessing and using data, but without the requisite skills is unable to utilise a resource that might be of significant use, not only to the application they have worked on with their partner, but also in gaining insights that support their own lived experience and knowledge of flooding in the area.

Access to TEK, local and lay knowledges: Whilst DIKW gathered, stored, and recounted in communities offers rich and, as increasingly recognised, value in developing understanding of complex issues such as flooding, it can be difficult to locate and access. Whereas open data, as explored in Chapter 4, can be stored, and accessed through data-repositories (although challenges lie in the need for tools and skills), more latent DIKW as held in people or culture of place might pose challenges in uncovering. Publicly available archival material, whether in analogue or digital form can be accessed, if one knows where to look, but latent or cultural DIKW are not always documented or may disappear over time, as Dix (2014) states "… much cultural knowledge: stories, songs, crafts, language, may be lost or at best locked in locally stored hard copy or old media, inaccessible to the external scholar" (Dix, 2014).

Figure 17: View from interview location at farm over the clough the interviewee watches for water

5.5.2 An example of DIKW in place: wisdom from the slab

During both interviews with IV1 and IV2 both interviewees spoke about the ways in which they look for water in the landscape to understand when there may be an issue. Reading the land is a fundamental practice of permaculture (Chapter 2, 2.10) as Holmgren (2020, p.10) states 'Reading the Landscape" to understand the pre-existing and often subtle but persistent patterns created by nature and ancestral use of the land, is the foundation for permaculture design." Both interviewees (in particular IV1 who is a permaculture designer) see reading the landscape over time as vital to understanding what is happening and designing interventions accordingly. They supplement this approach *with* data, rather than beginning with the data, as was seen in Chapter 4 (4.4.1).

We are surrounded by a rich array of data, wherever we are in the world, but the practice of interpreting it has become less familiar to many of us now that we can rely on others to transform it into information for our consumption. Those who work closely with the land, such as farmers, are still engaged in these practices.

IV2 told me that when they bought the farm, they walked the land, and they knew nothing about the place. Walking around the farm it was possible to see the impact of industrialisation on the landscape, with the canal running through the bottom of the valley electricity pylons,

the railway and tunnels, scars on the hills from mining and the reservoir up on the hilltop. While standing outside in heavy rain, IV2 pointed out to me how he looked across the valley to see the state of the water. Above their farm at the top of the hill, around 1 mile away is a disused reservoir, which can often cause flooding down the hillside. IV2 explained "I guess we've learnt quite a lot about when the reservoir is going to flood by looking at the clough[6] opposite (Figure 17). Just down from the top there's a cross and there's actually a slab here and I use that as it is a curtain water fall, about 6ft high and about 3ft wide and you will either get a trickle or it will spread wider and I will get up in the morning and I will see how much rain has fallen and think about what I need to do, based on the flow of the water in the clough." He also looks at the water level in the spring in his barn, telling me "If that's [the spring] is brimming I know we are probably in for a flood. Floods here don't result from the water rising, but mostly from the reservoir overflowing and coming down the road." As well as looking at the water, IV2 listens to and sees the wind, "I always fly the flag because the direction of the wind is important. If the wind is below a certain strength this time of year, I know the midges are going to be intolerable, so we change what we do. If the wind is above a certain strength II find the storm warnings quite unreliable." Furthermore, he told me that their end of the valley is the last to snow up in the winter and they find weather forecasts to often be unreliable. He told me "There's a different climate at the other end of the valley, which is another reason not to trust the weather forecast data, and we find that if the app says there will be 2mm of rain all day long, they don't have the language to show this will be a shower. With storm warnings if there is a chance of lightning, they will put a lightning bolt over the day."

IV2 also told me he still utilises weather lore, such as "red sky at night" (discussed in further detail in Chapter 2), in order to predict what the conditions will be like. As with IV3, who stated they are "learning from their mistakes." IV2 also said "we are learning on the job … I am now learning that I don't have to do the weeding until the bluebells are finished, because at that point the weeds come out and I know they will be soft enough to scythe, but I wait another month they will be harder and easier to cut. I also use longer term observations, such as the lichen on the walls down on that building, which shows that long-term this area has had quite clean air. I know there was a chemical works and tar works in the valley historically, but the natural systems have recovered to some extent."

This approach raises the potential of a synthesised approach. Where data are used to augment, or supplement other ways of understanding place, rather than placing heavy emphasis on what can be recorded and sensed automatically.

[6] A clough is a term used in northern England for a gorge or narrow ravine.

5.5.3 Reliability of and access to data, information, knowledge, and wisdom

Data are often referred to as objective, or raw, that truth can be drawn from the data which some consider to be value free, although this is not the case (discussed in greater detail in Chapter 2). In order to be used in artefacts, as explored in Chapter 4, data must be available in useable format, having been cleaned (description), and be from reliable sources and have reliable and complete metadata.

Gaps in DIKW: The location in which the interviews were held is not necessarily typical in terms of the number of groups carrying out work locally to alleviate flooding. In this location there is lots of DIKW, but potentially a lack of co-ordination in gathering and sharing it. However, in other locations there may not be such resources, where people are not gathering their own data or information and as a result a lack of knowledge and wisdom.

There are gaps in data, information and knowledge which lead to issues where data that cannot be gathered and measured automatically. when walking around the farm IV1 and IV2 explained the issues with flooding that are caused by a dis-used reservoir around 1 mile away, at the top of the hill on which the farm sits. During his time there, IV2 has observed the land moving and slumping, which is linked to the reservoir which fills up during periods of heavy rain. This movement of land and the ensuing issues with water coming down the hill cannot be sensed easily, other than watching and logging it over time and the issue is exacerbated by the geology, as the land is formed from layers of millstone and mudstone, with layers of grit stone underneath, so water percolates down and, as IV1 said, "this is like having 3 feet of ball-bearings under the ground." IV2 explained that the organisation who own the reservoir struggle with information about its history and past issues. Records were lost in the changeover in the canal system and during the privatisation of the reservoirs."

I asked IV2 whether there was any data that might be of use to them, but that was unable to access, and they told me that "finer grained weather data would be of most use."

There were other potential gaps in DIKW, sometimes occurring as a result of clashes in political views or values, for example between IV3 and farmers, who also have in depth knowledge of the land on which they work. The gaps in data also mean modelling often cannot work at a small scale, so does not include small interventions that might make an impact. There are also issues in gathering such data, for example collecting data on surface water flooding, or the way in which water cascades down the steep valley sides as observed by IV2. Such gaps in data can be alleviated through observation, using photography (as seen with IV5 and the example of cyclists collecting photographs), much in the same manner as with citizen science, where collectively people gather and share data.

Data gathered from and in place is often used for modelling floods. In the Calder Valley modelling has been carried out and informs flood warnings issued by weather agencies such as the MET office and by organisations such as the Environment Agency. As part of their work with the flood community group in the Calder Valley IV3 commissioned modelling work to try and understand the impact of the burning of the grouse moors in the area on the level of water in the town during an incident (see section 5.4.1). She told me about three different layers she believes exist with modelling, the first of which she called the "people layer," which relates to the actions of a complex array of actions carried out by those who work in flood management on both public and private land. As part of their work, they took some staff from the Environment Agency out onto the moors to explore the potential for natural flood management. On the visit they noticed drainage that had been installed on the private estate where grouse shooting occurs without planning permission and so this was not available as data for modelling. IV3 told me "You can model all you like, but you can't model away stubborn people." This lack of data might have a significant impact upon modelling but also on gaining a clear understanding of that location and potential solutions. IV3 also told me about the issues relating to farmers and those grazing animals on common land, saying "it's not actually in the farmers economic interest to do the natural flood management … there has been an increase in sheep farming, but they still see it as a traditional livelihood …", furthermore sheep can cause damage to trees, which cannot be modelled. Speaking to IV3 made it clear that understanding and managing water is incredibly complex and to ensure solutions there needs to be a wide ranging bringing together of data, information, and knowledge, where people understand how to apply the data and information. She also spoke about the importance of soil capacity and its impact upon drainage, both of which are current gaps in the data and difficult to gather where land is in private ownership. The second "layer" IV3 spoke about was "modelling with one metric", which is like the approach of data re-use seen in Chapter 4, where perhaps air quality data was "mashed" with house energy usage. In this instance however she told me about the need to get outside and that "people have done it in an office essentially … you have complicated ecosystems to understand and looking at it through one point of you isn't useful … You've got the water framework directive people in one is place; you've got the flooding people … and thinking about integrating all of that data and information is difficult. The third layer related to the small little interventions in place, but they can make a stark difference … people think about flooding as a valley bottom occurrence, but actually it isn't. Places halfway up hillsides flood and little features can make a difference. Someone can build a wall and it doesn't get added to a model, because they generally can't get to that level of granularity in that detail in models."

5.5.4 Pathways Forward

Understand how DIKW might be incorporated into understandings of place: Knowledge stores such as flood memories that have been carried out in academic research (McEwen et al.2017). These offer rich and vital accounts of not only incidents such as flooding, but wider knowledge about place. However, these are not always open and accessible for use (except for where research has been funded by public bodies such as UKRI (UK Research and Innovation) and data sets must be made open). As Dix (2014) suggests, metadata relating to not only what data are available about and/or in a place, in addition to local knowledge that resides there would be an asset.

Map local knowledge, lived experience, DIKW in place: Open data stores are used to present available datasets and are used at events such as hackathons. What would a dual analogue/digital store that was a repository for data, information, knowledge, and wisdom about a place look like and how might it be used? For example, bringing together open data, archives, stories, folklore, art, literature, scientific information about the Calder Valley that can be both analogue and digital, that can be contributed to and used by a wide range of people. In materialities of place (e.g., cultural): For example, literature about a place, or a particular event in a place, exhibitions, or drama (for example The Dukes in Lancaster held an exhibition and original play responding to Storm Desmond). Thinking more widely about local knowledge systems in the gathering, storing and re-use of DIKW: incorporating the concept of local knowledge into systems of data would also bring about different understandings of place.

This section has presented possible ways through which DIKW might be incorporated into place through exploring how people living in separate locations are able to embed data within their understanding, as well as other approaches they use.

The following section introduces the emerging concept of More-than-Data, which is drawn from the insights presented in this and the previous chapters.

5.6 More-than-Data: an emerging approach

The methods of observing and understanding place explored in this chapter demonstrate how data can form *an* understanding of place, but this in the case of interviewees IV1 and IV2 the data supplements other forms of understanding, such as using their senses of sight, hearing and feeling. The complex assemblage of data, place, programmers, and stakeholders, as well as the myriad other entities that inhabit place such as wildlife, complex eco-systems, natural habitats conceal a vast array of values which might be affected by any solution to issues faced in that place. We need to think about more than the needs of the programmers and the

stakeholders or people that live in that place, to encompass what Haraway refers to as the Chthulucene (Haraway, 2016), where the human and nonhuman are inextricably linked in what she defines as "tentacular" practices (this is discussed in more depth in Chapter 2).

In our two interviews that were carried out whilst walking around the farm and observing a range of features IV1 and IV2 spoke often about permaculture (2.7.4). The principles of this design method accrue slow and deep understandings of place using a different type of data and information, based upon long term observation of and engagement with the place. Such observations and engagement with a location is not limited to permaculture, for example farmers spend a lot of time in the same location and often take a broader, more holistic view of that place.

A key insight gained from interviewing IV1 and IV2 was that they both consider data as having a role to play in understanding place, particularly around flooding and they both have an interest in open-source software and data. However, they both spoke of a need to balance the drive towards focussing too heavily on data in understanding and shaping place, with methods of design that are slower, more considered and bring about deeper knowledge that might be shared in a multitude of ways, rather than through digital means. This approach might be considered one that takes "more than data" as a starting point and has scope beyond a human-centric approach to understanding place.

The More-than-Data approach recognises the value and potential of using data that are sensed automatically, or gathered through technological methods (e.g., that data discussed in Chapter 4), but also recognises the value and potential of wider approaches to understanding place, such as information, knowledge, and wisdom. By flattening the hierarchies of both DIKW (as opposed to the current conceptualisation as a pyramid, see Chapter 2, 2.6.1) and the dominance of human centred DIKW systems, a more integrated and balanced approach to understanding place can emerge. From here-on in this thesis, the term More-than-Data (MtD) will be utilised, as building upon, and developing the concept that weaves together data, information, knowledge, wisdom and lived experience.

5.6.1 More-than-Data for, in and through place

This builds upon section 4.5.3 in previous chapter – where this idea is introduced e.g., how might DIKW be gathered and re-used for, in and through place? Thinking about moving through place as well – as experienced during the interviews with IV1 and IV2, where we walked and discussed the issues, but having visited the place and walked it twice, as well as walking around the wider area, the notion of walking started to materialise and to think about how MtD can be dynamic.

Dealing with uncertainty: Data is often considered as objective truth that offers a stable view of the world (Chapter 2.2) and that reassurance about a given situation can be gained through looking at the data. However, in areas such as the location of the interviews in this chapter people deal with uncertainty regarding flooding. Having been through highly stressful situations, residents in the area become anxious when there are prolonged periods of rain, as More-than-Data. We can count what we see in a particular place, such as wildlife, traffic, people, and this constitutes quantitative data. Such data can be input into spreadsheets, both analogue or digital and utilised in much the same way that automatically gathered or sensed data might be. Both have their uses of course, but place is about much more than quantitative data, as explored in Chapter 2 (2.5).

To navigate and experience place through the mediation of a mobile device and applications driven by data, we lose connection with our immediate location. We not only lose our ability to navigate through relying upon digital maps, but also miss environmental cues around us that enable us to engage wholly in our surroundings.

This reliance upon data leads to a reductive approach, as Macfarlane (2007, p.141) states "The power of grid maps is that they make it possible for any individual or object to be located within an abstract totality of space. But their virtue is also their danger: that they reduce the world only to data, that they record space independent of being." This chapter seeks to explore that which go beyond data in order to uncover potential practices that enable and encourage approaches to understanding place that might use data as supplementary material, rather than the sole material. Brings about a question of how might we *add* data to maps, to bring together diverse types of understanding into one place that does not privilege one way of knowing over another, but instead starts from the need to understand a place and all the components and beings, whether human, animal etc in that place?

Longevity and long-term accumulation of More-than-Data In the interviews with IV4 and IV5 they talk about engaging with people who have lived in the same place for 50 years, sometimes more. Living or working in one place for an extended period of time enables long-term understanding of that place to accrue, but this might be in opposition to the ways in which people live and work now, in that we tend to move around more. What might this mean for developing long-term knowledge systems where inhabitants do not live in the same place and continue to pass knowledge to new generations, as we find in TEK systems?

In a study carried out in the Upper Calder Valley following the floods of 2015, Forrest et al. (2018) found that "the accumulation and retention of flood memories and lay knowledge, which are important to flood resilience … tend to fade over time" (McEwen et al. 32017)

What would traditional or local knowledge look like in an urban environment, or diverse types of places? The interviews took place in rural or semi-rural locations (small market town

in middle of a valley etc.) The traditional of TEK is also cited in non-urban locations. However, as x% of the global population moves to the urban and to cities, what might this mean, how might it be captured and used in future?

Balancing data and deeper understandings: In the two interviews with IV1 and IV2, which both took place outside while walking around the farm, both interviewees spoke about the environment in great detail, pointing towards a depth of knowledge and wisdom, as they both apply data and information about place into action. IV2 uses technology, but more in support of their observations than the primary mode of understanding. The majority he used were weather apps, but often found them to be inaccurate due to the location the farm is in. The granularity of the forecasts is not entirely useful and so he often relies upon their own observations. When I asked IV2 whether he uses data-driven mobile applications in their daily work on the farm, he told me that "I use two weather apps – forecast.co.uk and the MET office weather app. However, my partner uses a different weather app and often gets completely different predictions to me."

Knowledge from lived experience: The interviewees have also experienced flooding, but from different locations along the Calder Valley. By experiencing flooding over time, they have become attuned to the situations and events that can lead to flooding. IV4 told me that "…even a few weeks ago we had a bad bout [of rain], We had a lot of surface water flooding, the drains were overwhelmed. The rivers sat fine; they weren't over topping …" This demonstrates the different cues IV4 observes and puts together the different pieces of data and information to calculate whether the rain will cause serious flooding.

Observing the changes in rainfall and its effect on the land over time is also demonstration of how lived experience is embedded in understanding place. IV4 continued by telling me "We are almost back to the point we were before, when [the flood of] 2015 happened, we'd had six weeks of torrential rain … now we probably need three days." These observations are in line with evidence that demonstrates the severity of rainfall over shorter durations is now occurring (Archer and Fowler, 2015), and supports the practice of more recent flood science, that incorporates lived experience and distinct types of knowledge. Further lived experience that is embedded in place was highlighted by IV5, who said "…being an outside, an outdoors person and you look at it. You go, "two days of bad rain and we're in trouble." This approach is being encouraged by IV4 who said "We [flood charity] are asking people just to be mindful and observe what is happening around them, to look at the weather, that's a big thing. Look outside and look at the forecast for the week … My neighbour's garden backs onto a river, so he goes out and looks at their steps and he knows that he is on step three, so he is ok, but once gets to step four he knows that things aren't great." This highlights the potential for systems of MtD to be developed in a location, that bringing together open MtD, as well as open data,

can potentially tackle complex issues, and that lived experience is a highly valuable resource that has often been ignored by organisations and governments.

5.6.2 Pathways Forward

Building repositories of More-than-Data from scratch: One of the key issues highlighted in Chapter 4 was the reliance upon only data which was made available, and this is often limited due to access issues. In Chapter 5 it became clear that a rich array of MtD exists in a location and bringing this together into a repository that can be used by different people or groups offers opportunities to develop more engaging designs, products, and services. However, the repository should be designed according to the place, as mot everywhere will be like the Calder Valley, where there are groups and individuals gathering data and information or carrying out interventions in place.

Adopt a "more than human" approach to gathering and re-using data: Data are gathered not only about humans and our activities, but from the environment and increasingly from animals (for example IoT (Internet of Things) connected farms). Therefore, thinking more broadly than human contributed or extracted data, or that which are sensed from the environment offers the potential for building a richer picture of place.

Explore and adopt a range of practices to gather and share More-than-Data: As demonstrated by IV1, who felt "workshopped out", there is a need to explore new practices of gathering and sharing of MtD that is engaging and perhaps less time consuming. Digital technologies such as the internet, where people can share their experiences and understandings offer a distributed method where people can engage in their own time. However, as these methods do not offer a richer picture and flatten the experiences of people's own understandings, methods that bring communities together, but in more creative ways that also offer benefits for the participants might be developed. For example, organising walks or outdoor events where participants can get out into a place and engage in a convivial activity that brings the benefit of sharing with others as well as giving their experiences to organisations. This might also lead to organisations gaining deeper, more contextualised understandings of place.

Make the gathering and sharing of More-than-Data more equitable and beneficial to all: Rather than extracting DIKW from local communities, organisations, and community groups it might be useful to explore how a more equitable practice might be developed. Whilst it is encouraging that a wider range of experiences and understandings are being incorporated into flood science to ensure that it is not completely driven by data, it is important that communities gain benefits too.

Establish requirements of More-than-Data and the reliability required. Explore longevity and futureproofing: The current methods of gathering data rely upon contemporary technologies, which might become outdated, therefore rendering vast amounts of data obsolete and inaccessible. Whilst paper archives and museum collections take up space as they expand, we are still able to access them, even hundreds or thousands of years in the future. Understanding that DIKW can and will take different forms is important, as is understanding how they might be stored and access in future. This should be built into any development of DIKW repositories or stores.

5.7 Chapter Summary

This chapter has explored the following research question:

RQ1.2: What do information, knowledge, wisdom and lived experience driven understandings of place look like in literature and practice?

By engaging with the interview participants who live and work in a particular location, insights have been developed that demonstrate that whilst situated knowledges are valuable and have much to contribute, it is also important to identify and bring to the fore different approaches to understanding a location and the inherent differences in values and politics that are embedded there. Furthermore, this chapter has highlighted the potential for weaving together data, information, knowledge, wisdom and lived experience, which has been brought together and developed into the concept of More-than-Data.

Engaging in walking and talking with participants, using the "go along" interview method, was valuable in understanding the landscape and the interviewee's perception of and engagement with the place The interviews were semi-structured, with key questions asked but also the conversation was influenced by what we saw and the conditions on the days I visited. On the first visit there had been significant rain and the interviewee told me about how he would know that there would be flooding by observing the cues in the landscape. This proved to be a key insight that has informed the development of More-than-Data.

In chapter the interviews are very much engaged with place and do not exclusively take a view from above, except for when they use maps or mobile applications. Their understandings of place come from their experience and collaborations with a range of people and places. For example, IV2's understanding has also been passed on by the previous owner, who he has spent a lot of time within order to gain knowledge of the history of the place. In the west we rarely now pass on inter-generational knowledge or experience of place, whereas as demonstrated in Chapter 2, Traditional Environmental Knowledge is by its essence, passed on down from generation to generation (as in Section 5.4.3. This also raises interesting points about the nature of digital data and its longevity, and the resources and equipment required to

maintain such data stores. Traditions such as oral storytelling of place-based legends pass on through generation to generation, only to cease if the community dies out. Technological systems on the other hand change rapidly and become obsolete. What might happen to the vast amounts of data we now collect in the future?

Traditional environmental knowledge and local knowledge are conceptualised differently and not always made explicit. As explored in Chapter 2 (2.7.2) TEK in the UK has been embedded over the years, but not as explicitly as with practices found in indigenous communities around the world, who still employ methods of communication such as song, poetry, and oral stories. I did not explicitly discover these, except the rush gathering festival at the valley farm, as told to me by IV2. Information and knowledge are passed down, as seen with IV2 and the previous farm owner. Sharing of information and knowledge is evident, as seen with all interviewees, who work with others to share and communicate around the issue of flooding. One of the key benefits of traditional environmental knowledge systems is the richness of the practices used to collect and communicate DIKW and wisdom about a place. However, these forms of knowledge are based in tradition and history, rather than looking towards the future and engaging in contemporary life. Furthermore, these modes of understanding might be exclusive and only of interest to

Chapter 5 - Situated data: People and place	Practices and people	Bring people together around a specific issue
		Understand the diverse and complex nature of communities
		Explore and articulate common and conflicting values and politics
		Understand tensions between different communities of practice
	Situated artefacts	Tangible DIKW about a specific issue in support of mobile applications
		Consider potential usefulness of using particular technologies in which data are embedded
		Understand how MtD might be incorporated into understandings of place
		Map local knowledge, lived experience, DIKW in place
	"More than data"	Build repositories of MtD from scratch, according to the particular place
		Adopt a "more than human" approach to gathering and re-using MtD
		Explore & adopt a range of practices to gather & share MtD
		Ensure gathering & re-use of MtD is equitable & beneficial to all
		Establish requirements of MtD and the reliability required. Explore longevity & futureproofing

Table 9: Pathways Forward developed Chapter 5

those already interested in place. They may not be of interest or indeed attractive to all. Folklore is still used, particularly when relating to weather, but these traditions are becoming less prevalent in contemporary society. These ways of understanding place are also often linked to the rural, rather than the urban. It would be interesting to explore how folklore, or weatherlore, might be considered in both rural and urban environments, how they can engage with contemporary life and offer meaningful methods of engaging with place. They are a way of understanding and communicating key facets of place and of nature and might be of particular use in understanding our changing environment. What might a contemporary environmental knowledge system look like? How might contemporary culture be included in systems of environmental, local, and lay knowledge?

The More-than-Data concept, as explored in 5.5 and the potential to include non-traditional forms of data, such as using environmental cues and those from nature is a key insight from this chapter and chapter 4. Data as conceptualised in Chapter 4 can either be the key component, or it can augment a particular approach in order to build a richer, more meaningful, and engaging picture of a place and explore issues through these different lenses.

This approach mirrors the traditional environmental knowledge systems explored in Chapter 2 that offer a different kind of qualitative data, often overlooked in the quest for certainty and predictability. I found in the search for hackathons online that those relating to floods are predominantly prediction or communications apps (need to write more on this near start of this chapter).

In the interviews I found passionate people both at the hack and in the town in the Calder Valley– bringing them together in a place, rather than the programmers carrying on with their practices and being separated from place and its people limit their ability to create meaningful interventions from place-based data. Strong political views that reflect the community in which they live – there is a sense that the community often coalesce around a particular set of values. However, as IV3 demonstrated, there are conflicting politics and values as to the impact of the burning of grouse moors. This is important to consider, to try and articulate the values of people involved to make these explicit. Also, what is important to some is less important to others. Approaches such as natural flood management can be effective but sometimes groups go ahead with schemes because it seems like the correct thing to do, and it is important to bring together a different range of expertise and experience.

There is interesting potential in thinking about place-based data in a unique way, of including More-than-Data that are sensed or derived *from* and *through* place. Rather than taking a *data-up* approach, as was demonstrated at the hack event, and focussing only data that are presented in an open format online, a wider and more integrated approach that brings in information, knowledge, and wisdom from a diverse array of people might offer more innovative and create

designs to tackle issues such as flooding. The gathering of data as people move through place, as our lives and our moving between our physical and perhaps more cyborg selves, whether by wearable technologies, GPS, mobile phones, or drones can offer dynamic and interesting forms of data. involved, rather than jumping to the technological solution or eschewing technology completely.

Chapters 4 and 5 seek to understand how data-driven and situated knowledges of place might be brought into balance through the collection of a diverse array of heterogeneous data, information, knowledge, and wisdom.

The interviews carried out in Chapters 4 and 5 demonstrate a need to balance the drive towards focussing too heavily on data in understanding and shaping place with methods of design that are slower, more considered and bring about deeper knowledge that might be shared in a multitude of ways, rather than through digital means. Through carrying out the interviews and applying the findings to the literatures explored in Chapter 2 I have identified both benefits and challenges of both the data-driven and situated understandings of place. This identification enables Pathways Forward of both approaches (Table 10) to be articulated and explored further in the next stage of this research. A key finding is that there is potential for re-balancing the data-driven with the situated, but this needs careful consideration by those designing alongside DIKW.

By engaging with place in diverse ways, ways that are often analogue and take a slower, more reflective approach to a place and those who inhabit it, a rich picture that is underpinned by situated knowledge that is enabled and enriched by data can emerge. Rather than immediately adopting a "data-up" approach to understanding place, by collating what data, information, knowledge, and wisdom is available about a place, a balanced, yet still rigorous and reliable ecosystem of place can be created. However, this also relies upon engaging a diverse range of people to uncover these assets so that one dominating approach and range of values emerges. In contrast to the findings relating to hackathons in Chapter 4, which demonstrate that often, whilst attempting to tackle complex social issues and suggesting what Lodato and DiSalvo (Lodato and DiSalvo, 2016) call new forms of social action while lacking the construction of publics, the examples presented in this chapter demonstrate that publics are formed in place around specific issues, in this case to tackle flooding.

Understanding data as a material that is both situated in and flowing through place, rather than being static, is important in re-balancing the data-driven and situated approaches. By conceptualising More-than-Data, to bring in information, knowledge, wisdom and lived

	Theme	Pathways Forward
Chapter 4 - Hackathons	Practices and people	Create a public around a problem or design challenge
		Pre- and post- event engagement with data and issues
		Consider different event/activity formats to encourage wider participation and diversity
		Harness the sense of collaboration and solidarity
	Data-driven artefacts	Expansion of hackathon (and data) toolboxes
		Consider data as a component of tackling an issue, rather than the whole solution
		Harness well-meaning nature of participants
		Dig down into other data-sources
		Use tools guided by the issue or theme being explored
		Take a view from the ground-up
		Explore creative uses of data
	Place: sites and locations of data collection and re-use	Situatedness
		Go outside
		Exploration of what a specific, situated and located space or place might be in relation to an event
		Explore range of venues – in urban and non-urban locations
		Explore data in, from and through place
		Think about how data are themed (e.g., by place)
Chapter 5 - Situated data: People and place	Practices and people	Bring people together around a specific issue
		Understand the diverse and complex nature of communities
		Explore and articulate common and conflicting values and politics
		Understand tensions between different communities of practice
	Situated artefacts	Tangible DIKW about a specific issue in support of mobile applications
		Consider potential usefulness of using particular technologies in which data are embedded
		Understand how DIKW might be incorporated into understandings of place
		Map local knowledge, lived experience, DIKW in place
	"More than data"	Build repositories of DIKW from scratch, according to the particular place
		Adopt a "more than human" approach to gathering and re-using DIKW
		Explore & adopt a range of practices to gather & share DIKW
		Ensure gathering & re-use of DIKW is equitable & beneficial to all
		Establish requirements of DIKW and the reliability required. Explore longevity & futureproofing

Table 10: Summary of Pathways Forward developed in Chapters 4 and 5

experience, this brings into play richer and more diverse resources and potential materials within a place. Exploring data that are situated in place, that are both gathered automatically.

In Chapter 5, I observed the accrual of lived experience and knowledge of the people interviewed. Design methods such as permaculture encourage the observation of place over time, from multiple human and non-human perspectives. This is a counterpoint to the speed of the hackathon practice and the myth of speed and innovation. However, it might not always be practical to observe or engage with a place over a longer period. The hackathon does encourage short engagement with data, which means artefacts can be developed over a brief period of time, but the limitations of this approach also lead to lack of development of useful artefacts and exclude a range of potential participants. As the insights from Chapter 4 (4.4.3) suggest, there is lack of time for reflection in the hackathon practice.

The insights gained from Chapters 4 and 5 represent what might be seen as opposite ends of a spectrum, with the high-speed approach of the hackathon at one end, and the slower approaches of those seen in chapter 5 at the other. A balance might be the development of pre-sessions, that events are developed over a longer period to ensure greater engagement and longevity, giving participants opportunity to reflect

As the interviews in this chapter demonstrated, it is possible to understand place through using our own senses rather than relying completely on data, as Chapter 4 highlighted. This can potentially encourage more creative, engaging, and diverse pictures of place, that also enable those without the technical capabilities of designing sensor-based data systems to be involved and engaged.

Both chapters highlighted the importance of bringing people together around a specific issue, in essence forming a public. By bringing together a range of experiences, genders, age, and backgrounds it is possible to design more engaging solutions for key issues in place. Creating diversity of places where practices occur and from where MtD are collected and re-used is also important. Different places present different challenges and opportunities. Visiting the hack in the city and reading literature around the data-driven world tend to focus on the urban, whereas data also has the potential to play a key role in rural and isolated places (Dix, 2014) and both have different challenges.

The insights developed from chapters 4 and 5 have informed a series of Pathways Forward that synthesise both data- and non-data driven understandings of place. From these two chapters the concept of More-than-Data has emerged, which can potentially bring about more situated and engaging modes of understanding a place. Furthermore, by encouraging the gathering and re-use of a range of various sources, including people's lived experience, this opens routes for including a wider range of people than are currently engaged in the data-driven society.

The next stage of this research will explore how More-than-Data can be put into practice. By embedding the concept into the practice of walking, the next stage of the research explores how we can develop rich understandings of place, that bring into balance data- and situated understandings of a place.

6 Designing More-than-Data Walks

This chapter and chapter 7 present insights drawn from five walks that were designed and carried out to explore how the concept of More-than-Data (Chapter 5, 5.6) might be embedded into a new practice. The two chapters relating to the walks (6 and 7) have been split in two. This chapter explores the practical and operational aspects of carrying out the walks and the subsequent chapter details the thematic, content, and post-walk insights. The following chapter explores the content and output of the walks and consideration of post-walk activities. The insights presented here and in Chapter 7 are framed within a linear structure, but the insights are cross-cutting and sometimes overlap.

The aim of this chapter is to highlight the key design elements that shaped the walks and the insights that emerged from them to illustrate the benefits of taking time to explore the place in which a More-than-Data (MtD) walk might be held, who might be involved and the methods through which MtD will be gathered. The walks take the Pathways Forward from chapters 4 and 5 as a basis upon which to design the format, tools, content, and potential re-use of the MtD. Throughout this chapter the Pathways Forward are developed and supplemented, based upon the insights developed and are summarised at the end of each section.

The research questions explored in this chapter are:

RQ2: How might More-than-Data be embedded into a new practice that uses walking?

RQ2.1: How might walks be designed to encourage a More-than-Data approach to understanding place?

By exploring this question, the insights presented here establish the conditions through which the walks engage with More-than-Data in, from and through place (this is explored in Chapter 7).

The walks took the "Pathways Forward" (Table 18) developed so far (Section 5.5.4) as their starting point and were developed using a practice-based approach. Each section of the chapter highlights the existing links to the Pathways Forward (PWFs) and those that emerge from the findings here.

Exploring the phase before the walks and considering this as a key element of a design process as a counterpoint to the nature of the hackathon, where much of the activity occurs during the event itself and is bound by the format and the data available, with little consideration to wider stakeholders. Spending time and effort before designing an event, to consider key elements such as where it should take place and why, who should be invited, what type of MtD could

be collected and, vitally, the theme or issue that will be explored, can offer significant benefits in the collection of rich and engaging data, information, knowledge, wisdom and lived experience about a place.

Chapter 4 highlighted the need for practices that re-use data, and the hackathon, should place greater emphasis on activities that occur prior to and post event, in order to mitigate issues that lead to participants jumping immediately to a solution, based upon that data made available to them. This limited approach seen at the hackathon often leads to a partial idea that has not been explored or tested with wider stakeholders or communities, and due to time restrictions, the consideration of design processes which might enable greater engagement with place and people are not carried out (4.4.1). Furthermore, designs and ideas created at hackathons are often not developed after the event, meaning time, energy and resources are wasted.

The findings from the walks illustrate how the reification of the hackathon process, through the development of an alternative practice, or range of practices, can bring about deeper and more engaging understandings of place than those offered by data alone.

The empirical research carried out in this chapter and Chapter 7 uses Research through Design as an underpinning, where I engage with designing the walks and the associated artefacts. This practice-based research is also underpinned by post-phenomenology, as it was essential that I observe and engage in how the participants engaged in place and the emerging More-than-Data

6.1 Data collection and analysis processes

The methods used for the collection and analysis of data as described in this section were also used in Chapter 7.

Sampling strategy and participant recruitment

The sampling strategy for the walks (participant recruitment is presented in 3.4.5) are highlighted below in Table 11.

Walk	Sampling Method and Strategy
1	N/A (myself only)
2	Purposive/ Convenience (participants on the funded project on Tiree)
3	Purposive: Snowball/ (invites sent out to departments in University)
4	Purposive: Snowball
5	Purposive/Snowball/Convenience: Participants from prior walks and interviews, contacts from colleagues and members of the public (random)

Table 11: Sampling strategy and methods for walks

Data collection, processes, and storage

A range of different data were collected (as illustrated in Table 12, below).

	Method of collection	Storage
Photographs	Taken by myself and walk participants using DSLR cameras and mobile phones	Transferred from phone/camera to external hard drive (encrypted)
Field notes	Me: notebooks before, during and after walks	In home office. Some images taken and stored with photographs
Maps (pouches and booklets)	Participants used during walks and were able to draw/write on	University office.
Objects in maps/pouches	Participants gathered during walks through using map pouches	University office. Some had to be disposed of due to decomposition (e.g., mud and seaweed). All objects were photographed and kept on an external hard drive

Table 12: Data collection and storage processes for the walks

Analytic methods of working with the data

Analytic methods and process are detailed in Chapter 3 (3.5). Each of the different data were brought together, and photographs of each of the data types (Table 12) were printed to aid analysis. As the data took different forms, but were mostly visual, I found the adaptation of annotated portfolios (described in Chapter 3.5) to be useful in synthesising the array of visual materials. The data were all stuck onto a wall, and I used analogue methods of sticky notes to annotate the different images. Through doing this is I was able to draw out themes and developed the approach to splitting this chapter and Chapter 7 into process focus (this chapter)

and thematic/theoretical focus (Chapter 7). The process of bringing all this data together was challenging, but my method of working visually (which stems from my previous experience of art practice and curatorial practice) aided sense-making. From the images and the notes, I made associations between themes, which were then coded (using open coding) to add to the Pathways Forward.

The Pathways Forward, as described in Chapter 3.6, were a method I developed to analyse and synthesise the myriad insights developed through this research. As the types of data gathered through the interviews (Chapters 4 and 5) and the walks presented here and in Chapter 7 were quite different, using text from interviews and photographs, notes and artefacts from the walks, the use of the Pathways Forward helped me to make sense of this data. It was essentially a form of thematic analysis and enabled me to maintain a structure and framework for presenting the insights to the reader and thus showing the development of the insights throughout the research.

6.2 Walk Contexts

The decision to use walking as a mode through which to explore More-than-Data is documented in Chapter 3 (3.4.4) and literature underpinning this choice is discussed in Chapter (2 0). The specificities of each walk differed, but the overall design process of the walks shared characteristics, such as the development of tools, design of a route, development of content and themes. The number of walks, themes, and locations (Table 13**)** came about through the process of designing and carrying out the walks and from opportunities emerging from relationships with other researchers and projects. Table 11 shows the separate locations chosen for the walks, from the peri-urban, farmland and estuary of Lancaster, to the island of Tiree, coast of Sunderland Point, rural industrial landscape in Yorkshire and back again to the urban river in Lancaster

6.2.1 River Lune, Lancaster

The first, exploratory, walk took place along the river Lune that flows through the city of Lancaster, out to the estuary and Morecambe Bay. The walk served two key purposes:

Figure 18: Walk 1 location, River Lune Lancaster

Figure 19: Walk 2 location, Island of Tiree Scotland

Figure 20: Walk 3 location, Sunderland Point Lancaster

Figure 21: Walk 4 location, Warland Yorkshire

Figure 22: Walk 5 location, Mill Race Lancaster (river Lune)

- To gain experience of walking whilst considering the notion of data, what it looks like and means in a location, building on Powell's Data Walks (2019) and Taylor et al.'s Data in Place (2014)
- To gain an understanding of what organisational and logistical considerations, such as activities and tools, might be useful in developing the future walks with participants

The route began close to the city centre and followed the river away from the urban into the edgelands, towards the salt marshes and farmland that lies beyond. This location was chosen as it is an area in which I have walked frequently, and this familiarity enabled me to use the knowledge of the place as a basis upon which to add layers of data and information. A further reason for the route choice was mix of urban, peri-urban, coastal, and rural landscapes, from the Georgian sandstone merchant's houses on the Quay, down to the Freemans Woods and farmland towards the estuary, salt marsh and sea beyond. These different terrains offered the potential of heterogeneous data sources to uncover and explore.

During the walks I created a ribbon map as I moved, on which I drew the route and key points along it and noted what I considered to be MtD in the environment.

6.2.2 Rural Data Walk: Isle of Tiree, Scotland

The participants of this walk were attendees of the DEN Digital Economy Network project (the 12th Tiree Techwave and island residents. The two aims of the walk were:

- To understand how walks with participants could be organised.
- To explore what data means on a remote and rural island.

The environment on Tiree offered a contrast to data walks that are predominantly held in urban locations (2.3.2), exploring what data means in a place that has significant infrastructure issues. The island experiences significant issues receiving adequate broadband due to the ageing infrastructure. The island receives 2G mobile phone data connectivity, which results in a lack of access to data "on the move" due to a lack of mobile phone signal reception.

Participants were led along a simple route using a map, and a discussion session was held afterwards. Participants were asked to collect and record their thoughts and ideas however they liked, whether through photographs (using their own mobile devices or cameras), maps, notes, drawings, or any other media.

At the end of the walk the groups came together to share their responses, which were audio-recorded and transcribed during the session. These artefacts were then reflected upon alongside the images and notes I made during and after the walk to develop the themes and insights.

6.2.3 Sunderland Point, Lancaster

The walk took place at Sunderland Point, a small coastal village located around 8 miles from Lancaster city centre that once served as the main port for the city. The village is rural, although situated relatively nearby to Morecambe and Lancaster and is the only place in the UK that is part of the mainland but gets cut off by the tide twice daily.

This walk followed a circular route and was led by a local writer who has authored a book about Morecambe Bay (Lloyd, 2016. The aims of the walk were:

- To explore how we might understand a place through gathering a heterogeneous data set, including analogue and digital MtD.
- To experiment with both analogue and digital tools for collecting such MtD in and from place.
- To explore how we might bring these differing modes of understanding place together after the walk.

The tools used on the walk were a lo-fi wearable map and a mobile phone application called SnAPP (**Error! Reference source not found.**), which had been developed as part of a research project to capture a person's mood through tactile interaction.

A post-walk session was held in Lancaster city centre and consisted of a Q&A with the author and opportunity for participants to explore the wearable maps and SnAPP data, which were both displayed.

6.2.4 Warland Farm, Yorkshire

Warland is a hamlet located near the town of Todmorden in Yorkshire and comprises a small number of houses and farms. It is in a steep valley, through the bottom of which runs the Rochdale Canal, which was once a major transportation route for the mills in the area. The landscape is rural and isolated, but with many reminders of its industrial heritage, with the marks of the Industrial Revolution still visible, such as the major railway line passing through the tunnels in the hillside, disused mines and reservoirs sitting high on the moortops. The land in the valley is now largely agricultural, used for cattle and sheep grazing. The valley has faced significant flooding in the past, largely due to high volumes of water flowing down the steep hillsides, causing issues in the valley below.

The walk was guided by the owner of a farm in the valley (who was interviewed in Chapter 4) and enabled participants to gain an understanding of the landscape and the challenges faced with water in the landscape. This was the first walk that explored the theme of flooding, in particular exploring how we might work with water in the future, rather than working against it. Participants were invited specifically for their interest in flooding and hydrology, data science, design, and permaculture.

The aims of the walk were:

- To explore what types of MtD can be collected during a walk and how they are manifest
- To explore what kind of post-walk activity might encourage participants to think about how we might use the artefacts gathered and produced during the walk.

Waterproof map pouches were made, and each contained four prompt cards to consider during the walks. For the post-walk activity, a large map of the walk route was created, and participants were asked to pin a selection of objects or artefacts collected or created during the walk and pin them to the map, explaining their reason for collecting or creating it onto a tag.

6.2.5 The Mill Race, Lancaster

The final walk took place in Lancaster City Centre, exploring the route, history and flooding challenges of the Mill Race, an underground river that once flowed openly through the city providing water for the mills. The river still runs underneath the city but has been culverted and blocked off in different locations and as a result often causes surface water flooding. The Mill Race can now only be seen at two locations in the city; its outfall into the river Lune and down a drainage cover in the city centre.

The aims of the walk were:

- To explore the differences between carrying out walks in urban and rural locations.
- To understand how walks can be carried out with members of the public, as well as invited participants.
- To develop a tool that engages participants with less tangible MtD in a location, through exploring how we can read a place like a city and how we can understand hidden features.
- To consider how we might engage with modes of knowledge and wisdom such as weather lore in a contemporary setting.

The tools for the walk were a folding map, with instructions, a set of prompt and question cards and a folding notebook. Walks were guided by me and a research colleague but were also designed to be self-guided. Questions differed for the invited participants and members of the public and were more focussed upon data that were available or not, or that which might be useful, in order to understand how and why the Mill Race caused flooding issues.

6.3 Design decisions

Design was used in both the creation of the walk activities and the tools used by participants during the walks. Drawing upon work by Gaver et al. (1999) who used cultural probes to enable research participants to engage with specific areas of research, and Research through Design (described in Chapter 3.3.2) to embed an exploratory mode of practice-based research in this describes how I made design decisions for the walk activities and the artefacts that supported them, as well as the ways in which these decisions influenced the gathering and analysis of the research data. One of the fundamental approaches from the Cultural Probes work (Gaver et al. 1999) was the capture of “inspirational data” through using the materials with elders in their research. The notion of capturing this more subjective material, that stimulate imagination and an “impressionistic account” guided the design of the walks and the

WALK	LOCATION	THEME	PARTICIPANTS	TOOLS	GUIDED	RESOURCES	OUTPUTS
1	Lancaster – River Lune Urban/peri-urban/coastal	Data in place Prelim fact finding MTD in place	Myself	Camera, smartphone, notebook	No	Own equipment	Ribbon map Photographs Field notes
2	Isle of Tiree, Scotland Rural – remote island	Data in rural & isolated place Preliminary –fact finding MTD	PhD students from DEN project, participants of Tiree Techwave, Tiree residents	Cameras smart phones Notebooks	No – instructions & route provided	Funding: DEN Collaboration: researcher (Southampton University)	Photographs Transcription and audio recording from post-walk session
3	Lancaster, Sunderland Point – rural & coastal	Tools for heterogeneous data collection Development of themes and tools Gathering	Academics and students from SCC Lancaster, artists, writers, design academics and PhD students	Wearable maps Cameras smart phones Snapp mobile application	Guided – writer who had written about the area	Funding: SCC (Lancaster University) Collaboration: researchers from Lancaster	Wearable maps, film Aurasma map exhibited at Data Publics Exhibition, SnAPP data & map
4	Warland, Yorkshire – rural	MTD & flooding Development of themes and tools	Flood charity volunteers, natural flood management specialist, permaculture designer, design academics, PhD students (computing & design), data scientists, computing academics, writer	Wearable maps Cameras Smart phones	Guided by Interviewee from Chapter 5 (owner of farm)	Funding: Fellowship project from SCC (Lancaster University) Collaboration: Fellowship project from SCC (Lancaster University)	Map pouches map with MTD attached photographs, fieldnotes
5	Lancaster, Mill Race urban (city centre)	Hidden urban MTD and surface water flooding Development of themes and tools	Members of public, retired engineer from City Council, flood modeller, design academics, computer science academics, permaculturalist, writer, data scientist	Map pouches Notebooks Cameras smart phones	Guided by myself & colleague researcher	Funding: Awarded from fellowship funding Collaboration: SCC/Imagination Lancaster & public	Filled in notebooks Photographs Field notes Prototype Lancaster Flood Ontology

Table 13: Details of the five walks

	PATHWAY FORWARD	REFERENCE
PF1:DATA-DRIVEN ARTEFACTS	Take a view from the ground up	PF1.1
	Dig down into other data sources	PF1.2
	Use tools guided by the issue or theme being explored	PF1.3
	Expansion of hackathon and data toolboxes	PF1.4
	Explore creative uses of data	PF1.5
PF2: PLACE-SITES AND LOCATIONS OF DATA COLLECTION AND RE-USE	Get outside	PF2.1
	Explore range of venues – urban and non-urban places	PF2.2
	Situatedness	PF2.4
	Think about how data are themed (e.g., by place)	PW2.5
	Map local MtD in place	PW2.8
PF3: PRACTICES AND PEOPLE	Explore and articulate common and conflicting values and politics	PW3.1
	Pre- and post-event engagement with data and issues	PW3.2
	Consider different event formats to encourage wider diversity and participation	PW3.4
	Understand tensions between different communities of practice	PW3.5
	Bring people together around a specific issue	PW3.6
PF4: SITUATED ARTEFACTS	Consider usefulness of using particular tech in which data are embedded	PW4.1
	Gather/record MtD about a specific issue in support of mobile applications	PW4.2
	Explore and adopt a range of practices to gather and share More-Than Data	PW5.3

Table 14: Pathways Forward developed in Chapters 4 and 5

the tools. This was a direct counter-design to that of sensors that seek to gather more objective data.

6.3.1 Design of the activities

Each walk explored a different location and theme, with different participants (as described in 6.2). In order to engage participants with the themes and locations, and to ensure useful

research data was gathered, it was important that the activities for each were considered both in light of the place, theme, and participants. For the first walk, carried out by myself I carried tools. The reflections from this activity were embedded into the first walk carried out with participants on Tiree. As this was the first walk with participants, I kept the activity simple, and participants were simply asked to look around them and think about a series of prompts. This walk was very much a trial, to understand how I might design activities for further walks with people in different locations. From the observations I made during this walk it was apparent that whilst the walkers were engaged in the place and considered the questions, it was easy for them to become somewhat distracted by their surroundings and other walkers. Furthermore, having no tools or methods of collecting artefacts or thoughts meant that participants had to rely on their memory (individual and collective) in the reflective session afterwards. As this was a group activity, not every participant contributed to the discussion, meaning that the research insights gained did not represent all involved.

The insights from Tiree were designed into the Sunderland Point walk, where a more focussed activity was designed, both during and after the walk. So that participants could gain information as they walked, a guide walked with them. The guide was an author who had recently published a book about the area, and so was able to offer insights relating to the history and ecology of Sunderland Point. Working with the guide, I chose which stops would be made around the walk, which were chosen as specific historical or environmental points of interest. These points were then used to design the wearable map, which featured small wooden location markers (described in section 6.3.2). The activity itself saw participants respond to what they could see or thought about at the specific locations on the walk, and they could use the wearable map in any way they saw fit. Designing the activity in this way meant that the distraction I saw on Tiree was significantly less on the Sunderland Point walk. The activity was structured to both enable time keeping, which was important as there was a session after the walk in a different location) and also to offer participants a structure as they walked. However, they were not asked to respond in a particular way to the points, rather they had freedom to respond to whatever they liked.

The design of the activity on walk 3 highlighted the usefulness of having a guide as people walked, but also of the need for participants to have freedom to respond as they walked. One of the key elements of the walks was the interaction between participants, so designing activities that discouraged this would have led to less rich data produced. Asking participants to stop at a location meant they were free to do what they liked between stops, whether this was talking to other walkers, collecting artefacts, writing, or drawing and this was designed into all the walks. This approach struck a balance between the completely unstructured approach of Tiree and a guided walk, where the guide might talk to participants as they walk, as well as on scheduled stops.

I also used the guided approach on the Mill Race walk. This felt more important as we were exploring a feature in the environment that can only be seen at one point. Choosing the route and creating the information to be conveyed at each stop was somewhat challenging for the Mill Race, as there was a different urban environment. The activities for the Mill Race walk were more structured than the other 3 walks, as it explored different themes, and the prompts were more specific. I designed the activities this way in order to try a slightly different approach and to explore what gathering different data would mean to the overall research. Participants were given small notebooks and along the route had tasks that were described in the notebook. These were themed around experiencing the city, to try and understand the different senses participants used and to explore how we might develop future weather lore. Out of all the activities these were the most challenging to design, particularly in that the Mill Race was no longer visible.

Overall, in the design of the activities I aimed to adopt a simple approach. By over-designing the activities participants would not have had space to reflect or talk to others, thus negating some of the key benefits I identified in walking as a practice. I sought to balance designing activities that did offer structure, but that also enabled participants to have freedom in their responses. As a result, the data gathered through the activities offered a rich seam of insights into the different locations.

6.3.2 Design of the tools and artefacts

The design decisions of both the activities and tools broadly shaped what data types were collected and then analysed. The walks at Sunderland Point (3), Warland (4) and the Mill Race (5) all used designed tools that enabled participants to gather either physical artefacts (3 & 4) or responses to prompts and questions (5). Whilst participants were told what they might do with the tools, e.g., gathering artefacts in the pouches for 3 & 4, or write or draw on the pieces of paper provided, no further guidance was given. The tools were designed to act as a framework for the gathering of the data, rather than shaping the participant's responses. Pragmatically, participants were constrained by the dimensions of the pouches and the materials provided (small pieces of paper, small pouches, and larger map pouches). The lo-fi nature of the designed tools also enabled participants to use or adapt them as they saw fit. Some participants on walk 4 drew on the map pouches, making drawings and notes as they walked, which turned the pouches into artefacts. The small pieces of paper included in the pouches limited participants to individual notes or drawings, and those who drew on the map pouches wished to draw a continuous representation of their walk.

The lo-fi nature of the tool designs was also important in thinking about how the design principles (Chapter 8) might be adopted and used by different audiences. As I explored hackathons (Chapter 4) it became important to consider the inclusion of those who were not

engaged in the realm of data, or who do not have technical skills in programming or developing apps. By designing analogue, lo-fi tools such as the wearable maps and pouches, opportunities for engaging with More-than-Data with different audiences was possible. The design of the pouches is simple enough for those without technical making skills to adapt and make their own.

The tools were also designed to be portable and to not impede in the task or the movement of walkers. The wearable maps were perhaps more impractical for walkers, as the strings were long and were wrapped around people (fig 35, p.209). After observing their use on walk 3 I decided to design something that was more akin to an existing map pouch that walkers use to contain their map. It was also important that the pouches were waterproof or resistant, which prompted the use of Tyvek, a waterproof, strong paper that can still be written on. This material worked well, and A3 pieces were folded and glued to make a simple pouch. On walk 4 I added a piece of acetate with a hand drawn map of the route, so that walkers were able to see the route and also add notes or data points with pens.

Practicality of design was also important for walk 5, but as it took place in an urban environment and participants were not asked to collect artefacts, I designed notebooks rather than pouches. Small booklets were folded, which had questions in and space for responses, and these were carried on small wooden clip boards (fig 34, p.208). This design changed the nature of the data gathered, which in this instance was text and drawings, rather than physical artefacts. Participants were also given a small pack of cards that were designed with a range of manhole covers found on the walk on the back and featured the task for each location on the other side (fig 34). They were also given a map of the route, which I adapted to fit the walk route and include key points (fig 34). Whilst the walks I carried out around the Mill Race were guided, the tools were designed so that participants could carry them out at any time on their own.

Reflecting on the design of the tools, they were kept lo-fi to engage with place and to enable the simple construction for others to make them. The tools were also guided by the location, to ensure that participants were not distracted (the use of the mobile application on walk 3 highlighted that having a device often distracted the walker). Furthermore, the tools were designed to frame the activity, with freedom for participants to adapt or use them in a range of ways. The concept of cultural probes (Gaver et al. 1999) was key to the original design of the map pouches, to enable participants to respond to prompts or questions, but in a less structured way than the probes.

6.3.3 How the design decisions determined what data types were collected and analysed

The data gathered on walks 1 and 2 consisted of thoughts that were noted down after the session. This meant that there was little visual material produced, which felt as though an opportunity had been lost by walkers creating their own responses to what they saw and discussed. Whilst the written notes from the Tiree walk made in the session afterwards were interesting, they did not enable me to gain deeper insights to the types of data that walkers found interesting. When analysing this data from the large pieces of paper, I found I had little context to what types of data participants referred to and little idea about where it had been discussed or located. This reflection led me to the design of the physical artefacts for participants to gather data on the subsequent walks. For walks 3-5 I found analysis of the data much richer and much more tangible. I found that having insights into where the data related to and understanding the different things that had been collected or written in the same or similar locations on each walk led me to deeper insights into a particular location.

For the analysis of the physical artefacts, I started to develop different modes of analysis (these are discussed in Chapter 3). I also found that having images of the walk itself offered deeper insights into the walks and the practice I was developing, as well as the material elements of the walk. However, this meant I had hundreds of data points, that were physical, photographs or notes, which proved to be a challenge. For walk 5 I designed the activity and the materials so that I would have text only, or images, and that participants would not remove any artefacts from the location, for both ethical and practical purposes.

6.3.4 Added value of drawing on design

Here RtD enabled me to experiment with the design of the activities, artefacts, and tools. The design of the tools emerged as I became more experienced in designing and carrying out the walks and as I observed on their use and reflected on their usefulness. The idea of participatory mapping was important in the design of the tools, but maps were made by the artefacts gathered, rather than the making of 2 dimensional maps.

The iterative nature of RtD and the sense of exploration that I found when designing the walks and the tools enabled me to embed the insights from each walk into the next, which then enabled me to develop the pathways forward. The design of the route, the themes, information given, tools and artefacts were all synthesised. The actual making of the tools, the maps and the drawing of route-finding maps helped me to think through the themes and engage with the place in which I was working. The very materiality of making these materials helped me develop insights, and to gather a rich array of research data, much of which was also tangible. This tangibility spoke to me more deeply than the experiences with exploring computational data about a location, and feedback from participants was similar. Through the process of designing the whole walk, from the route to the tools, to the data gathered, I was able to gain valuable insights which then fed into the design principles (Chapter 8).

6.4 Discover: Pre-walk insights on logistics, content, and tools

The insights presented in this section relate to considerations made prior to the walks taking place and form a key component of the Design Principles presented in Chapter 7. Whilst the nascent practice of Data Walking emerges (Masson et al.2020; Powell, 2019) there is grey literature, such as blogs, that detail walks, but at present there are few heuristics that support the design of such walks (Chapter 2, 2.3.2). The insights developed in this section also respond to the lack of consideration of key issues such as location, wider stakeholders and additional data that would be of use pre-event at hackathons.

Insights that emerged from Chapter 4 and form an important part of the More-than-Data process demonstrate the importance of and need to consider a range of issues including organisational, content (e.g., the data, combined with information, knowledge, and wisdom available in and about a place), thematic and collection methods prior to an event taking place.

6.4.1 Getting Outside

Pathway Forward 2:1 "Get outside" emerged from comparisons made between observations from, on the one hand the hackathon (Chapter 4) and in literature relating to this practice (Chapter 2), and on the other hand the experience of carrying out walking interviews in Chapter 4. Many practices that engage in the re-use stage of the data-lifecycle must take place indoors due to the requirements of hardware, internet access and an environment in which to focus on the challenge. I also found that due to the time constraints placed upon hackathon participants they were unable to leave the location of the event to gain insights into the location in which they were seeking to solve issues. When reflecting upon the interviews I carried out whilst walking in the Calder Valley (Chapter 5), it was clear that being outside enabled me to understand quickly the issues faced with flooding and water in that location. Walking, or "go-along" interviews (Kusenbach, 2016) are useful in enabling the use of prompts in the landscape as interviewees move through place. Talking to the interviewees outside and simply observing the hillsides opposite, and the way in which water was flowing down through the farm itself gave me an immediate grasp of the issue, which was perhaps made more pertinent due to it raining heavily at the time.

By getting outside into a place it is possible to observe what is not on the map. This does not only refer to features in the environment, but also the weather, flows of information and people, and processes that take place in that location. For example, the data used at the hackathon that related to accident hotspots seems abstracted when on a map and while the text in the dataset gives some details, getting out into the place itself enables the data to be contextualised and understood more deeply.

Embedding “going outside” into a practice of More-than-Data was therefore vital and walking affords this, whether simply going outside for a short walk or taking part in an organised event, such as the four walks I carried out with participants. When pausing for a rest at the top of a hillside on Walk 4 one participant, a data scientist, remarked that she had looked at the maps of the Calder River catchment and this valley in relation to rainfall and flooding, but seeing for herself enabled her to understand more deeply the steepness of the valley. Furthermore, it is difficult to capture sensed data on the amount of water flowing down the hillsides, as flood data predominantly consists of rainfall plus river gauge data. In this environment observing and being outside is important in understanding what is happening with water. The same is true of the Mill Race in Lancaster, where the water course is itself hidden and there are no sensors located in any of the remaining sections. It is only when one gets outside, to see the impact of the rainfall that it is possible to gauge whether surface water flooding will occur in the city centre.

Going outside is a fundamental component of More-than-Data walks and addresses the issues highlighted at hackathons, where the participants tend not to engage in being in the place where the data they are using has been gathered from. Hitherto un-seen cues in the environment that are contingent upon the location and might not be sources of data, or indeed included on maps or images of a place, offer rich potentiality for understandings. These chance encounters that might not be experienced whilst located indoors add a sense of serendipity to the gathering of MtD and can add to its richness.

Going outside does not have to be the only component of More-than-Data practices. Activities can also be organised indoors where equipment and logistical challenges dictate, but these should form part of a process and range of acts that are seen as additional to getting outside. This is illustrated in more depth in Chapter 8, which sets out possibilities for locating a range of activities within a More-than-Data practice design process.

Links to Pathways Forward

PF2.1: Get outside

6.4.2 Logistics: The importance of planning prior to walk

In order to carry out walks it is essential to consider the logistics that make events a success, such as location, transportation, any refreshments, routes, tools and attracting participants. The locations of the five walks were all familiar to me, having visited them all at least once prior to designing them.

The timing of walks was essential, as was considering the weather and having a Plan B in case things went awry. One challenge faced with Walk 3 was the tide which cuts off the causeway to Sunderland Point twice each day. Getting data about the tide times was challenging as the

local tide tables for Morecambe Bay give the tide height for the bay itself, rather than Sunderland Point which lies further inland in the Lune Estuary. Therefore, calculations must be made as to the specific timings, with guidance being not to enter the causeway two hours before or after high tide. Whilst thinking about aspects of walks such as timing and location is somewhat mundane, they are essential to consider and to be thoughtful. Almost as a counterpoint to the accepted format of the hackathon, where timing seems defaulted at 12-24 hours, the More-than-Data walks were scheduled and timed around convenience for participants (Walk 4 was arranged according to invited participants" availability due to transportation requirements to the location) and in the case of Walk 3, organised around the tide. Walks 3 – 5 all had guides and the timings were roughly scheduled prior to the walks taking place. Walk 2 on Tiree demonstrated that participants can wander off and take more time in particular locations than others, meaning the scheduling of the walk and any post-event session might be affected. This observation was also made during the guided walks, during which participants noted that they sometimes felt rushed to move along and stay with the group when they had found something of particular interest in a location and wanted to spend more time there. The guides also kept groups moving in most cases and where they lingered longer at a point of interest, they might spend less time in other planned locations, demonstrating it is not possible to strictly schedule timing. This is less problematic where a walk takes place without a post-walk session, but where activities are planned afterwards it is important to take this practicality into account.

It is also important to consider the location for any pre- or post-walk activities that may be designed, in terms of accessibility and suitability. A city centre meeting room was used for the post-walk activity on Walk 3 and a large tent, already located at Warland Farm was used for Walk 5's post-walk session. Refreshments were also provided for Walks 3 and 5, and water provided for walks 2-5.

Planning events in advance affords the ability to pay attention to questions that are often neglected during hackathons, as they tend to jump into the accepted practice and format of many events. Considering where the event should be held, who should attend, how the logistics will be organised means paying attention and exploring a range of alternative activities.

Links to Pathways Forward

PF3:2: pre-and post- walk engagement with MtD and issues

PF3.3: Consider different event formats to encourage wider diversity and participation

6.4.3 Where: Deciding upon locations and taking a view from the ground up

The way in which data are used at hackathon events tends to be shaped by the data available, which are often related in some way to the location in which they are held, for example river gauge or rainfall data from the wider area, or traffic or air quality data from the city or town. From the data as starting point participants explore what could be done, often creating their own problems or challenges, rather than those faced in the place or communities.

By starting from the ground up, looking at a place in depth and then exploring challenges or issues, the locations for the five walks were chosen for specific reasons. The river Lune was chosen for Walk 1 as it holds an interesting array of landscape from the urban to peri-urban, with potentially interesting challenges to be explored around land ownership and development, as well as flooding which is frequently experienced in the area. Walk 2 was explored in terms of what data meant in a rural, isolated location and what issues were discovered around data scarcity resulting from lack of infrastructure. The challenge explored on Walk 3 focussed on understanding how we might gather data that are both digital and analogue using lo-fi tools. Both Walks 4 and 5 focussed specifically on flooding, with a rural and then urban location chosen to offer counterpoints and to explore the differences and similarities in these places.

Beginning by looking simultaneously at a place and specific challenges, then building a picture of who might be interested or useful in developing a richer picture, before tackling the data available about that place means a more focussed and potentially meaningful approach to understanding place. These issues also offer alternatives to the challenges around data-up approaches (4.4) and the lack of continuity of designs that often do not go further than the hackathon itself.

Links to Pathways Forward

PF1:1: Take a view from the ground up

PF2:2: Explore a range of venues – urban and non-urban places

6.4.4 What: Designing a brief in and for different locations, issues and challenges

When designing the walk themes and tools and deciding upon location, participants, and outputs, it was important to develop a brief that was of interest to potential participants and engaged with the place. This was particularly true in the case of the public walks (Walk 5), as the event had to be interesting enough to attract participants (recruitment discussed in Chapter 3 Table 4).

Thematically, Walk 4 posed the greatest challenge in terms of developing the content and making it interesting and relevant for a wider audience than those specifically interested in data and flooding. The challenge resided in the Mill Race being largely hidden, with the only images being in history books or maps. Whilst the route of the hidden river was apparent on maps and there were historical images in the one book written about the Mill Race and its history, trying to bring it to life and explore MtD relating to this context was more challenging than pointing out where water caused issues or where MtD resides in the landscape of Walk 3, where there were visual and physical cues in the landscape (e.g., watching water flow down the side of the valley, the reservoirs, debris from the most recent flood and canal etc. In the city centre, away from the Lune there were no obvious signs of water as the walks took place during a particularly dry period in early July. There was little evidence of water and no evidence of flooding, making it challenging for participants to visualise MtD relating to this theme. To help participants visualise the river running through the city before it was covered over wooden bridges were made and placed around the route at the corresponding locations on the maps (Figure24) which did help them to visualise how it once wound its way through the city centre. The concept of weather lore was introduced to encourage participants to imagine the manifestation and experience of weather in the city.

These challenges highlight the need to not only think creatively about the theme being explored, but the importance of visiting a location and understanding how the history, challenges and experiences of that place might be evoked for participants to engage with MtD that might be in that place. By carrying out two walks exploring the theme of flooding in two contrasting locations, it was clear that different tools and approaches to collecting MtD are required, particularly when exploring a hidden feature such as the Mill Race. This hidden, latent consideration of the Mill Race also mirrors the challenges with Data Walks, in that data

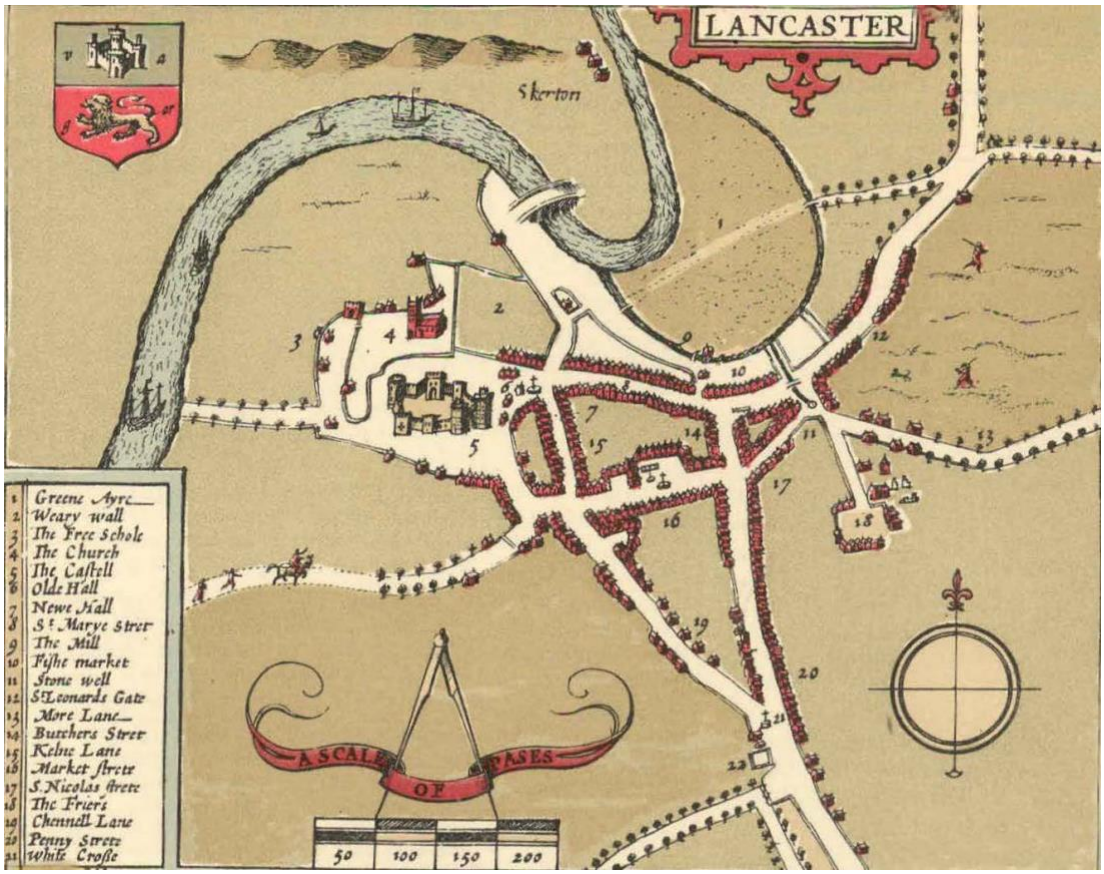

Figure 23: Speed's map of Lancaster showing the Mill Race

dashboards, or other forms of visualisation.

Developing a brief based upon and located in a specific place, rather than relying upon data that are gathered from that place, as occurs at hackathons, can lead to more meaningful responses and designs relating to the place and those who inhabit it. Themes inspired by and developed in a location mean real, rather than perceived, issues are explored, and resultant designs relate more specifically to that location, rather than being abstracted and largely applicable to anywhere. The themes of the walks carried out for this research were driven by issues relating to water, in particular flooding, and therefore provided a focus for the MtD that were gathered, and enabled participants to understand the theme and share their own lived experiences. Where possible, inhabitants of that place should be involved in shaping the themes, based on their own interests, challenges or issues.

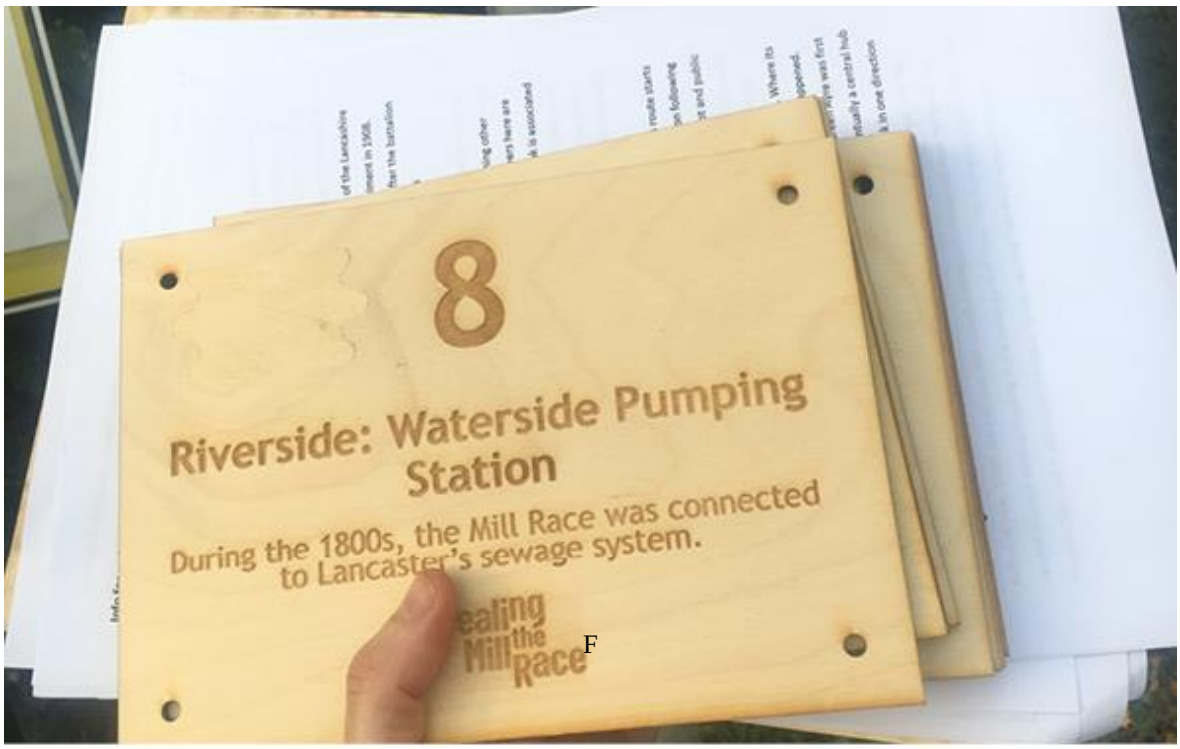

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Figure 24: (above and below) Wooden plaques used on Walk 5 to locate key points and features no longer there

Links to Pathways Forward

PF1.2: Dig down into other data sources

PF2.11: Base MtD collection on existing issues/challenges/themes/interest, rather than perceived issues[7]

PF3.9: Develop theme in and for the specific location and involve those who inhabit it where possible

6.4.5 Pre-walks and planning: walking and talking

To understand the location in which the walks were held and discover any accessibility issues I carried out pre-walks for 2-5. Maps were used and annotated to design the route, with the owner of Warland Farm guiding the route planning for Walk 4 due to the hilly terrain and his local knowledge of suitable routes.

On walking around the route of the Mill Race for Walk 5 I stopped to make some notes, when a resident of the flats which sit next to the water course came to talk to me. When I explained the nature of the walk, he told me about his own experiences of living so close to the Mill Race and the flooding he had experienced during Storm Desmond. He also told me of the smell that came from the underground water source when it was about to flood, which was an urban version of "reading" the landscape. This informed several of the prompts used on the walk, which the resident participated in. On an additional pre-walk, when taking images for the Flood Ontology I stopped for refreshments in a café close to the walking route with a colleague. We were overheard discussing the walks by the family of a retired engineer who had taken the photographs used in the only publication about the Mill Race by a local historian. He was contacted and attended a walk, during which I walked with him and annotated a map to gain a clearer understanding of the precise route it took and his recollections of the condition of the water source. This experience was a crucial addition to the development of the walks and my own understanding of the Mill Race, which I then shared with walk participants. As the Mill Race is really a location that is data-scarce, relying upon information and knowledge gained over time by both the historian and the engineer was vital. Added to this, the experience of the resident who could smell the Mill Race added a further dimension to understanding the place, one that I had not thought of considering in an urban environment.

Carrying out reconnaissance walks in the location where the walk is planned offers serendipitous engagement with inhabitants of that place and can enrich the development of the walks by exploring a place through a new lens. By walking around the city focussing on the Mill Race, which I had not done before, I saw the city in a different light and discovered new

features that had previously hidden the water source, such as being able to glimpse it flowing through the city by peering down the drainage cover. My own perception of the city changed through the serendipitous meeting with the engineer who I walked the route with. Had I relied only on maps to create the route, this would not have happened.

Links to Pathways Forward

PF2:4: Situatedness

PF2:8: Map local More-than-Data in place

6.4.6 Who: Bringing a group of people together around an issue, challenge or theme

In Chapters 4 and 5 the importance of bringing people together around an issue, challenge or theme was made apparent in differing ways. At the hackathon it was clear that the participants worked well together and shared a purpose of creating something of value, however the participants were not diverse and did not include stakeholders who might have contributed to defining and exploring the issues faced in the city (4.3.2). Chapter 5 highlighted the importance of considering the different "publics" who contribute to the complex ecosystem of actors who can contribute to the defining and exploration of issues in a range of ways (5.3.2). These insights contributed to the way in which participants for Walks 3-5 were approached and how they came together on the walks. Participants on Walks 4 and 5 (invited participants for Walk 5) shared an interest in flooding but came from a wide range of disciplinary backgrounds and had different lived experiences of flooding, whether personal or professional. During the walks it was clear that the act of walking itself acted as a powerful mode through which to bring people together around this theme. I observed participants who had not met before walking and talking, sharing experiences and knowledge as they moved. Participants also commented that this was a key benefit of the walks, as was sitting and sharing food after the walk. This experience situates the walk within wider lived experience, where participants can sit and share, which in turn adds new experiences. Hackathons are not able to achieve this slower, more situated, and engaging experience due to time constraints. The interactions I observed at the hackathon event took place as participants worked or shared short breaks, rather than taking time to sit, or walk together.

As walking offers opportunities to work towards resolving conflicts (Webb, 2017), they also offer potential to bring to the surface, explore and articulate value conflicts and politics, an issue identified in Chapter 5 (5.3.3). It is important, once the walks have been designed to think carefully about who might be invited. While the potential benefits of engaging with conflicting values might offer rich conversation and a deep picture of the issues encountered in that location, it is important to understand the potential difficulties and power imbalances

this might bring out. Mapping the potentially differing values of potential participants can help visualise possible conflicts and raise awareness of these issues within participants.

Links to Pathways Forward

PF3.5: Bring people together around a specific issue

PF3.8: Consider the potential conflicts of values and politics when designing the walk and inviting participants – how might these conflicts play out during the walks and what might encourage their drawing out?

6.4.7 What More-than-Data can be gathered before a walk?

As discussed in 6.4.5, taking a "ground" or "issue" up approach offers greater potential in exploring challenges and issues than taking the "data-up" approach of the hackathon (Chapter 4 4). Consideration of the type of MtD that can be gathered prior to a walk is important, although challenging.

Identifying what MtD might be in a place is key to understanding what might be collected pre- or during walks. Table 13 highlights some examples of what MtD might be in a place. The consideration of potential MtD that could be gathered prior to a walk is important to consider, in order to understand in more depth, the challenges faced in that place and the ways in which MtD collected pre- and post-walk might affect the ways in which the MtD are stored and then re-used.

As Kitchin (2014) highlights, there are diverse types of data available in and from place, as well as that which is generated *through* place and categorises the distinct types as data that are "easy to ensnare – data that are openly expressed (what is typed, swiped, scanned, sensed, etc.: people's actions and behaviours, the movement of things)", these data constitute Big Data. In addition, there are data that are what he terms "exhaust" which are defined as "a by-product, of the primary task/output, and auto-generated metadata." These data "may not have been designed to answer specific questions and the data produced might be messy and dirty" (Kitchin, 2014). Kitchin also refers to "small data," which is the kind of data that More-than-Data seeks to weave with that which are "easy to ensnare," as well as exhaust data.

Prior to Walk 1, I already had data relating to the weather, tides, and river height; information relating to the location and the types of building and wildlife, knowledge about staying away from the riverbank because the mud is very sticky and deep. Before Walk 3, I gathered information and knowledge by visiting Sunderland Point, using historical and geographical information which was then combined with my own knowledge of the area, including about the wildlife. The book written by the author leading the walk also offered knowledge, and wisdom from around the Bay, for example Cedric Robinson, the Queen's Guide to Morecambe

Bay sands who has lived and walked in the area for decades. For Walk 4 I had to visit the location to gain information about the location in order to create the route and the map, knowledge about the history was gained through walking and talking with the guide on a pre-walk and he shared his wisdom about living in the place, which had been passed down to him from the former owner.

Prior to Walk 5 I spoke with a business owner who had experienced flooding and knew a lot about the Mill Race historically, but who also used his wisdom of knowing when to act through watching the environment and using his senses to understand. Furthermore, I gained a deep insight into the real course of the Mill Race through walking with the engineer. who had experienced it and through talking to the resident who could smell when the area was going to flood. These experiences all enriched my understanding of the location prior to organising the walk. This approach differs to that of the hackathon, in that only data are gathered prior to the event. The datasets are often sorted into themes, cleaned, and sorted through to ensure they are both legally re-useable and prepared for re-use. More-than-Data relies upon MtD being gathered and considered prior to events in order to create richer, diverse pictures of a place that are then brought to life and enriched during the walks themselves when synthesised with lived experience and the imaginations of the participants.

Links to Pathways Forward

PW2:1: Get outside

	USED IN PLACE	**COLLECTED IN/THROUGH PLACE**
Data	Statistics relating to river level, rainfall, air quality – data that are openly expressed Exhaust data	Location data gathered through mobile phone e.g., through using exercise app that charts route Physical data from wearable device – heart rate etc River levels from gauges Rainfall levels from gauges GPS tagging of images taken on my mobile phone Citizen science – using sensors or logged by participants
Information	Digital maps – displaying data of that location Historical/wildlife information present in location (e.g., information panels) or accessed online Seeing that the birthday card that has been washed up by the river is still there means that the tide hasn't been higher since	Notes I take on my phone as I walk Images taken when I walk by the Lune in different conditions Access to heart rate data when exercising through the app (visualised)
Knowledge	Knowing that if river Lune is high, it will be impossible to walk down by the shore at Marsh Point Seeing the water flowing over the clough at Warland and knowing flooding will occur in the valley	Looking back at the images I took (information) next time I walk along the river, or from the same time the previous year to compare the conditions Walking by the Lune regularly, looking at and feeling the mud and river level and knowing the tide times means I won't go down by the shore at high tide I know the sounds of each of the birds I can hear from walking regularly & checking online when I return home, so I know next time
Wisdom	Weather lore – (need to think more about this!) Knowledge passed down over time …	More-than-Data seeks to develop "wisdom"

Table 15: Illustrations of Data, information, knowledge, and wisdom found in place

	Examples to be gathered pre-walk
Data	Flood data – historical & contemporary; social media gps tagged posts; census data; weather data
Information	Maps – digital and OS; historical information relating to geography, social history, maritime history
Knowledge	Paintings; poetry; literature; blog posts;
Wisdom	Inter-generational wisdom passed down through songs about the place
Lived experience	Oral histories, interviews, or conversations with people in the location. Participant's own lived experience of the issue/theme

Table 16: Examples of MtD to be gathered pre-walk

PF2.12: Map MtD in a place – develop typology of MtD that includes data, information, knowledge, wisdom and lived experience

6.4.8 Identify data deserts and scarcity

In Powell's data walks participants are asked to explore whether a place is "data calm" or "data" rich" (Powell, 2019, p.113). These concepts are important to consider and offer participants a method through which to develop their own ideas about what data are. Kitchin (2014, p.149) refers to "data deserts" and "data deluges", using the example of Irish public administration data sets which have a limited coverage of data and are full of gaps and "silences." Applying metaphorical language to the realm of data might offer a way through which participants are able to understand certain aspects of a phenomenon that are largely abstract and often invisible at the point of collection.

The Tiree walk brought to the fore issues of data scarcity, as opposed to deluges, which might be experienced in urban locations. Scarcity can relate to data that have been gathered already and can refer to both "big" and "small" data. The notion of data scarcity in a world where huge quantities of quantitative data are produced every year is paradoxical. However, much of these data are collected and gathered without much thought being given as to how they might be used. Issues relating to data scarcity may result from a lack of data being gathered due to infrastructure issues (e.g., lack of connectivity meaning data cannot be collected from a location), or lack of coverage which may have only partial coverage due to issues with collection or purposefully being left off the map. Kitchin also refers to issues with the type, quality and quantity of data being gathered being a consequence of the tools and technologies

used to gather it, the context in which the data are generated, and the data ontology employed (Kitchin, 2014).

Both types of data-scarcity were encountered on the walks. I found data scarcity resulting from lack of infrastructure on Tiree, and that which results from lack of collection (and infrastructure) on the Mill Race walk.

Walk 2 took place on Tiree, a remote island where only 2G can be received and residents suffer from not only being able to use data that they produce themselves, but also, they are left off the data-driven maps (0). The experience of Walk 2 on Tiree demonstrated that even though a location might be data scarce, due to infrastructure issues, it is not information, knowledge, or wisdom scarce. There is a danger of those living in rural and/or isolated areas of being left off the map (Dix, 2014), of not having their data represented, which can have both positive (not being constantly monitored or surveilled) and negative (not being represented on the map) consequences.

On Walk 2, several participants challenged the concept of collecting data in the remote context and held an appreciation for the unknown elements. One participant commented "It [data] seems somewhat out of place on Tiree," while others noted that "I quite like … the lack of data" and "I was struck by what I felt was a lack of immediate information." Another felt ambiguous about how our relationship with data is intermediated, saying "I can see the information is useful in our lives … you can't check or forecast so easily here … I feel I get a bit bogged down with tech … [its] nice to not need to rely on it so much." Of course, these comments were made by visitors to the island, many of whom enjoyed the opportunity to disconnect from technology for several days. This position is different to those who live on the island and require data, or connectivity to carry out work or contact with friends and family.

When carrying out the walk in Lancaster, a city with excellent mobile connection and potentially a wealth of data gathered from arrays of sensors and residents the notion of data-scarcity was an issue I did not expect to be addressed. However, the very nature of the Mill Race, that it is now fragmented, and different organisations are responsible for various parts of it, means that no reliable data are gathered about it at all. The regular surface-water flooding, in particular the serious flood that occurred in the city centre during Storm Desmond in 2015 cannot be predicted using sensors. Evidence shows that the drainage system and Mill Race are significant contributing factors to the city centre flooding (this is a separate issue to fluvial flooding from the river Lune), however business owners and residents who have experienced this rely upon their own lived experience and past observations to predict when flooding will occur and make the relevant plans.

It is therefore important to consider whether a place is data scarce or abundant in terms of specific types of MtD and to explore the consequences of this before designing the walk. For

example, an area might be abundant in some areas, but scare in others. A city centre may contain vast amounts of data, but it may be more challenging to uncover knowledge and wisdom. Just because a place might not have good digital connectivity does not mean it is not worth exploring, as it may have rich seams of information, knowledge, and wisdom latent in its environment, or in other locations.

Links to Pathways Forward

PF2.10: Explore what MtD, or elements of MtD are absent from a location

6.4.9 Guiding walks guides narratives and MtD collection

Walks 3-5 were guided, to provide a narrative scaffolding and enable me to observe the walk and engage with participants, rather than lead it myself. By engaging participants in narratives about the place, which in themselves consisted of a range of MtD shared by the guide the aim was to offer a more situated experience of the place for those who had not visited it prior to taking part in the walk. However, by giving participants a pre-defined narrative of the place throughout the walk, the type and content of MtD would be reflected in what participants created and gathered. This is important to consider, in addition to potential biases of the guides, where they are offering more than historical, geological, or geographical information about the place, such as sharing their lived experience. The guides for Walks 3 and 4 both had lived experience of the location and their own personal situated understandings. For the Walk 3 guide, who had authored a book featuring the location, she wove in narratives of people she had interviewed as well as the historical, geological, and geographical information and data about the location. A point of tension arose when the group stopped at Sambo's Grave (Fig.27) where a young boy who died on a slaving ship is buried on the coast and a discussion arose between the guide and a participant who had been engaged in a creative project about Lancaster's slaving history. This demonstrated the tensions and differences that arise in a location, based upon personal experience and values (as discussed in 5.3.3). These tensions should be mapped and in this case the participant noted it in their wearable map pouch at that location using text (This was also noticed by several other participants in that location).

The guide for Walk 4 owned the farm (and was an interviewee in Chapter 5), so shared his own lived experience of that place, of experiencing flooding, as well as historical, geographical, and geological information and data he had gathered himself and had been shared by the previous owner and other residents. This was augmented by two other participants who live and work in the area, who shared their own experiences of flooding and how they had dealt with it locally. Walks do not have to be guided, there are some examples of self-guided maps and booklets in different contexts that encourage walkers to respond to specific prompts in their location and then share their results online. The Mill Race walks were

designed to be self-guided which is why a map and instructions were developed, along with the small notebooks and cards that would be easy to send to participants. Self-guided walks might have the feel more of a drift or derivé than the guided walks, which had a more formal feel and guided the narrative of the walks.

Whilst the self-led option offers the opportunity for walkers to move at their own pace and choose their own routes, the sharing of their insights and products of the walks should be considered. Enabling the sharing online would facilitate this but might frame and therefore limit what can be shared and potentially limit access to those with the skills and access to the hardware required.

Gathering and re-using the MtD collected might be a challenge and there is a need to consider how this might be done, either physically or digitally. A further challenge of designing self-guided walks is how to bring people together in smaller groups or individually and facilitate the conversations that were a key benefit and strength of groups with different participants walking together.

Links to Pathways Forward

PF3.1: Explore and articulate common and conflicting values and politics

PF3.4: Understand tensions between different communities of practice

PF3.6: Consider whether walks should be guided or self-guided and consider the benefits/challenges in designing tools and themes*

PF3.7: Explore whether walks should be synchronous or asynchronous, where participants can walk on their own and then contribute and pool their MtD remotely or physically

6.5 How will More-than-Data be gathered from the walk?

Walking is a generative activity, as van Es and de Lange (2020) discuss, using the example of a researcher producing a data log of her walk using an app. This notion of being generative is placed within the context of walking as a research method (see 2.3.2), whereas More-than-Data walks aim to engage a wider range of participants and to exist beyond academia. As More-than-Data walks aim to gather and explore a wider range and conceptualisation of data, they are generative in a unique way. The methods and tools with which More-than-Data will be gathered from place, both prior to and during walks is important to consider because it influences the whole More-than-Data lifecycle. As seen with hackathons, the use of purely digital and sensed data influences the outputs, which are embedded within technological systems tends to dominate. By doing so, we tend to miss what might be considered “thick” data, comprising rich descriptions and experiences about a place. Whilst it is sometimes beneficial to develop applications or visualisations of data, a wider range of designs could

benefit the engagement with issues and challenges faced by different groups of stakeholders in separate locations, some of whom may prefer or benefit from analogue or lo-fi technologies.

6.5.1 Tools: designing useful but lo-fi methods of MtD collection

Walks 1, 3, 4 and 5 all used tools to enable participants to either gather or produce responses to the walks and make the experience more interactive and engaging. Analogue tools were used in all walks except Walk 3, where a mobile application was used, and participants were free to use their own mobile devices.

The development of the lo-fi wearable maps and pouches came from a need to enable a low-resource and skill level in creating them, as well as a portable tool that could be used easily by walk participants. The wearable maps were so called as they consisted of a long piece of string with location markers on and were supplied with small pouches, paper clips and paper so that participants could fill them and attach them to the string at the relevant stopping point. The pouches developed for Walk 3 (Figure 29) consisted of a folded and glued piece of waterproof paper attached to a piece of string and contained small pouches, paper, and pen. The walk route was printed onto clear acrylic and attached to the front of the pouch and participants were free to annotate the map and draw on the pouch itself (Figure 27). For Walk 5 participants were given a clip board, ready-made plastic map pouch containing a small notebook, small pack of prompt cards and route map with instructions on the reverse (Figure 31).

The challenge for all walks was to enable participants to adapt the tool and use it in ways that worked for them while walking. Walking and using a mobile device have become commonplace today, although it is challenging to pay attention to the environment in which one is moving. Attention was a similar challenge in using the analogue tools too, although participants told me they found the pouches to be tactile and they preferred writing or drawing to typing into a mobile phone or taking photos as they moved. It is not possible to entirely remove issues with attention, as writing and drawing demands attention, as does typing on a mobile device. However, having a tool that only enables an analogue response might enable participants to engage more with the location and theme with no temptation to carry out other tasks simultaneously, such as looking something up online, taking photos and sharing on social media. Exploring a balance between digital and analogue tools is important and should be made explicit at the start of the design process, with tools design specifically for that location.

Figure 25: Example of writing in wearable map (1)

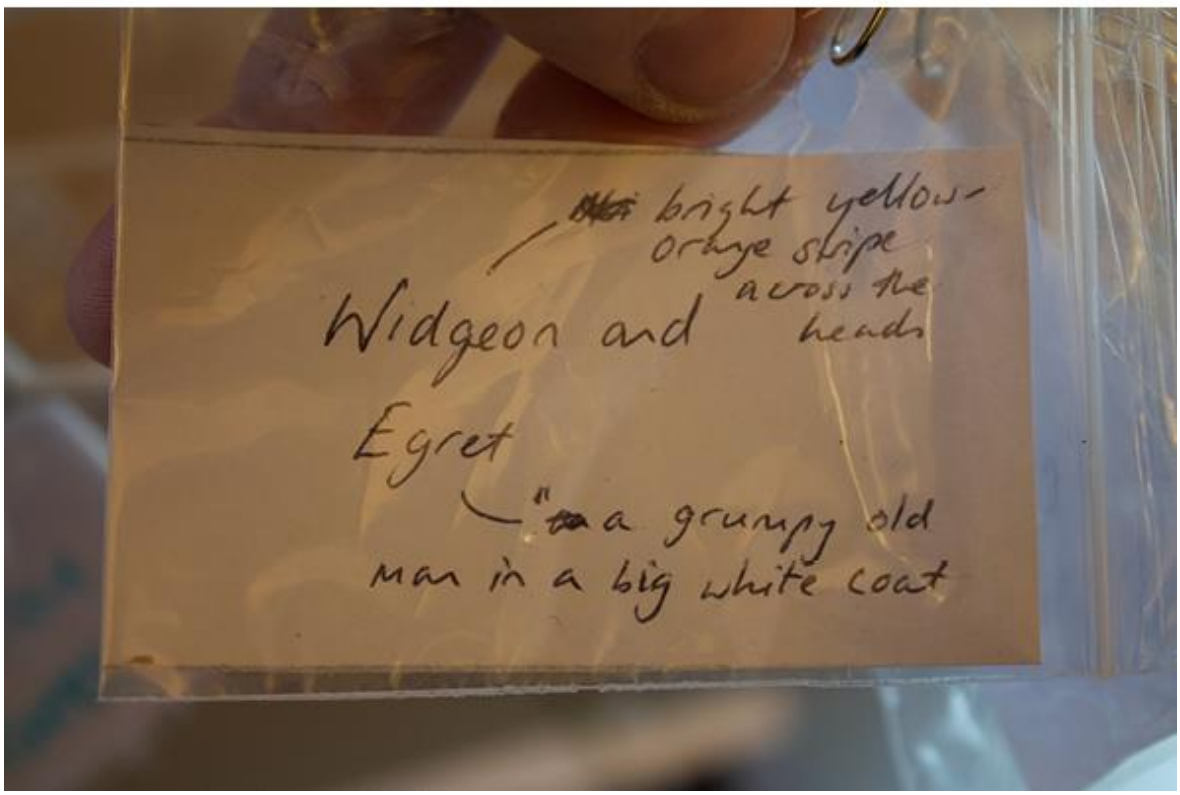


Figure 26: Description of birds in wearable map pouch

Figure 27: Sign for Sambo's Grave on Sunderland Point

Figure 28: Feather collected in wearable map

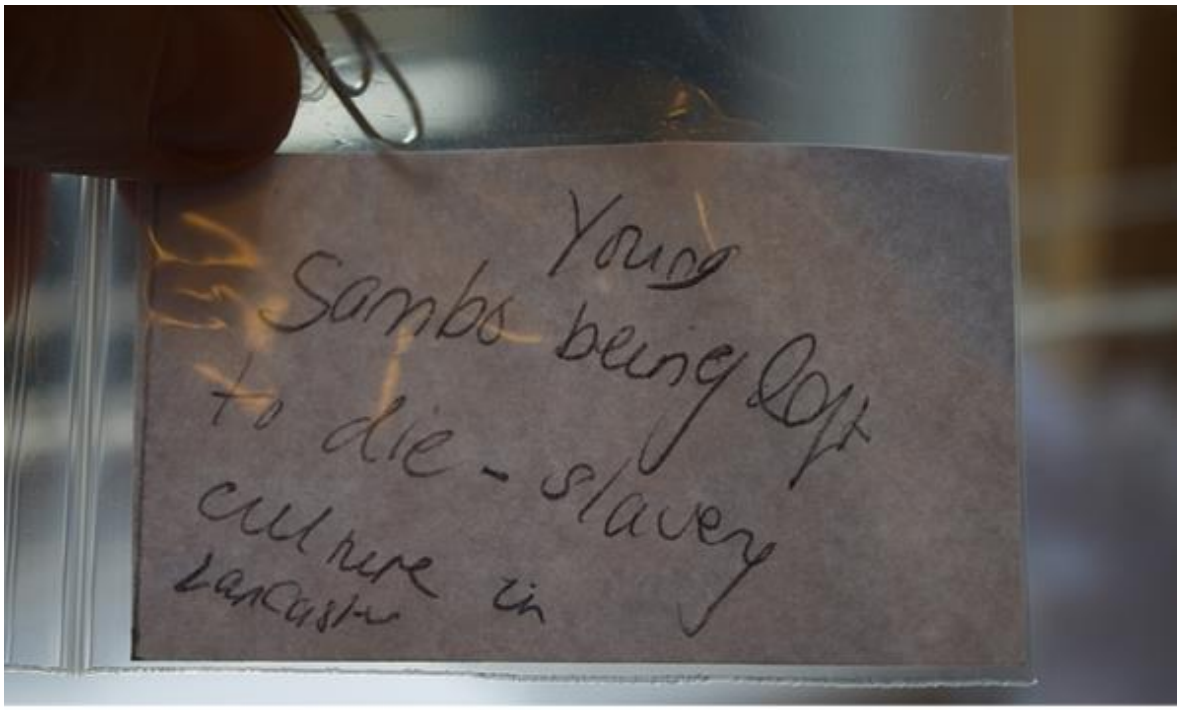


Figure 29: Writing about Sambo in wearable map pouch

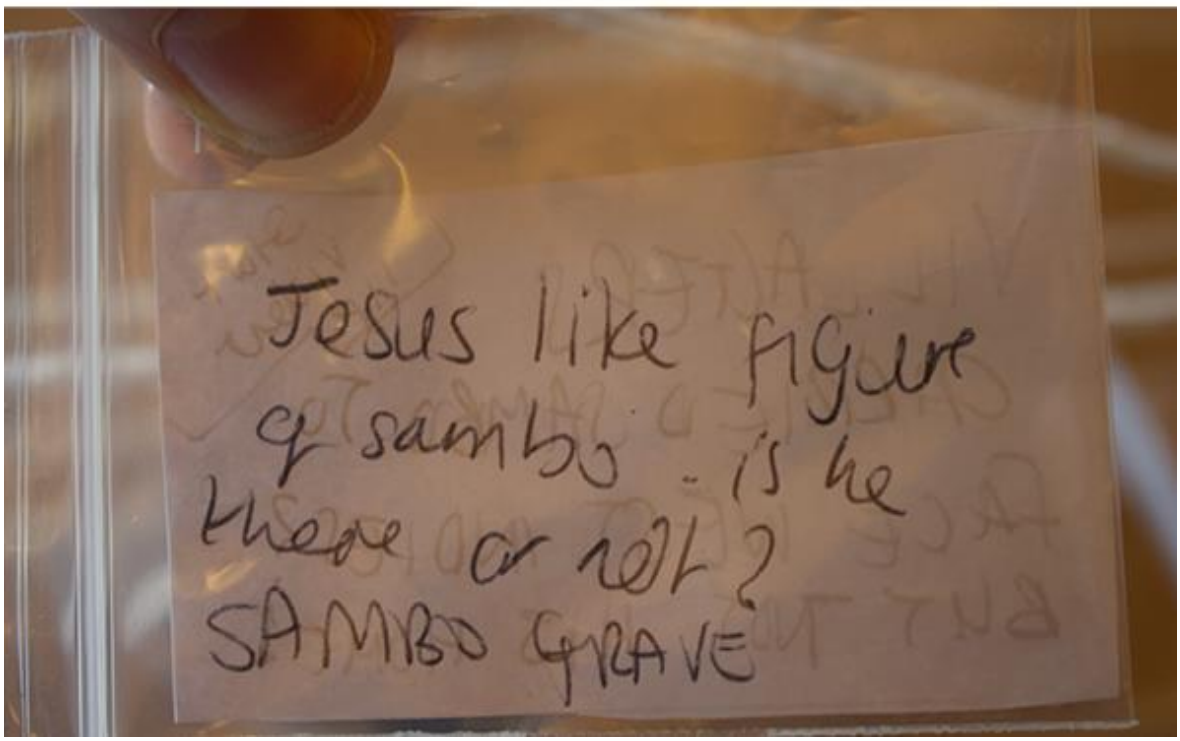


Figure 30: Writing about Sambo in wearable map pouch (2)

For example, it was important that the pouches for Walk 4 were able to be used in the rain due to the nature of the weather in to write or draw as they moved. Using analogue tools also challenges the emphasis on using digital tools to collect and understand only digital or sensed data, as was explored in Chapter 4. This approach can lead to a narrow focus on technological artefacts, missing the potential for more diverse outputs and encouraging participants who do not have the same levels of data literacy as those taking part in hackathon events. Reflecting on Walks 3 and 4, where participants gathered objects (see above) it seemed to be paradoxical that I was aiming to understand place through situated experience and tangibility, whilst simultaneously removing small yet significant elements that location and Walk 5 used a Japanese style folded notebook so participants were able of that place. Whilst the wearable maps were tangible and enabled participants at the post-walk events and indeed myself in the analysis to grasp what MtD were present in that place, taking parts of it away felt unethical on reflection. The responses participants created in the drawings and the texts or notes represented the place and enabled a tangible response and reflection afterwards, whereas once objects such as sheep droppings, seaweed or clumps or Morecambe Bay mud were removed from their context and studied in the office environment they lost all their meaning and context. The seaweed and the mud became dry and served no real purpose once they were contained in a small plastic pouch in my office on the university campus.

The notion of contingency and human sensory experience of the walks were removed from the objects once they were removed from place and did not serve purpose, except for acting as prompts for analysis. The objects could be recorded through photographs, text or drawings that serve to build a rich picture of place that remains in that context. As we remove ourselves from the place, it continues to exist in our memory and if we visit again, it becomes renewed, a palimpsest that we create. It is possible to create this kind of record of place by capturing our experiences of the place, through writing, memories we share, images, photographs and whilst these collective data do not recreate the place in its entirety a rich seam of MtD can be developed. This takes further the work exploring data in place data walking and city-walks (Chapter 2).

Analogue tools offer a lo-tech and often low-resource approach to capturing MtD in a location, as well as the potential for prototyping, where the walk is part of a wider series of events. Designing and making the lo-fi prototypes for this research meant I was able to try different things out. This approach also demonstrates that designing a walk does not have to be done by a designer or someone fluent in programming, app development or data science. Creating lo-fi tools which are resource constrained offers the potential for creativity, of working withing specific constraints, and means walks can be developed by a wide range of people**.**

Links to Pathways Forward

PF1.3: Use tools guided by the issue or theme being explored

PF1.5: Expansion of hackathon and data toolboxes

PF4.1: Consider usefulness of using particular tech in which data are embedded

6.5.2 Tools: Potential and challenges of digital tools

Participants on all the walks were able to use their own devices, such as mobile phones and cameras to record the walks, in addition to using the tools provided. It was observed that on all the walks most participants used the analogue tools, with only several participants using their phones or cameras to take photographs on the route. The only walk where participants were provided with technology was Walk 3, where four participants were given a mobile phone to use the SnAPP mobile application. I wanted to explore the potential for digital technologies in the preliminary stages of the walks, to understand what they afforded versus analogue tools, but I wanted to step outside of what Powell refers to as the "technological framework" when describing her Data Walkshops (2019, p.217). Whilst I was interested in the phenomena of data as embedded and entangled withing technological frameworks and the ways in which they are manifest in digital technologies, I did not wish this aspect to dominate the walks and give participants a new app to use. Rather, a key aim of Walks 3 -5 was to understand how non-digital data, entangled with information, knowledge and wisdom are manifest, can be gathered and build a picture about place. The key advantages I anticipated in using the mobile app in Walk 3 was the ability to log GPS location of MtD could offer a precise location to a map when gathering the range of MtD and the capturing of data as participants moved through a place (e.g., location data, social media posts, images) and understanding where there might be areas where MtD are abundant or scarce, depending upon what is tagged there. The SnAPP mobile application used as a "minimal interaction unit" which is operated by clicking a smart button mounted in the phone's audio jack, participants could click the device – one click representing a location reminder and two clicks representing a question they wanted to ask, text was entered at that point. The app was coded to enable the data collected from use to be directly uploaded to Google maps and generate a map featuring the data, which consisted of text. Both forms of data would enable the accurate logging of data and movement, perhaps along with the tagging of MtD as we moved through a place, which might then be combined with the analogue data after the walk.

Figure 31: Wearable map pouch in use on Walk

Figure 32: Wearable map pouch for Walk 4

Figure 33: Wearable map in use on Walk 3

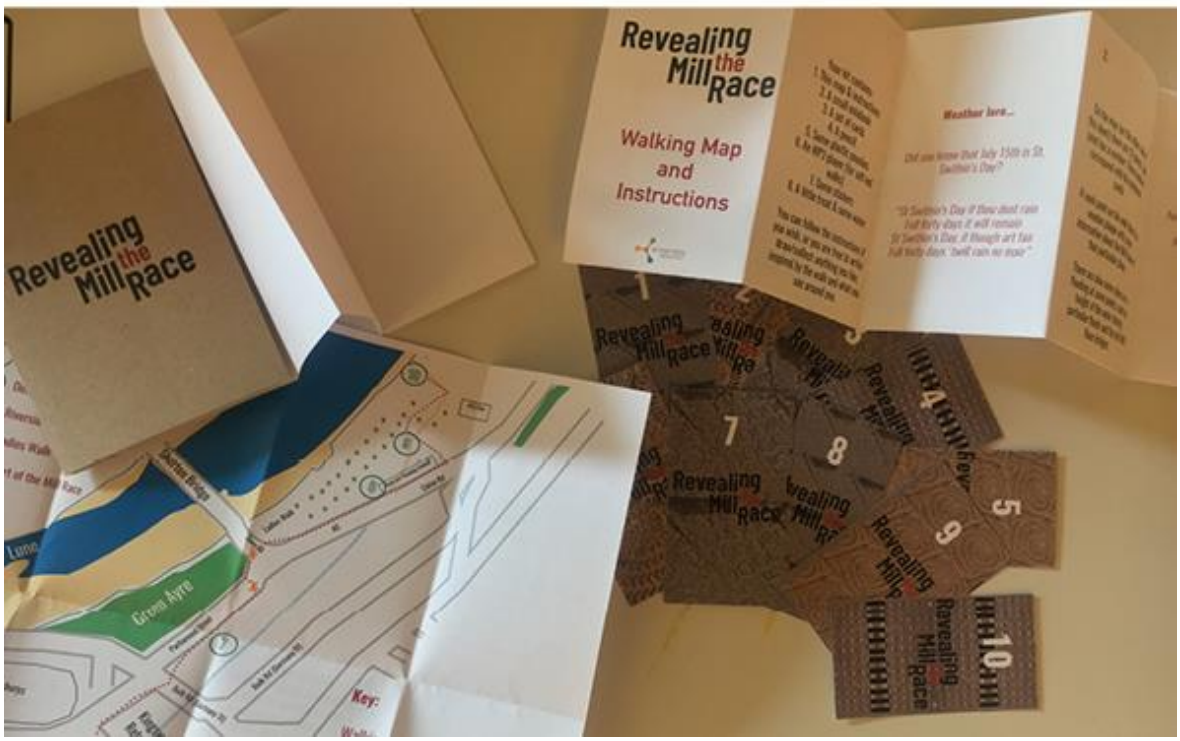


Figure 34: Artefacts designed for Walk 5

Figure 35: Wearable map designed for Walk 3

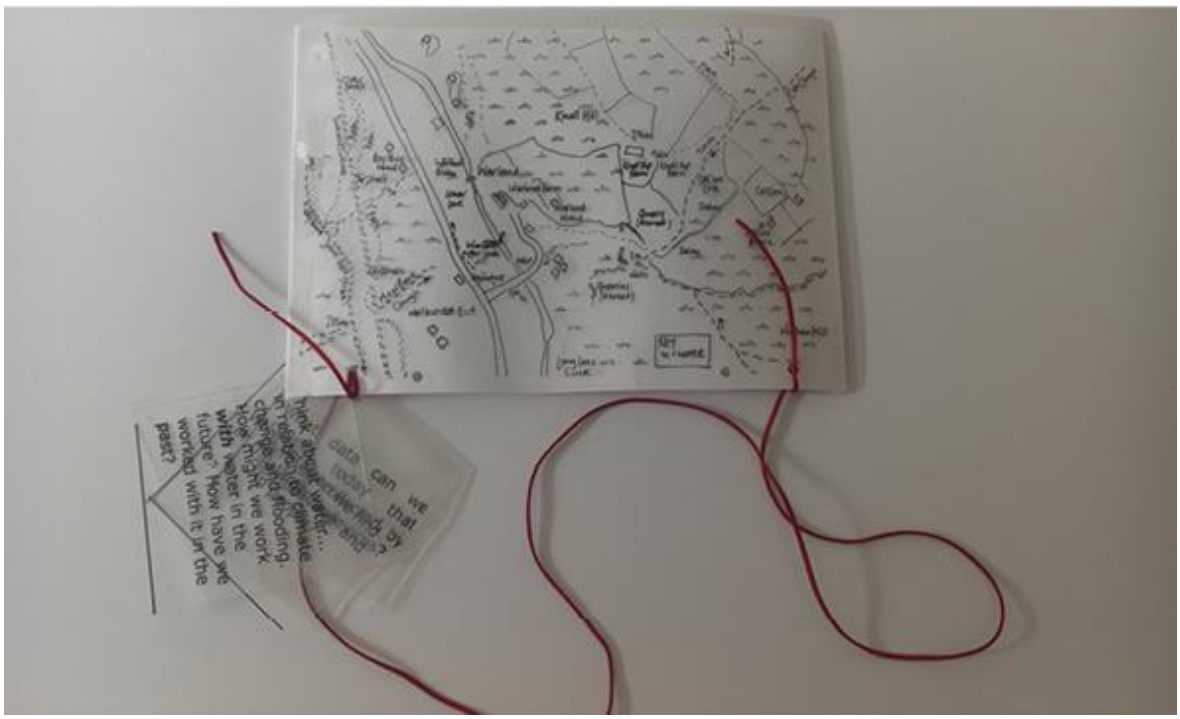


Figure 36: Materials designed for Walk 5 with map pouch

When exploring the data provided by the SnAPP users (Figure 37, below), it was clear that the text-based responses could be captured by analogue means and the users explained that they felt slightly removed from the place by using a mobile phone to mediate their experience, in contrast to those who used the analogue map and felt it did not detract from their experience. One participant who used the mobile app explained that they felt "jolted outside of the walk" through using a mobile, even though they did find the ability to tag their location useful. The GPS location tagging of the text input by the app users was useful (Figure 37), as it enabled the pinpointing of their question or comment. However, tagging images with a GPS location is possible on most smart phones, where the images can then be visualised on digital maps. The analogue maps enabled the logging of location using tags in the order the walk stopped at but did not enable a precise location. The challenge lies in bringing together the digital and analogue to develop a rich picture of place. At the post-walk event for Walk 3, the data points captured on the SnAPP app were projected and the analogue maps displayed and very few participants at the event engaged with the data on screen, whereas the tactile nature of the analogue maps led people to explore and engage with other

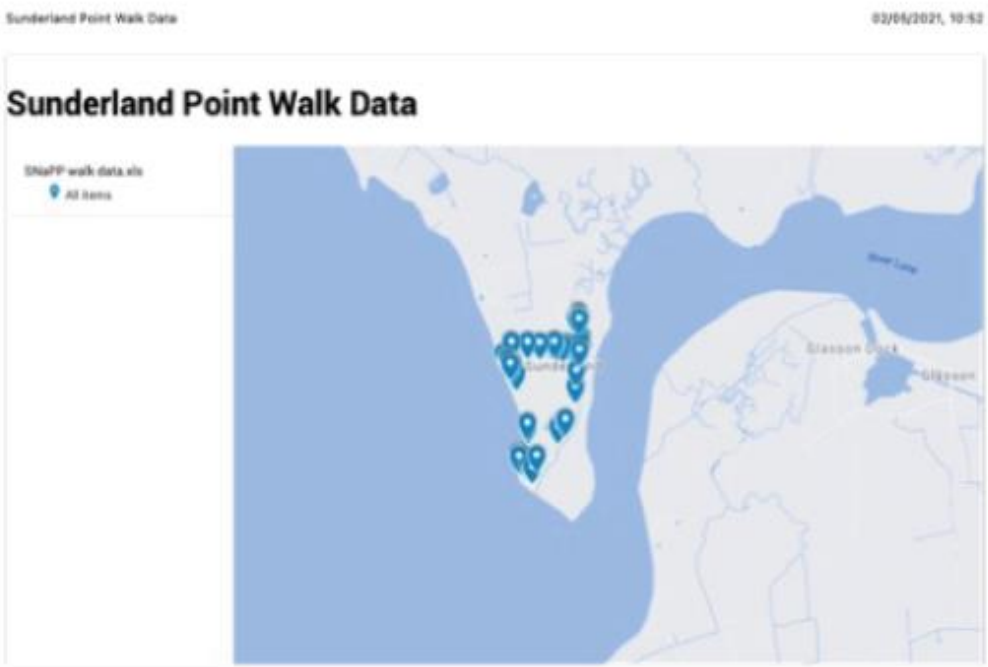


Figure 37: Data from SnAPP app placed on Google map

participants. Both the analogue and digital maps offered the ability to understand areas of MtD abundance and scarcity, although this was artificially created on the walk as the guide stopped at specific locations where participants made notes or gathered artefacts. Whilst participants could collect or create with the app or map at any location, it was clear that more was created at the stops than through moving through the place itself. Whilst the use of digital technologies offers interesting modes of gathering data in and through place, the range of work already done with digital data prompted me to develop analogue tools for the future walks, rather than digital technologies. Through the development of lo-tech mechanisms and enabling participants to use their own digital and mobile devices on Walks 4 and 5 an alternative approach to that of dominance of the digital in the realm of data. Whilst there are benefits of utilising digital technologies during walks, this should not be the driving force. In order to ensure tools are relevant to the specific walk considering this as a design decision is vital. By including this consideration in the design process, rather than it leading the design process, suitable and relevant tools for the specific walk that enable the capture of MtD within that location should be developed or used.

Links to Pathways Forward

PF1.6: Explore creative uses of data

PF4.2: Gather/record MtD about a specific issue in support of mobile applications

PF4.1: Consider usefulness of using particular tech in which data are embedded

PF5.3: Explore and adapt a range of practices to gather and share MtD

6.5.3 Thinking of More-than-Data as a design material

Much of the data that are automatically sensed and collected are gathered without a clear definition of the way in which they will be re-used (Chapter 4 4.4.2), meaning vast amounts are stored without ever being analysed or used. There are also issues in the cleaning and preparing of open data that are used at hackathons, which are often datasets comprising of data that have been gathered for a purpose and are being re-used in

a different context. There are limitations in the way such data are re-used at hackathons, such as river water level gauges and rainfall data being mashed together to create a flood prediction app, or the potential re-use of traffic accident data (or the other data sets explored at the hackathon visited in Chapter 4).

The consideration of data as a design material highlights the need for the materiality of data (and in this context information, knowledge, and wisdom) to be embedded within the collection, storage, and re-use cycle. The mode of MtD collection using tools shapes the type of artefact that are gathered and produced during walks, and therefore impacts the potential

re-use designs. For example, artefacts such as the drawings relating to Margaret the fisherwoman on Walk 3 (7.1.1) offer visual representation of the knowledge shared during the walk, whereas audio files relating to the fisherwoman also exist. The use of these audio and images, in addition to data located in that place can be embedded in re-use designs that might be digital *or* analogue. This dual analogue and digital approach is not seen at hackathons where digital data on its own becomes the design material, which leads predominantly to the production of digital artefacts such as mobile applications, visualisations, or dashboards.

By explicitly conceptualising MtD as a material with which to design responses to themes, challenges, or issues in a location, we can begin to think about suitable design processes (detailed further in Chapter 8). We see the hackathon practice as based upon the design charette, or sprint, but explicit design processes are rarely made explicit or followed, due to time constraints (4.3). By understanding that MtD being gathered will be used as a design material and shape the designs further in the process, it is hoped that this will enable greater engagement with the whole design process, from the gathering of the MtD through to the designing of artefacts that embed it as a material.

Links to Pathways Forward

PF1.9: Explore the synthesis of analogue and digital data*

PF1.10: Consider MtD as a material with which to design*

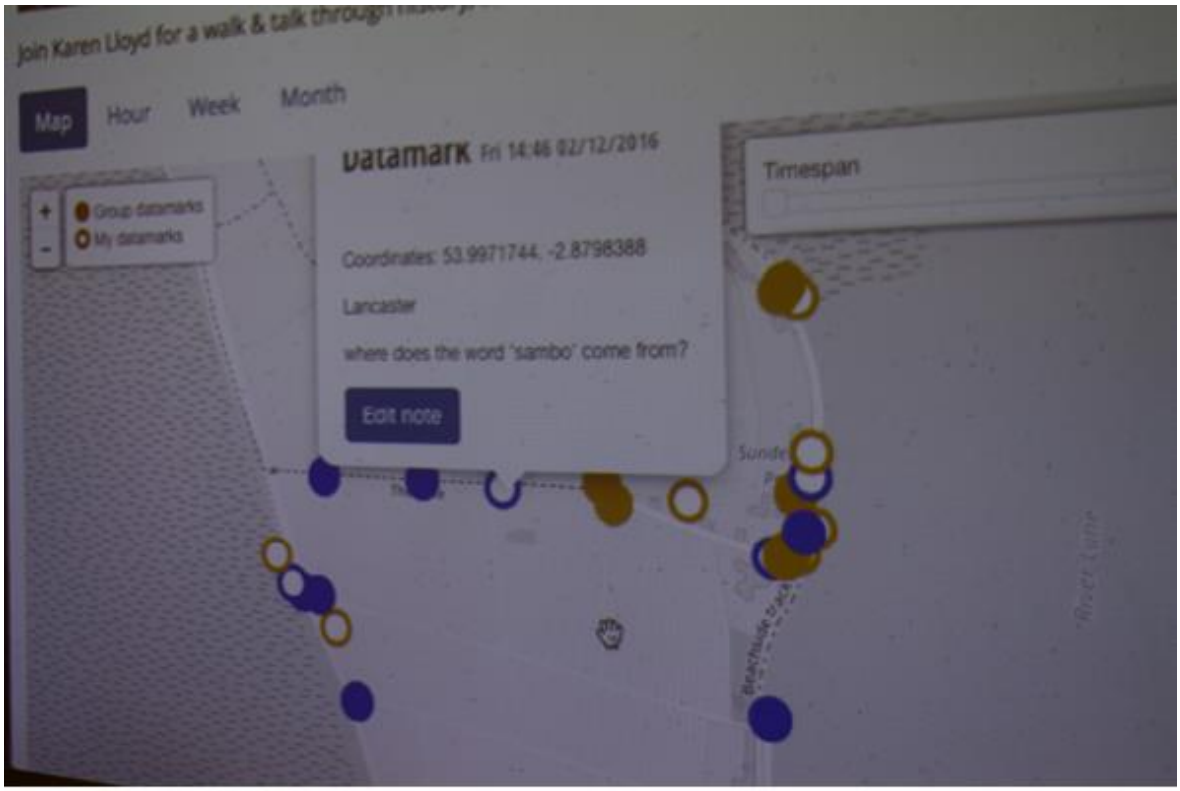


Figure 38: SnAPP mobile data projected after Walk 3

Figure 39: SnAPP mobile application in use

6.6 Chapter summary

This chapter has presented insights developed from designing the walks in order to offer responses to the research question

RQ2: How might More-than-Data be embedded into a new practice that uses walking?

RQ2.1: How might walks be designed to encourage a More-than-Data approach to understanding place?

Insights included in this chapter were drawn from reflections made prior to, during and after the walks and built upon the Pathways Forward (that were drawn from chapters 2, 4 and 5. The insights that have been developed in this chapter have subsequently led to the development of existing PFs and the addition of new ones, based upon the experiences of carrying out the walks.

Those insights included in this chapter relate specifically to the design of the walk, that is the consideration of how and where they would take place, who with and the tools that would be used. Insights in the following chapter explore the themes, content, and materials of the walks, as well as the opportunities and challenges of storing and re-using the MtD that are gathered at all stages. There are themes in the two chapters that overlap and are cross-cutting, such as the design of the tools as discussed in this chapter and reflections on how they were used to gather MtD in chapter 7.

This chapter has highlighted the process of designing the More-than-Data walks, which involved the consideration and interrogation of place, including the need to understand and gather MtD that exists and the deserts that exist, the type of location which might be urban, rural or the edgelands of a town or city, the development of themes or issues of import, the people who can be brought together around a theme or issue and the tools that might be used to collect the MtD. Through designing and carrying out the walks and reflecting upon the process, it is apparent that by considering these elements separately prior to a walk or event taking place, the conditions are established through which walks can engage with place and weave together both data-driven and non-data driven understandings, through the concept of More-than-Data.

The insights presented in this chapter demonstrate the need for exploration of how MtD will be gathered prior to an event, as the content will shape and inform the ways in which the materials are stored and re-used. Furthermore, the insights highlight the benefits of engaging with a particular place and exploring it using themes, or issues. Chapters 2, 4 and 5 of this research highlighted the challenges associated with the organisation and format of hackathons

and resulted in the consideration of what an alternative activity, or event, that engages with data about place might look like.

Considering the development of the walks as a design process was integral to this research (this is explored in more depth in Chapter 8). Understanding key elements that form "what," "why," "how" and "who" questions before carrying the walks out enabled me to develop activities that, as is explored in more depth in the following chapter, embodied More-than-Data. The design of the walks was partly iterative, with insights emerging from walks that became either stand-alone, or were folded into the subsequent walk, or walks. Time spent reflecting on the walks, during and afterwards, using images and the artefacts created enabled me to draw out the key elements that are integral to the design. The key findings that emerged from the research and can help highlight how walks can be designed that not only enable understanding of place, but also to embody More-than-Data.

A fundamental element of designing the MtD walks was going outside, which addresses the issues highlighted at hackathons where participants remain indoors throughout the event. This is largely due to the constraints around infrastructure and equipment, in addition to the time constraints placed upon participants. By considering MtD walks as one of a series of processes within a wider series of events and activities (explored further in Chapter 8), going outside becomes embedded, as the technical and infrastructural requirements are included in separate parts of the process. I found that the inclusion of unseen cues in the environment, that might be contingent upon the weather, or as I found on Walks 1 and 2, upon the tide, in addition to serendipitous encounters, have the potential to embed more engaging and insightful elements to gathering MtD that are not based solely on maps.

Building a picture of a place from the ground-up and developing MtD from this perspective, rather than working only from data that are available about a location, as we often see at the hackathon (Chapter 4, 4.4.5) offers deeper and more diverse understandings to be gathered. From Walk 1, rather than a data-up approach, we see a ground- or place-up approach to gathering MtD.

Developing a brief based upon and located in a specific place formed a key part of the design process for the walks and explored both urban, rural, and peri-urban locations. This demonstrates that MtD walks can, and should, be carried out in a range of locations, rather than relying upon the urban realm, which tends to be the site of conversations relating to data and of data walks.

Themes that are inspired by and developed in a location mean real, rather than perceived, issues are explored, and resultant designs relate more specifically to that location, rather than being abstracted and largely applicable to anywhere. Exploring the theme of water in two distinct locations, Warland and Lancaster City Centre, highlighted the rich potential of

differing experiences of participants and different methods of designing walks and tools that gather a range of MtD. A key benefit of MtD walks is that they can be designed for a range of places, and different contexts and challenges, but utilising the same fundamental design considerations (as explored in Chapter 8). A fundamental element of developing the themes for the walks came from carrying out reconnaissance walks and exploring a range of issues in a place, before deciding upon the key themes. Tiree was the ideal location for exploring what data meant on a rural and isolated island, where data was perceived to be scarce. Sunderland Point offered the opportunity to explore a location rich in narrative both in terms of its history and geography. Exploring the theme of water and flooding for the walks in Warland and Lancaster City Centre offered the opportunity to see this issue in different contexts and to explore the challenges of locating water in both rural and urban environments. My own perceptions of the walk locations changed through the serendipitous encounters, particularly on the Mill Race reconnaissance walks where I met two different people with differing lived experience. These experiences highlight the benefits of not only getting outside but exploring specific themes and carrying out walks to understand a place in depth.

This chapter also highlighted the benefits and challenges of bringing people together around an issue, which was a fundamental consideration in their design, particularly Walks 3 – 5 which all involved a range of participants with differing expertise and lived-experience. Lively conversations took place on all the walks, in the spirit of conviviality. However, as walking also offers opportunities to work towards resolving conflicts,) they can also bring to the surface underlying tensions and conflicts of values. This highlights the need to consider participants carefully, which can be challenging if inviting general public. While the potential benefits of engaging with conflicting values might offer rich conversation and a deep picture of the issues encountered in that location, it is important to understand the potential difficulties and power imbalances this might bring out. By embedding the mapping of differing values into the design process, this can help to visualise and draw out potential values conflicts between participants.

THEME	PATHWAY FORWARD	REFERENCE
PF1: Data-driven artefacts	Take a view from the ground up	PF1.1
	Dig down into other data sources	PF1.2
	Use tools guided by the issue or theme being explored	PF1.3
	Expansion of hackathon and data toolboxes	PF1.5
	Explore creative uses of data	PF1.6
	Explore the synthesis of analogue and digital data	PF1.9
	Consider MtD as a material with which to design	PF1.10
PF2: Place- sites and locations of data collection and re-use	Get outside	PF2.1
	Explore range of venues – urban and non-urban places	PF2.2
	Explore situatedness in the place through its inhabitants and plural histories*	PF2.4
	Think about how data are themed (e.g., by place)	PF2.5
	Map local MtD in place, lived experience, MtD in place and using wider archives e.g., oral history/art projects	PF2.8
	Explore what MtD, or elements of MtD are absent from a location	PF2.10
	Base MtD collection on existing issues/challenges/themes/interest, rather than perceived issues	PF2.11
	Map MtD in a place – develop typology of MtD that includes data, information, knowledge, wisdom and lived experience	PF2.12
PF3: Practices and people	Explore and articulate common and conflicting values and politics	PF3.1
	Pre- and post-event engagement with MtD and issues	PF3.2
	Consider different event formats to encourage wider diversity and participation	PF3.3
	Understand tensions between different communities of practice	PF3.4
	Bring people together around a specific issue	PF3.5
	Consider whether walks should be guided or self-guided and consider the benefits/challenges in designing tools and themes	PF3.6
	Explore whether walks should be synchronous or asynchronous, where participants can walk on their own and then contribute and pool their MtD remotely or physically	PF3.7
	Consider the potential conflicts of values and politics when designing the walk and inviting participants – how might these conflicts play out during the walks and what might encourage their drawing out?	PF3.9
	Develop theme in and for the specific location and involve those who inhabit it where possible	PF3.10
PF4: Situated artefacts	Consider usefulness of using particular tech in which data are embedded	PF4.1
	Gather/record MtD about a specific issue in support of mobile applications	PF4.2
PF5: More Than Data	Explore and adopt a range of practices to gather and share More-Than Data	PF5.3

Table 17: Pathways Forward from chapters 5 & 6 with new additions shaded in grey

By developing a typology of MtD present in a location, as I explored in Walk 1 (6.2.1), it is possible to highlight gaps, or data deserts. These can be understood as being caused by infrastructure or gaps in data, information, knowledge, wisdom or lived experience. If a location has poor connectivity, as we saw on Tiree, this does not mean a location should be excluded, as there may be an abundance of information, knowledge, wisdom and lived experience that make it worthwhile exploring. Furthermore, this can be seen as an opportunity to fill in and address the gaps from the place-up.

Exploring whether walks should be guided or self-led was important to consider in the design process, as this also affects the design of tools for walks. One of the key benefits of group walks were the conversations between participants that occurred while walking, at the interstitial points of moving through the place. However, we should remember guides bring their own lived-experiences and understandings of a place, which will impact upon the MtD that are gathered. Whilst this is not a significant issue, as there is no expectation of objectivity from the guides or participants, it should be reflected upon when exploring the outputs of walks. Enabling walkers to carry out their own journeys and even routes is perhaps more reminiscent of the derivé, or drift and whilst not explored fully in this research, it is an interesting approach that could be investigated further in future research. This method also presents challenges in gathering and sharing MtD that are gathered, which may be addressed through exploring digital presentation methods.

The design and use of tools were key components of understanding *how* More-than-Data walks can be designed. This chapter highlighted the benefits and challenges of using both analogue and digital tools. I found that analogue tools offer a lo-tech and often low-resource approach to capturing MtD in a location, as well as the potential for prototyping, where the walk is part of a wider series of events. This approach also reveals that designing a walk does not have to be done by a designer or someone fluent in programming, app development or data science. The benefits of using digital technologies related to the ability to geo-tag the MtD, enabling the potential for adding meta-data (this is explored further in Chapter 7.

Whilst there are benefits of utilising digital technologies during walks, this should not be the driving force. In order to ensure tools are relevant to the specific walk considering this as a design decision is vital. By including this consideration in the design process, rather than it leading the design process, suitable and relevant tools for the specific walk that enable the capture of MtD within that location should be developed or used. Furthermore, as Borgman states, so much of our engagement with place is mediated through technologies (Borgmann, 2017). Engaging with and developing our senses in place should be valued equally with the use of sensors.

The final consideration explored in the design process in this chapter was the consideration of MtD as a design material. Through explicitly conceptualising MtD as a material with which to design responses to themes, challenges, or issues. By understanding and being connected with the MtD gathering and collection processes, in addition to having a deeper understanding of the place and its inhabitants, we might see MtD as being situated within that location and begin to develop sustainable and meaningful design propositions emerging.

The findings above highlight the key considerations made in designing the walks and demonstrate how More-than-Data walks can be designed. Whilst this is but one approach to designing walks that engage with place, it is based upon synthesised empirical evidence that was gathered in chapters 2, 4 and 5 of the research and through practice and the gaining of experience, as evidenced in this chapter.

The initial stages that occur prior to the walks happening address some of the key challenges explored in chapters 2, 4 and 5, such as the limitations placed upon participants of hackathons through their organisation and format of the events. The benefits, such as bringing people together and embedded data as part of a solution, rather than the whole, have also been considered here.

The insights presented here are built upon in the following chapter, which explores the content of the walks, including the types of MtD gathered during the walks, different forms of understanding place such as weather- and folklore and how we might re-use MtD and send it out into the world through visualisations, propositions, or provocations. Together, when synthesised with the insights developed in this chapter, the two chapters form the basis of the design heuristics presented in Chapter 8.

7 Weaving More-than-Data into Practice

This chapter forms part 2 of the findings from the five walks, and specifically explores the content and output of the walks and consideration of post-walk activity. The insights have been developed by weaving together those discovered in Chapters 4, 5 and 6, taking into consideration the Pathways Forward (Chapters 4 and 5).

The research questions explored in this chapter are:

RQ2: How might More-than-Data be embedded into a new practice that uses walking?

RQ2.2: How do the walks contribute to the More-than-Data design process?

The aim of the chapter is present the encounters with More-than-Data (MtD) made by me and participants during and after the walks. These insights are drawn from the artefacts created during the walks, photographs, and observations I made as we walked. The findings are structured according to the themes drawn from the analysis and explore how More-than-Data can be conceptualised and gathered from a location, issues and challenges encountered during the walks and how the material and digital artefacts gathered from walks might be stored and presented. The chapter also includes a summary of the findings presented here and concludes with a synthesis of the insights from Chapters 6 and 7 and what this means for the Contributions offered in Chapter 8.

This chapter explores the ways in which the walks were designed in order to encourage a More-than-Data approach to understanding place. Specifically, this chapter seeks to highlight the content of the walks and how the design of the walks can encourage a More-than-Data approach to understanding place, that weaves together data, information, knowledge, and wisdom, with lived experience.

Findings from Chapters 2, 4 and 5 research pointed towards the need to synthesise modes of understanding that encompass situated and lived experience of place and create encounters with both digital and analogue data, information, knowledge, and wisdom. These insights then formed the foundations of MtD which seeks to weave together these different modes of understanding place. This chapter specifically explores the content of the walks and the questions arising from thinking about how MtD might be understood, used as a design material, and be re-used in engaging and creative ways.

Table 18 shows the Pathways Forward (PF) that were developed through Chapters 4 and 5 of the research, including only those that are explored in this chapter. Through the chapter further

insights suggest changes to the PFs and new ones are also developed, these are included in Table 19 at the end of this chapter.

Data collection and analysis processes

The data collection and analysis processes used in this chapter are described in Chapter 6 (6.1) and were applied to all the data gathered on the walks.

7.1 Discovering More-than-Data in Place: Towards defining the challenge

The insights developed from research data gathered during the walks explore both the artefacts gathered and produced, along with the ways in which they build a new practice that embeds More-than-Data in place. The insights were drawn not only from elements of the walks that worked well and yielded useful artefacts, but also the challenges of the walks and elements that weren't included but, upon reflection, would be a useful addition.

7.1.1 Temporality and ephemerality: catching More-than-Data

Place and our movement through it are being increasingly mediated by data and technologies, and whilst this enables efficient wayfinding and information gathering, there is a sense that we are losing connection. As Borgmann (2017 states "At a time when we allow media technology constantly to insert itself between humans and reality, immediate contact with the world needs to be invigorated as well." This concept of "immediate contact" has been present in all the walks, where participants have been encouraged to engage with the place and people as they walked, being free to use their mobile devices, but mostly choosing to use the analogue tools provided. In a society where an emphasis is placed upon the tangible and quantifiable, accepting that some experiences are fleeting, intangible and sensory is a challenge. This is manifest in our discomfort at sitting with not knowing something of having a world of data, information, and knowledge at our fingertips.

Salmon fishing appeared again on Walk 3 when the guide told participants about Margaret the Salmon Fisherwoman who uses the traditional net method in the waters around Sunderland Point. This moment was captured by several participants (through a drawn

THEME	PATHWAYS FORWARD	REFERENCE
PF1:DATA-DRIVEN ARTEFACTS	Dig down into other data sources	PF1.2
	Explore creative uses of data	PF1.5
	Consider data as a component of tackling issue – not the whole solution	PF1.6
PF2: PLACE-SITES AND LOCATIONS OF DATA COLLECTION AND RE-USE	Get outside	PF2.1
	Explore range of venues – urban and non-urban places	PF2.2
	Explore data in, from and through place	PF2.3
	Situatedness	PF2.4
	Consider how MtD might be incorporated into understandings of place	PF2.7
	Exploration of what a specific, situated and located space/place might be for event	PF2.9
PF3: PRACTICES AND PEOPLE	Explore and articulate common and conflicting values and politics	PF3.1
	Pre- and post-event engagement with data and issues	PF3.2
	Understand tensions between different communities of practice	PF3.5
	Bring people together around a specific issue	PF3.6
PF4: SITUATED ARTEFACTS	Consider usefulness of using particular tech in which data are embedded	PF4.1
	Gather/record MtD about a specific issue in support of mobile applications	PF4.2
PF5: MORE-THAN-DATA	Adopt a “more than human” approach to gathering and re-use of MtD	PF5.1
	Build MtD repositories from scratch according to the particular place	PF5.2
	Explore and adopt a range of practices to gather and share MtD	PF5.3
	Ensure gathering and re-use of MtD is equitable and beneficial to all	PF5.4
	Establish requirements of MtD and reliability – think about futureproofing	PF5.5

Table 18: Pathways forward developed from Chapters 4 and 5 of the research

representation, written note, and prose, (Figure 41). Shortly after the walk Margaret was featured in a radio programme, offering a richer picture of her experience and this tradition. She has also been recorded for the Morecambe Bay listening project and her story told in the site-specific art project “Fleeting.” In addition to the passage written about her in “*The*

Gathering Tide" (Lloyd, 2016), the book written by the walk guide, Margaret as a character and her experiences that are deeply embedded in place are recorded. However, they are stored in a range of locations and her practice of fishing and recollection cannot be recorded in "data," but offer a rich, often temporal, and experiential account of place.

Through collecting objects on Walks 3 and 4, participants tried to capture the place in which they were walking and gathered the objects because they were either interesting to look at or touch, represented something important about that place, or triggered memories. Walking itself is, what Rose (2017, p.26) calls "a sensual, multi-sensory and somatic practice which can illicit an emotional understanding of place." This was evident during the all the walks, where participants sometimes paused just to be in the location. During Walk 3 the whole group paused to look over the snow-capped peaks (Figure 44). The moment was not recorded but added to the fundamental experience of the walk. We can never capture absolutely everything about a place. We can build a picture, even recreate these ephemeral and place in virtual reality. However, the fleeting light, the smell of the salt marshes and the stickiness of the Morecambe Bay mud cannot be measured or captured to store and then re-use later. For sensorial experiences, we can capture essences in art, through imagery Morecambe Bay at the Lakeland mountains just as the sun broke through the clouds and shone on and words, but there is always a limit to what can be captured. However, by including these rich snapshots of a place at a particular time we can enrich the understanding of that place. Walks 3 to 5 evoked these senses, and some were captured by participants, such as one small pouch from walk 3 containing mud from Sunderland Point (Figure 45), which had dried after two days, or seaweed that became congealed (Figure 46). The smell lingered when the pouch was opened, reminding me of that day, but taking part of the location away in order to create a picture of the place, on reflection felt unethical. A pouch from Walk 4 contained horse dung (Figure 43) accompanied by a note asking, "Is this data?"

On Walk 5 participants were asked the question "Can you feel the wind right now? What direction is it coming from?" In order to bring in sensory experience, to counter the dominance of understanding the city through sensors, which recalls Offenhuber's observation that we have moved away from using our own sensors, relying more on the sensors we find all around us (Offenhuber, 2015). Walkers commented "[I] feel it on my face. Wet a finger. Watch the trees, seems to be coming from the north;" "The sensation of the wind can be felt but the direction is unknown without a compass;" "The Wind is blowing from behind me, it's very refreshing on the back of my neck;" "[I know where it is coming from] by wetting my finger, placing it in the air and feeling the direction the wind is blowing." These small experiences of stopping to feel the wind point towards how we can include our own senses, but don't necessarily have to log or record everything. As Edensor (2000) highlights, walking can stimulate reflexivity and chance occurrences that are contingent, heterogeneous, decentred,

fleeing and unrepresentable. So much of our movements through cities are recorded, as Bowker (2013, p.1) points out "It is getting difficult to walk the streets of a major city without one's progress captured by some gatekeeping device. It is getting difficult for trees to fall in forests without non-human observers." Whether we need to record everything during our passage through a place, or whether we should sometimes simply pause and feel the wind, is a thought to be considered in the design of More-than-Data practices.

7.1.2 More-than-Data In, Through and From Place

Data Walks are a method of interrogating issues around data in place (Powell, 2019; van Es and de Lange, 2020), particularly relating to power and socio-technical situations. They are also being used to collect data from a location using sensors and mobile devices and framed within the practice of participatory design (Hunter, 2020). The production of More-than-Data as we move through place (Chapters 4 and 5), point towards the potential of making explicit how and where they are produced and collected. Data are gathered by objects (Flyverbom and Madsen, 2015) and from as we move through a location, using wearable devices and mobile devices. Data are not only collected about us, as human, but animals who pass through a place (e.g., IoT systems that gather data from animals used to locate them and monitor their health).

The area surrounding Freeman's Woods has been designated as a flood overflow and the area of land is now a small reserve that attracts a wide array of birds depending upon the season and the water level, which changes according to the tides in the estuary. This dynamic nature of gathering data and information, then sharing it, is an asset that is more challenging to do via analogue methods, However, historical records and archives are vital and often discussed on the website by members to explore and understand how the changing weather is affecting the populations, not only weather in this local area, but the impacts upon migrating birds from Greenland, Iceland, and other Arctic regions whose patterns are changing.

On Walk 2 some participants logged their walk using a popular exercise logging mobile application, which was still able to capture their GPS data even without a 3G signal. When asked why they did so they replied that it was what they always do when going for a walk, mostly to log their step count and distance walked. This basic data can be useful in logging routes walked and has potential to add positioning of MtD. However, the data gathered about GPS and route is gathered and stored in the cloud, in the vast data centres that form part of what Urry (2014) calls the nature of Offshoring, and the "moving of resources, practices, peoples … from one national territory or another, and how they are wholly or partly hidden from the view of the public and/or public authorities." The gathering of data through smart phones seemed to embody this notion, where the user has no access to the "raw" data, instead engaging with the data that has been stored in a vast data centre in potentially a different country, which is then curated and presented back to us in the form of maps or visualisations.

We, as data-providers have no real agency once the data enter the “black box” and this was made apparent on Walks 1, 2 and 3 where I gathered data on my phone, participants used their own devices and were supplied with devices on walk 3. One participant on Walk 3 who used the mobile SnAPP app commented “I didn’t have a real sense of where my comments or questions went once, I pressed the button on the phone and entered the text, whereas those using the wearable maps could refer to the objects or writing they produced and carried with them on the walk.” This comment responds to the notion of the “black box,” where data are gathered from us and then seemingly disappear, only to be presented back to us in the form of visualisations in mobile applications or on maps to track our movements.

Links to Pathways Forward

PF1.2: Dig down into other MtD sources

PF1.5: Explore creative collection and uses of MtD

PF2.3: Explore MtD in, from and through place

7.1.3 More-than-Data Absent from Place

Walks 1, 4 and 5 interrogated and made visible contentious data that were absent from place. Walk 1 highlighted the nature of data that make visible issues, again relating to “Offshoring” (Urry, 2014), in this context concerning land-banking by a property investment company registered in Bermuda, to backers based in Hong Kong.

Freeman’s Wood (**Error! Reference source not found.**) is a wooded area lying between the river, an industrial estate and housing estate on the edgelands of the city. The land was once split, with one section acting as a recreation ground for the adjacent linoleum factory and the other section a dump for waste linoleum. The land is now owned by a property investment company registered in Bermuda, to backers based in Hong Kong, who erected high fences in 2011 to stop locals using the space. The myriad BMX trails and paths that had been built and worn throughout the woods were no longer accessible to local people. A planning application submitted in 2019 on behalf of the landowners triggered a court battle to establish the land as a Town Green due to its regular use

Figure 40: Signs surrounding Freeman's Woods in Lancaster

by local people for decades, which was ultimately successful and led to the planning application being withdrawn (Friends of Freemans Woods, 2020).

The data and information about a piece of land used regularly and valued by local people, many of whom do not have access to green space was not only held in a different location (archives and planning data and investments by faraway corporations. I had checked the land ownership details and planning application data on my mobile phone while standing on the edges of the wood, logging my search terms on the browser and the GPS location of the photographs I took, adding to the vast amount of data relating to a place but which disappears into remote data centres completely removed from the original point of collection.

This site is also the subject of Trespass, a commissioned piece, created by artist Layla Curtis (Curtis, 2017), that captures personal stories and lived experience from local people relating to the woods. The smartphone app uses GPS to enable users to walk around the woods and listen to recordings at specific locations and uses "personal memories, shared histories and speculations on the future of the space … recorded in a series of audio interviews while interviewees walked across the space" (Curtis, 2017). By gathering More-than-Data as she walked with participants Curtis adds voices and lived experience to the location, which can be listened to as one moves through the location, locating the route on the custom drawn map on the mobile screen.

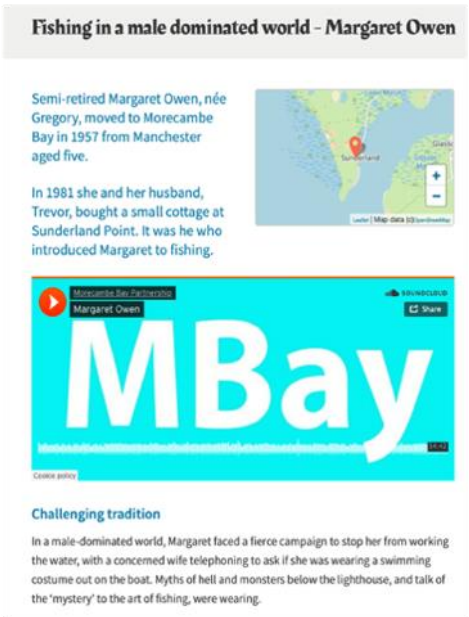
The application offers one way through which More-than-Data can be gathered and then mediated through place, using mobile technologies and GPS. Using a mobile application enables a dynamic, site-specific aural experience to take place, as well as gathering and re-distributing the lived experiences, knowledge and experiences of people who have used this place over time. This application echoes uses "personal memories, shared histories and speculations on the future of the space … recorded in a series of audio interviews while interviewees walked across the space" (Curtis, 2017). By gathering More-than-Data as she walked with participants Curtis adds voices and lived experience to the location, which can be listened to as one moves through the location, locating the route on the custom drawn map on the mobile screen.

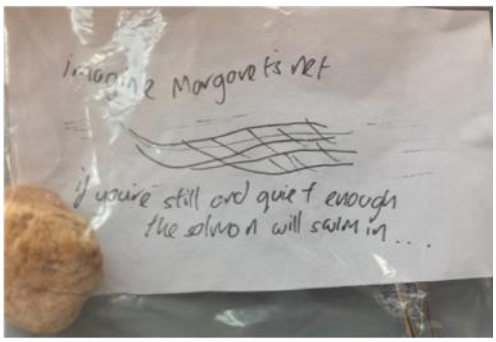
The application offers one way through which More-than-Data can be gathered and then mediated through place, using mobile technologies and GPS. Using a mobile application enables a dynamic, site-specific aural experience to take place, as well as gathering and re-distributing the lived experiences, knowledge and experiences of people who have used this place over time. This application echoes Crivellaro's "*City Walks"* (2015) in its use of mobile applications and the recording of stories as people walked. It is also interesting to note that Freemans Wood lies on the boundaries of the city, on the edgelands between industrial land being rapidly transformed into housing, and the rural land that emerges from the wood out to

the estuary and beyond. This kind of response can enrich the experience of the user, or walker, without having an impact upon the place through relying on static, printed materials that can be defaced and degrade over time. The use of mobile applications such as Trespass excluded the sensory experience, I had of visiting the wood, of the light passing through the trees and the smell of woodland and I almost missed seeing a deer disappearing into the bracken while looking into my phone, hearing the rustling while I was distracted. A wide array of data will be available for this location, such as planning applications, environmental monitoring, building plans, GPS data and recordings for the Trespass app, to name but a few, but are stored electronically in data clouds located in data centres, or in paper or electronic archives in dispersed locations. There is also a depth of lived experience and knowledge relating to the woods, embodied in the people who live, and have lived, and have moved through the place.

Walk 5 highlighted issues relating to the lack of infrastructure data and sensed data regarding the Mill Race, which would prove useful in predicting when there might be issues with flooding. Prior to the walk taking place I interviewed a local business owner (who was also a walk participant) about his lived experience of flooding in the city centre. Through gathering historical information about the Mill Race, combined with his own lived experience of having no access to data from the sub-terranean water source, he had become an expert in understanding the key issues that caused flooding. Much like the interviewee (Chapter 5) who experienced flooding on his steep valley-sided farm, the business owner observed the weather through applications and observation, in addition to knowing how rainfall would begin to affect the drainage locally. Through gathering what information and knowledge was available locally, and through combining this with his own lived experience he had developed wisdom in this area. In our interview he highlighted the lack of data from the Mill Race, both infrastructurally and sensed data. The issues with infrastructure relate to the Mill Race itself, which is now somewhat fragmented and does not flow uninterrupted, as it once did. A range of organisations are responsible for different sections of the piping and water flow, and it is potentially challenging to install sensors due to the infrastructure itself. This highlights the issues of data deserts, or scarcity, even within urban locations and points towards the complex nature of today's urban realm in terms of ownership and responsibility. Where open data offers opportunities to interrogate and use sensed data about a location, it also suffers significant limitations in this kind of location, where the data simply are not available due to infrastructure issue.

Walk 5 highlighted an absence of data and information, through infrastructural and contingent lack. There is a lack of infrastructure as there are no sensors in gullies or the Mill Race, which would enable the monitoring of water levels, and the weather resulted in the contingent lack





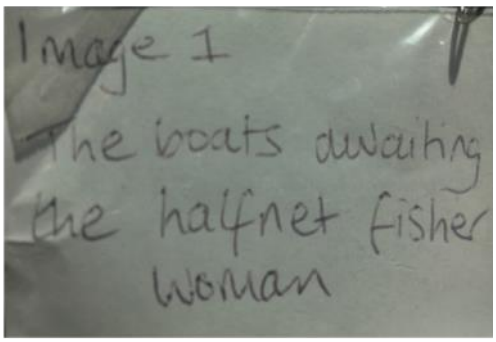


Figure 41: Different types of MtD capturing Margaret the fisherwoman

Figure 42: Mud collected on Walk 3

Figure 43: Description of view from beach

Figure 45: Seaweed collected from Walk h

Figure 44: Horse dung collected on Walk 4

of data and information as it was an exceptionally dry period and there was no water visible in the city centre, even the river Lune was particularly low. However, it was still possible for participants to engage with the theme, through imagining what might be possible with sensors and through sharing their own lived experiences of water and flooding. These two conceptualisations were supplemented by participants responses to the weather-lore, which enabled them to use their imagination and refer to when the weather

Participants invited to Walk 5 were interested in data science and/or the environment and flooding, one participant owned a local business which had been affected by flooding numerous times. They were asked about data they thought might be useful in helping tackle the Mill Race, as there is little available. The comments from the participants" notebooks demonstrated the weaving together of lived experience and context specific specialist knowledge into potential interventions that would enable more accurate monitoring and data collection from the Mill Race.

One participant suggested "Peer to peer network apps that work without wi-fi and internet. Problem is you need mass subscription for them to work (e.g., Firechat). Flags to signal threat. Sounds. Floats on river that trigger responses." This approach brings together the gathering of data through methods that do not need Wi-Fi and internet access, both of which would be problematic in the Mill Race and tangible, visible interventions such as the flags, sounds and floats on the river. A further tangible intervention was proposed by a different participant, who suggested "Perhaps something floating at the bottom of one of the manholes. When levels rise so will the float. This could be attached to a stick that will protrude when levels below are at or near flooding risk." This suggestion would offer tangible, visible cues that the water was rising in the Mill Race and tackle the key issue of the under-ground water source being currently un-monitored and largely invisible.

Using sensors was suggested by a participant, who wrote "Cameras placed alongside crucial points along the Mill Race can help give an indication of any possibility of flooding. Sound of the water can be captured through using sensors." Sensors can be of great use where the source of the flooding is not visible, or indeed audible. Sensors were again suggested by another participant, who suggested "Rain gauges with telemetry – posting online with thresholds showing totals from previous floods. Groundwater sensors, sewer level sensors, holding tanks level sensors AND publish the data on live web sites, that will start to spread the word." These sensors could be used in conjunction with more visual, tangible interventions that are both hosted online and physically within the city.

The suggestions highlight that being outside and experiencing the site of the issue can bring about potential designs for interventions that are both digital and analogue, as we see above with suggestions for tangible, visible cues around the city, enmeshed with more data-driven

sensor-based solutions. Furthermore, the issue of More-than-Data that are absent from a place, in this case relating to the Mill Race and its impact upon surface water flooding in the city, was foregrounded in this walk and explored by participants, who not only thought about the way in which data might be collected, but also how it might contribute to understanding of flooding in the location.

Links to Pathways Forward

PF2.10: Understand the points of data deserts and scarcity prior to designing the walk, when analysing and reflecting on MtD that are gathered pre-walk. Explore the causes e.g., infrastructural or relating to contentious issue

PF3.2: pre-and post- event engagement with data and issues (to understand what MtD is or is not available in or about a place

7.1.4 Arising tensions: politics and values

A key finding from Chapters 4 and 5 was that tensions between political views and personal values arise around issues (for example around flooding and causes). Bringing people together around an issue was highlighted as a Pathway Forward and was explored on Walks 4 and 5.

Walk 4 brought together contentious information, knowledge and wisdom concerning landownership and management in the Calder Valley (discussed in Chapter 5, 5.3.3). Flooding is a major issue in the Calder Valley and has been linked to the burning of the grouse moors (Chapter 5). Data and information around this issue is scattered in a range of locations, such as archives and within a range of private and public organisations (e.g., within the organisations of the private landowners and public organisations such as Natural England or DEFRA (Department for Environment, Food and Rural Affairs). This data and information are woven into polemics that embody political and personal values, communicated through individuals or through media such as the news and social media. The vacuum of data, information, knowledge, wisdom and lived experience can be filled by partisan views and opinions, which is a danger and highlights the potential benefits of More-than-Data in ensuring that not only data are captured, but also that we understand and capture the values and political nature of these contentious issues.

Participants of Walk 4 noted that the land in the valley and on the hillsides is now agricultural and large-scale grazing can have an impact upon water run-off from the hills. As with the burning of the grouse-moors, agricultural land-use and intensive farming is also a highly contentious issue and represents a range of implicit values between farmers, landowners, and local activists. No farmers were invited onto the walks, but they would offer not only information and knowledge about their experience of working with the land, but also lived-experience and perhaps alternative values that should have the opportunity to be highlighted

and form part of the More-than-Data landscape of the area. Furthermore, walking to explore conflicts in values and in conflict resolution is an area of contemporary research (Webb, 2017) that is gaining traction. However, organising walks where conflicts of politics and values need to be treated carefully. Plotting or mapping the possible value and political conflicts of potential participants prior to the walk would offer the opportunity to understand these potential antagonisms.

All these examples of data that are absent from place relate back to the issues surrounding the sourcing of useful MtD about a location (4.5) and that data that are made open and made available on data-stores are not presented by place but thematically. Furthermore, the diaspora of MtD, that all exist in different forms and various locations, including within people and place, make discovery challenging.

Links to Pathways Forward

PF3.1: Explore and articulate common and conflicting values and politics

PF3.6: Bring people together around a specific issue

PF3.7: Plot or map potential conflicts or values of proposed participants/issues in the place prior to the walk to understand how this might affect or add to the potential value of More-than-Data that are gathered.

7.1.5 Weaving folk- and weather-lore into More-than-Data

We do not need to read the weather now, particularly in cities, but as the interviewee (P4) told me in Chapter 5, reading the weather and the landscape over time gives him a deeper connection to the place and he cannot always rely on the forecasts. Whilst reading the weather may be of limited accuracy, the Met Office state "Some signs in nature are recognised as accurate indications of an ensuring change in the weather and the Shepherd of Banbury's Rules were considered sufficiently accurate and useful that several pages of the Met Office Meteorological Glossary were devoted to them even as late as the early 20th century" (Met Office, ND).

Whilst we now can inform and plan our time outdoors according to mostly accurate weather prediction using websites, mobile applications or weather forecasts on the TV or Radio, Weather Lore adds a richer, observational layer to our knowledge that are embedded in place and change according to specific location. Similar to Weather Lore, Folklore is considered to be a "body of knowledge, mode of thought" (Ben-Amos, 1971) and is "the learning of the people" (Burne, 1931). These two ways of knowing of information and wisdom are rooted in place, changing across geographies and temporalities.

The interviewees in Chapter 5 spoke about both folk and weather lore and how they read the landscape. A conversation with Interviewee PX about the first cuckoo call of spring and the associated folk lore was recorded in note form and when designing walk 5 in Lancaster the notion of exploring weather-lore in a city was embedded into the walk. This fit with the questions I wished to ask Walk 5 participants about how they engage with weather, from prediction apps on mobile devices, to reading the landscape and whether they still use traditional weatherlore (such as "Red sky at night, shepherds delight"). The purpose of including these alternative methods of understanding place, was to explore whether knowledge and wisdom of place and lived experience was valuable in the MtD approach.

The notion of folklore being an "indicator of the culture of a people, their collective sense of place in the world and of meanings with which they imbue the landscape" (Bunkśe, 1978) suggests that by weaving both folk- and weather-lore into MtD offers opportunities to enrich the collective understanding of place. Whilst Walk 5 did not explore folklore, it did explore the weather, and reflections on the process and the conversations between participants suggest weaving in stories and folklore would be a valuable addition. Participants on Walk 5 in Lancaster were given a small pack of 10 cards, all of which had a question or activity to carry out (Figure49 p.239). They were asked to create their own short piece of weather lore, either based upon what they could see, feel, smell, hear at that time, or based upon a weather-related phenomenon they experienced in a different location. The weather in Lancaster prior to the walks had been very warm, with the area seeing the longest warm period since records began in 1910 (Office, 2018). The walks focussed on flooding, yet there was no water anywhere. Even the River Lune was particularly low, and the walks all coincided with the tide being out. This notion of contingency is important to consider, both in terms of practical considerations of walks, and in terms of any MtD that might be gathered during the walk. During my test walks there had been plenty of water about and I could hear the Mill Race running underneath the city through the drain covers and see it as it flowed out into the Lune. The lack of water did mean that participants found developing weather lore relating to wate "on-the-go" challenging, but the unusually dry conditions did act to spark conversations on draught and the unpredictable nature of our weather today.

The notebooks provided on the walks (Figure 49) included examples of weather lore to aid participants in developing their own examples. What the participants produced was contingent upon a range of circumstances and available data they were able to sense during the walk. As the walks took flooding as their key theme participants thought about water and rain, which some also stated was inspired by Lancaster's high rainfall and cloud cover annually (Crowder, 2018).

The short examples developed by participants

1. The beast from the east brings less rain, but it gets helluva cold
2. If you can see birds walking alongside the river lune, then the weather is bound to remain dry…no rain, no thunder
3. Rivers of roads, no water in sight, pounding rain on slate at night, tomorrow we will start our watery fight (by Desmond, 2015). Do not try to (make) sense (advanced weather sensor type of sense), write poem of (non) sense (perhaps that's all we can do)
4. If you can see Ashton Memorial, it's about to rain, if you can't, then it's already raining
5. Swallows fly close to the ground – true! But I can't see them today – I can sense rain in the air, birds are quiet, a humid stillness…

Participants seemed to struggle with the idea of creating new/fictional weather lore was, some suggested when asked, due to time constraints, they would have liked to go away and think about it then reflect with their ideas. Two participants also suggested that being in an urban environment made it difficult for them to create their own weather lore, particularly as they had travelled to the walk from a different area. They were therefore unfamiliar with the city centre and due to living in a rural environment, told me they observed the weather and changing patterns in their own surroundings but were finding it challenging to do so in the city. They did however use their own lived experience, both from Lancaster and beyond, in their short verses, such as "If you can see Ashton Memorial …" and "I can sense rain in the air." This is a concept that was under-developed for Walk 5, but from the engagement the participants demonstrated during the walk, it is an area that would be interesting to develop further. Perhaps using MtD that have been gathered, participants would be able to develop weather lore in their own time after the walk itself, once they had the opportunity to reflect and explore the other types of MtD that had been gathered pre-and during the walk.

One idea that was not taken further to gather MtD on a walk and to develop, through working with a poet and a writer future folklore about that place, using poetry, song, and other creative methods. Instead, participants were asked to quickly think of context specific lore as they walked through Lancaster, using the weather and the Mill Race as inspiration. The notion of Future Folklore (Maxwell, 2016) offers interesting opportunities to explore how More-than-

1.

Revealing the Mill Race

Walking Map and Instructions

Your kit contains:
1. This map & instructions
2. A small notebook
3. A set of cards
4. A pencil
5. Some plastic pouches
6. An MP3 player (for self-led walks)
7. Some stickers
8. A little treat & some water

You can follow the instructions if you wish, or you are free to write/ draw/collect anything you like, inspired by the walk and what you see around you.

Weather lore...

Did you know that July 15th is St. Swithin's Day?

"St Swithin's Day if thou dost rain
Full forty days it will remain
St Swithin's Day, if though art fair
Full forty days 'twill rain no mair"

2.

On the map (on the other side of this sheet) there are 10 points. Each point has a number. These numbers correspond with the numbered cards.

At each point on the walk there is a wooden plaque with some information about the Mill Race or that particular place.

There are also some clues as to flooding at some points, such as height of the water during particular floods and the old Mill Race bridges.

Weather lore...

Red sky at night, shepherd's delight,
Red sky in the morning, shepherd's warning

3.

You have 10 cards which each correspond to a stopping point. At each point have a read of the card and write your thoughts down in the notebook.

If you make notes between the stopping points, please stick a coloured stickers next to it & add one in the same colour to the map in the corresponding place.

For self-guided walks, the audio guide should be played at each stopping point (not while walking, due to safety issues).

Weather lore...

If woolly fleeces bestow the heavenly way,
be sure no rain will come today

4.

Weather lore cards:

Weather lore is an old way of understanding & predicting the weather through short verses (see examples on this sheet).

There are 3 weather lore cards - 1 card for each line. Try and create a piece of your own weather lore based on what you can see, feel or have experienced about flooding in Lancaster.

Weather lore...

When sound travels far and wide,
a stormy day will betide

5.

Most importantly...
There are no right or wrong answers!

We have indicated suggested crossings on the map. Please be aware of uneven surfaces and walk carefully through the city.

The responsibility for the health, safety and wellbeing of the walker belongs to the walker themselves. beautiful city and we would love you to share your thoughts, words, pictures and anything you find on the walk with us.

And thank you for taking part in our research project.

Figure 46: Designed map and instructions for Walk 5

Data gathered about a location might be used to develop stories set in the future, or to explore with design methods such as Speculative Design or Design Fiction.

The notion of creating weather lore from More-than-Data that encompasses the changing nature or the weather and its effect upon our lives and those of the other creatures who inhabit our spaces is also one which offers potential for understanding place more deeply.

Links to Pathways Forward

PF1.5: Explore creative collection and uses of MtD

PF5.7: Weave together different ways of knowing, such as folk- and weather- lore into the gathering of MtD

7.1.6 Building knowledge and wisdom through the walks

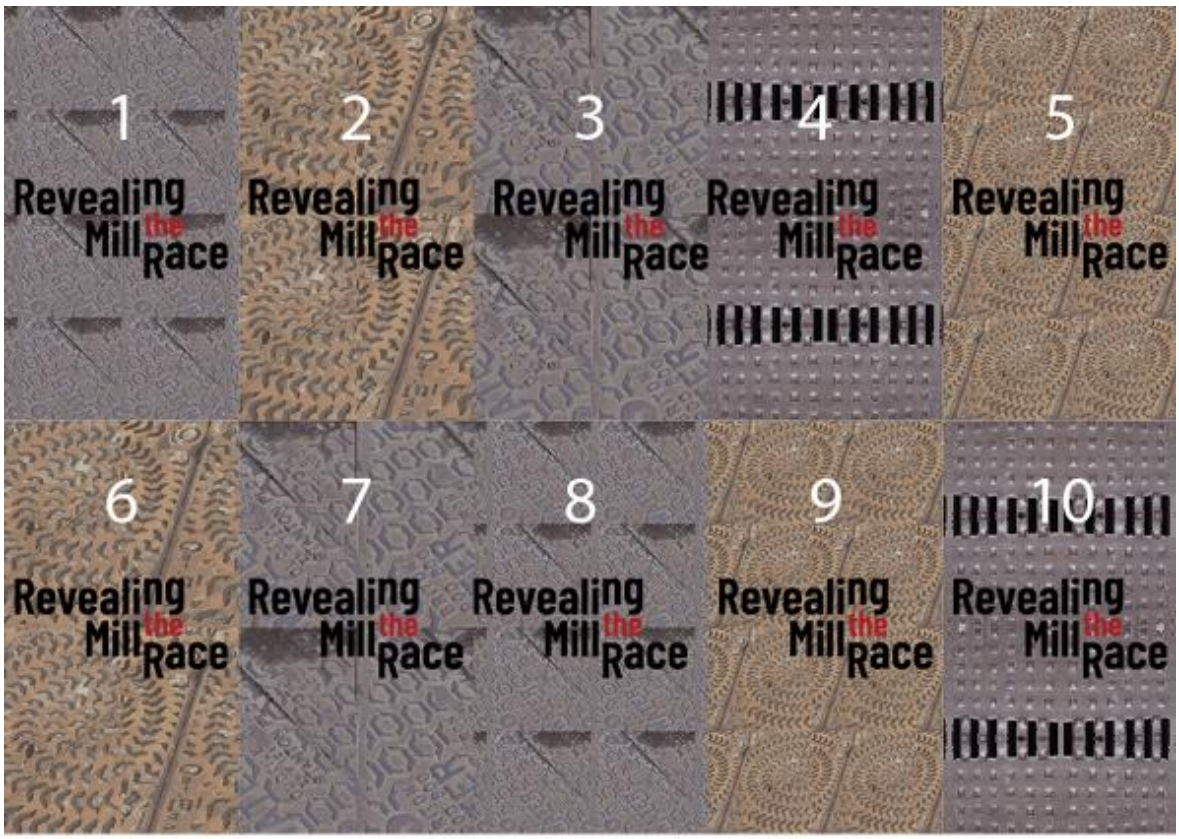
Literature relating to walking as a knowledge building practice highlights the act of moving through a place and the ways in which we grow to understand that location (Chapter 2). We begin a walk with a route in mind, or a location through which to wander and as we walk the temporal and ephemeral nature of moving, of using our senses means that when we arrive at our destination, we have experienced something, we may have learned something new, or noticed something we had not seen before. As explored in Chapter 2 (2.8) Ingold (2010) states that we build knowledge as we "walk from place to place", and that walking is critical to the relation between the body, its movement, and the formation of knowledge. It is this building of knowledge whilst moving through place that this finding section highlights, and the ways in which this might be facilitated during More-than-Data walks.

When I set out on all the walks I had a route in mind, for Walks 2-5 I knew who I would be walking with and what we would explore and think about. However, I could not predict the added information and knowledge I would accrue during each walk and how my perception of that place would change as a result.

The process of dialogue between participants is as important as what is gathered before and during the walks, as I observed on Walks 4 and 5, that participants learned from one another during the walks. This added information and knowledge produced by and between walkers affects what they choose to gather or produce and how they interpret it afterwards. The process of working together and sharing information and knowledge occurs between hackathon participants but walking or moving through a place offers a deeper, more situated sharing and building of knowledge with time to then reflect on the challenge more deeply. At the hackathon participants work together, but the event format does not afford the opportunity to reflect upon

Figure 47: Wooden bridge place markers

Figure 48: Walk participant using water listening stick



1.
How do you record, understand or predict the weather? (E.g. do you use phone apps, or read the environment or weather?)

2.
Write line 1 of your weather loreversein yournotebook(what can you see, feel, hear, or what have younoticedaboutthe weather?)

3.
Haveyouexperienced flooding?
Where was it and what happened?

4.
Write line 2 of your weather loreversein yournotebook(what can you see, feel, hear, or what have younoticedaboutthe weather ?)

5.
Can you feel which direction the wind iscomingfromright now?
How?

6.
If you have experienced flooding in the past, did you know it was going to happen?
If so, how?

7.
Have you seen or smelled any signsofwaterduring thewalkorwhereyou are now?

8.
How much of your averagedayisspent outside?

9.
Write line 3 of your weather loreversein yournotebook(what can you see, feel, hear, or what have younoticedaboutthe weather ?)

10.
How do you think flooding might be tackled in the city in the future?

Figure 49: Cards designed for Walk 5

whether the original challenge and their understanding of it still stands once they have the data and have begun developing their designs.

The process of walking, with the new knowledge and the ephemeral, temporal experiences that cannot be documented or recorded means that walkers arrive at their destination having gathered MtD from the place. Walking is also a somatic experience (Edensor, 2000; Ingold, 2010; Rose, 2017) through which we return to the body and build understanding of places through our own senses. The walk, with its simultaneously tangible and intangible experience brings about reflection, as some participants spoke to me about after Walk 4. One walker, a data scientist, commented that being able to sit and reflect both during and after the walk gave her a different insight into what she perceived would be the challenges local people faced with water prior to the walk (river level and rain fall in the valley) to the challenge after the walk (high volumes of water running down the steep valley sides).

A key intention for all the walks was to capture lived experience in several ways, whether relating broadly to a location or specific themes, such as flooding. The notion of capturing lived experience in the walks was sparked by the interviews carried out at the hackathon and by the interviewees, who had lived experience of an issue which they wanted to base an application on but did not manage to engage with programmers to develop their idea. Furthermore, organisations such as the Environment Agency and DEFRA are beginning to understand the importance of folding in lived experience of flooding into their evidence bases (Lane, 2010). As such, the collection and use of lived experience has been embedded into More-than-Data.

Walk 5 participants were asked to note their experiences of flooding and responses included issues relating to flood warnings, or lack of, the memories of Storm Desmond which hit Lancaster significantly in 2015, and more technical experiences woven into their professional experience. One participant noted "[We had] No warnings for Storm Desmond as Government flooding warning system did not work. New system is supposed to work, but…Since Desmond we installed automatic pumps in cellars that also send a signal to mobile phones when activated." The flooding in the city centre was not directly caused by the river Lune exceeding its banks, instead being caused by the myriad issues (including the Mill Race) in the city that are not monitored by water levels. Another participant spoke of their experience of flooding due to rain fall, and "It also flooded in Desmond before we moved there, according to the neighbours, this happens every 5-8 years." Memories of the lack of electricity during Storm Desmond was recalled by a participant who said "though I did not experience the harsh effects of the flood water, there was no electricity for a period of 3 days, and this brought life to a stand-still in some ways. Also, whenever there is heavy rain, there is bound to be a broken road or overflowing water from under some roads." The impact of having no electricity relates back to the issue of data deserts and periods of data scarcity. During the period that mobile

phone masts were not working after Storm Desmond there would have been significant gaps in data collected from mobile phones and even from sensors that rely upon electricity and communication. As we experience greater changes in our weather and more extreme storms, connectivity and the potential for data-gaps should be considered.

One participant wrote about their experience in their old home, noting "Several times." "In North Wales in the early 2000s we lost a chunk of our garden when the [river] flooded. Rivers Authority (before EA) put in groynes and changed shape of river so it would flood onto meadow opposite. However, there are plans for major housing development and 100+ houses in the field above and residents have concerns about the impact of surface run off. (The flood protection measures only have lifespan of 20 years)." This note highlights issues with providing clear data and information about the potential of future planning and building to people living locally. It also foregrounds the potential for involving lived experience in the evidence provided for such decisions and the design of future housing, in that those living nearby have experience and have observed issues with water, where the data may not have been gathered by environmental agencies. The same participant also wrote [I experienced flooding] in Lancaster – in Desmond, only 2 inches or 3 in cellar. Think there's an underground stream/spring in Freehold, when there's heavy rain, I do get moisture in cellar – occasionally a cm or 2. Have tried to find an old map but can't find." Issues with flooding that are caused by geographical features, again which there is no data or information about are also becoming increasingly important, as rainwater increases and causes issues in new areas. Enabling people to share their own experiences, through methods like crowdsourcing and building up MtD in this manner also offers potential for building knowledge in these circumstances that emerge with our changing climate.

It was challenging to gather wisdom on the walks, although it was shared between participants as we moved. For example, the guide for Walk 3 lived and worked in the valley we walked through and (as demonstrated in Chapter 5) has developed wisdom about the area throughout his time there. During conversations between the guide and those with wisdom in different areas, such as the permaculture specialist and the natural flood management expert, they imparted wisdom in their respective areas, which then took on a new form relating to that place. Time constraints meant the component parts of data, information, knowledge and lived experience could be discussed and gathered during the walks, but as Mulgan (2021, p.10) points out, a key component of wisdom is the consideration of time and taking a long view, stating "the ability to grasp the relationships of the present to both past and future – to see issues in their temporal context and to spot what future potential lies in present things, whether seeds, landscape, people and societies." This approach shares the long-term nature of understanding a place with permaculture (Holmgren, 2010) (Chapter 2, 2.10), where data,

information, knowledge and lived experience become part of the natural ecosystem, forming new wisdom over time.

A reflection made after completing the walks, taken from field-notes I made during each of them related to the way in which the More-than-Data was gathered during the walks and was immediately accessible to participants. As we walk and build knowledge (Edensor, 2000; Ingold, 2010), the walks highlighted the ways in which this can be facilitated, particularly using analogue and lo-fi tools. This immediacy and accessibility were held in tension with the data that are gathered from and about us, from, through and in place, which are sensed and then stored. These data must be processed and analysed, before being passed back to us for us to encounter digitally.

The snapshots of knowledge that were built through the walks captured in the text and artefacts of participants, when woven together with wisdom imparted during the walk or built afterwards, have the potential to be of significant use when aggregated. Participants take away with them reflections that accrue during the walks and indeed afterwards. Enabling participants to engage with the materials gathered during the walk afterwards offers the potential for building knowledge further.

Links to Pathways Forward

PF2.4: Situatedness

PF3.8: Think about how participants will reflect afterwards on their experience and share with others.

7.1.7 Reading the landscape: the curiosity of un-knowing

Participants read the landscape in walks 2-5 in order to respond to the prompts – this approach, of permaculture, enable a deeper understanding of a place and attunes one to noticing changes over time. This way of observing is embedded into Traditional Environmental Knowledge. However, we are often not attuned to this way of observing. I was concerned when designing walk 5 located in a city, that participants might not get the same rich experience they seemed to from the walks located in rural environments. This arose from the nature of the Mill Race, that it was hidden, and the only cues in the landscape were features such as drainage covers (Figure48 p.238) or the two sites the water could be seen flowing underground or into the river. However, through telling the story to the participants around the city it was possible to convey imaginaries, to get them to imagine how the city once was. On the walk (5b) for invited participants one walker suggested the use of VR (Virtual Reality) or digital technologies to chart the route of the river through the city, making use of the potential for mapping physically onto the invisible. Another walker suggested charting the route in an ephemeral manner using

chalk to mark the route of the river out, or picking the drain covers that mark its location and decorating them in some way.

This way of seeing and observing is not solely the realm of the rural environment. As contemporary walkers such as Dunn (2016) and Rose (2017) demonstrate, when moving repeatedly through urban spaces it is possible to gain deep and rich understandings of that location that are enlivened by knowing what has gone before, woven in with their own lived experiences of that place. These rich written histories build upon those walkers, or flâneurs, who have gone before. Whilst many of the participants in the four walks had not visited the locations before and did not know the deeper histories of that location (which the guides had accrued), they had a deep sense of curiosity and did not place importance on answering all the questions that arose. For example, participants on walk 3 noted down questions or statements in their pouches and seemed happy to sit with the unknowing, rather than seeking out the answers through using their mobile devices.

Pathway Forward PW2.9 "Exploration of what a specific, situated and located space/place might be for event" suggests that a space/place itself can be situated and located. This is true of all spaces and places, as it is people, and more-than people who accrue a sense of place (2.5.3). Place is always in the process of being "made" (Massey, 2008) and on reflection, post-walks a place is by its nature located, in that it exists. The situatedness of a place relies upon its inhabitants, who build the knowledge and wisdom, through their own lived experience. Therefore, this Pathway Forward should reflect the nature of place being contingent upon the stories, data, information, and wisdom held *about* and *in* the place to understand the nature of situatedness in that location.

Links to Pathways Forward

PF2.4: Explore situatedness in the place through its inhabitants and plural histories

PF5.8: Encourage curiosity and that it is ok to not know something

7.1.8 Quantifying the walks as experience: impact beyond the data

The difficult to quantify benefits of the walk are the participant's experiences and the ways in which they take the walks and embed their learning into their future work. I did not carry out post-walk interviews with participants but did receive comments from several who took part. Below are comments from two emails received from two participants from Walk 3. It is interesting to note that both participants found the process itself useful for carrying out their own work in the future. This is potentially a significant benefit of carrying out the walks, in addition to bringing people together.

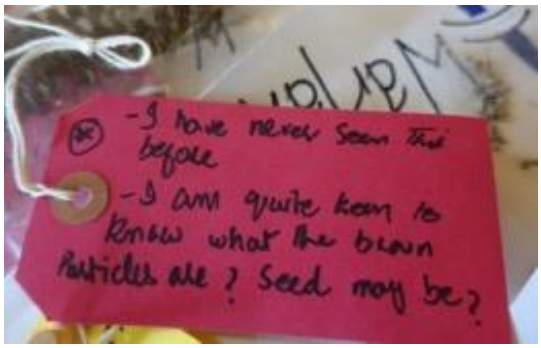
Email 1 received from Walk 3 participant on 21.7.2017:

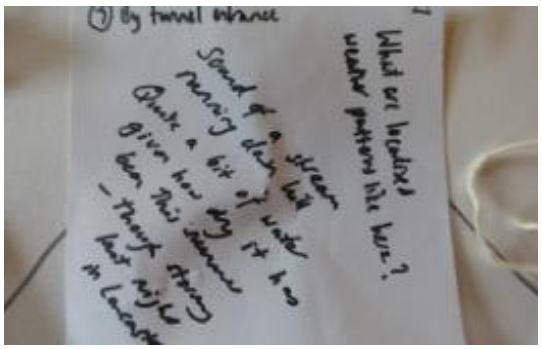
> "Reflecting on the process, it is valuable experience for me in taking forward the bio-regional agenda (bio-regional mapping activity involving citizens). Personally, on the theme of water in the landscape, it [the walk] made me reflect more deeply on my personal mapping and appraisal methods when I am out in the landscape … I work with patterns (general, transferrable) and niche (constrained environment) and … I gathered "data" on these through photographs … and narrative (thanks to [the guide]).
>
> My artefacts/objets trouvees were eclectic, but I just went with instinct and opportunity. If prompted, I could develop further rich narratives from these touchstones."

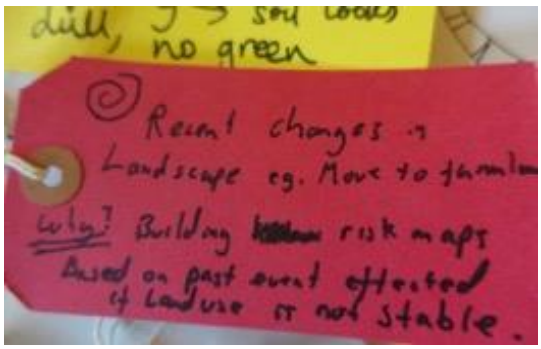
Email 2 received from Walk 3 participant on 22.7.2017:

> "I found being challenged to take a different/alternative route to gather data, information and knowledge from the catchment very interesting and will take these ideas into my future work both in this area and elsewhere."

Two other participants who work for a local flood charity also engaged with the guide from Walk 3 after the walk to go back and visit the farm and understand more about his methods of dealing with water. These engagements demonstrate the conviviality that can be engendered through walking and bring people together around an issue. Whilst participants at hack events are often enthusiastic and well meaning, there is often a lack of engagement with a diverse range of participants who might come together around a specific issue and the walks enable this to occur.







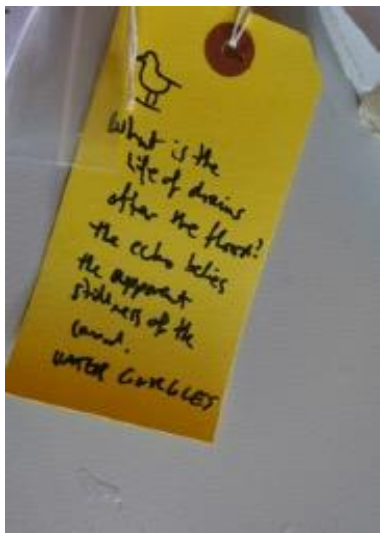


Figure 50: Labels and notes from Walk 4 that suggest questions

Links to Pathways Forward

PF3.8: Participant engagement after the walk/event

7.2 Re-use of More-than-Data and its journey out into the world

The following insights refer to the post-walk phase and relate to the content and thematic elements of the walks (Chapter 6 explores the design of the walks and the processes carried out after the walks). It is important to understand how the MtD gathered pre- and during the walks might be stored and then re-used, where it should be considered as a design material. Seeing the MtD through the lens of design (which is explored in greater depth in Chapter 8, where it is embedded into design principles), and as a design material, can enable the development of a wide range of products, interventions, or propositions by a range of different people. Chapters 4 and 5 highlighted the need to understand how MtD and its collection informs its future use (this is discussed in greater depth in Chapter 6. Furthermore, understanding what might be required in terms of storage and of the future use of MtD in advance of the walks, can ensure future designs are not limited by the infrastructure and materiality of the MtD. We see these limitations at the hackathon, where either a lack of data, or its embedded nature within the technological systems of data gathering and re-use.

The following section highlights key insights developed after the walks that begin to interrogate and understand the opportunities and challenges of considering MtD as a material.

7.2.1 Designing post-walk activities

A key finding from Chapter 4 was that one of the limitations of the hackathon resulted from the format of the event and the lack of continuity and develop of designs once the event had finished. At the end of the event participants may stay connected informally or socially, but this does not always result in their project from the hackathon being developed further. By thinking about what happens after an event, such as the walks, we begin to develop a sense of continuity and engagement with a place in the longer term. Recent research regarding data walks carried out by Masson et al. (2020) examined five data walks carried out. Three of the five walks contained either a discussion or an activity after the walk, classified as discussion between the group, one took place online, and another was classified as a debriefing. A walk carried out a Ravensbourne and involved students and professional designers (Hunter, 2020) involved a post walk design and making session, which was classified as "data wrangling and visualisation." The only other walk to involve a "making" or "ideally a critical making activity" (Masson et al.2020) was Powell's data walk (Powell, 2019).

Walks 2, 3 and 4 included post-walk sessions. The aims of the sessions were to understand what participants had discussed during the walks and to offer the opportunity to talk about the prompts or what they had gathered using the SnAPP app (Walk 3) or wearable maps (Walks 3 and 4). The post-walk session for Walk 2 involved a discussion which was recorded and then transcribed, taking the form of a discussion. Participants engaged enthusiastically during the session, demonstrating that this method does encourage discussion and thought about what data are in a place. We did not take the session further; in that we did not take the insights gathered from the discussion and develop them into ideas or products. This was partly due to time constraints, we were on the island for five days and participants were working on projects for the Techwave, and partly due to focussing more on the walk and the discussion afterwards, which served to inform the theme and design of the subsequent walk (Walk 3). Walk 3's post-walk session was held at a location in Lancaster and included a Q&A session with the walk guide relating to her book, refreshments, and the opportunity for participants to explore the contents of the wearable map. The rich array of artefacts gathered and produced during the walk offered an opportunity for participants to engage with the tangible artefacts and many more did this than look at and interrogate the digital data gathered from the SnAPP mobile application that was projected onto a screen in the same room. Whilst the walk participants did not engage with or design with the MtD gathered during Walk 3, me and a colleague did take the wearable map contents and develop their display and explored the potential for synthesising the digital and physical MtD. Walk 4 concluded with a session that was held outside, the aim of which was to understand what, and participants were asked to select a small number of artefacts or objects they had collected then pin them to the map at the corresponding location, then write the reasons (Figure55 p.249) on a tag attached to the artefact/object. This worked well in terms of the participants engaging well with one another. This exercise also worked well in that it encouraged participants to reflect on why they had collected each artefact/object. What seemed more of a challenge was understanding how the MtD might be used, without offering them tangible examples. The task did provoke a discussion as to what the participants had discovered about flooding in the valley and their exchanges of professional knowledge and lived experience. This discussion itself was an act of building wisdom from the walk, where participants were applying their knowledge and lived experience to a specific issue (in this case how to deal with and through discussing their reasons with one another (Figure54 p.246), and we were able to see where there was flooding in the steep-sided valley). This points towards the need to add scaffolding to the tasks or challenges participants are asked

Figure 51: Walk 3 participants discussing wearable maps

Figure 52: Detail of wearable maps from Walk 3

Figure 53: Detail of labels on map from Walk 4

Figure 54: Participants adding content to map on Walk 4

Figure 55: large map made after Walk 4

Figure 56: Detail of labels on large map after Walk 4

to explore and in the application of the MtD that are gathered pre- and post-walk. If a key challenge highlighted in Chapter 4 was the need to understand and define a challenge or issue, for which the MtD could be used as part of the solution, then the experience of this post-walk session further highlights the need for this approach. A more structured session where participants were told to think about what would be done in the post-walk session would have offered scaffolding to their task of gathering MtD through the walk itself. Being told about the post-walk prompts they would be asked to apply to the MtD they gathered prior to walking, they would have been more equipped to explore its possible uses. Therefore, we find that it is vital to communicate the ways in which MtD will be explored and interrogated in post-walk sessions before the walk begins, so that participants are able to hold that in their thoughts as they walk. Building this into the tools that are developed is one method of providing this framework and structure to the MtD that will be gathered.

The key challenge experienced on all the post-walk sessions was time limitation, as the walks over-ran (due to participants being highly engaged in the walk) and for Walk 3, participants had to travel back from Sunderland Point into the city centre, which posed its own logistical challenges. Attempting to hold sessions immediately after walks is difficult, particularly where participants are asked to commit a full day to an event. As was discovered at hackathons, this time demand is often what puts off those with families or other time commitments. This therefore raises the potential for holding events either after an event (e.g., not on the same day), or exploring holding follow up design activities asynchronously. Having time to reflect upon the walks and what was gathered is important and responds to the principles embedded in Permaculture, of reflection and understanding a place over time (2.7.4).

Asynchronous methods of collaboration after an event could occur in person, or online and both approaches carry their own opportunities and challenges. For example, working together online gives participants the opportunity to be involved in their own time and under their own terms. However, the MtD that has been gathered shapes the potential for online engagement and therefore should be captured in a way that is useable in online formats, such as through images, text, audio, or video recordings, or have pointers or links to the tangible, physical artefacts, or other online resources that are of use. Gathering this together in the MtD store prior to walks would facilitate this online, post-event collaboration. However, limitations such as lack of access to hardware (computers or decent internet provision), or skills, might limit participants' ability to be involved after the event. Therefore, it is important to understand these limitations at the point of recruitment or engagement with participants prior to the walks and post-walk events being designed.

Links to Pathways Forward

PF1.7: Understand limitations of participants in terms of access to hardware, connectivity and skills *before* the walks or events are designed

PF3.2: pre-and post-event engagement with MtD and issues/themes

PF3.9: Consider synchronous/asynchronous and in-person/remote methods of collaborating to design with the MtD post walks. This should be explored *before* designing the entire process, right at the start

PF4.3: Build in consideration of the type of MtD to be collected and the way in which it might be used post-walk

Once MtD has been gathered prior to and during the walks it is important to consider how it might be used. The lack of consideration as to how data might be re-used at the point of collection and the limitations this causes was highlighted in Chapter 4 (4.4). Understanding that analogue and digital MtD might be gathered before carrying a walk out can enable broader and less limited uses. The insights in this section explore how the MtD might be displayed in ways that are interesting, useful, and engaging and that go beyond graphic data visualisations that represent data as highly stylised and seamless representations of tangible phenomena (Halpern, 2014).

7.2.2 Display and re-use of More-than-Data: challenges and opportunities

The MtD captured on walks 3 and 4 were developed further into both physical analogue and digital artefacts to explore the potential for re-use post-walks. The artefacts from Walk 3 at Sunderland Point were developed as part of an exhibition at the *Data Publics* Conference (Crivellaro, 2017) and consisted of a short film made during the walk (Mullagh, 2017), an interactive map using the Aurasma virtual reality mobile application and a display of the wearable maps (Figure 57). The Aurasma VR app (Autonomy, 2011) enables users to link digital content to objects, images and locations and can view the digital content by scanning the trigger images on the application. A map of the walk was printed and tagged, so that people with the app on their phone could scan the map and see the diverse types of MtD gathered at that location (Figure 57-62 p254-256). This was a useful exercise in enabling the bringing together of both analogue and digital MtD, but as with the post-walk event, on observation more visitors engaged with the physical maps that were laid out Figure 65) than with the Aurasma map. This is not to say that the digital map was not engaging or interesting, but that the physical and tangible objects offer a more immediate and potentially engaging experience in that context. To explore the possibility of having an online repository that was map based and therefore place-based I worked with a data scientist to develop a prototype Flood Ontology for Lancaster that was based upon the Mill Race Walks 3-5 demonstrated the value of

gathering an array of More-than-Data, including MtD, and the need for a place-based repository of this rich resource. This approach was (4.5) that the data are organised thematically, rather than by place. The Lancaster Flood Ontology (Figure63) pulled in open data relating to the location and linked to and signposted to other data points, that included historical information about the place, such as tracing the route of the Mill Race through the city centre and links to historical maps, to links and images of the theatre production and art exhibition held at The Dukes Theatre in Lancaster in response to Storm Desmond in 2015.

Links to Pathways Forward

PF1.8: Explore the synthesis of analogue and digital data

PF4.1: Consider usefulness of using particular tech in which data are embedded

PF5.3: Explore and adopt a range of practices to gather and *share* MtD

Figure 57: Walk 3 display at Data Publics Exhibition

Figure 58: Close up of film and signs from Data Publics Exhibition

Figure 59: Detail of wearable maps displayed at Data Publics

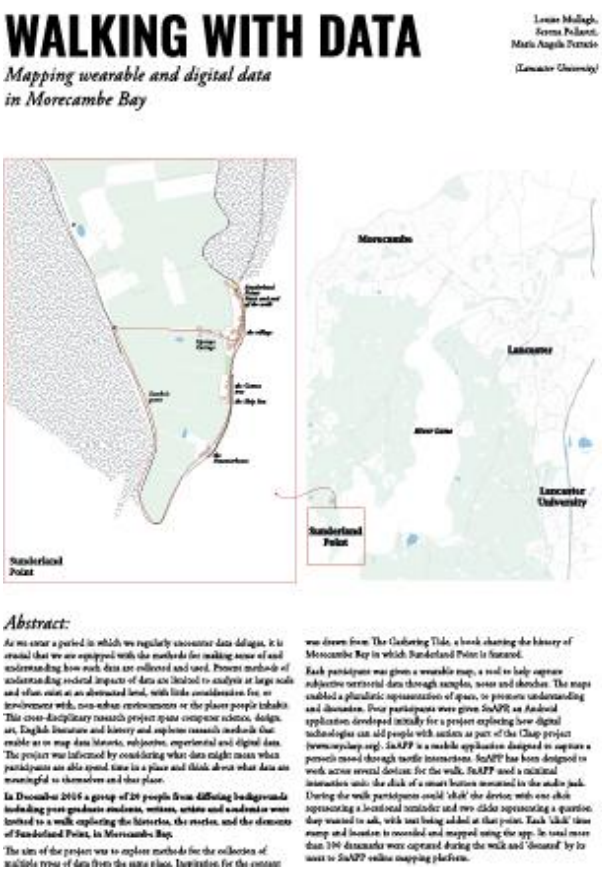


Figure 60: Detail of Aurasma app visualisation at Data Publics

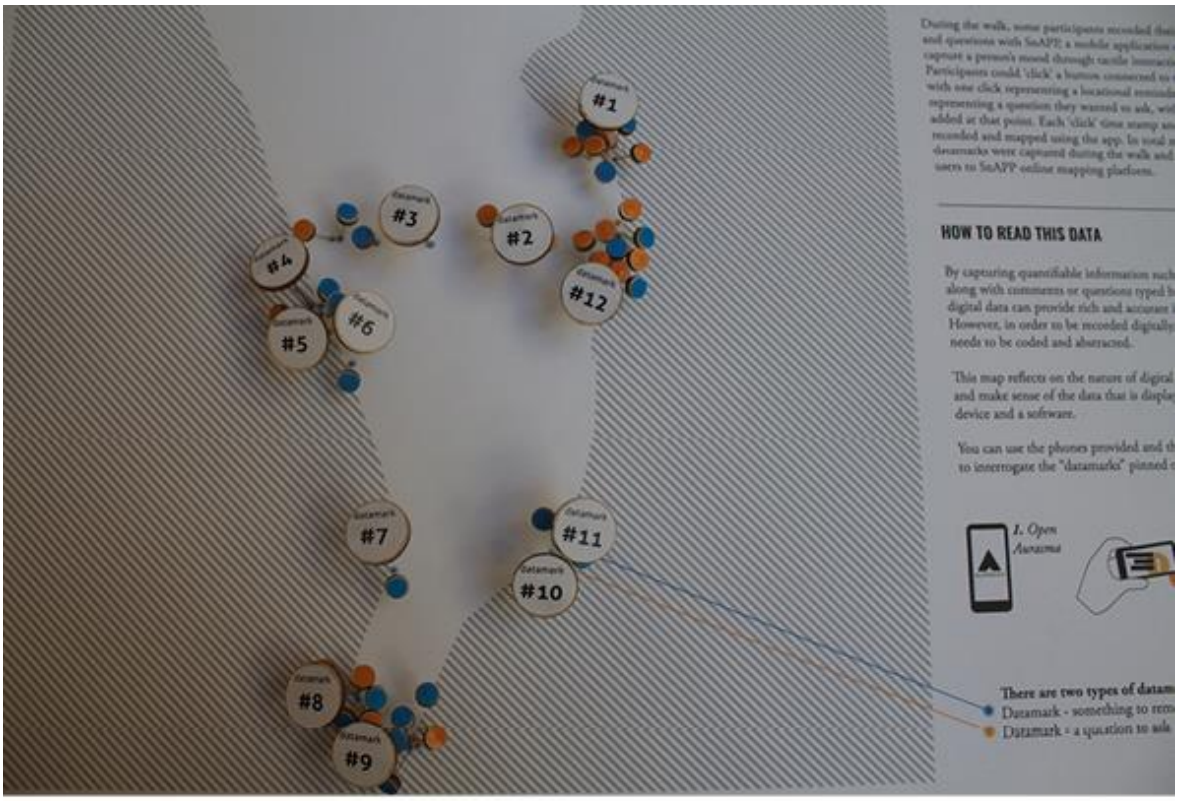


Figure 61: Detail of information presented at Data Publics

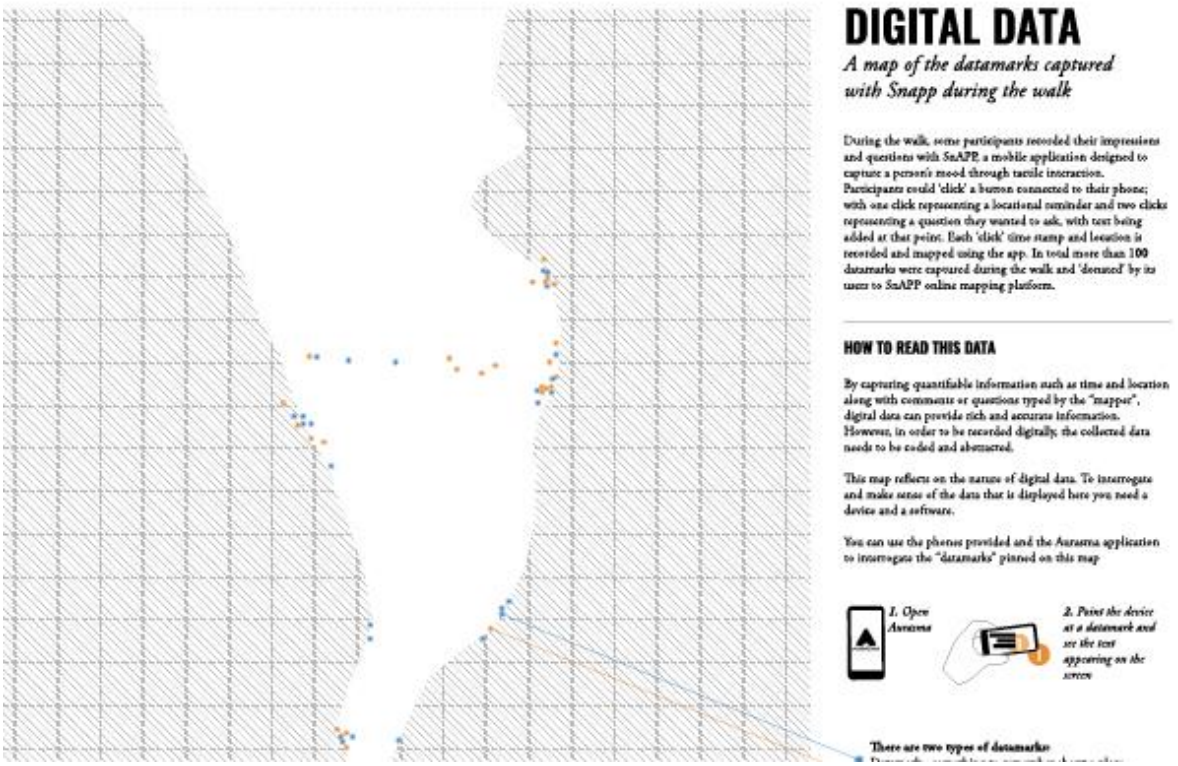


Figure 62: Digital Data aurasma map at Data Publics

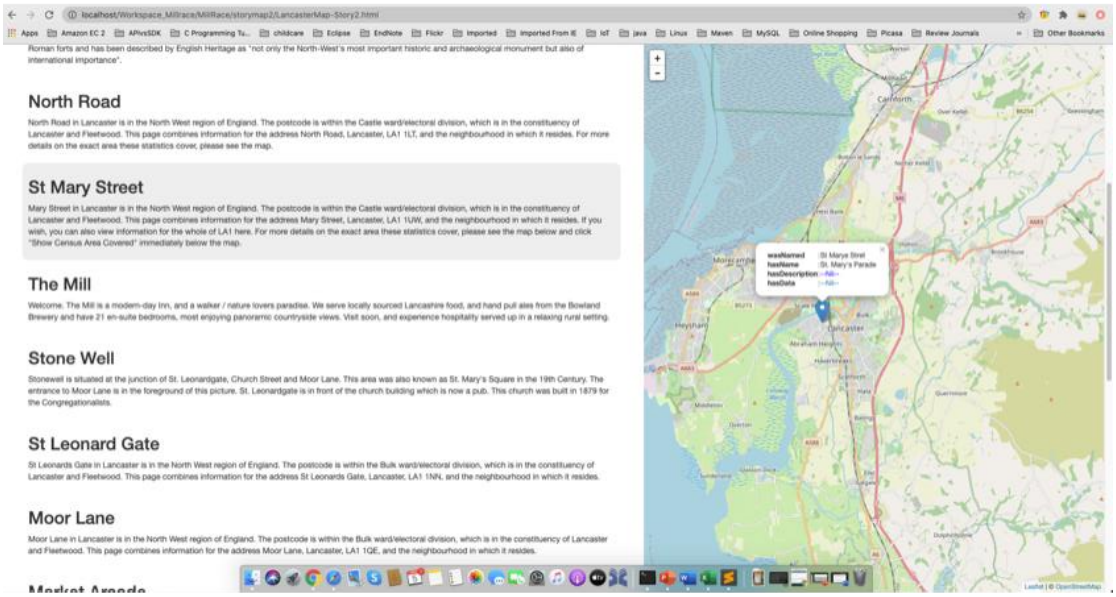


Figure 63: Detail of mock-up of Lancaster Flood Ontology

7.2.3 Visualisation of Data

Exploring not only data visualisation as designed using technology, that produce seamless visualisations that often place greater emphasis on the aesthetics than communicating the information and knowledge, but also analogue visualisations, produced by hand. Recently hand-drawn data visualisation has become more visible, in the work of artists such as Posavec and Lupi (2016) that embodies a more "human" approach to that which is predominantly seen as being embedded within the abstracted black box of data-driven visualisations. "Data analysis promises an "objective" way to grasp the complex and dynamic reality we live in. Visualised via colourful dashboards, infographics, and charts, it puts forth, persuasively and seductively, a seemingly accurate and unbiased assessment of reality. However, the translation of the social into data involves a process of abstraction that compels certain compromises to be made as the data are generated, collected, selected, and analysed" (Schäfer and van Es, 2017, p.13).

Presenting the wearable maps from Walk 3 at the Data Publics exhibition echoed the approach taken by Posavec and Lupi (2016) to demonstrate that data does not have to be presented through screens and graphic visualisations. Going one stage further, of visualising the contents of the wearable maps was not carried out but would have presented an opportunity to understand how this type of tangible artefact could be used as the foundation of visualisations that are both analogue and digital. The data presented from using the SnAPP mobile application was limited, in that only the GPS location was presented through the Google map. This type of visualisation offers little context and limits the display to tags and text only. Whereas the potential of the artefacts gathered, such as the drawings of Margaret the

Fisherwoman (Figures 39 & 40), seaweed, Morecambe Bay mud and collective descriptions of the wildlife seen during the walk, offer other potentialities of visualisation that are not limited to the restrictive technologies within which computer-generated graphic visualisations are.

Links to Pathways Forward

PF1.5: Explore creative collection and re-uses of MtD

7.2.4 Technical requirements: storage and analysis of More-than-Data

Whilst the development of technical solutions is beyond the scope of this research, consideration was given to technical considerations that arose prior to, during and after the walks. It is important to consider these challenges and opportunities in order to include them in the More-than-Data heuristic that will be presented in Chapter 8.

It is important to consider how the MtD will be stored and curated, an area that is discussed within the realm of bog and open data (2.1). The term "curation" is used frequently in the realm of data and is used to describe organization and integration of data from various sources and can refer to the presentation of data. It is important to understand how we can make sense of the vast amounts of data and information that has been produced and will be produced in the future, in ways that are meaningful and useful to us. However, if one were to consider the root of the term to "curate," to look after and to think more of More-than-Data as the materials with which to understand and look after a location.

Linking MtD that are analogue and digital poses a challenge, both in terms of technical skills, and the format. Linked data share "expectations of behaviour" (Kitchin, 2014, p.53) which enable data and documents to be machine-read and processed. The challenge of attempting to synthesise analogue, rich data and digital data lies in the creation of metadata which would enable catalogues or archives to be readable. Thinking in terms of linked More-than-Data to enable searching requires the tagging of meta-data – thinking about what would be of use for ensuring operability. A key question that could be explored in further research would ask what do the above mean in relation to tangible, physical analogue More-than-Data.

PF5.9: Go beyond digital visualisations and explore analogue visualisations as well

Digital can help, but as highlighted in Chapters 4 and 5, starting with the issue/challenge and exploring that with a range of people before jumping to a solution is important. One area that could have been useful to develop was to categorise all the research data gathered on the walks in terms of MtD. This would enable a picture to be developed as to both what constitutes MtD in place, how participants understood this and to enable categorisation of meta-data that could match digital categories. However, challenges lie in tagging physical artefacts and adding

them to digital spreadsheets is time consuming and takes a level of skill at using software such as Excel. The potential for automatic tagging using lo-fi digital technologies, such as the smart button used in the SnAPP mobile application has the potential to not only tag MtD but also to tag the GPS location of any artefacts created. However, it is important to not only develop a digital map of the location of MtD, as this partially mirrors the approach taken at hack events. The difference in the approach of the walks and that of the hack to maps lies in the generation of the MtD being different, that data generated on the walks the MtD are generated by participants *in* that place, rather than digital data points that have been abstracted.

This is an example of considering where the digital technology fits and using it to support the More-than-Data approach, rather than beginning with an idea for an app or other technological fix and then working backwards. The More-than-Data approach acknowledges the potential of technologies, but always in support of, rather than leading, the design of artefacts.

Links to Pathways Forward

PF3.10: Build a team who have skills across all collection, storage, and re-use methods*

PF5.5: Establish requirements of MtD and reliability – think about future proofing*

PF5.10: Consider how MtD will be stored and re-used before the walk/event*

PF5.11: How will MtD be curated, both in terms of storage (will *everything* be stored) and how this relates to its use

7.2.5 Logging and analysis of the outputs

The key artefacts I worked from when analysing the walks were images, fieldnotes and the artefacts themselves, which consisted of the wearable maps with the pouches filled by participants (Figure52) map pouches containing artefacts and objects (Figure56) and the notebooks (Figure36) completed by participants. For Walks 3 and 5 I used spreadsheets to capture the type of artefact and broke down the contents of pouches into separate data-points. This proved useful in identifying the distinct types of artefacts (object, drawing, descriptive text, entered into an excel spreadsheet. A key benefit of adding the artefacts and text to the spreadsheets was that it enabled me to sift through and make sense of them as I added them. However, this was a less engaging activity than sorting through the tangible artefacts.

In the spreadsheets I began categorising the artefacts and logging whether they were objects, drawings, text or other. However, this process did not add any significant insights and I spent more time physically exploring the tangible artefacts that had been developed on the walks using the different tools (Figure59). Seeing the artefacts in relation to one another pointed towards the way in which tangible objects become something different and removed once they

are digitally recorded in spreadsheets. However, the issues I identified relating to the removal of objects from a place caused a tension when exploring the artefacts from walks 3 and 4. It was also apparent that an image of the object itself worked as well, even though this became a representation of the object.

Through carrying out the analysis of the rich and digital MtD gathered during the walks it became clear that physically sorting through the artefacts was a useful and engaging exercise, although the tensions between gathering physical objects and using visual representations of them became apparent. It was also clear that using spreadsheets offers the opportunity to record the MtD in a manner that becomes sharable and can potentially include meta-data about the MtD, such as where it was collected, what it signifies and the type of artefact. This places the MtD within the same technological framework as digital data that are or collected, which can add usage, but again, tensions exist within transforming rich, tangible data into abstracted text and symbols.

Links to Pathways Forward

PF4.1: Consider usefulness of using particular tech in which data are embedded

PF4.2: Gather/record MtD about a specific issue in support of mobile applications

7.2.6 Building a More-than-Data store

Understanding how MtD could be stored is an important consideration and whilst the notion of storing the MtD that was gathered during the walks was not explicitly explored or developed in depth in this research, the insights developed in Chapters 6 and 7 of the research point towards the need to consider how MtD might be stored and then accessed.

Where Big Data are gathered and stored in vast Data Stores or Data Repositories, MtD stores might be the antithesis of the vast Data Centres used to capture and store the massive amounts of data collected every moment of everyday. The ways in which the MtD in the form of physical, tangible artefacts and digital data can be stored and then accessed is vital to consider once walks or other More-than-Data practices have been carried out.

Data-lifecycles include reference to the storage of data, whether in vast data centres or more locally. The challenge lies in the nature of the MtD that are gathered, which might take the

Figure 64: SnAPP data exported in CSV file on Excel

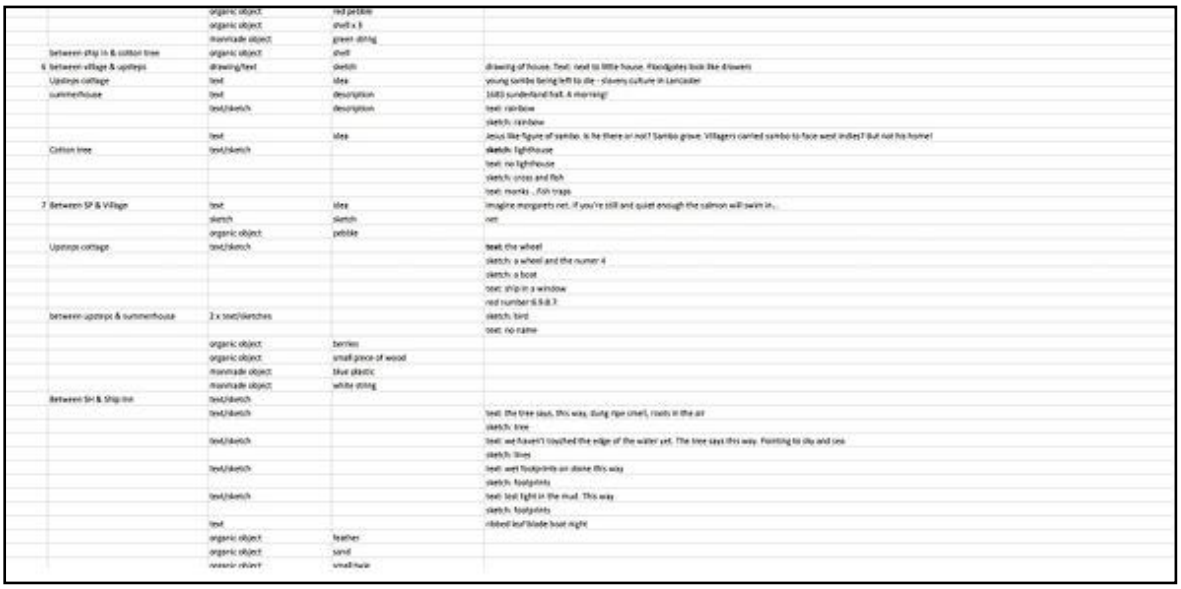


Figure 65: Manually input data into Excel

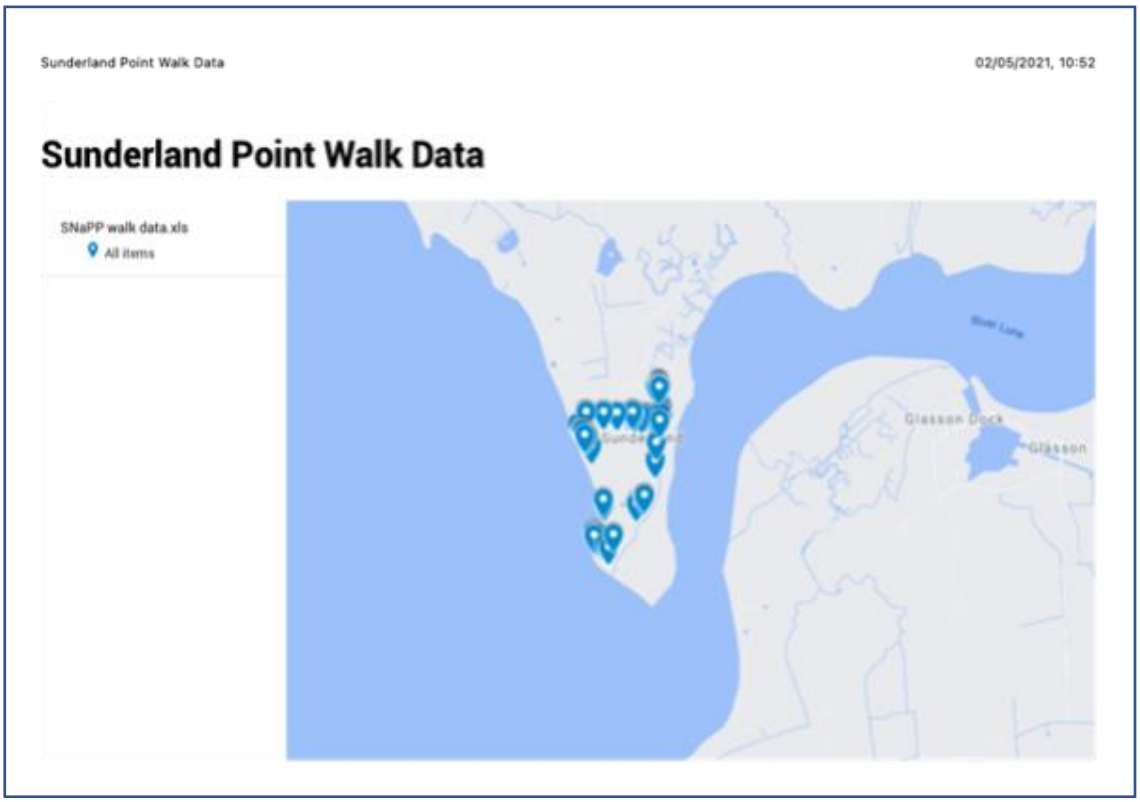


Figure 66: Walk 3 SnAPP data plotted onto Google maps

form of digital data or physical artefacts. As discussed above, the notion of linking MtD would enable a searchable database.

Dix comments on the changing pace of technology and old media that is inaccessible (Dix, 2014), this also relates to PW5.5 – (Establish requirements of MtD and reliability) and the need think about futureproofing. This was also a comment I made on the ribbon map during Walk 1, that many of the historical and cultural artefacts that constitute data (e.g., census data, maps), information (documents, images), knowledge (cultural artefacts such as written documents, paintings) and wisdom (oral history, writing, cultural artefacts) are held in an analogue format in museums, archives, libraries that might have been digitised. Whilst these forms of MtD might not be available during a walk (except where they are digitised and can be accessed on a mobile device) they are accessible in person, even where this requires special permission. Data that are gathered automatically and through digital means, however, are often stored in a black box, at a data centre, or in a format that is not readily accessible, unless you have the skills of the programmers (as explored in Chapter 4). This also poses questions around futureproofing, and whether these digital data will be stored in a format that will still be accessible in the future, or whether they will be lost and inaccessible.

Links to Pathways Forward

PF5.1: Adopt a More-than-Human approach to gathering and re-use of MtD

PF5.2: Build MtD repositories from scratch according to the particular place and issues

7.3 Chapter Summary

This Chapter has presented insights that emerged from the content, themes, and post-walk reflections. The design of the walks was informed by the Pathways Forward (Table 19), which have been developed through this chapter, some have been edited to ensure they reflect the insights gathered after the walks were carried out, and new PFs have been added based upon these insights. Through carrying out the walks, the research presented in this chapter has explored and offered answers to the following research questions:

RQ1.2: How might walks be designed to encourage an approach to understanding place that embodies More-than-Data?

RQ1.3 How do the walks contribute to the More-than-Data design process?

The following section details how these research questions have been explored and responded to in this chapter.

Data, information, knowledge, wisdom and lived experience have been entwined and embedded within the concept of More-than-Data, as developed in Chapters 4 and 5 of the research. Individually the MtD artefacts gathered and produced by walk participants do not tell the story of a place, which is the same as individual data points that comprise Big Data. But when they are aggregated and accumulated, this picture becomes richer and deeper. The act of analysis, of physically sifting through all the MtD encourages reflection and interaction with the tangible objects and artefacts gathered pre-walk and produced on the walks. Visualisations or designs produced from the MtD are counterpoint to the visualisations and dashboards we see that are ostensibly objective and abstracted (Renzi, 2015; Schäfer and Van Es, 2017).

The walks were designed in such a way as to consider the methods and tools through which MtD can be gathered, whether using analogue or digital methods and the insights that emerged also pointed towards the importance of the ephemeral experiences of the walks that could not be tagged or recorded. By engaging with the ways in which MtD are present or absent from place and understanding this prior to carrying out walks, a "ground up" approach is developed which is a counterpoint to the "data-up" approach highlighted in Chapter 4 and prominent at hackathons. By designing the walks to engage with MtD in a place and exploring what this means, it is apparent that it is possible to understand place through this synthesised

"understanding" that weaves together data-driven and place-based systems that may sometimes appear to lie in conflict with one another.

The insights in this chapter demonstrate that data, information, and knowledge and lived-experience can be captured when walking and walkers do not necessarily need to make explicit which of the artefacts or data points gathered during the walk relate directly to these explicit forms of understanding a place. If the designers of the walk understand how MtD might be present in a location prior to designing collection tools, and how those tools can be used to gather the MtD, it should be possible to gather a rich picture of place. Wisdom, which is a cornerstone of traditional knowledge systems (2.7.2) and is seen to lie in opposition to data-driven forms of understanding, which yield information, is borne from the walks and the work carried out prior to and post walks. Through encountering place and other participants, the development of wisdom through practice and theory become embedded in the process of walking and reflecting afterwards. It is still possible to gather wisdom during a walk, but this depends upon the participants and their understanding of that location. For example, a walk with the Queen's Guide across the sands of Morecambe Bay would gather wisdom as he has spent such a long-time walking in the area and has amassed decades of data, information and knowledge that form the basis of his wisdom. Carrying out one walk with participants in a location they are not familiar with creates a challenge in gathering wisdom just from that one walk.

Walking was successful in terms of bringing a wide range of people together around a specific theme or challenge, whether they were specifically invited or attended a public walk. As the literature (Chapter 2) illustrates, walking offers a mode of engagement that encourages conviviality and can even be used in the process of conflict resolution.

Whilst the design of the walks is but one example of a practice that engages with More-than-Data and the aim of this research is not to generalise, the insights and experience developed in this chapter demonstrate that the elements developed through the process of the Pathways Forward offer the potential for an engaging approach to understanding place. By interweaving More-than-Data with the method of walking it is apparent that we might begin to synthesise data-driven and place-based understandings of place that draw attention to the challenges and benefits of both systems of knowing.

THEME	PATHWAY FORWARD	REFERENCE
PF1	Dig down into other MtD sources	PF1.2
	Explore creative collection and uses of MtD	PF1.6
	Consider data as a component of tackling issue – not the whole solution	PF1.7
	Understand limitations of participants in terms of access to hardware, connectivity and skills before the walks or events are designed*	PF1.8
PF2	Get outside	PF2.1
	Explore range of venues – urban and non-urban places	PF2.2
	Explore MtD in from and through place)	PF2.3
	Explore situatedness in the place through its inhabitants and plural histories*	PF2.4
	Consider how MtD might be incorporated into understandings of place	PF2.7
	Map local knowledge, lived experience, MtD in place AND using wider archives, repositories (such as oral history, art projects) *	PF2.8
	Understand the points of data deserts and scarcity prior to designing the walk, when analysing and reflecting on MtD that are gathered pre-walk. Explore the causes e.g., infrastructural or relating to contentious issues*	PF2.10
PF3	Explore and articulate common and conflicting values and politics	PF3.1
	Pre-and post-event engagement with MtD and issues/themes to understand what MtD is or is not available in or about a place*	PF3.2
	Understand tensions between different communities of practice	PF3.4
	Bring people together around a specific issue	PF3.5
	Plot or map potential conflicts or values of proposed participants/issues in the place prior to the walk to understand how this might affect or add to the potential value of More-than-Data that are gathered? *	PF3.8
	Participant engagement after the walk/event: on reflection was there any wider impact of the experience? *	PF3.11
	Consider synchronous/asynchronous and in-person/remote methods of collaborating to design with the MtD post walks. This should be explored before designing the whole process, right at the start *	PF3.12
	Build a team who have skills across all collection, storage, and re-use methods	PF3.13
PF4	Consider usefulness of using particular tech in which data are embedded	PF4.1
	Gather/record MtD about a specific issue in support of mobile applications	PF4.2
	Build in consideration of the type of MtD to be collected and the way in which it might be used post-walk	PF4.3
PF5	Adopt a “more than human” approach to gathering and re-use of MtD	PF5.1
	Build MtD repositories from scratch according to the particular place*	PF5.2
	Explore and adopt a range of practices to gather and share MtD	PF5.3
	Ensure gathering and re-use of MtD is equitable and beneficial to all	PF5.4
	Establish requirements of MtD and reliability – think about futureproofing	PF5.5
	Explore concept of “Less-than-Data” – where the focus is on the ephemeral and sensed experience that can’t be captured and accept this will be part of the wider and longer-lasting experience of walks *	PF5.6
	Weave together different ways of knowing, such as folk- and weather- lore into the gathering of MtD*	PF5.7
	Encourage curiosity and that it is ok to not know something*	PF5.8
	Go beyond digital visualisations and explore analogue visualisations as well*	PW5.9*
	Consider how MtD will be stored and re-used before the walk/event*	PF5.10
	How will MtD be curated, both in terms of storage (will everything be stored) and how this relates to its use? *	PF5.11

Table 19: Pathways Forward from Chapters 4-7 of the researc

Whilst the emphasis and focus of this research is on the notion of More-than-Data, the walks illustrated the counterpoint to this approach, that of Less-than-Data. As was experienced on the walks, sometimes pausing, and using our own senses as we move through a place can be as valuable as gathering MtD as we move.

How do the walks contribute to the More-than-Data design process?

Through designing the walks with More-than-Data placed at their core, this chapter highlights how walking can engage with this approach to understand place. By breaking down the design process of the walks and exploring the contents of the walks, as well as the post-walk activities and ways in which MtD might be stored and re-used, the insights presented here demonstrate that the practice of walking offers a range of benefits that bring together the core components of More-than-Data.

Understanding what MtD might be in a location, how it might be gathered in, from and through place has been explored here, in addition to the implications and challenges of these conceptualisations of More-than-Data. By moving through a place slowly with other people, or alone but reflecting on what MtD are there, we see the accrual of data, information, knowledge and lived experience. Wisdom is also a product of the walks but is developed through a longer-term process that continues after the walks.

Gathering MtD through somatic and sensory methods

Identifying More-than-Data that are absent from places is challenging and thought needs to be given to this prior to walks. Where the location is scarce in either all or some of the constituent elements of MtD relating to the theme or challenge being explored, this does not mean that it is not worth choosing that location. For example, when exploring water in the city for Walk 5 there was little present at that time due to the exceptionally dry weather, and so there was less information or data as we walked. However, participants were still able to discuss their own lived experiences relating to the theme and imagine what data might be of use, that was scarce due to infrastructural issues (lack of sensors in gullies and in the Mill Race itself). Walk designers need to visit a location to interrogate what can be seen and what cannot and to dig deeper into other sources of data, information, knowledge, and wisdom that might be located elsewhere.

Not everything experienced on a walk can be captured – the ephemeral and intangible sensory experiences are vital, but these cannot be captured easily. However, these sensory experiences enrich the experience of walkers and therefore can contribute to the artefacts they produce during walks.

When synthesised, the insights drawn from this chapter highlight key elements that support and lay the foundations for More-than-Data. Whilst this is but one method, or practice, that

might be used to gather or understand MtD in place, it offers the framework that might be applied to different events or activities.

7.4 Synthesis of Chapters 6 and 7

This section brings together and synthesises the key findings from Chapter 6, which explored the design and planning of the walks and Chapter 7, which sought to understand how the walks can embody the concept of More-than-Data through exploring the content of the walks, post-walk activities and considerations of display, storage, and re-use.

RQ2: How might More-than-Data be embedded into a new practice that uses walking?

RQ2.1: How might walks be designed to encourage a More-than-Data approach to understanding place?

RQ2.2: How do the walks contribute to the More-than-Data design process?

The insights taken from the walks deal more comprehensively with the preliminary stages of data collection and storage. This was due to a focus being placed upon the initial stages that are often neglected during the hackathon, where consideration is often not given to how, where or by whom the data are collected, or what the data might be used for in the future (Chapter 4.4). By considering these initial stages, as emphasised by the More-than-Data lifecycle, the products produced that then go out into the world may have an increased chance of being of use, or meaningful to people connected to the place in which they were gathered, stored, and re-used.

It would be useful to explore the latter stages of data re-use in more depth, and this will be explored in the Future Research section of Chapter 8. These latter stages have been considered here in a conceptual manner, based upon experience gained during the walks and the attempts to hold post-walk events.

Walks form an integral component of the More-than-Data design process, but they could be substituted with alternative practices, such as spending time in a place without moving, of being in a place and getting to know a small part of it. The walks can be stand-alone, in that a walk as one event can capture a range of MtD. They might also be seen as part of a wider process, where additional events or activities, whether in person or asynchronous and online can add to the development of unique designs.

The walks considered a range of design decisions, with the design of tools and the consideration of both digital and analogue tools explored. The walks were designed to not use digital mobile technologies in the gathering of MtD, after using a mobile app on Walk 3. Whilst digital mobile technologies offer useful methods through which to tag MtD locations

through GPS, analogue tools were used to offer a counterpoint to dominant modes of gathering data which were explored in Chapter 2.

Whilst not explored in depth in this research, the walks can be valuable in the process of both collecting data which can then be utilised as design material to build a rich picture of place and become, rather than a Data Store, a MtD Store, or repository. Such a store or repository can comprise of both digital and analogue data, if considered carefully and can be deployed as an open resource that can be added to. Challenges lie in the presentation and locating of analogue and digital MtD, such as the storage of physical MtD. However, utilising digital technologies that begin with the values and usage of the MtD that are designed with this use in mind, can enable wider access and use of the rich MtD gathered during walks. Some sensed MtD that are ephemeral and contingent on the location cannot be stored or made into a physical, tangible artefact and exist only in a description or creative response, the type of MtD that "you had to be there" for.

A key finding from the walks was that wisdom accrues through the process and isn't always captured during the walks. Rather, it is the process of walking and gathering rich data, information, and knowledge about a place (More-than-Data) that enables wisdom to be borne of the process.

A range of artefacts were produced by participants during the walks using the wearable maps (Walks 3-5) and the mobile application (Walk 3). Using the artefacts and findings from Walks 3 and 4 further work was carried out to explore how the MtD might be presented, through the exhibition from Walk 3 and the Flood Ontology from Walk 4.

More-than-Data straddles macro and micro understandings of place, through acknowledging the potentiality of big and open data, whilst also recognising the value of small, rich data and weaves these together with information, knowledge and, ultimately, wisdom.

The design of the walks embeds MtD into all the stages, from the pre-walk exploration of MtD that exists in a place, the design of tools used to gather MtD, to the development of themes and issues that will be explored during the walks. This approach to understanding a location considers place more as an ecosystem of different assemblages of data, information, knowledge, wisdom and lived experience, rather than through the lens of data alone, which we saw in Chapter 4 with hackathons.

Considering MtD from, in and through place provides a conceptual framework to consider the different methods of gathering MtD and the interrogation of its meaning and purpose. MtD from place can be that which is in a place, whether gathered through sensors (e.g., rainfall, air-quality, river gauges), or surveillance data such as images from CCTV, or analogue, sensed data such as smells, or sounds. Furthermore, this might be lived experience that is shared by participants or accessed through archives such as oral history. MtD in place could be flora and

fauna, or the movement of animals located there, or the built environment which can tell us historical information. Lived experience specific to that location might also be MtD in place. MtD through place captures data such as location as gathered on our mobile devices as we move through a place logging our route, or biometric data gathered from wearables, this might also refer to traffic data and information. Knowledge and wisdom also come into being as we walk through a place, as we build from experience and from engaging with the place or participants.

The design of the walks did encourage the collection of More-than-Data and demonstrate how taking time and resources to consider how walks should be carried out, where they should be located, who should attend and the tools with which More-than-Data will be collected are vital. By exploring this early stage, it is intended that the issues relating to having only limited data to use, that data not being contextualised in a place, and the lack of suitable tools to engage participants in the gathering of data are tackled. Furthermore, it is vital that these areas are considered as they influence the way in which the data, or in this case, More-than-Data can be stored and re-used (Kitchin, 2014).

Bringing together people around an issue is key to engaging with More-than-Data, from, in and through place. This is vital and is being addressed more in contemporary hackathons, where event designers try and encourage a wider, more diverse array of participants from the arts and science (4.3.2). However, diversity of participants is fundamental to MtD, and participants should be either selected with a range of backgrounds that might be able to explore the challenge in creative ways, but also engage with wider public audiences and participants who, even though they may not be "experts" in the field, can offer rich and diverse lived experience.

By considering both the design and weaving of More-than-Data into the walks, which are one possible method of embedding MtD into place, the challenges and opportunities encountered in Chapters 2, 4 and 5 of the research are explored in depth. Issues highlighted in the format and content of hackathons which lead to lack of engagement with place and those who inhabit it, and that are also limited by the nature of the materiality (or lack of) of the data used have been explored through the walks. The insights presented in this chapter highlight the benefits of taking time to explore and consider not only the logistical planning of an event, but also the importance of considering who might be involved and where they may take place. All these contingencies should inform the development of the tools and the collection of MtD, which then informs its re-use, rather than relying upon digital tools and frameworks which can ultimately limit the potential of engaging and creative designs. By considering these issues in this chapter through designing the walks myself, the accrual of experience as each walk was carried out, then reflected upon, enabled me to understand the key themes and challenges through encountering them.

Chapters 6 and 7 have presented insights gathered from carrying out More-than-Data walks. Taking the concept that was of More-than-Data that emerged from Chapters 2, 4 and 5, the walks sought to explore how a practice might embed the More-than-Data concepts in understanding place. Furthermore, the development of the walks enabled the development of insights into the planning and organisation of walks, and the type of tools that might be of use.

This phase of the research highlights that walking offers opportunities for gathering More-than-Data and enabling the sensitive and engaging re-use. The practice of walking is aligned with the core underpinning of More-than-Data, in that it enables the development and gaining of knowledge when moving through a place.

Challenges lie in the development of suitable tools that allow the synthesis of digital and analogue More-than-Data. To explore technical solutions is beyond the scope of this thesis, but suggestions and considerations as to how this might be explored further are offered in Chapter 8.

The walks demonstrated that not all our passage through place need to be recorded, whether through digital or analogue means. Sometimes pausing to feel the wind or appreciate the texture of the ground beneath our feet is enough. These experiences enhance our understanding of place in intangible and ephemeral ways and run counter to the rhetoric of data, where everything that can be is collected, often without considering how it will be used or the implications for design.

Furthermore, the presentation of MtD can present to wider audiences the diversity and plurality of a place and those who inhabit it. It is people, and other inhabitants of places who shape them, whether urban or rural. By making visible the MtD gathered in a place and opening it up, the current limitations and barriers to access that are endemic within the data-driven society can be challenged.

As a practice that engages with the challenges of both data-driven and situated approaches to understanding place, the walks enabled me to gain insights into how people come together in a location and that while walks are a valuable activity on their own, they are useful when placed within a range of activities that engage with More-than-Data from before its collection right through to its use as a design material. Bringing people together around an issue is a key benefit of the walks, and seeing them within a larger ecosystem of events, there are opportunities for the same people to come together repeatedly and gain not only understandings of the place, but also each other. Through this longer-term engagement, whether in person or using distributed methods (such as online communities) wisdom grows.

The placing of the walks within a wider ecosystem of the More-than-Data lifecycle also reflects the benefits of design approaches such as Permaculture. Taking the long-term view,

of engaging with place over time and in different contexts challenges the short-term and fast paradigm of innovation that is embedded within practices such as the Hackathon.

Thinking about designing the More-than-Data lifecycle and embedded principles such as those that underpin Permaculture will form the foundations of the More-than-Data design heuristics presented in Chapter 8. By embedding More-than-Data in existing, but adapted, design approaches and processes, the heuristic device (Design Principles) have the potential to offer a framework within which those who do not have knowledge or experience of using design or data are able to create their own practices.

More-than-Data Walks are not specific to one location but can be applied to different contexts and woven into a specifically design sequence of activities that are of use and specific to a particular location. As the walks demonstrated, there are rich seams of MtD located in places, whether urban, rural or on the edgelands of towns and cities.

7.4.1 Ontological challenges of More-than-Data

One of the key challenges posed by this research is that data-driven and embedded understandings of place, which are often categorised as being ontologically opposed, can be synthesised to form the concept of More-than-Data. One approach to this dilemma is to accept that these two ontologically different modes of understanding do not have to be synthesised, that it is important to hold both together simultaneously, as Haraway (2016) suggests, to "stick with the trouble." By attempting to clean up, cook or neaten data-driven modes of understanding and those which are situated, we potentially lose some of the richness of that mess. Within TEK empirical modes of understanding exist, often in the form of longitudinal observation of the environment. There is room for both data-driven and situated understandings to co-exist, but we should be aware of the potential challenges and issues of each, in addition to the benefits.

More-than-Data seeks to foreground the ontological nature of data, information, knowledge, and wisdom through offering ways in which the diverse types of understanding can be best suited and situated within a place and offer meaning to those that gather and use it.

It may not be possible to technically synthesise big data and wisdom, or knowledge produced in a location, but by understanding their attributes, differences, and potential similarities, both can contribute to richer understandings of place.

The following chapter takes the insights gathered from Chapters 2, 4, 5 and 6 of the research and considers the ways in which design can be used within More-than-Data. By plotting these insights onto a design process, it is possible to understand how to develop More-than-Data practices that take into consideration the requirements from pre-walk to post-walk and beyond.

The insights are then synthesised into a heuristic for More-than-Data walks, which are presented in the form of design principles.

8 Designing Principles for More-than-Data Walks

This chapter presents two contributions of this research; the concept of More-than-Data (MtD), and a set of heuristics through which MtD might be embedded into a practice, titled "Design Principles for More-than-Data Walks."

The research question explored in this chapter is:

RQ3: What might design principles for More-than-Data Walks look like?

These two contributions synthesise the findings of the research presented thus far, presenting dual understandings of place that are based upon More-than-Data. The concept of MtD consists of data, information, knowledge, wisdom and lived experience gathered from, in and through place, and can offer alternatives to existing practices such as the hackathon. Based upon both theoretical understandings that underpin More-than-Data (Chapter 2), empirical evidence developed through interviews (Chapters 4 and 5) and a practice-based approach through carrying out walks (Chapters 6 and 7), the Design Principles set out a framework through which to design walks and associated events.

The purpose of the Design Principles is to galvanise and mobilise designers, programmers and developers, data-scientists and citizens who do not currently engage in the data-driven society. This is done through offering signposting to explore different modes of understanding place. The aim of this approach is to make visible and manifest the myriad rich and thick, tangible, and intangible potential of More-than-Data.

Chapters 2, 4 and 5 research developed the concept of More-than-Data. This is an approach that encourages a re-balancing of data-driven and situated understandings of and engagement with place. Chapters 6 and 7 of the research explored the notion of a situated, place-centred practice that embodies More-than-Data through walking. This final phase of the research brings together and synthesises the previous chapters to answer the first part of the research question: "What would design principles look like that encourage a situated, place-centred practice which seeks to re-balance data-driven and situated understandings of place?"

This chapter presents the heuristics that have been developed through the process of accruing and developing the Pathways Forward presented in the previous four chapters. Furthermore, the chapter suggests a design process, process, that can provide the framework for More-than-Data walks, either as stand-alone events or as a component of a wider series of events and activities.

The word “heuristics” comes from the Greek word “heuriskein,” meaning to discover or to find (Moustakas, 1990, p.9). This research has been a journey of discovery that I have shared with a number of people in different locations, in which I have explored myriad forms of data, information, knowledge, wisdom and lived experience. During the walks, participants discovered and found rich forms of More-than-Data in a range of places. To see the design principles that have emerged through this process as a set of heuristics reflect the journey and the process of designing and carrying out the walks. Therefore, considering the Design Principles as a set of heuristic encourages those designing walks, or other MtD activities, to discover and find their own routes, themes, and participants.

8.1 Who are the principles for?

As Chapter 2 (2.3.2) demonstrated there are very few “how to” guides for developing data walks, or walks that critically engage with data, but there have been calls for the development of research methods for data walks (van Es and de Lange, 2020). Kits to collect data have been developed for citizen science projects, or art projects, such as that developed by data artist Jer Thorp (Thorp, 2021). Writing about data walks tends to describe the walk and then the insights garnered or describe the methodology in an academic context (Powell, 2019). Whilst this is useful and adds to the understanding of how to carry out such walks, the following design principles can be adapted to people with a range of understandings (examples for different “users” are included in the principles).

By carrying out walks with a range of participants, including those who are engaged in data practices (6.4.6) and those who do not have a background or are actively engaged in these practices, it was clear that through the act of walking and exploring a range of issues within a place, it is possible to engage a range of people in gathering and potentially re-using MtD in place.

8.2 Development of the Design Principles

The Design Principles have been developed through analysis of the Pathways Forward that have accrued through Chapters 4 to 7 of the research

Table 20). At the core of the principles is the concept of More-than-Data, which has been explored through carrying out the walks and reflection upon them. By carrying out the walks it became clear that some Pathways Forward had become either embedded in the notion of More-than-Data or were repetitions or similar to other Pathways Forward. In Chapters 4 and 5, the term DIKW was used to represent data, information, knowledge, and wisdom. reflection upon them. By carrying out the walks it became clear that some Pathways Forward had become either embedded in the notion of More-than-Data or were repetitions or similar to other

Pathways Forward. In Chapters 4 and 5, the term DIKW was used to represent data, information, knowledge, and wisdom.

The concept of More-than-Data emerged towards the end of Chapter 5 when the findings were synthesised. As such, the term DIKW has been replaced by More-than-Data (MtD) from Chapter 5 onwards and in the Pathways Forward that are synthesised in Chapters 6 and 7 and presented in Table 1. The Pathways Forward informed the Design Principles through the collation of key themes developed through the empirical research presented in Chapters 4-7. As described in Chapter 3.6, the framework of the Pathways Forward assisted in the sense-making of the large and diverse array of data gathered through the research. Through synthesising the insights into the framework of the Pathways Forward, I reflected upon each of them and operationalised them through the creation of the Design Principles. Both the Pathways Forward and the Design Principles are but one response to the data gathered through this research, and other researchers might arrive at different results. However, by carrying out the research in a methodical manner, the Pathways Forward offer an approach to make sense of More-than-Data and the process used to arrive at both this concept and the Design Principles. The themes developed in Chapters 4 and 5 were: data-driven artefacts; Place- site and locations of data collection and re-use; Practices and People; and Situated Artefacts. These themes have been re-developed for being included in the Design Principles.

The design principles are a heuristic guide that suggest routes to developing More-than-Data walks or practices and designing with More-than-Data. The design principles also include suggestions relating to Speed's (2016) *Ablative Framework* for designing *with, by* and *from* data. Data are expanded upon, and instead the framework is suggested in relation to More-than-Data, to encourage people to explore how this wider, richer resource that can be gathered through use of the design principles can be used as a design material.

PATHWAYS FORWARD
Take a view from the ground up
Dig down into other data sources
Use tools guided by the issue or theme being explored
Harness well-meaning nature of participants
Expansion of hackathon and data toolboxes
Explore creative uses of data
Consider data as a component of tackling issue – not the whole solution
Explore the synthesis of analogue and digital data*
Consider MtD as a material with which to design*
Get outside
Explore range of venues – urban and non-urban places
Explore MtD in, from and through place
Think about how MtD are themed (e.g., by place)
Explore how to collect metadata of More-than-Data in place
Consider how More-than-Data might be incorporated into understandings of place
Map MtD in place
Exploration of what a specific, situated and located space/place might be for event
Explore and articulate common and conflicting values and politics
Pre- and post-event engagement with data and issues
Consider different event formats to encourage wider diversity and participation
Understand tensions between different communities of practice
Bring people together around a specific issue, challenge or point of interest
Consider whether walks should be guided or self-guided and consider the benefits/challenges in designing tools and themes*
Explore whether walks should be synchronous or asynchronous, where participants can walk on their own and then contribute and pool their MtD remotely or physically*
Consider the potential conflicts of values and politics when designing the walk and inviting participants – how might these conflicts play out during the walks and what might encourage their drawing out?
Develop theme in and for the specific location and involve those who inhabit it where possible
Consider usefulness of using particular tech in which data are embedded
Gather/record MtD about a specific issue in support of mobile applications
Adopt a ‘more than human’ approach to gathering and re-use of MtD
Build MtD repositories from scratch according to the particular place
Explore and adopt a range of practices to gather and share MtD
Establish requirements of MtD and reliability – think about futureproofing
Go beyond digital visualisations and explore analogue visualisations as well
Consider how MtD will be stored and re-used before the walk/event

Table 20: Pathways Forward that feed into Design Principles

8.3 The Design Principles

The Design Principles have been developed through the process of accumulating the Pathways Forward. The principles aim to be of interest and use to a range of people, including those who are already engaged in data practices, and those who are not. Each of the principles contains suggestions for each of these potential audiences and act as heuristics, rather than strict frameworks.

The principles are divided into three main categories of situating, engaging, and balancing. These three components arise from the overarching research question, which explores how data, information, knowledge, wisdom and lived experience might be woven together to bring about situated, engaging and balanced approaches to understanding place.

1. **Get outside and take a view from the ground up:** Explore a range of venues, both urban and non-urban locations in which to host events or activities. This can help bring about greater connection between the theme and the designs created. Before holding a walk, go out into the place of interest and map the terrain, issues that might arise and explore. Try and see if you can identify people or places of interest. Then make a physical map which contains all the areas and potential people of interest. Use this as the starting point to the project.

2. **Map people and place:** Map who would be interested in taking part in walks, activities, or events: Based on the place, think about who might be interested and bring together people around the specific issue, challenge or point of interest. Consider the potential conflicts and tensions of values and politics when designing walks and activities – how might these conflicts play out during walks and what might encourage their drawing out? An activity before the walk, whether online or in person to map people's values (what is important to them) and the knowledge and/or lived experience they have of the issue can be of use. Creating a physical or online map of interests and differing values can help mediate possible conflicts. There might be people who would be interested in developing the technical components where needed, such as digital designs or bringing together data or information that exists about a place, or people more interested in gathering physical and tangible recollections, or audio.

3. **Encourage and celebrate diversity:** Bringing together a diverse group of people and thinking beyond people to the non-human inhabitants of a place can help develop an interesting and engaging walk. A diverse range of experiences, wisdom and knowledge about a place can bring about more diverse and interesting designs later in the process. Think about different genders, ages, life experience, backgrounds, professions. Understanding the barriers to certain possible participants will help engage a wider range of people, who may have caring responsibilities, health, or access issues.

4. **Co-create or design the specific situated theme with others**: It is important to develop a shared understanding of a theme or issue. This comes initially from the place but can be shaped once participants have been identified.

5. **Design reflective events and activities:** Think about design a series of events or activities that include and periods of reflection as well as activity. These could be online or in person, enabling a range of people to take part and to give participants time to reflect and to gain feedback from different stakeholders. Think about the format of walks, will there be a guide, or can people do the walk in their own time? This is important as it will affect the range of activities. Can people share their walk reflections and MtD in person, or online?

Go for a walk, or a series of walks:

6. **Explore MtD in, from and through place:** What MtD exists in that location, or about the location that is held elsewhere (such as archives, museum collections, online collections, audio, or video). What MtD can be gathered from the place – whether using your own senses or gathering it from sensors or open, big, or online data sources? What MtD are collected as you move through a place – e.g., from the devices you wear or carry, or from other methods such as CCTV, or the knowledge, wisdom or lived experience that is shared between participants as you move through the place?

7. **Map the MtD in place:** Through developing tools, which can be lo-fi, or digital, map the MtD that are produced before, during and after the events or activities, such as walking. Tools such as simple map pouches or folding notebooks can be used, with or without prompts, to help people gather MtD. This could be conversations had during walks, notes made, images drawn or taken. Think about non-human participants as well, such as animals, trees, rivers, and the MtD they might contribute, or what they might be able to use in support of their flourishing in the world.

8. **Make tools guided by the place, issue, and people:** Gathering MtD on pre-walk events and during the walks can be done with digital tools such as mobile phones, wearable devices, or cameras. These can be of use in logging location of where any MtD are gathered, or perhaps where an interesting conversation occurred. Images are also useful to share and add to a MtD store afterwards. However, also think about making lo-fi tools such as map pouches, wearable maps, or folding notebooks for participants to use. Encourage people not to remove things from the place, to leave it as they found it, and instead either make notes, draw, or record sounds or images of points of interest during the walk. Some things can't be recorded, such as fleeting light, smells, or the way something feels, but this is fine. This is part of the experience of the walk and should be encouraged.

9. **Explore a range of practices to re-use and share the MtD:** Make a More-than-Data Store. The MtD store might take the form of a library, either online or physically, where

people can contribute, share and the use the MtD that are there. As a rich resource about a place, that brings together people's information, knowledge, wisdom and lived experience, the MtD store can take many formats. The guiding principle is that it should be open and sharable by all.

10. **Explore bringing together digital and non-digital MtD**: There is a vast amount of data gathered from, or as we move through places. Bringing together different types of data, information, knowledge, wisdom and lived experience can create rich pictures of places and help to solve issues faced there, or just a better understanding between different people. Having a store of digital data can be of significant use, as can a store or archive of physical or analogue objects, such as we find in archives and museums. Technical requirements – metadata, future proofing. Consider the usefulness of using particular technologies in which data are embedded.

11. **Using MtD as a design material:** Explore creative uses of MtD – go beyond digital visualisations and explore analogue visualisations as well- includes developing innovative ideas and getting feedback

12. **Explore how the MtD can help understandings of place:** By exploring and using the previous 11 principles, there should be a rich array of MtD that can now be used in understanding a place. This rich resource has the potential to be used in a range of different circumstances, whether it is designing a new product or service for the place or bringing together the different MtD to explore and begin tackling an issue that has been identified in the stages so far. Think widely, and spending time reflecting, after any activities that have been held. Send the designs or products that have been developed out into the world to understand how they engage with place.

8.4 Chapter Summary

This chapter presented a series of design principles that can be used to develop More-than-Data walks, and other practices. The research question explored in this chapter is:

RQ3: What might design principles for More-than-Data Walks look like?

The design principles are a synthesis of the Pathways Forward that have been developed in Chapters 4-7 of the research. In answer to the research question above, the design principles for More-than-Data Walks take the form of a set of heuristics that bring together considerations of people, place, design, More-than-Data, and the context-specific design of tools and products or services that are situated, engaging and balance data, information, knowledge, wisdom and lived- experience. In developing the design principles, this chapter has demonstrated that, whilst more rigid frameworks and methods of developing practices that embed More-than-Data, a more flexible set of heuristics offers potential for a wider range of people engaging

with the data-driven society, as well as wider notions of information, knowledge, wisdom and lived experience.

As was explored in Chapter 4, hackathon events tend to overlook the embedding of design processes that enable data to be utilised as a design-material and lead to solutions that are often only of partial use and/or not taken further than the event. In Chapter 2 approaches to designing with and for data was explored, such as HCI approaches (often using design methods such as co-design, participatory design, or design fictions). These examples demonstrate that data can be usefully used as a design material and these approaches can lead to more considered design solutions (Chapter 2). However, less literature and practice has explored the design process of hack events, and alternative practices that might bring about more lasting, sustainable, and engaging uses of data as a material.

Whilst practises such as data walking (Chapter 2.3.2) offer a route towards understanding place and the entanglements and assemblages of data that reside there, at present there are few guides or heuristics that enable a wider audience, beyond academia, to use this approach. The design principles offer one way of enabling engagement, that is flexible but also offers guidance and signposting for those who are not as familiar with the concepts. The More-than-Data walks also engage with a wider range of understandings of place, which can potentially have broader appeal and impact than focussing solely upon data.

When reflecting upon the findings from Chapters 3 and 4, that highlighted the opportunities and challenges of both data-driven and more situated approaches to understanding a place, from which More-than-Data emerged, it was clear that whatever was developed in terms of principles, or guidance to embedding this approach should be context specific. Rather than developing a rigid framework or methodology for the More-than-Data walks, this flexible approach can both offer guidance and signposting for those less engaged with concepts such as big and open data yet leave enough flexibility to ensure the approach is suitable. Findings from Chapter 4 and the literature relating to hackathons suggested that an alternative format that tackled some of the key issues of this data-driven practice should be designed. These issues inhibit many of the opportunities of these events, such as the bringing together of enthusiastic people, who in turn have a shared sense of purpose, as well as the potential to share and develop skills and experience. A further key issue with practices such as the hackathon, is that they are embedded within a particular culture, where it is usual for young people to spend intensive periods of time coding, and following the same, or similar, organising principles, means that less consideration is given to exploring alternative organisational options, that might encourage greater engagement, wider participant, and diversity, both in people who attend, outcomes and locations in which they are held.

Through gaining an understanding of how people living in more rural locations and facing specific challenges in Chapter 5, where a mix of technologies which are data-driven, and situated understandings derived from time spent in the environment, I reflected that it was indeed possible to weave together More-than-Data. One of the key purposes of the design principles is to encourage those designing More-than-Data walks, or alternative practices, to explore different modes of understanding a place, and a range of formats, rather than jumping straight into the data, as is often seen at hackathons. The research carried out in Chapters 6 and 7, through engaging in the practice of walking highlighted the benefits of bringing together More-than-Data, but also highlighted challenges which can and should be explored through the design principles. Bringing a group of people with a wide range of skills is necessary, rather than relying upon those with technical expertise. Whilst it was beyond the remit of this research to explore how bringing groups together can be done successfully, I found that finding people who have a shared interest or issue, such as flooding, was key. I began with an idea that flooding would be a good theme to explore, and this influenced my decisions and research design. However, had I not been able to gather groups of interested people, this theme could have been revised. The challenge resided in being able to access and find specific people, some of whom I encountered serendipitously, which is often the case, in research and in life. The design principles aim to encourage this serendipitous element to More-than-Data by remaining open and contingent, enabling people to develop walks in ways that fit their own location and those who inhabit it (both humans and more-than-humans).

In the design principles tools are developed specifically for the walk context, rather than leading the process. This is the same with the data, which is considered alongside information, knowledge, wisdom and lived experience, rather than as the whole solution. In the data-driven society emphasis is often placed on the development of technical tools for gathering, storing and analysis of data, which are then re-used through tools which limit the potential engagement with the data. The consideration of tools that are designed and developed in the specific context means that they might be digital or lo-fi and analogue. By using predominantly analogue tools in the walks carried out for this research it was apparent that lo-fi tools enable engagement by participants and offer the opportunity to prototype different types of design. Whilst digital tools were useful in the walks for recording locations, participants preferred to use the analogue map pouches to gather items as they went. By suggesting options, but not encouraging the immediate jump towards digital, and therefore going down the route towards technological solutionism, the design principles offer the opportunity to step back and see the development of tools as a component in the process, rather than the key aim.

The influence of permaculture principles in this research is shown in the design principles through the encouragement of those designing MtD walks to take time and not rush through the process of gathering and re-using data. One of the key principles of permaculture is taking

time to observe the place in which the intervention is planned, often over the course of a year so that it is possible to see the effects of every season. This is a counterpoint approach to that which is embedded in the paradigm of the data-driven society, where innovation is vital and the development of new products and services at speed is also embedded in practices such as the hackathon.

Whilst the design principles have not been tested, but instead form the final phase of this research, future work, as explored in the following chapter, would involve taking the principles and testing them with a range of people in separate locations. Through bringing together and synthesising a range of empirical evidence gathered from literature, interviews and carrying out walks, the design principles presented here offer but one format and set of heuristics. However, the research presented also highlights ways in which the current data-driven society might be brought back into balance with engaging and situated practices. The research did not set out to negate the use of data, but to explore how we might use our own senses and interrogate the places we inhabit.

The following chapter presents the conclusion of this research and the key contributions it makes, as well as potential for future work.

9 Conclusions and future work

The data-driven society poses questions as to how we understand the places we inhabit, through the promotion and prioritisation of quantitative data over insights that are often unique, nuanced, and complex. This research has explored how we might bring these differing modes of understandings, through the development of More-than-Data and the embedding of this approach into the practice of walking.

Whilst the vast amounts of quantitative data gathered from not only the places we inhabit, but also from ourselves as we move through places offer valuable insights into certain aspects of those places, it is important that we maintain engagement with place that are manifest in different practices and activities. The data-driven society often excludes people, whether through infrastructural, geographical, or social reasons, even where they have valuable insights and lived experience to contribute. This research offers a more balanced, nuanced approach to the predominantly data-driven society, through the development of More-than-Data and a set of Design Principles that can be used as a heuristic device to gather and re-use a range of types of data, information, knowledge and lived experience.

The research questions that emerged during the research process aimed to develop a response to the data-driven society and to explore and develop a practice through which place can be explored.

The following sections highlight how the research questions have been addressed, highlight limitations of the research, and set out a pathway for future research.

This research sought to answer the following research questions:

RQ1: How might data, information, knowledge, wisdom and lived experience be woven together in order to develop situated, engaging, and balanced understandings of the places we inhabit in our data-driven society?

RQ1.1: What do data-driven understandings of place look like in literature and practice?

RQ1.2: What do information, knowledge, wisdom, and lived-experience driven understandings of place look like in literature and practice?

RQ2: How might more-than-data be embedded into a new practice that uses walking?

RQ2.1: How might walks be designed to encourage a more-than-data approach to understanding place?

RQ2.2: How do the walks contribute to the more-than-data design process?

What might design principles for More-than-Data walks look like?

9.1 Findings

Through the theoretical underpinning of phenomenology and post-phenomenology, this research interrogated diverse ways through which place is understood. The hackathon as a site of data practice was explored in terms of the motivations of participants and the ways in which the infrastructure of these events limits the potential benefits. In particular, the interviews and literature pointed towards a tendency to engage with and encourage only with narrow groups of participants who are often young and educated. This, in turn, mirrors the data-driven society, which, contrary to the claims made for the potential of big and open data for empowerment, excludes those who do not have access to the data, whether through infrastructural, geographical, or social reasons. The highlighting of these inequalities is fundamental to this research, as influenced by post-phenomenology and, as such also feeds into the rise of Critical Data Studies. Whilst these theoretical explorations of data are of importance in bringing to the fore issues arising from the data-driven society, it has been highlighted that there are few tools that enable the methodological and rigorous engagement with them. One approach that has emerged in this field is the data walk, which, although lacks a universal definition or set of guidelines or principles, seeks to open, and interrogate the relationships between data, people, and place. The engagement with a place through sustained experience, whether through working or living in a location was explored in Chapter 5. The interview findings demonstrated the importance of weaving in information, knowledge, wisdom and lived experience, particularly where complex issues such as flooding are experienced. Literature relating to hackathons highlights the problematic nature of using a narrow range of data with the intention to solve complex issues and this was born out in the interviews carried out at the event. The two contrasting approaches discovered in Chapters 4 and 5, and the insights developed therein offer potential ways forward which tackle issues uncovered in both sets of interviews.

9.1.1 Weaving together data, information, knowledge, wisdom and lived experience to understand place in the data-driven society

This overarching research question emerged from literature relating to the data-driven society, which prioritises quantitative approaches to understanding place. These understandings include the gathering and re-packaging of sensed data and location-based data collected from our mobile devices and connected sensors that form part of the constellation of IoT devices. In contrast to these data-driven understandings of place, systems that involve the gathering and handing-down of information, knowledge, wisdom and lived experience were explored. From the literature, two sets of interviews were designed and carried out that sought to augment the findings presented in Chapter 2.

The synthesis of the literature and interviews highlighted the potential for weaving together data, information, knowledge, wisdom and lived experience. This was evidenced through the ways in which data can be of significant use in contributing to understandings of place, but it needs to be considered as supplementary rather than the primary material. The research has also explored how heterogeneous ways of knowing, that have been seen as existing and acting withing two opposing epistemological paradigms of positivism and neo-positivism (data-driven and situated) might be understood and synthesised. The non-data driven modes of knowing that are embedded in "local" knowledge systems, that have been considered as less important and valid than those situated in data-driven understandings have been foregrounded in this work. Whilst tensions still exist, particularly in the technical elements of bringing together MtD, as well as in competing values and tensions within communities and locations, the research has opened up a space in which to engage with and further develop discourse around Critical Data Studies and the implications of the data-driven society.

Issues of the hackathon as a key site of data practice were uncovered, including lack of diversity of participants, focus on speed and convenience, and lack of design frameworks. However, benefits were also highlighted, including the well-meaning nature and skilful approach of participants, which could be harnessed to ensure a more balanced, useful, and meaningful practice. The insights developed through the hackathon interviews gave rise to the consideration of what a more engaging practice might look like, based upon the Pathways Forward that emerged from this chapter. This is important to consider as we gather ever more data and we are required to analyse, visualise, and re-use these data. Understanding how practices such as the hackathon might become of greater use, rather than tending towards following previous formats is vital in the wider discourse and research surrounding the data-driven society and within Critical Data Studies. The potential for weaving together DIKW was further explored in Chapter 5, and it was in this chapter that the concept of More-than-Data emerged. Through carrying out the interviews in Yorkshire, I gained valuable insights into how people engage with place. All the interviewees have spent time in the location and have spent time observing and gaining first hand lived experience, particularly relating to flooding. Insights from the walk and talk interview I carried out with the farm owner, and the flood charity workers made evident the potential for bringing two differing types of understanding together. Their use of both data, whether through the collection of it themselves when recording rainfall or using weather forecasting or flood prediction applications, alongside observations and experience of the weather, combine to offer a more balanced use of data and non-data driven understandings.

These insights, when woven together into More-than-Data provided the basis, or the framework, for embedding within a practice. As I pointed out in Chapter 3, the research does not seek to offer generalisable findings or applications, but rather offers one example, based

upon empirical research. More-than-Data can act as a starting point for deeper discussions and the development of other practices. A key finding of the research is that by bringing together a range of people around a point of interest or issue, and then exploring an array of data, information, knowledge, wisdom and lived experience can offer insights into how pluralistic understandings of place can come together to form a rich picture. Whilst technical challenges remain, the concepts brought to the fore address key challenges posed by Critical Data Studies, namely the revealing of how we gather data from place and what we might do with it in order to develop ethical and accessible tools.

9.1.2 Embedding More-than-Data into a new practice of walking

The insights that emerged from the literature and interviews, presented in Chapters 2, 4 and 5 were synthesised through the Pathways Forward. This approach shows the development of key themes that were folded into the walks, and then into the Design Principles, as presented in Chapter 9.

This part of the research took as its starting point the data walk, which has emerged in recent years as a practice that seeks to engage in the interrogation of data as it relates to and resides in place (Masson et al.2020; Powell, 2019; van Es and de Lange, 2020). However, this research goes beyond current practices of data walking to encompass More-than-Data and to explore a wider range of locations than data walking has. Whilst incorporating the exploration and interrogation of data, the approach developed in this research also brings together information, knowledge, wisdom and lived experience, all of which can be gathered and re-used through the process of walking. The walks carried out in this research demonstrated the rich potential of utilising this mode of understanding place to engage a wider range of participants than are currently engaging in aspects of the data-driven society.

The MtD walks presented here also expanded the practice of data walking by taking place in both urban and rural locations. This expands upon existing data walking locations which tend to be predominantly urban. The location of data walks in urban environments continues the discourse of the data-driven society, and smart cities, which often exclude peri-urban, rural, and remote locations. This focus upon the urban has led to a gap (Dix, 2014; Walker et al.2020), which has excluded those who inhabit places other than urban from the data-driven discourses. They are unable to either contribute data or make use of data that have been gathered from that location. Issues such as lack of mobile phone signal, reliable broadband, or coverage on digital maps (as were designed by participants at the event in Chapter 4 and are often features of hacks), and issues specific to these locations are excluded from data discourses. By carrying out walks in a range of locations, the gap identified by Walker et al. (2020) and Dix (2014) was explored and should become part of the wider Critical Data Studies discourse.

A question raised at the end of Chapter 4, was “what would an alternative practice to the hackathon look like”, and data walking, and more specifically, More-than-Data walks offer one feasible alternative approach. If placed within a range of practices and events, as highlighted in Chapter 8, walking can become a valuable component of and vehicle for the gathering of More-than-Data that can then be utilised in designing with and for data (and More-than-Data).

9.1.3 Design Principles

The principles are intended to be a heuristic guide to developing More-than-Data practices in place, rather than offering a rigid, one-size-fits-all framework. By developing More-than-Data, an example of a practice in which this can be embedded (walks) and the set of design principles, this research has presented a way in which data, information, knowledge, wisdom and lived experience can be woven together to offer situated, engaged, and balanced understandings of the places we inhabit in our data-driven society. This is however but one approach and one practice, but the design principles could be deployed in a range of alternative practices (9.6.1).

9.2 Critical Reflection

9.2.1 Political aspects of the research

The interviews and walks helped to expose certain political aspects of data and how they are gathered and re-used, and these depend often upon the personal or institutional values of those gathering and re-using it. Situated and traditional modes of understanding place have been dis-privileged through the focus upon those understandings which are automatic and computational data-driven. Whilst this research has explored how this might be addressed through engaging with place through walking, wider issues around indigenous knowledge and TEK still remain. This research did not address the broader, more global modes of understanding place, but was very much focussed on the UK. Therefore, it did not gain deeper understandings of TEK that are practiced elsewhere. There are issues pertaining to colonialism of TEK, which has been used in recent years to highlight the ways in which we might engage more deeply with the changing climate, but Western science has tended to extract that knowledge which fits into the paradigm of science. It therefore ignores and dis-privileges ways of knowing that are orally communicated, or that are rooted deeply in the land over centuries.

What the research did draw out was the political nature of space, how it is managed, and data gathered about it. Chapter 5 highlighted this through interviewing people who had experienced repeated flooding in that area. One interviewee in particular drew attention to the contested nature of land ownership, that the issues of flooding were seen to be caused by the land

management practices of private landowners. This in turn, highlights challenges in obtaining data, which might add to a richer and more complete picture of a location. This area requires further work, in collaboration with specialists in open data. It also demonstrates the need to bring together a wider range of people than I did through this research. It would have been useful to interview and include on walks farmers from the area and private landowners, to understand how they gather understandings about that place. This might have been challenging, particularly due to the personal politics of those I interviewed, and at the time I did not feel equipped as a researcher to tackle this challenge. Furthermore, the use of snowball sampling meant that participants suggested contacts they knew and shared their own political values and similar understandings of place. For future research however, and as a result of my skills development since then, there are ways in which this area could be developed, and more people involved to create a richer, and politically more diverse range of understandings.

9.2.2 Reflections on Big Data and the data-driven society

Through carrying out this research and exploring place and data through walking, I have reflected upon my own views of big data and the data-driven society. In the preliminary stages my research explored smart cities and the ways in which data was being used from place to aid understandings of place. What drove my motivation for this work and has been developed further through carrying out this research, were the ways in which the rhetoric around big data was being amplified, particularly through the smart city. One of the key messages was that the more data that are collected the better, even though the intended use of such data was often not considered at the beginning. Furthermore, through reading about the rise of Big Data it became clear that claims for its potential in solving complex problems were perhaps often over-stated.

One of the key issues I had with big data was the emphasis on digital and automatically collected data as the only way we can understand the world. Whilst data had been collected for centuries and had been used to assert power (as explored in Chapter 2), the growing use of computational data gathered through sensors has grown at a rapid rate. The environmental impact of gathering vast amounts of data is also a key concern that was raised during this research and could be the focus of a PhD thesis in itself. Vast amounts of data, whether through sensors, social media posts or communications, mean ever more storage is required and this requires energy. The development of under-sea data centres, where the water can cool the vaults struck me as a concerning development. Furthermore, what would we ever use this data for?

The ways in which engaging with place through lived experience, experientially has become second place to the data-driven and that everything must be recorded. One of the most interesting reflections of this research has been the letting go of recording everything, that our

experiences in a place can only be recorded to a certain extent, and that it is important to remember that there are ephemeral experiences that enrich us and build knowledge but cannot be recorded (Chapters 6 and 7). A final reflection upon big data, and the data-driven society is the presumption that everything must begin with a digital solution first, rather than exploring other, perhaps more creative analogue or hybrid options. That digital data can only tell us so much about our world and that we must not ignore those other ways of understanding that have been with us for centuries.

9.2.3 Influence of my previous career on this research

The PhD journey, from the MRes to completion of the thesis has been an intense and very varied learning experience. When I began the PhD, I had spent a year diving deeply into computing and design, having had little previous experience of these two areas. Whilst my previous career as a curator and having completed an MA enabled me to synthesise different knowledge, it was still a challenge to understand and then carry out original research in computing and design. As discussed in Chapters 1 and 3 (1.6.1., 3.1.1), my previous career and research influenced both the research subjects and my own research practice. This research was certainly influenced by my values, of bringing together diverse types of knowledge, and to giving different modes of understanding a clear voice. My previous creative practice was also an important influence upon this research, as art practice and theory both informed the way in which I carried out my research (e.g., influences of the situationists, critical cartography and environmental art). I feel this approach enabled the cross-disciplinary nature of this work, and I was not stifled or challenged in taking this approach. However, this was also due to the values of the Directors of the Highwire CDT and my own PhD supervisors. This approach has been fundamental in my development as a researcher, as I still carry out cross-disciplinary research and feel this is a rich area for me to develop.

The PhD journey enabled me to develop a range of research skills, from carrying out interviews to organising research events. I had developed skills required for engaging with research participant and developing events in my previous career, through designing and implementing events and exhibitions. However, designing research activities and events is different in some respects, in that the act of carrying out research, gathering data, analysing it, and writing it up differ to my previous experience. I applied for and was successful in receiving small pots of funding for the Tiree and Mill Race walks, which enabled me to develop skills in designing and communicating a research project. This has been of significant use in developing my own research career.

During my PhD journey I took on short-term roles as a research assistant, and then research associate, and was then successful in securing a role as Senior Research Associate. The research I carried out during my PhD worked in tandem to this, with my skills developing

through designing and carrying out interviews and walks, and then through carrying out research for my paid roles. Through this work I learned a huge amount about the both the logistical challenges of carrying out interviews, to the care that needs to be taken in working with research participants. I also learned much about the time it takes to analyse data, and the intellectual challenges required to synthesise and write up research data. Working across disciplines, which I feel is one of my key skills has enabled me to develop as a rounded researcher.

Whilst working across disciplines has been one of the great opportunities of this research, I also feel it ties into the research limitations. As I spent a significant amount of time becoming familiar with not only literature from differing fields, but the key philosophical approaches they take, this meant I perhaps had less time to carry out the field work for the walks. The process of designing and carrying out the walks was very time consuming, and often challenging. As I had no previous design experience, designing the artefacts for the walks, including the promotional materials, tools, and supplementary materials (e.g., maps) took time and were perhaps not quite as finished as they may have been. However, I learned a significant amount about the design requirements and also took guidance and advice from my peers and colleagues. This has helped me to understand design processes, which I now use frequently in my research practice. The design of the walks and associated materials have also influenced the ways in which I organise and carry out workshops for my current design practice.

I have recently developed the walking tools in collaboration with a designer for a funded project (see section 9.7.2 (below) that used walking to explore design fiction and policy making in public places. The experience and insights developed through the PhD research, from logistical challenges to the design of tools were fed into the walks (both in-person and virtual). Furthermore, this practice is becoming embedded in my research that explores design for policy, in that I am interested in exploring how methods such as walking might be used in both data gathering for policy and the policy making process itself.

9.2.4 Development of the methodology through the research journey

As Crotty (2014, p.1) states, the array of research methodologies can appear bewildering to the fledgling research student. In Chapter 3 I highlighted the cross-disciplinary nature of the Highwire Programme and the challenges associated with aligning oneself with a research paradigm when working in this manner. Throughout my research journey I have been largely aligned with critical perspectives on technologies and wider research philosophies. However, this alignment has developed over time, from my first engagement with phenomenology during my MRes year, in reference to understanding place, through to developing a more fitting alignment with post-phenomenology.

The earlier framing of my research has therefore developed throughout this research journey, which I have tried to capture in the description of the methodology and throughout my processes. As I became more exposed to different methodologies, I began to align myself more with approaches that enabled me to explore a range of methods that were appropriate to the research itself. In Chapter 3 I present the discussion regarding action research and research through design. This exploration reflects the challenges I encountered throughout the research, where I did not quite feel my research approach and practice completely aligned. This tension still exists in my research now. However, the methods I use (for example, I am currently carrying out research using action research) are all underpinned by a desire to understand how and why people do what they do, and where design might intervene within that. At the beginning of my research journey, I struggled to see where I fit between management, design, and computing. Whilst it was clear there was no need to define oneself in any one of these areas, I now consider myself to be a "design researcher." Through aligning myself in this manner, I am still able to utilise different research approaches, most often research through design, and I am able to explore computing and other disciplines through the lens of design. This development and the synthesis of my previous research journey and methods has been a fundamental component and result of my PhD research.

9.2.5 Critical reflection of the research process

The processes of carrying out this research were often "messy," with entanglements between places, people, and artefacts, combined with the challenges of analysing and synthesizing the different forms of research data. Whilst the plans for the research, as outlined in Chapter 3, followed broad cycles of research, design and activity, the processes were entwined with different influences emerging and being embedded into the design of the walks and the analysis of the data created. To make sense of the process I often made charts on a wall, which helped me to see what types of data I had collected and how these were related. However, it was important to me to try and make sense of these multiple sets of data to enable me to author this thesis and communicate the research with readers. Whilst my process was often "messy" and I was submerged in making sense of the data, it was an important part of the process to design and refine diagrams that represented that data. This process has been influenced by my previous experience of fine art and curatorial practice. As a curator one of my key roles was to "make sense" of things, whether a solo exhibition, collection exhibition displayed thematically or chronologically, or of the narratives and histories of a building. The final product, the exhibition or display, or text was always polished, neat and "made sense." The work required to get to that finished product was not displayed, unlike the process of showing sketchbooks that I was used to during my fine art degree.

The process of designing and carrying out the research was complex and was often difficult to capture, particularly in a format that could be communicated to an academic audience. Gathering people and attempting to transport them to a location, trying to keep to a specific time and ensure people did not wander off during the works was a challenge and was often messy.

My analysis of the research data was often visual and took the form of large walls full of photographs, notes, and string to try and connect and synthesise the walks. I had a lot of data. The walks produced a lot of tangible objects, some of which were physically challenging to look after (e.g., the sheep 'poo,' seaweed, and Morecambe Mud). When reflecting of the process of gathering the objects from a place it was clear that they should not be removed from the place just for the purpose of research, or in the process of developing MtD walks.

Whilst I knew I would carry out walks relatively early in the research process, I was not sure where they would take place, who would attend. Once I had organised the walks and developed the tools, I was not sure how they would be used, or what people would collect. Whilst I could control the theme and the overall structure, the very flexibility of the tools I had designed meant there was potential for many objects to be gathered, many different types of text and responses to the walks by participants.

Through developing diagrams of the research process, in particular my methods and literature relationships I attempted to make sense of what was an inherently messy research journey. The nature of inter-disciplinary research and the use of different methods to gather different types of data made navigating this sense-making process more challenging to me. As I am not trained in design, I found the use of graphics to communicate the processes difficult. These figures that were produced for the final thesis using software such as InDesign were based on original sketches, a method I am more comfortable using. Offering rough sketches in a final thesis felt like a risk, and my curatorial instinct to tidy and make sense came through. Whilst writing up the research, I was aware that this is a thesis and needs to have relative clarity and I found that through the use of tables and diagrams I could present materials and also to help the reader quickly see a summary of key information at once. I was limited in presentation in more creative ways due to a lack of skills in this area. Whilst the presentation and neatness of diagrams might be considered ontologically similar to that of the data-driven society, which I critique in this work, conventions of academic work and presentation limited my visual approach in this instance. I did develop the diagrams through drawing, which went through various iterations, and were often illegible to a reader other than myself. Presenting these diagrams that were somewhat unfinished presented me with a discomfort, and so they were transposed into diagrams using InDesign. The aim of the diagrams in Chapters 1 and 2 are to enable the reader to gain an overview of the areas of study and to see the relationships between the areas of work I carried out. Reflecting upon this process it may be that my curatorial

instincts, to gather and then package and communicate ideas and processes in a formal, polished manner remains.

9.2.6 Use of Pathways Forward

The Pathways Forward (the development of these is described in Chapter 3.6) were a method of collating the diverse array of data gathered through the interviews (Chapters 4 and 5) and the walks (Chapters 6 and 7). I gathered the research data in divergent phases, with the literature informing the interviews, which then informed the walks, which in turn informed the Design Principles (Chapter 8). As explained in Chapter 3, I had a lot of data to analyse and develop insights from, which took the form of text, images, and physical artefacts. The process of analysis (as described in Chapter 3) helped me to sift through the data, and I began taking notes and annotating photographs. As I did so I began to highlight key principles, or "patterns" that emerged through the analysis. This began with the interview data analysis, where I began with "possible ways forward." This approach is similar to that of Alexander's Pattern Language (Alexander, 1977), which are repeating issues that are developed into solutions. As I analysed, I kept a running log of the different "possible ways forward" and these began to accumulate as I carried out the thematic analysis. As I began to analyse the walk data it seemed to make sense that I continue the process, as it enabled me to make sense of the different types of data and build a set of insights that accrued throughout the process. When sifting through the walk data and began writing the results, I played with the concept of "Pathways Forward," which both fit with the notion of walking and also seemed to be more positive than "possible ways forward."

The Pathways Forward were operationalised by becoming a framework through which I logged, firstly in draft form, using handwritten notes on a simple pro-forma, themes and ideas that emerged through the analysis of the research data. As they developed in each phase of the research, I then formalised them and tested them to see if they were valid.

One of the key points of using the Pathways Forward was to enable legibility and consistency, both to myself as a researcher making sense of the data and for readers of this thesis. By continuing with the same format and building the insights as the research progressed, I was able to consider different ways forward, but with a consistent format. One limitation in this approach, however, was that I was led by the previous Pathways Forward and in their early development did not get rid of any that had become redundant as I carried out the walks. I was also limited a little by the format. When attempting to visualise the development of the Pathways Forward, I logged visually which PF led to novel approaches, which enabled me to understand whether each PF remained valid.

This approach is one method researchers working with a range of data might work with that data and build insights throughout various stages of the research. It is a formulaic method of recording and developing research insights, which can then be built into recommendations, design principles or form the basis for visual designs. The development of this method could be developed as a tool for other researchers in future research, as I explicitly developed and used it in the context of my own work in this instance. I developed the method without particularly considering it to be a method that might be used by others, as it was fundamentally a sense-making tool that helped me keep the insights clear and consistent.

9.3 Advancement of academic discourse and practice

This this section presents how research advances cross-disciplinary academic discourse and practice.

This research is engaged with and contributes to the field of Critical Data Studies, particularly in calls for tools and methods to critique the role of data within society, as boyd and Crawford (2012) call for. By developing More-than-Data and a new practice, this research highlights how walking can engage with not only data in a place, but also interrogate the lack of data, where it comes from and how it might be brought into balance with other forms of knowing. The challenges to the emphasis and hubris of big data, as critiqued by Dalton and Thatcher (2014) is furthered in this research, by bringing attention to the ways in which data can be used in addition to other ways of knowing, rather than relying solely upon the technological solution. Dalton and Thatcher (2014) talk of the nature of big data which "recedes from our attention as it saturates and structures our everyday lives." By exploring how data has become the dominant mode of understanding place, this research expands upon this area of study and offers a method (More-than-Data) that recognises the potential benefits of big data whilst working with its limitations. The approach taken in this research has sought to critically challenge the hubris and rhetoric of big data, as highlighted by Critical Data Studies, but through reflecting upon other approaches, such as the Critical Theory of Technology, it offers pragmatic and more nuanced considerations of data.

The work has sought to address the challenges around critically understanding and engaging with the ways in which data are collected and re-used. For example, as Kitchin (2014) states, that quantitative approaches can be useful, "their limitation in understanding human life should be recognised and complimented with other approaches." This research suggests another approach, that of More-than-Data, which offers a complementary method of understanding place.

The de-valuing of social knowledge that is not achieved through the automated collection of data is discussed by Couldry (2017, p.237) and this is an area that is furthered and explored in this research. By exploring how we might use situated knowledge, this research has presented ways of understanding place that, through gathering More than Data and the practice of walking, can once again value the types of knowledge that have been marginalised by the rise of the data-driven society.

The practice of the hackathon is explored both in Chapter 2 (2.4.3) through literature and in Chapter 4 through empirical research. In Chapter 2 I present key literature that seeks to understand the practice of the hackathon and the artefacts they produce. The practice is presented as one method through which data can be re-used and can often have positive outcomes for those taking part. However, the literature highlighted that the breadth of participants and the areas they seek to work in are often limited (Porter et al. 2017). A further area identified by Porter et al. (2017) was that of developing a "flexible design process, producing user needs." This research has sought to expand upon the literature and practice of the hackathon through exploring how the positive aspects of the events might be broadened and applied in different contexts. The literature and empirical research presented here demonstrate the potential for data, whether big or open, to be considered and used with other ways of understanding place, through the development of More-than-Data. This research recognises the usefulness of data, whilst bringing it back into balance with situated knowledge, wisdom and lived experience and enabling wider engagement with people and place than currently occurs at hackathons.

The weaving together of walking and understandings of place in this research contributes to and furthers literature and practice relating to data walking and to contemporary understandings of place. The literature relating to data walking is nascent, but with interesting and valuable practices being formed by researchers such as Powell (2019) and research being carried out by van Es and de Lange (2020) and Masson (2020). This field of research highlights the potential of being in a place and engaging with different audiences to interrogate how data impacts our surroundings and our developing relationships with it. Whilst the literature and practices of data walking offer useful insights into how being in a place, there are no guides to enable people to develop their own walks to interrogate a range of different issues. The research presented here both builds upon the literature in this field, by exploring the use of walking in a wider sense, and to the development of tangible tools that can contribute to this field.

By developing the More-than-Data Walk principles and offering examples from my own walks, this research contributes to contemporary understandings of place, how it is mediated and how we might navigate our way through the rhetoric of the data-driven society. Building upon the work by Massey (2008), who sees place as forever being built and boundaries being

dissolved, this research looks to understand how we might engage with such concepts of place and make sense of them. Today, place is not bounded or static, and this is made more complex by the addition of data that are gathered from place and from us as we move through it. By gathering More-than-Data in place through the use of physical maps, this research builds upon how we might develop tools and methods that can make manifest the myriad modes of understanding present in place and offer a more subjective, anti-Cartesian approach to place. The real of big data takes the view from above and often presumes what are gathered to be objective, however, as the research presented here highlights, it is possible to present a rich array of More-than-Data that can contribute to understandings of place. Furthermore, this research offers insights into the political nature of place, by underpinning the literature with key concepts by De Certeau (1988) and Lefebvre (1991). Through this work, it is apparent that bringing together the political nature of big data, as is explored in Chapter 2.2, and the political nature of space in Chapter 2.6.2 is a contribution to literature relating to the data-driven society. As a cross-disciplinary piece of research, the contributions made here synthesise the key issues of data and place, which furthers the academic discourse across these realms. By offering insights into how data are political, and furthermore, how place is political, and then embedding these into the practice of More-than-Data, this research furthers this key area.

9.4 Challenges and limitations of the research

As discussed in Chapter 3, I was embedded within the research. My own experience of Storm Desmond in Lancaster during 2015, and the ways in which data and digital technologies enable and limit our understanding and mediation of place during these increasingly common extreme weather events led me to think about flooding and use that as a theme for walks 4 and 5. I did not remove myself from the research in order to develop an objective view of the research, but I acknowledged my own biases and experience in my own field notes and in reflections after interviews and the walks. My own experience of flooding enabled me to develop questions for the interviews carried out in Yorkshire, with those who also experience flooding in a more engaged way. Whilst our experiences differed and my own experience was not as serious, it gave me a deeper understanding of the types of issues faced in those circumstances. However, my experience also influenced who I spoke to when I visited the Calder valley and certainly influenced the types of questions, I asked them. This experience has made me more reflective of my own experience and biases as a research associate and is a process I carry out whenever designing research, which often involves carrying out interviews.

This research explored the process of designing and carrying out More-than-Data walks. As demonstrated in Chapters 6 and 7 there is potential for the process of MtD to extend beyond the activity of walking and in Chapter 8 principles for this are introduced. As highlighted

in7.2.1, which explores how MtD might be sent out into the world, post-walk sessions could be held. Walks 2, 3 and 4 did involve post-walk sessions, but these were not perhaps as extensive or organised as effectively as they may have been. Issues with timing of the walks limited what could be achieved in post-walk sessions and I did not engage with online activities, which would have enabled some testing and development of insights in this particular element of the walks. However, this is an activity that could be developed further in future research (see 9.6 below for a discussion of the potential in this area).

The interviews took place at one hackathon event. Whilst the purpose of the interviews was to develop insights into the motivations, opportunities, and challenges of such events, that was synthesised with literature in Chapter 2 (2.3.1), the ten interviews offered a limited range of insights. Attending one event was partly down to resources and time, in that going to more events was possible, but at that stage the resources I had were planned for the walks. The interviews carried out in Yorkshire were also limited, in that I visited three separate locations and spoke with a range of participants. Using the snowball technique for the interviews in Yorkshire was useful but led to a group of people who shared similar values being interviewed, as they either knew each other, or represented organisations that were important to other interview participants. The insights gained at the hackathon and in Yorkshire were particularly important in the development of the research questions emerging from that phase of the research and informed the development of More-than-Data. For future research, should this thesis be developed further, it would be useful to cast the net more widely, to interview people involved in a wider range of data practices, such as Human Dara Interaction (HDI), Critical Data Studies (CDS), data art and perhaps more hack events.

Carrying out the walks with a diverse range of participants was a great privilege and formed a fundamental part of not only my PhD research journey, but my journey into my research career. Walking with around 80 people in total, in different places and their enthusiasm to take part in the research cemented my decision to become a researcher. However, organising people, ensuring walks were interesting and even of use for participants, as I believe research should not be a process of extracting knowledge and experiences from participants, was challenging and often nerve-wracking. The first walk I carried out with participants took place on Tiree, which was the ideal setting for experimenting and gaining an understanding of the possible challenges. The key issue faced was one of time. I never seemed to allow adequate time for walking, carrying out tasks and then carrying out a session afterwards. This was in part due to participants enjoying themselves and becoming engrossed in the walks and with the place, but also down to the amount of time required to ensure the content of the walks was enough, and of interest.

Planning the walks, particularly walks 3 to 5 that involved participants, or involved travelling away from Lancaster, which is my home city, proved challenging logistically. I secured

funding to cover transportation, refreshments, and the development of materials for walks 4 and 5, which enabled me to invite more participants and develop the tools. However, the administration that came along with that was challenging. Ensuring the walks were carried out safely was challenging, carrying out risk assessments meant visiting each location several times prior to the walks taking place (on Tiree the risk assessment was carried out when I arrived, prior to the walk).

I would stress that, whilst carrying out this research over an extended period of time enabled me to fit the work in with paid research employment, balancing the development and carrying out of the walks whilst working full time as a researcher proved a challenge and ultimately impacted upon what I was able to carry out with the Mill Race project.

I had planned to develop materials for the Mill Race walk to enable people to guide themselves around the city. These were partially developed, but time constraints prevented me from implementing these.

The research data gathered from the walks, such as the images, fieldnotes and the tools used by participants was rich. I catalogued the images and artefacts after each walk, then photographed all the materials gathered on the walks. It would have been beneficial to talk more formally to participants after the walks, or to send them digital feedback requests or surveys. This would have enabled me to understand what the participants gained from the walks. I did engage with some participants after the walks and made notes during the conversations, and several participants emailed with reflections after the walks, which proved particularly useful. Building this reflection with participants into future research would be greatly beneficial and would add an additional layer of data that could enrich the findings presented in this research.

9.5 Contributions to Knowledge

This research contributes to and expands upon the theories and research being developed in the field of Critical Data Studies and to the emergent practice of data walking. In the research I have presented a critical exploration of theoretical and practical aspects of the data-driven society, specifically as these relate to understandings of places we inhabit. Furthermore, I have sought to synthesise predominantly data-driven understandings of place, with situated understandings. By developing the concept of More-than-Data and embedding it within walking, this research offers a cross-disciplinary and novel approach to how we might explore places in the data-driven society. The research also answers calls to expand tools for critically understanding data (Kitchin, 2014) and the development of methods for data walking (van Es and de Lange, 2020)

The two key contributions to knowledge presented in this research are

1. **The concept of More-than-Data -** an exploration of how MtD can be embedded into the practice of walking. More-than-Data is defined as "a heuristic guide that encourages and embeds the collection, conceptualisation, interrogation, storage and re-use of data, information, knowledge, wisdom and lived experience in, through and from place.
2. **A set of twelve Design Principles** that can be used by a wide range of people that embed More-than-Data in place.
3. **The "Pathways Forward" Method** that was used to collate and make sense of the emergent findings through the research.

The research offers contributions to both theory and practice. It builds upon Critical Data Studies taking the concepts and exploring how they might be embedded within a more mobile practice. The research also builds upon practices that engage with data, taking the issues and opportunities from hackathons and the nascent practice of data walking. By enacting interrogations of DIKW and lived experience in relation to place, the mobile practice of walking becomes a mode through which a wider understanding of people and place can be developed. The research offers a deeper exploration of walking as it relates to data and place than has currently been included in academic literature. This exploration not only involves the benefits and opportunities of using walking in this context, but also a critical appraisal that contains key challenges relating to practical and more conceptual issues.

The contributions can engage with the following areas of knowledge:

- Critical Data Studies and critical understandings of data; p
- Practices of data (e.g., those wanting to organise hackathons or other data-driven events);
- Human Computer Interaction (HCI)
- Human Data Interaction (HCI)
- Design Studies (with and for data)
- Research through Design
- Human and Cultural Geography (e.g., understandings and mediation of place in the data-driven society)
- Data-driven society and media/cultural studies
- Data-walking (theory and practice).
- Environmental practices e.g., permaculture
- Design and policy studies (e.g., through the use of creative methods to gather evidence and engage policy makers in place-based policy making)

9.5.1 Intended audiences for the research contributions

The intended audiences presented here are suggestions based upon the literature explored in this research, as well as the empirical research carried out. The list is not exhaustive, and the audiences could of course come together, as they did on the walks presented in this research, to explore More-than-Data and create valuable stores.

CONTRIBUTION 1: THE CONCEPT OF MORE-THAN-DATA

This contribution is a cross-disciplinary approach to understanding place that could be utilised by a range of individuals and groups from within and beyond academia.

Data scientists: Gathering heterogeneous data about a place and through seeing prompts in a location can add additional inspiration for data that had not been considered previously.

Software developers: To Encourage diverse and place-based designs that encompass a range of data and limitations e.g., data scarcity, lack of infrastructure for data gathering.

Community interest and activist groups, members of the public: Through capturing a wide array of MtD groups could add to community/place-based archives and existing oral history archives. Events for groups within communities can gather wide array of MtD. MtD gathered can be used as evidence e.g., in planning or by activists to present lived experience as well as data.

Artists: Using a rich array of MtD in a place to create locative media/artworks in and about a place. This could be gathered in a range of media.

Policy makers: MtD can help understand diverse ways of seeing & experiencing place that synthesises data-driven, lived experience and environmental. Develop a strong place-based evidence base. It could also help to engage with wider stakeholders (e.g., above with community interest, activist groups).

Researchers across multiple disciplines: MtD can form the basis of diverse, cross-disciplinary research proposals where researchers with different expertise can work across different forms of data, wisdom, traditional knowledge etc.

Designers: Using MtD as a design material that forms the basis of designs that are located within a place and for a place, to understand broad and/or specific elements of place.

Environmental practitioners (e.g., permaculture, farmers): Those who work closely in a place already often have a deep knowledge about that location. MtD might enable them to bring together complex understandings of their location, including for example environmental data, with longitudinal observations over time.

CONTRIBUTION 2: DESIGN PRINCIPLES

Hackathon organisers: The principles could assist those seeking to organise an event such as a hackathon to explore alternative approaches to the re-use of data. This approach, as explored throughout this research, can enable wider and more heterogeneous engagement with those who are not engaged in the use of data.

Data walk organisers: These could be within or beyond academia. One of the key benefits of this contribution is that it offers scaffolding to develop an approach and an event, which can be adapted according to the aims and objectives of the organisers.

Community groups, activists, members of the public: The design principles enable a range of people to develop a MtD walk. As a piece of future research, the development of a "how to" guide for MtD walks would be of use in assisting those who are interesting in putting the design principles into practice.

Artists: As MtD offers a scaffold for the development of creative approaches to place, the Design Principles can enable artists to develop walks and gather this through engaging methods that synthesise technological, data-driven and situated understandings of place.

Researchers across disciplines: As the research presented here highlights, data walking is being used to explore a range of emerging areas, including the use of technologies in cities, how data are collected and re-used, as well as creative explorations of data in place.

The Design Principles could also be of use to policy makers and non-governmental organisations in designing MtD walks to explore a particular location to highlight key policy areas and build an evidence base.

CONTRIBUTION 3: PATHWAYS FORWARD

This contribution is primarily of use to researchers, as it was developed through carrying out this research and offers a method to collate and make sense of research data from heterogeneous sources. Throughout this research the method has been used, and it has been written about in Chapter 3, but could be developed further in future work, with testing carried out by other researchers leading to a more rigorously designed method.

9.6 Future Work

The potential of this research to reach a range of audiences lies in its aims, which are to bring data about, from and through place, using More-than-Data practices.

9.6.1 Expanding the Design Principles for MtD walks beyond academic research and practice

A key piece of future work would be to design and carry out a series of activities as described and suggested in Chapter 8 (8.3) to test out a range of different More-than-Data practices and engage a wide range of participants. This would require resources but could form the basis of a cross-disciplinary research project both within and beyond academia. Due to constraints within this research a resource kit or site was not developed but would be of significant use and benefit in accompanying the Design Principles. Resources would include a visual guide to More-than-Data, containing key examples that are visualised, a website that would enable people to contribute their own MtD and examples of walks, as well as a guide to setting up a physical MtD store.

Expanding the project could include exploring how participants might work from afar and asynchronously, as suggested in the Design Principles. It would also be of great interest to send the Design Principles for More-than-Data walks out into the world and see how they are appropriated by diverse groups, which could be carried out organically or through a designed research and practice project.

9.6.2 Design for policy

My current research role explores how design methods are being used in the development of policy at local, regional, national, and global levels, across a diverse array of disciplines. The potential for using waking to understand diverse types of technology is currently being embedded into a research project in which I am involved, called Participatory Policies for IoT (at the Edge) Ethics (Jacobs, 2021). The project explores how we can co-design policies at a local level for IoT devices and edge computing in public spaces. A walk has already been held that engaged local policy makers in understanding MtD in the location and is exploring how this can be woven together.

A further project is currently in development with researchers in computing, that will take the design principles and test them in walks, with the theme of food security, local growing and how this might inform policy.

9.6.3 Exploring how More-than-Data can be sent out into the world

This research produced the concept of More-than-Data and embedded it within the practice of walking, in order to understand how different types of knowing in place might be brought into balance. Due to time and resource restrictions focus was placed upon the development and carrying out of five walks, in various locations, with a range of participants. A range of insights

were developed, which formed the basis of the design principles, which were not tested. It would be of interest to gather a range of participants to carry out the entire process involved in the design principles in order to understand how they are received and to develop them further. This could form the basis of a research bid, which seeks to engage audiences who are not currently engaged in data practices, to work with those who are.

I see the research presented here as the beginning of an exploration that weaves together my current work as a researcher within a design-led research centre, to develop and nurture the relationships I have cultivated through the walks and interviews I have carried out.

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APPENDIX 1: ETHICS FORMS

Participant information sheet - Walks

I am a PhD student at Lancaster University and I would like to invite you to take part in a research study called Datadrifts: A journey through people, place and data, that explores how we might collect environmental data (in particular about flooding) from the landscape and lived experience, and not just through digital technologies, sensors or gauges. The research also forms part of a wider research project at Lancaster University: Digital Technologies for Living with Environmental Change.

Please take time to read the following information carefully before you decide whether or not you wish to take part.

What is the study about?

This study aims to develop a new method to engage different communities in exploring data: how data are collected about and by them, what data means in different places and the potential usefulness of collection of novel forms of data such as drawings, memories, photographs and historical accounts.

Why have I been invited?

I have approached you because I am exploring how different communities collect and re-use different types of data. I am inviting people who live or work in areas that experience flooding, environmental and flood scientists, data scientists and software engineers, artists, people involved in natural flood management and designers.
I would be very grateful if you would agree to take part in this study.

What will I be asked to do if I take part?

If you decide to take part, this will involve the following:

- Taking part in a walk, to be held at ….. It will take place between …. with refreshments provided.
- We will walk around the location and use 'wearable maps' – (resembles a map holder with pouches to collect 'data'). The walk will take no longer than 90 minutes. There will the option of going on a walk led by a local resident, or a self led walk. For both walks maps will be provided. If weather warnings are issued the walk will be postponed. Please bring weather appropriate clothing and suitable shoes. Water will be provided for during the walk.
- Any materials you collect, or produce, such as drawings, notes or photographs will then be used in the session afterwards. If you would like to keep the maps and materials you make, this will be possible. I will take the materials away, catalogue them and return them to you by post.
- After the walk we will collectively present what we have collected and discuss how this is important, or not, from our own perspectives and record our findings onto a large map. This activity will take around 90 minutes.
- After the event I would like to contact you to find out about your experience of the event. This will take the form of an online questionnaire that will be sent out to you after the event. It will take no more than 15 minutes to complete.

Highwire PhD Research Project

Interview Consent Forms -Todmorden

Material gathered during this research will be treated as confidential and securely stored until completion of the PhD (further information can be found on the Participant Information Sheet). *Please answer each statement concerning the collection and use of the research data, then sign and date both copies of the form.*

Please initial box after each statement

1. I confirm that I have read the information sheet and fully understand what is expected of me within this study. ☐
2. I have been given the opportunity to ask questions about the study. ☐
3. I have had my questions answered satisfactorily. ☐
4. I understand that my participation is voluntary and that I am free to withdraw at any time without my legal rights being affected ☐
5. I understand that once my data have been anonymised and incorporated into themes, it might not be possible to for it to be withdrawn, though every attempt will be made to extract my data, up to the point of publication. ☐
6. I understand that the information from the interviews will be pooled with other participants' responses, anonymised and may be published. ☐
7. I consent to information and quotations from things I said during the interviews being used in conferences and published materials. as stipulated by the research council funding this PhD. ☐
8. I understand that the materials produced in the focus group will be subject to access criteria, as stipulated by the research council funding this PhD. ☐
9. I agree to the interviews being anonymised and archived and used by other bona fide researchers, respecting my anonymity as appropriate. ☐
10. I agree to photographs being taken during the event but that they will be of the process and not feature the faces of people. ☐

Revealing the Mill Race

Information Sheet

What is the study about?

Revealing the Mill Race is a small research project being carried out within Lancaster University's School of Computing and Communication, Imagination Lancaster and Highwire Centre for Doctoral Training. We are funded by Ensemble, a project that is exploring digital technologies and environmental change (EPSRC funded*). We are exploring how communities and businesses who experience flooding can contribute their knowledge, experiences and memories about these events in the city to the data collected by environmental and data scientists. The Mill Race is a stream that lies underneath the city and once fed the mill near Dye House Lane in the city centre. It started close to what is now Ladies Walk and can still be seen where it empties into the Lune, underneath Millennium Bridge. As the Mill Race is now covered over all we can use is imagination and historical maps to understand it, which is why we are trying to bring this old part of Lancaster to life through thinking about its future in the city.

Walkers will be given a kit that contains a map and instructions that will follow the course of the Mill Race and will take around 90 minutes on an accessible route. Walkers do not need to have knowledge about the Mill Race or flooding in Lancaster, we will provide as much information as we have. You are welcome to bring along smartphones, cameras, GPS units or any other gadgets you like – we would love you to share your data, images and experiences with us in any way you like. We will be providing maps, which you are free to draw on and some cards to give you some ideas as you walk. As this is a research project carried out at Lancaster University we will require walkers to read some information about the project and sign a consent form. These will be provided and explained before the walks begin.

The research forms part of the Ensemble research project at Lancaster University, which examines the role of technology in supporting a new kind of environmental science, that is a science that is open, integrated and collaborative, involving data scientists, computer scientists, experts in communication and also earth and environmental sciences. For more information, please see https://www.ensembleprojects.org/.

Why have I been invited? The aim of the project is to enable residents and other stakeholders in areas of Lancaster to share knowledge and experience with local decision makers and relevant research communities. We are inviting people who live and work in the areas of Lancaster affected by flooding to take part in this project.

Revealing the Mill Race

Consent Form

Name of Researchers: Louise Mullagh (l.mullagh@lancaster.ac.uk)

Please tick each box

I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these questions answered satisfactorily.	Yes □ No □
I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason. If I withdraw within four weeks of commencement of the study my data will be removed.	Yes □ No □
I understand that any information given by me may be used in future reports, academic articles, publications or presentations by the researcher but my personal information will not be included and I will not be identifiable.	Yes □ No □
I understand that my name/my organisation's name will not appear in any reports, articles or presentation without my consent.	Yes □ No □
I understand that the questionnaire I fill in after the event will not contain any personal information and once the data has been collected the digital version will be destroyed.	Yes □ No □
I understand that data will be kept according to University guidelines for a minimum of 10 years after the end of the study.	Yes □ No □
I agree to take part in the above study.	Yes □ No □

Name of Participant _____

Signature _____ Date _____

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

Name of Researcher / person taking the consent _____

Signature _____ Date _____

One copy of this form will be given to the participant and the original kept in the files of the researcher at Lancaster University.

APPENDIX 2: WALK IMAGES

1. Walk One, River Lune Lancaster

Figure 67: Ribbon map created on Walk 1

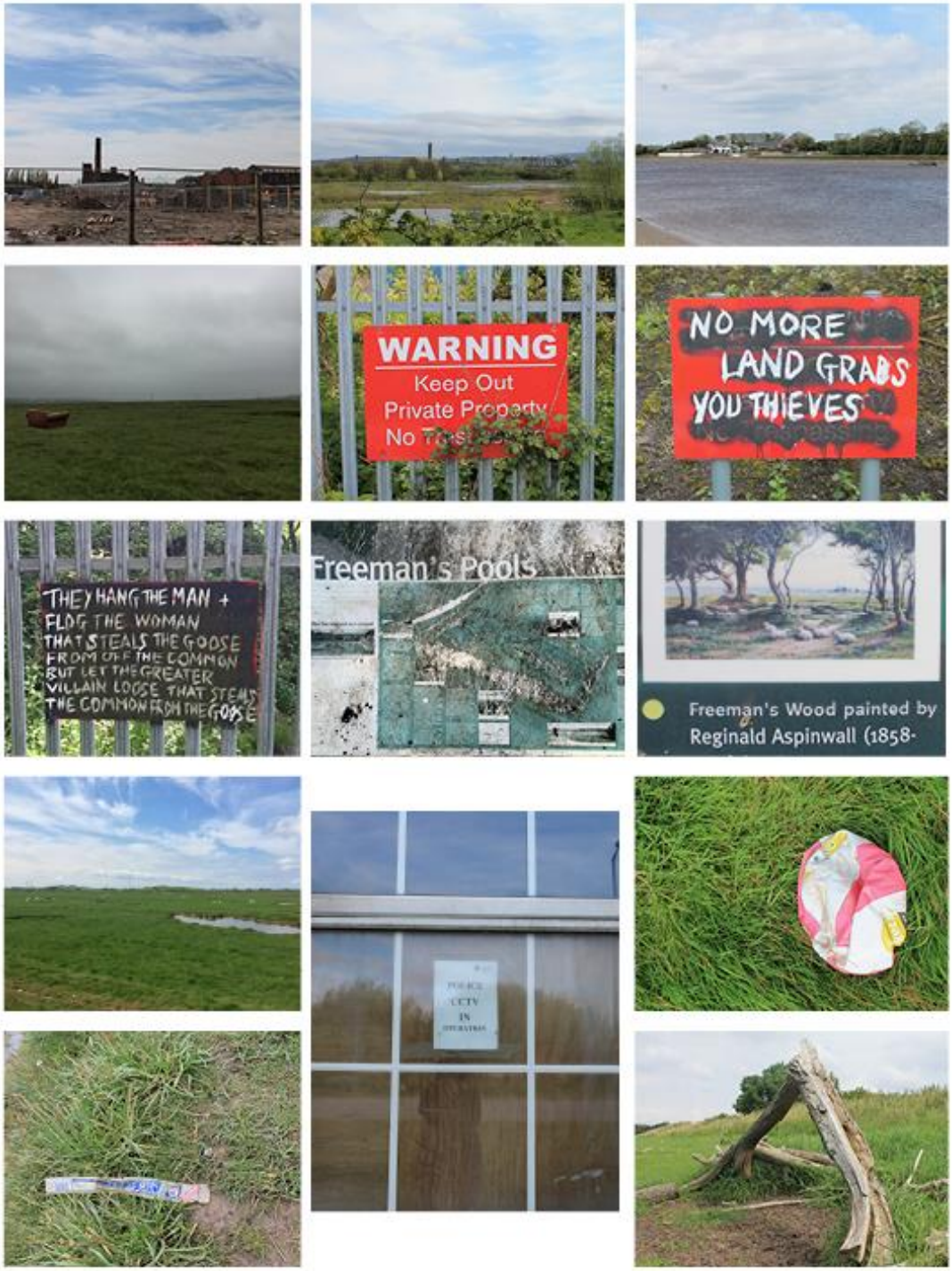


Figure 68: Selection of images from Walk 1 along River Lune

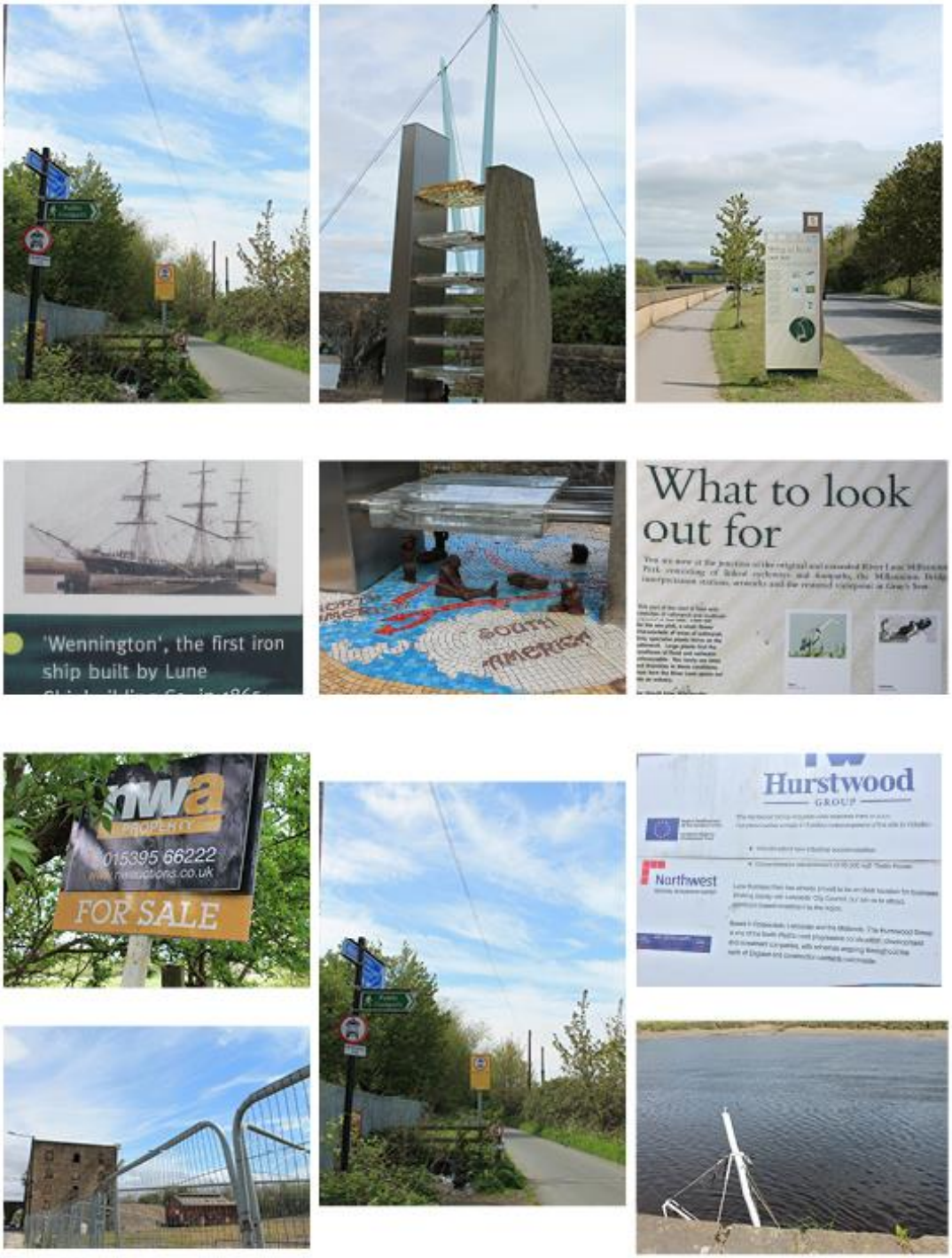


Figure 69: Selection of images from Walk 1 along River Lune (2)

2. Walk 2, Island of Tiree Scotland

Figure 70: Images from Walk 2 on Tiree

Figure 71: Images from Walk 2 on Tiree (2)

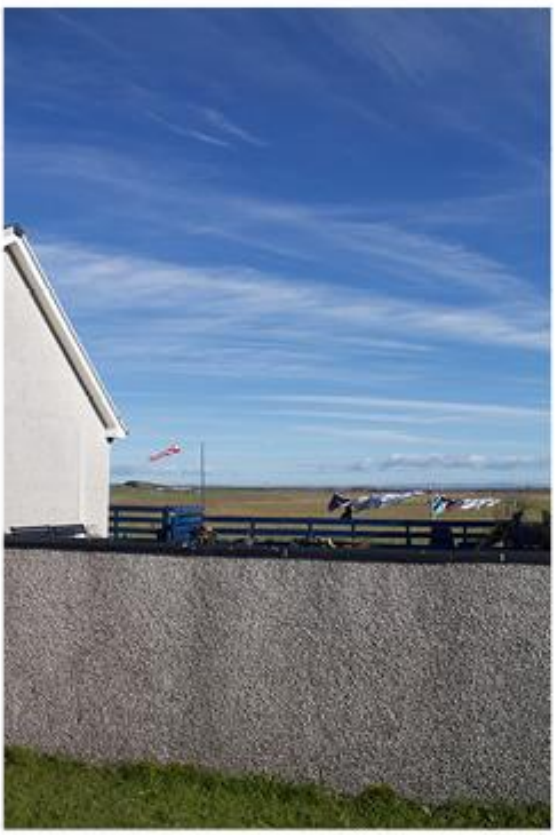
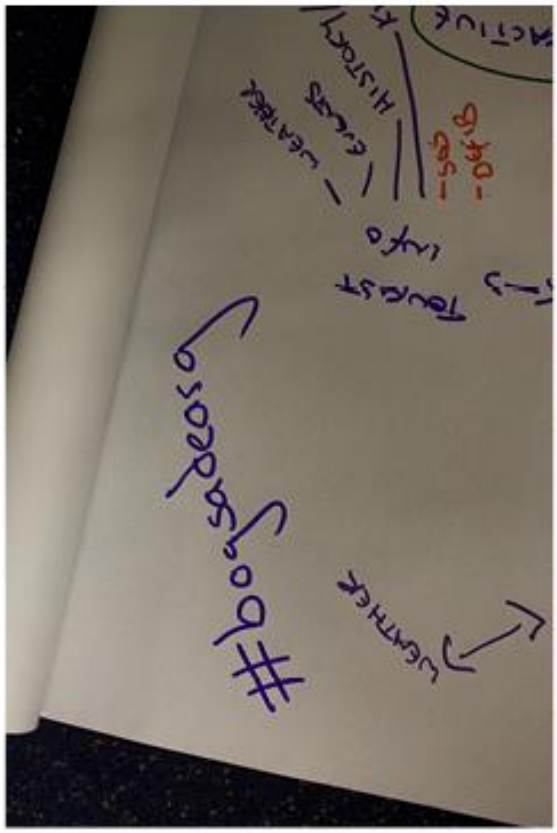


Figure 72: Images from Walk 2 on Tiree (3)



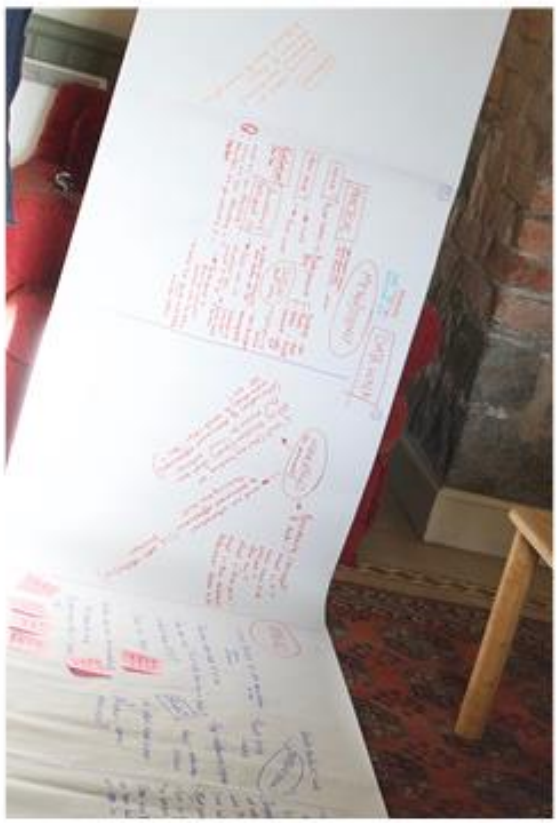
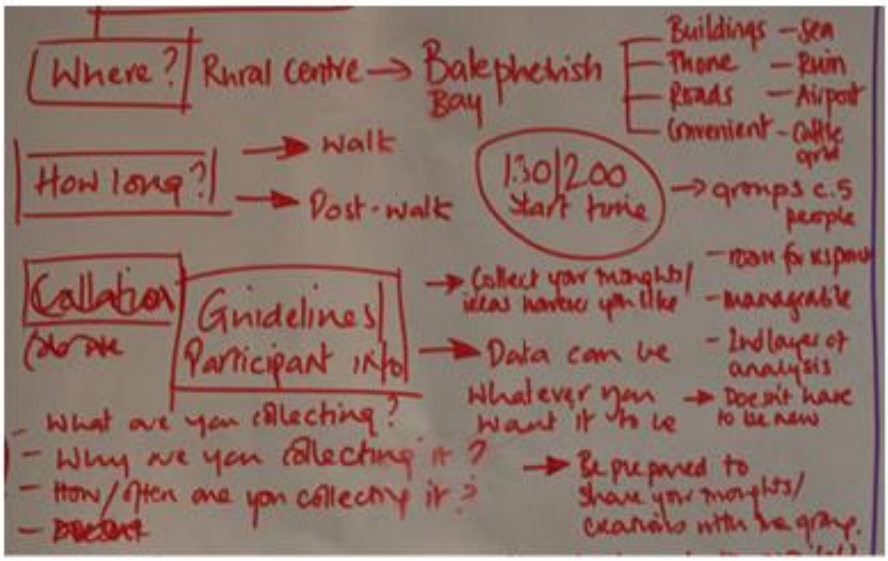
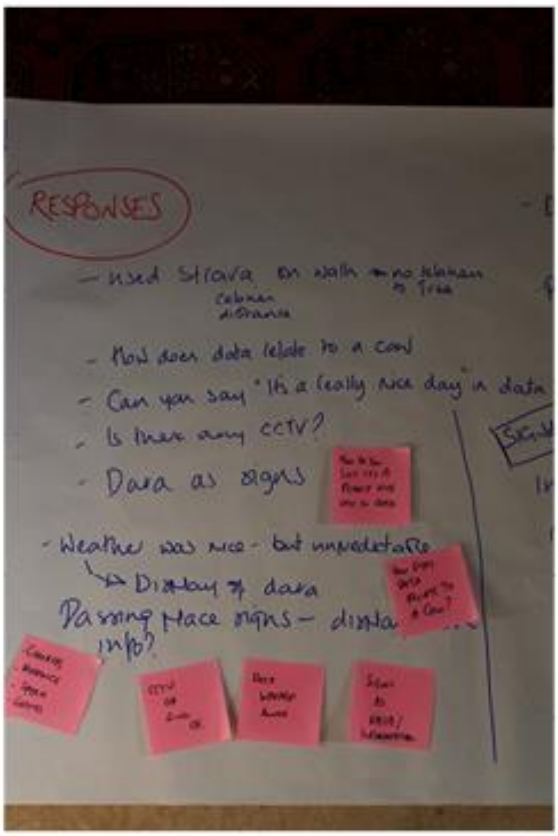
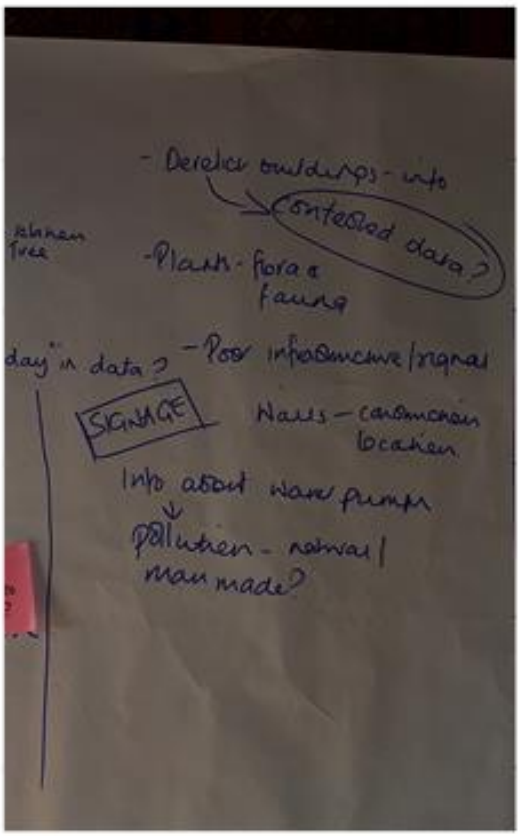


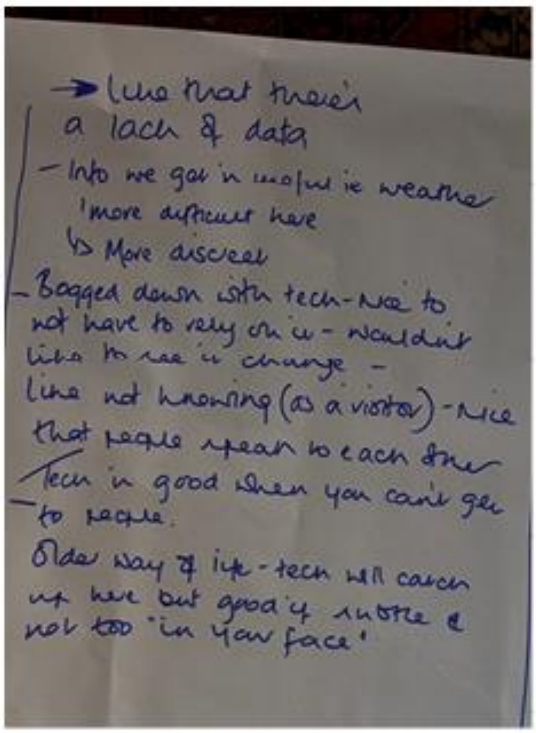
Figure 73: Post walk 2 on Tiree

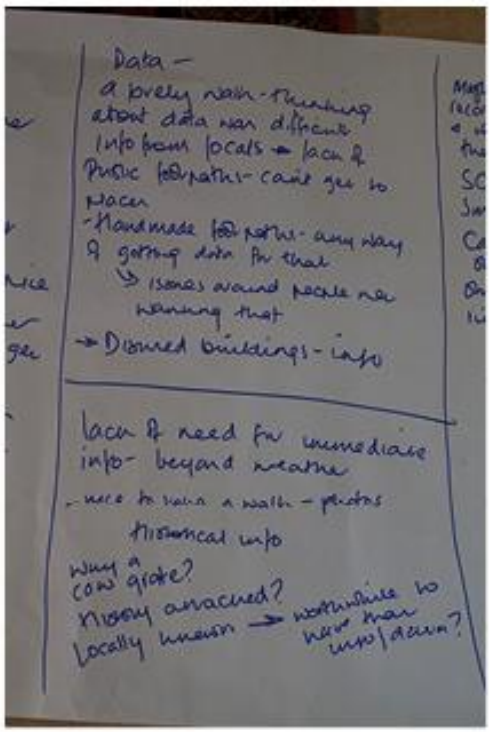
Figure 74: Notes taken from post Walk 2 session

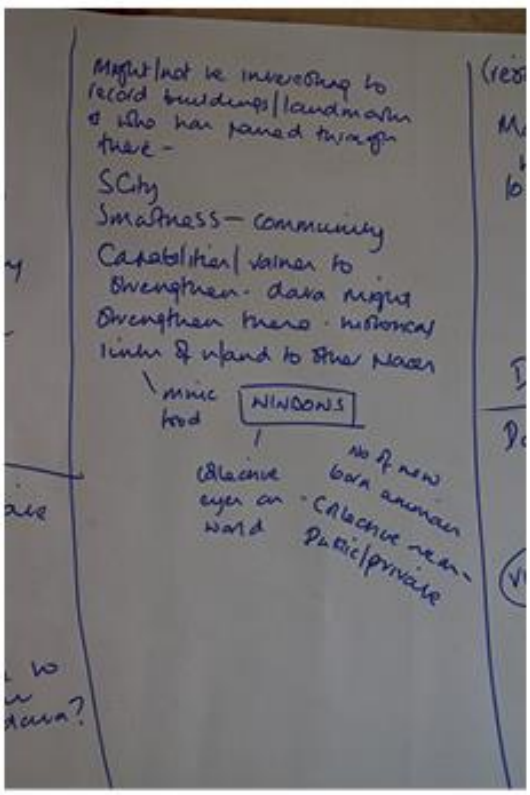












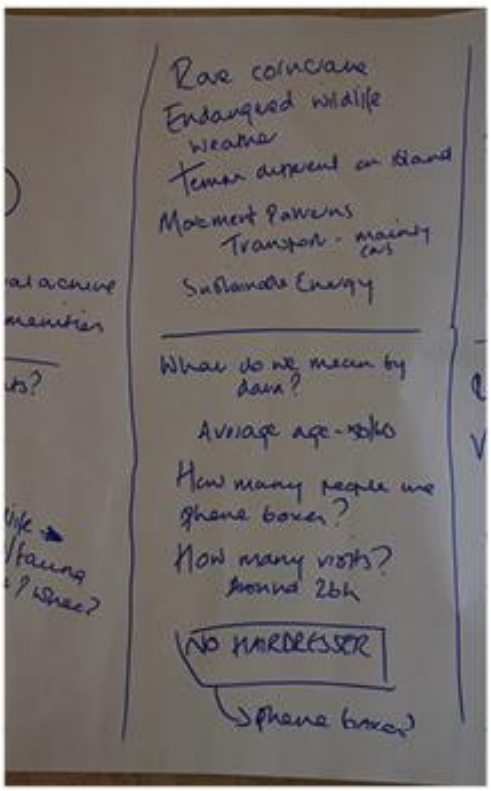


Figure 75: Notes taken on post Walk 2 session (2)

3. Walk 3, Sunderland Point Lancaster

Figure 76: Details of wearable map from Walk 3

Figure 77: Images from Walk 3

Figure 78: Detail of artefacts from Walk 3

Figure 79: Detail of display of walk 3 data (above after walk and below in research office)

4. Walk 4, Warland Farm Yorkshire

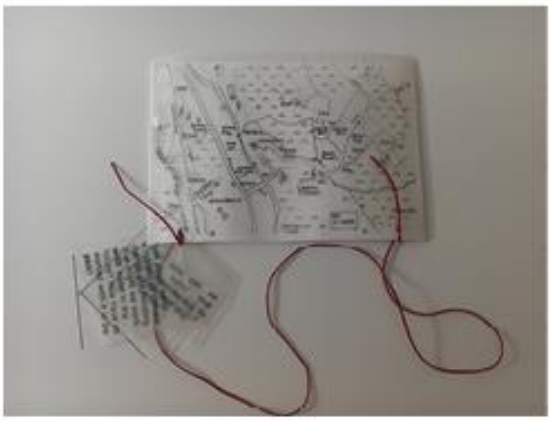


Figure 80: Detail of wearable map pouch on Walk 4

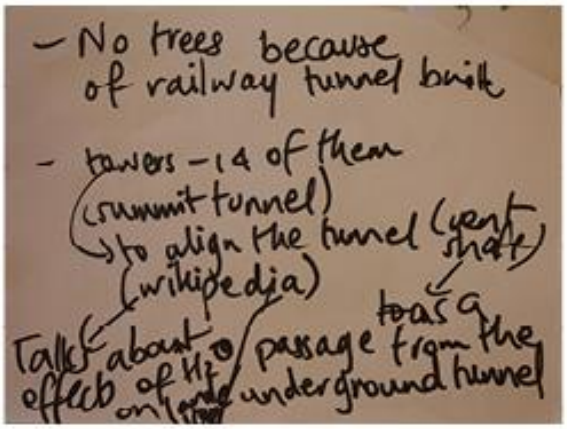





Figure 81: Images from Walk 4

Figure 82: Images from Walk 4 (2)

Figure 83: Details of artefacts from Walk 4



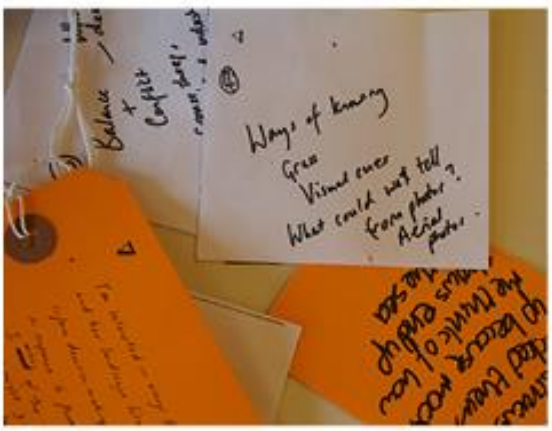


Figure 84: Detail of artefacts from Walk 4 (2)

5. Walk 5, Mill Race Lancaster

Revealing the Mill Race

The **Mill Race** is a stream that lies underneath the city and once fed the mill near Dye House Lane in the city centre. It started close to what is now Ladies Walk and can still be seen where it empties into the Lune, underneath Millenium Bridge.

As the **Mill Race** is now covered over all we can use is imagination and historical maps to understand it, which is why we are trying to bring this old part of Lancaster to life through thinking about its future in the city.

We are holding some walks to bring people into the city centre and think about and record memories, experiences and knowledge about the city and the floods we have experienced in recent years. We will also try to imagine what might be done to prevent flooding in the future.

The walks are being held on July 13th, 14th & 15th Guided walks - 1pm and 6pm each day
Self guided walks - 13th - 15th

For more information or to book please visit www.themillrace.org.uk

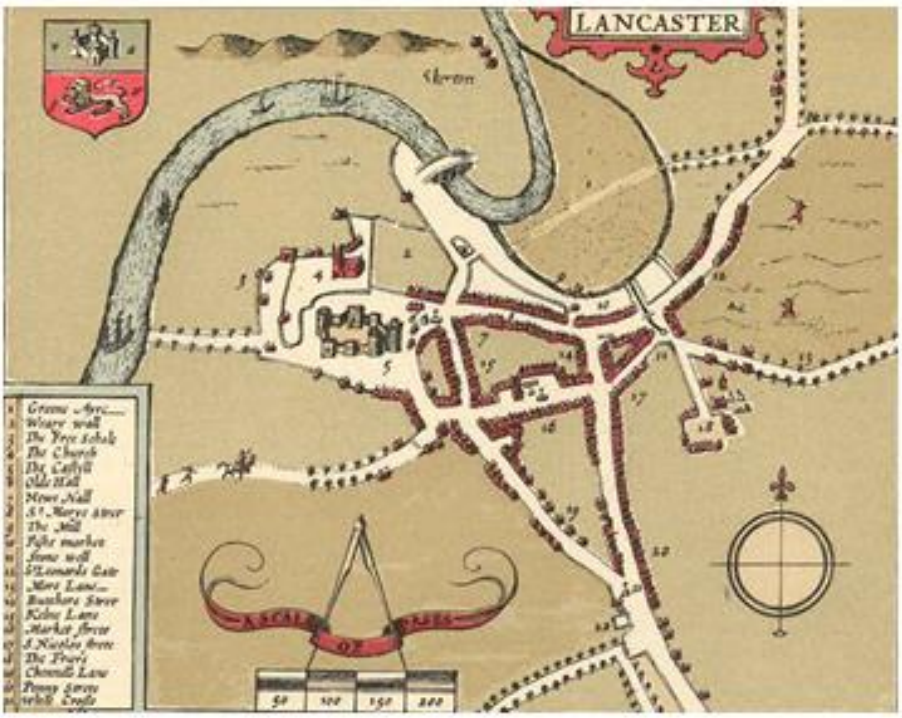


Figure 85: Poster advertising Walk 5

Figure 86: Images from Walk 5