Designing Community Driven Participatory Platforms

Reconfiguring Roles, Resources, Infrastructure, and Constraints for Community Commissioning

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Abstract

The advent of the internet and the rise of social computing provides new opportunities to explore the configuration of platforms to support collective participation and production of peer-owned resources. The commons-based peer-production model of Wikipedia is a prominent example of how the configuration of platforms can facilitate the collective efforts of individuals to perform tasks at scale, and for a common purpose. The role of citizens as consumers is beginning to transition into citizens as producers with the advent of these new models of collective participation. The introduction of citizens within these models of production can be seen in the process of requesting and accessing Open Government Data, facilitating engagement with academic research within Citizen Science, leveraging the collective computation of crowd workers, and providing global market places to capitalize on underutilized assets in the Sharing Economy.

However, the provisioning of infrastructure to support these technologies and the processes embedded within them continue to be provided as services *to* individuals rather than being provided *by* the communities who will utilize these resources. Therefore, this thesis extends beyond the individual and investigates how we can facilitate communities in expressing their own needs, identify supporting resources, and engage in the production of community owned resources. The contributions of this thesis are the introduction of the concept of community commissioning and the exploration of how the design and configuration of platforms can enable communities to take a leading role in technology commissioning. The approach undertaken to explore this area has been conducted through the design, development, documentation, and analysis of two large-scale social computing systems, *FeedFinder* and *App Movement*, that continue to be deployed and utilized by communities 'in-the-wild'. Case study 1 presents FeedFinder, a community driven information resource to support new mothers in sharing experiential data around breastfeeding friendly locations. Case study 2 presents the design and development of App Movement, a community commissioning platform to facilitate communities in proposing, designing, and deploying location-based review mobile applications to support the establishing of community driven information resources. This thesis draws upon these case studies to inform a novel framework that defines the practice of community commissioning and explores the implications of provisioning services to support new configurations of participation.

Publications

The research presented in this thesis has been published in the following peer-reviewed conferences and journals:

1. Andrew Garbett, Robert Comber, Edward Jenkins, and Patrick Olivier. 2016. App Movement: A Platform for Community Commissioning of Mobile Applications. In *Proceedings of the 34th annual ACM conference on Human Factors in Computing Systems – CHI'16*, ACM Press.
2. Lee, C., Garbett, A. & Wilkinson, D.J., 2017. A Network Epidemic Model for Online Community Commissioning Data. Available at: http://arxiv.org/abs/1702.07662
3. Emma Simpson, Rob Comber, Andrew Garbett, Edward Jenkins, Madeline Balaam.. 2017. Experiences of Delivering a Public Health Data Service. In *Proceedings of the 35th annual ACM conference on Human Factors in Computing Systems – CHI'17.*
4. Kellie Morrissey, Andrew Garbett, Peter Wright, Patrick Olivier, Edward Jenkins, Katie Brittain. 2017. Care and Connect: Exploring Dementia-Friendliness Through an Online Community Commissioning Platform. In *Proceedings of the 35th annual ACM conference on Human Factors in Computing Systems – CHI'17*, ACM Press.
5. Emma Simpson, Andrew Garbett, Edward Jenkins, Robert Comber, Madeline Balaam. 2016. Factors important for women who breastfeed in public: a content analysis of review data from FeedFinder. In British Medical Journal Open, Open Access.
6. Madeline Balaam, Rob Comber, Ed Jenkins, Selina Sutton, and Andy Garbett. 2015. FeedFinder: A Location-Mapping Mobile Application for Breastfeeding Women. In *Proceedings of the 33rd annual ACM Conference on Human Factors in Computing Systems – CHI'15*, ACM Press.

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Chapter 1. Introduction

This thesis investigates how technology can enable citizens to take a leading role in the commissioning of digital goods and services to support community-driven information resources. With the rise in social computing Human Computer Interaction (HCI) researchers have begun to explore how the technology enables individuals to engage with communities and facilitate the exchanging of knowledge. However, even as technology becomes increasingly embedded in everyday life, we as consumers have a limited influence over how these technologies are commissioned and designed, in part, due to the lack the skills, knowledge, or resources to do so. Therefore, the commissioning and design of technology is reserved for the technically literate through commercial entities within the free market, as part of Free and Open Source Software (FOSS), or as a government delivered service. In each case, the perceived levels of demand and commercial value of a final product, from a top-down perspective, dictate the motivations for commissioning technology. This results in niche communities being underserved until technology commissioners identify the needs of the community or until the venture is commercially viable to proceed.

However, with the advent of the internet, alternative commissioning models are beginning to emerge that challenge the existing models of production and consumption and collectively facilitate citizens to engage in the production of their own resources. Benkler (Benkler & Nissenbaum 2006) introduce the concept of Commons-based Peer Production to describe the large-scale social production of shared community assets whereby large numbers of non-hierarchical, decentralized collaborations between individuals can produce unified intellectual work afforded by internet technologies. These principles can be seen within the Wikipedia model of information commissioning and focuses on the creation of information through large-scale online platforms that facilitate the collaborative consumption and peer-production of shared collective knowledge. Similarly, Crowdfunding platforms have begun to challenge the existing models of product development, with highly motivated and technically capable individuals to pitch for funding of their own product ideas and seek funds directly from the consumer.

Engaging citizens in the commissioning of information is a uniquely challenging problem that has been explored by researchers in the form of civic technologies such as; cycling in the city (Le Dantec et al. 2015), highlighting public issues with FixMyStreet[1], and civic consultation through physical devices (Korn & Voida 2015; Crivellaro et al. 2015). The important factor embedded within these approaches is the shift from the way in which citizens interact with organisations of the state through data commissioning, collection and interpretation. The existing practice of data commissioning can be seen as a more transactional model of citizens requesting information from authorities and receiving a response in a one to one manner. This can be observed in the Open Government Data movement that focuses on data transparency in order to enable citizens to hold to account the actions of government departments. Within this interaction, the governing body acts as the creator, producer, and publisher of data that holds themselves to account and calls into question the actual levels of transparency offered. Accessing and interpreting this data requires both technical knowledge and skills to access as well as awareness of both the dataset and policies in place in order to understand the operational context.

The adoption of these technologies is a clear indicator that conducting this relationship online requires a certain level of structured process and mediation that is afforded systems designed specifically for this task. Looking more closely at these platforms (WhatDoTheyKnow[2], FixMyStreet, TheyWorkForYou[3], WriteToThem[4]), the focus is on structuring and supporting this relationship between citizen and government through novel approaches to commissioning information as well as the presentation of existing and freely available datasets in a more structured and easily digestible manner. These forms of technology encourage the sharing and dissemination of collective knowledge and support civic action in a manner that is decoupled from government. The commissioning and generation of the data from these interactions is either carried out by the state, in the instance of the Data.Gov.UK platform or in response to FOIs held by a third party such as WhatDoTheyKnow or council run FixMyStreet instances. However, in both instances the collection, processing, and analysis of the data continues to be

[1] https://www.fixmystreet.com/
[2] http://www.whatdotheyknow.com/
[3] https://www.theyworkforyou.com/
[4] https://www.writetothem.com

provided *to* citizens rather than *by* citizens themselves. Rather than allowing citizens to create alternative data sources to challenge and evidence issues. Data commissioning and collection requires the development of technological infrastructure to commission, collect, and disseminate this information between citizens. These models of commissioning offer the potential for enabling the widespread participation of individuals towards a common cause and democratizing the commissioning of digital services and knowledge. However, they are led by a vanguard of the technically literate, early adopters, who represent only a small portion of internet users. Therefore, this research explores how the commissioning of digital goods and services can become a more democratized process that enables communities to engage directly in the commissioning of technology to support community driven information resources.

This thesis describes research conducted over two case studies that explore how citizens can engage with the act of commissioning knowledge and technologies from varying perspectives; a research-led user centred design process, and a community led commissioning practice through an online platform. Case study 1 engages a community of practice in the co-designing of a mobile technology through a user-centred approach. Within this case study breastfeeding mothers within the North East engaged in the design and deployment of a mobile application, known as FeedFinder, that enabled new mothers to contribute places, ratings, and reviews to form a community driven health resource. The case study highlights the viability of creating these forms of information resources and explores how to understand the usage behaviour through the data resulting from the use of a health information resource. This is achieved through the analysis of log data that is created when interacting with the system as well as using external datasets, such as the Indices of Multiple Deprivation (IMD), to infer the socio-economic factors which might influence how individuals interact with these forms of technology. The motivations for performing this form of analysis is both that we as system designers can begin to understand the use of the technology but we might also be able to offer others with this contextualized information. Through interfaces to this dataset we could perhaps support healthcare professionals in the decision-making process when considering the allocation of resources. We can also support communities to change social norms around breastfeeding behaviours by providing mothers with the ability to evidence and share experiential data more publicly and bring awareness to these issues.

Case study 2 extends upon the findings and ideology of case study 1 and focuses on enabling a more grassroots approach to the commissioning of community driven information resources. After the deployment within case study 2 it became apparent that it was possible to provide the necessary tools for communities to appropriate and support these information systems themselves rather than being led by members of the research team. Within this case study a platforms based approach was taken (Olivier & Wright 2015) that focuses on the development of supporting infrastructure to remove the technical barriers as well as offer a dedicated online space for individuals to participate in the process. The resulting platform, known as App Movement, is a novel online commissioning tool for commissioning mobile applications, more specifically location-based review services. The service has seen the creation of over 111 campaigns, with 19 mobile application deployed to the Google Play Store and Apple App Store that serve a growing number of ~52,000 application users. This thesis explores these community resources further through the observation and discussion of three App Movement campaigns in chapter 7.

Lastly, this thesis reflects on the existing research presented in the literature review, two deployments of location-based review services, and the experience of delivering and deploying an ongoing commissioning service to define a framework for community commissioning and the provisioning of technologies to support this process. The implications of designing these technologies is discussed within the conclusion chapter. Reflecting upon the experiences of deploying a commissioning platform highlighted opportunities for further discussion around topics such as; lowering barriers to commissioning technologies; transparency and visibility of implicit and explicit data; ownership, moderation and governance of community-owned resources are identified through conducting the research presented in this thesis.

1.1 Research Questions

This research discussed in this thesis explores how communities can commission, design and deploy their own community driven information resources. The following research questions aim to explore this research topic further.

1. In what ways do citizens use and generate value from community-driven information resources?

2. How do we configure tools, platforms, and services to maximize reach and depth of citizen participation in the generation of community-driven information resources?

1.2 Research Approach

In order to understand how technology can play a role in the coordination and participation of communities in the commissioning of system, a case study approach has been adopted that attempts to observe this issue in action across a number of domains and within a number of contexts. These domains can be defined as; (i) A community of practice centred around breastfeeding within the North East of England, (ii) A number of online and offline communities of interest and practice through the App Movement online platform. The analysis of these domains was conducted through a mixed-methods approach which initially focused on observations within the communities of practice, with case study 1 and 2, which then shifted towards a more quantitative analytical approach. The design and development of the technical outputs were shaped through an action research process that incorporated user-centred design and understanding as the deployments became adopted and allowed the primary researcher to reflect on these changes. Within each of the case studies the focus is very much on attempting to develop a more robust, longitudinal deployment rather than in-the-lab studies. This approach focuses on the development of systems at scale and openly available for interaction by the general public and without intervention by the research team who act as service providers. This thesis defines this as a platform based approach that focuses on developing services to enable the self organisation and participation of citizens outside of a lab setting and is not led by researchers, but rather driven by the citizens themselves who use these services. A key benefit of taking this approach is that large online deployments provide a unique opportunity to observe how these technologies are adopted and used outside of the lab and in the hands of the communities who may, or may not, choose to engage with these technologies. This step closer to deploying 'real-world' tools requires that we reconsider our approach to design research prototypes and take more refined and production ready system approach to instil trust in the credibility and reliability of these services.

1.3 Summary of Contributions

Through the course of conducting the research presented within this thesis five contributions have been made to the field of HCI and a new field of community commissioning has been introduced. Within this thesis the following contributions have been made;

1. Establishing the concept of community commissioning and exploring the properties of this process through the development of a novel platform to support communities in establishing community driven information resources.
2. FeedFinder, a foray into the design and deployment of a large-scale community driven information service around the rating and reviewing of suitable breastfeeding locations. (i) A thematic analysis of qualitative survey data to understand the production and use of a community driven information system, (ii) A log-based quantitative analysis of a large-scale deployment of a location based review service to determine interaction behaviours and socio-demographic factors of service and data use.
3. App Movement, a novel community commissioning platform that enables the grassroots commissioning of mobile applications. The main contributions of App Movement include; (i) The design concept of a community commissioning platform, (ii) The deployment of a real-world, large-scale, community commissioning platform, (iii) The analysis and evaluation of App Movement and corresponding mobile applications, (iii) Design recommendations to inform future research of community commissioning services.
4. A reflection on the process of deploying large-scale social computing platforms as a research approach to inform the design and development of a community commissioning service.
5. The definition of a framework to understand the process of community commissioning and an ontology to discuss the provisioning of services to support the practice of community commissioning.

1.4 Thesis Structure

This thesis comprises of nine chapters that reflect upon two case studies to explore the design, development, and adoption of a community driven information resources and the process of supporting community commissioning in action. Through the exploration of these case studies it has also been possible to produce a novel framework that defines the process of community

commissioning and identifies the components of provisioning of technologies to support individuals in the production of community-owned resources.

Chapter 2 begins by introducing the growing research within HCI around the role of civic technologies and the potential to influence everyday civic life within a democratic society. These projects demonstrate the unique opportunity for research to be conducted 'in-the-wild' and observe how civic technologies become adopted by citizens outside of the research lab and in the context of the 'real-world'. Similarly, the internet's ability to connect disparate individuals online to form global communities also provides opportunities to engage in the design of these forms of technologies a much wider-scale. As part of this discussion the chapter outlines the motivations for individuals to engage with communities in a collaborative capacity, both offline and online, in the production of shared resources. The chapter discusses existing models of participation that leverage the collective efforts of communities and provides examples in areas such as; the development of open source software, the creation of open knowledge, utilizing crowds for computation, and alternative methods of crowd resourcing. These concepts introduce the foundations for exploring the concept of community-led technology commissioning and demonstrate the shift towards citizens as collective producers of goods and services.

Chapter 3 presents case study 1 - the motivations and design of FeedFinder, a community driven information resource to support new mothers in sharing experiential data around breastfeeding friendly locations. Currently, breastfeeding rates in the UK are far below the recommended levels as outlined by both the National Health Service and the World Health Organisation (McAndrew, F., Thompson, J., Fellows, L., Large, A., Speed & Renfrew 2012). This is especially true within the North-East of England where breastfeeding rates continue to remain lower than the national average and correlate strongly with areas of high deprivation. Within British culture, women continue to report negative experiences of breastfeeding publicly and have faced stigmatization around the practice despite the numerous physical and mental health benefits that breastfeeding a child provides.

In response to this issue we developed FeedFinder to promote breastfeeding more publicly and support mothers in collectively sharing their breastfeeding experiences within their locale. Chapter 3 also documents the user-centred design process taken in developing FeedFinder and

draws upon four design workshops with 21 new mothers who attend NHS breastfeeding support groups in the North-East of England. Within these workshops mothers completed two design tasks to prompt discussion and sensitise the research team regarding the qualities of breastfeeding friendly locations. These qualities were then incorporated into the prototyping and development of the FeedFinder mobile application. The FeedFinder application was launched in July 2013 and currently serves over ~11,500 mothers worldwide who have contributed ~3,600 experiential ratings and reviews for over ~3,500 breastfeeding locations worldwide. The application was initially launched with breastfeeding support groups in the North East of England and has been promoted via word of mouth, and continues to demonstrate the potential for these forms of community driven information resources. The chapter also presents a thematic analysis of survey data from FeedFinder users after four-weeks of application use to understand the value and use of a community driven information resource around breastfeeding. This initial foray into designing an 'in-the-wild' community driven information resource demonstrates the potential for these forms of technology to be driven and adopted by communities of practice.

Chapter 4 delves deeper into the implicit user interactions with the FeedFinder application to explore its usage and adoption by the community. The quantitative analysis utilizes session based summaries of Application Programming Interface (API) transactions to describe typical behaviours of a user during application use. The chapter presents three distinct modes of engagement with the FeedFinder application that can be described as; seeking, exploring and contributing behaviours. Understanding how and when mothers were interacting with FeedFinder provides us with deeper contextualized knowledge when designing features that encourage engagement such as prompting users to leave reviews, add new venues, or find similar locations. Due to the spatial nature of the data, external data sources such as OpenStreetMap can be used to identify the nature of the area (residential, industrial, commercial) as well as the sociodemographic factors that describe levels of deprivation through the Index of Multiple Deprivation (IMD). Using these datasets, it has been possible to identify the pre-emptive search behaviour of mothers rather than searching "on-demand" for much of observed sessions. The results also suggest that mothers typically map more deprived areas than affluent areas, suggesting the desire to map out locations where breastfeeding is not the norm to alleviate anxieties of breastfeeding publicly.

Chapter 5 focuses on new models of civic participation within the specific contexts of; Open Data, Sharing Economy, and Citizen Science to identify weaknesses and opportunities of these domains for the context of community commissioning. This chapter initially presents a discussion of existing commissioning practices spanning a range of technologies and concepts around citizen-led information commissioning for a civic purpose.

Reflecting upon these existing practices, it is possible to understand the current boundaries and limitations of these approaches to inform a framework for community commissioning (chapter 8) and inform the design of a novel commissioning platform (presented in chapter 6).

Chapter 6 presents case study 2, the design and deployment of App Movement, a community commissioning platform to facilitate communities in proposing, designing, and deploying location-based review mobile applications to support the establishing of community driven information resources. The platform provides communities with the ability to create campaigns as an expression of needs to collectively design and resource a location based rating and review mobile application that responds directly to a community need. This is achieved through an automated campaign progression that consists of three phases; the Support Phase, Design Phase, and Launch Phase. Within each of these phases the community contribute their collective efforts, be that in the promotion of the campaign, aspects of the apps design, or contributing their knowledge of their local area within the application once launched. The chapter documents the process of engaging with the App Movement campaigning process, architecture of the platform, and design considerations throughout the App Movement ecosystem and provides a foundation upon which the proceeding chapter draws upon to discuss three successful campaigns. Currently, the App Movement platform has been adopted by over 52,000 members supporting 111 campaigns, 20 of which have been successful in reaching their target number of supporters and 18 campaigns have generated mobile applications that are currently available in the Google Play Store and Apple App store.

Chapter 7 attempts to document three successful App Movement campaigns that utilize different approaches with regards to engaging and promoting the campaign within the corresponding community of practice. Although each of the campaigns exceeded the target number of supporters, not all case studies were able to actively engage the community around the design and launch of the application, despite this initial demonstration of support by the

community. The chapter attempts to understand why some campaigns were more ‘successful’ than others by identifying three distinguishable groups of campaign creators; embedded community members, supporting professionals, and lone citizens. The discussion also highlights the complications of designing novel technologies to support commissioning processes and the assumptions around technology literacy within these communities.

Chapter 8 begins by discussing the broader concept of commissioning within the context of public service literature that describes this process in terms of identifying community needs through the allocation of resources and procurement of services to meet these needs. However, this top-down approach to commissioning does not provide means for communities to engage in this process through the independent expression of needs, collation of resources, and design and development of community-owned resources. To explore this concept further the chapter reflects on the previous case study as well as the literature consulted in chapter 5 in order to introduce a novel framework that defines the process of community commissioning and the components required to provision these forms of technologies. The chapter comprises of two parts; the definition of community commissioning that outlines the underlying process of collectively commissioning community owned resources, and the components and complications involved in the provisioning of tools, platforms, and services to support this practice. The community commissioning framework identified in this chapter attempts to provide HCI researchers with the lexicon and taxonomy with which to discuss and design for the process of community commissioning more broadly.

Chapter 9 concludes with a discussion that incorporates the research presented in this thesis to revisit and reflect upon the research questions initially proposed in chapter 1. The main discussion points from each chapter are revisited and discussed. This closing chapter also clearly defines the opportunities for future work both directly with the App Movement service but also more broadly for the domain of community commissioning in HCI.

Chapter 2. Citizens, Crowds, and Communities

This chapter presents the underlying and related research that surrounds the concept of community commissioning and community driven information resources. These terms are used to describe the ideal of democratic platforms that enable the commissioning of technologies to support communities in the creation of community-owned information resources. The literature review deconstructs the concept of community commissioning into the constituent themes, drawing upon Social Sciences and Human Computer Interaction (HCI) research to understand how existing technologies and practices have been employed to motivate collective action within large online crowds. This thesis presents two independent case studies that operate in different contexts and as such, each case study contains a more in depth and contextually relevant literature review.

2.1 Civic Technology and participation

Within HCI there has been a drive for the development of new technologies and processes that support citizens in participating in their everyday civic life as part of their "civic duties" within a democratic society (Olivier & Wright 2015). These civic duties are centred around the notion of collective action to identify and address issues of concern within society through discussion, participation, and action. As designers, we have the ability to develop civic technologies that encourage citizens to participate in these shared issues however there are a number of concerns when creating such forms of technology. These are centred around moderation, ownership, and governance of systems to ensure wide-scale participation by all citizens. Existing efforts within HCI have focused on various forms of civic technologies within areas such as, but not limited to; situated voting (Vlachokyriakos et al. 2014; Taylor et al. 2012; Golsteijn et al. 2016) civic consultation (Le Dantec et al. 2015), transparency (King & Brown 2007; Aoki et al. 2009) and social movements (Crivellaro et al. 2014). These approaches have focused on the use of technology to enable discussion and debate as well as the collecting and observation of alternative datasets for demonstrating matters of concern (Disalvo et al. 2014). The use of social media platforms such as Facebook (Crivellaro et al. 2014; Howard et al. 2011) have been used to give a voice to campaigners, centralize debate, and gather supporters through increased visibility of the cause. The power of social media to increase these qualities was extremely prominent in the recent Arab Spring and the overthrowing of governments (Howard et al. 2011) through coordination of alternative

communication channels. Although not explicitly designed as civic technologies, these platforms have been re-appropriated for the purposes of political discourse and mobilization.

Interactions between citizens and the city have been explored through the collecting of "sensed" public data in what is described as Smart Cities (Nam & Pardo 2011). However, in this mode vast networks of software and hardware infrastructure are used to passively observe citizen behaviour for the purposes of optimization and retrospective observation by authorities for the purposes of planning. The collection and distribution of this data remains firmly in the hands of the organisation collecting and analysing this dataset. Alternatives to this model focus on enabling citizens to voluntarily and transparently collect data for use by both citizens and authorities.

Initial work that leveraged mobile phones as sensor platforms for 'sensing' the city and the lived experience of citizens focused more on the feasibility of these forms of technology to identify typical cycle routes, ride roughness, and noise pollution (Reddy et al. 2010). However Le Dantec takes this further through exploring how this data is used within the context of urban planning (Le Dantec et al. 2015), looking more closely at new methods of public participation between cyclists and municipal government planners as well as identifying a ground truth model of how cyclists move through the city. Through a series of public consultation sessions between municipal urban planners and engaged cyclists, Le Dantec reports of the crowdsourced mapping data being used in three different manners; as an *authority*, as *evidence*, and as *ambivalent*. The collection of this sensed data through a technical process led to planners relying solely on the data as an *authority*, with planners presuming that this data was definitive *evidence* of an exhaustive and complete dataset of cyclists' behaviour. However, interviews with citizens demonstrated that they were more defined by their environment and provided a deeper and more contextualized understanding of the reason behind their actions. The collecting of the data was also problematic in that citizens must identify as a 'cyclist' who's behaviour might be very different from that of a casual bicycle user, as well as the fact that socioeconomic factors impact upon universal access to these forms of technologies.

This study demonstrates the complexities in developing and deploying civic technologies as well as relying upon the resulting crowdsourced data for civic purposes. Therefore, as

designers we must be mindful of the tertiary or unintentional impacts of the technologies upon inclusivity and utility of the resulting datasets. Similar examples of these forms of technologies can be seen in web services such as FixMyStreet (Society 2016) that attempt to provide alternative, transparent means of crowd sourced data collection for the purposes of reporting, viewing, and discussing local issues. This act of making transparent citizen concerns provides a legitimizing and amplified voice with which authorities feel compelled to engage with (King & Brown 2007).

In order to deploy and observe these forms of technologies, HCI researchers have begun to move away from the lab and towards "in the wild" deployments, conducting social impact driven research in situ and outside of the lab (Rogers 2011; Taylor et al. 2013). This approach focuses on the affordances of mobile and web technologies to support civic participation through the collection of crowd sourced data. Rogers calls for a rethinking of the existing practices of developing and deploying *solutions* as designers of technology and requests that designers should be "*experimenting with new technological possibility that can change and even disrupt behaviour"* (Rogers 2011). This design method focuses not on designing for an existing practice but rather, experiment with new technologies that disrupt existing behaviours. This approach can be observed within the case studies later in this thesis, specifically around new models of technology commissioning within two real-world deployments; Case Study 1 - FeedFinder and Case Study 2 - App Movement.

2.2 Online and Offline Communities

The design and deployment of civic technologies is centred around encouraging individuals within communities to interact and participate in civic life. With the advent of the internet we are afforded the capabilities of communicating across vast distances from the most remote locations, enabling us to form new networks and communities within which we are able to share information and knowledge. That is, to the primary benefit of those who are able to access, interpret, and afford to engage with the internet. The early internet era led to the emergence of bulletin boards, mailing lists and Internet Relay Chat (IRC) that enabled individuals to participate and communicate with one another online. Rheingold (Rheingold 1993) defined these online spaces as "virtual communities" - "*social aggregations that emerge from the Net when enough people carry on those public discussions long enough, with sufficient human feeling, to form webs of personal relationships in cyberspace*". Current

platforms such as Facebook, Twitter, and Reddit provide the public with the ability to form large online social networks and demonstrate the potential for mass collaboration and participation online. Research around online social networks is extensive from retrospective observational behavioural studies (Java et al. 2007; Pempek et al. 2009; Joinson 2008), to quantifying and measuring influence and sentiment (Cha et al. 2010), and even attempting to use social interactions within communities to predict the outcome of US elections (Tumasjan et al. 2010). Whilst online communities per se are not the focus of this research, notions of community, communities of practice and communities of interest have a direct bearing on our understanding of the potential for civic technologies.

The notion of community and society has been defined and explored within various research areas and, due to the complexity of the subject, these terms 'community' and 'society' continue to be contested. The refinement of this definition is also due to the advent of the internet and the ability to form and engage with online communities. The focus of this thesis explores the notion of communities through kinship (Ferdinand & Price Loomis 1957), interest and practice (Wenger 1952). Tönnies (Ferdinand & Price Loomis 1957) presents two forms of social organisations; Gemeinschaft (community) and Gesellschaft (society). Tönnies proposes that individuals form social relationships based upon strong reciprocal bonds and an obligation to maintaining the wellbeing and kinship with one another (Gemeinschaft, community). In contrast, individuals can also participate in a form of more structured and impersonal society (Gesellschaft) and live amongst others whom do not explicitly share common kinship but construct a series of impersonal ties around more practical concerns and formal relationships. This sense of community, as Tönnies (Ferdinand & Price Loomis 1957) outlines, is derived from a shared geographic proximity of interaction e.g. schools, pubs, but more importantly this also comes from a shared understanding of local issues.

2.2.1 Communities of Practice

Wenger *et* Lave (Wenger 1952) introduce the term Communities of Practice (CoP) and describe the way in which a collective of individuals that engage in the process of sharing knowledge, resources, and skills begin to form a Community of Practice. Unlike a community based solely upon geographic proximity, these individuals are brought together through shared interest or concern and are able to improve upon their understanding through interaction with one another. However, Wenger *et* Lave define three crucial characteristics of

CoPs; the domain, the community, and the practice. The domain is best described as the subject matter that connects practicing community members i.e. teachers, nurses, journalists. The community is defined by a collective of individuals who are connected by a shared domain and whom perform a shared practice characterised by the domain. Finally, the practice concerns the ongoing learning and knowledge transfer between community members around a matter of concern, activity, or process. The way in which individuals transition from newcomer to practicing experts is through peripheral yet productive tasks described by Wenger *et al* (Wenger 1952) as Legitimate Peripheral Participation (LPP). This sees newcomers perform integral but peripheral tasks in order to become seen as more centralized members of a community once their experience is learnt and demonstrated.

The forms of knowledge created and shared amongst the community members within the two case studies presented in this thesis can be seen as an exchange of subjective, tacit knowledge (Polanyi 1966) – *"knowledge that is difficult to write down, visualize or transfer from one person to another"*. This form of knowledge exchanged between the various community members is a qualitative reflection of the practice engaged with by the individual and within the domain of the specific community. Case study 1 (FeedFinder), explores the values of sharing the lived experiences of breastfeeding mothers who are brought together through their shared practice of breastfeeding and reflecting upon these experiences to form a community of practice. The tacit knowledge in this context focuses on sharing and enquiring about the experiences of motherhood within a specific location and context. These mobile applications created by the community offer more than just location data but rather a qualitative, subjective content, drawn from the experience of community members. It is important to emphasize that the information resources commissioned by communities cannot simply be built upon existing datasets – i.e. Open Government Data – as the community require, and derive value from, the information resource that offers a domain-specific reflection of the practice that is not afforded by objective data sources. The practice that brings these community members together is not explicitly reflecting upon the information created, but rather conducting the practice that allows them to derive and share their own knowledge of the domain.

2.2.2 Social Capital

Understanding both the motivations for citizens engagement and participation with these shared community resources and the affordances of being a part of these communities can be, in part, described through Social Capital Theory (Coleman 1988). Coleman considers social capital as a collection of resources, accumulated through relationships with others, that can be actioned upon by an individual but cannot be physically or freely traded with those outside of the network of individuals. Bourdieu and Wacquant (Bourdieu & Wacquant 1992) define social capital as "*the sum of the resources, actual or virtual, that accrue to an individual or a group by virtue of possessing a durable network of more or less institutionalized relationships of mutual acquaintance and recognition*". The result of these resources may change dependent upon the continued relationships and interactions between the individuals. This concept of resources or "capital", borrowed from economics research, can be described as goods and services to be traded, actioned upon, accrued and shared amongst individuals within the community. Although social capital is not something that is tangibly acquired it can manifest itself as a form of indirect reciprocity wherein actor A performs an action for actor B, whom they trust will reciprocate the value derived from the action (Coleman 1988). Within this interaction elements of expected reciprocity, trustworthiness, obligation, and social structure are important factors in the maintaining and flow of social capital within a social network (Coleman 1988). Social capital has also been described in various ways that focus on particular outcomes or encompass various elements such as human (Coleman 1988) and relational capital. Human capital is discussed by Coleman (Coleman 1988) as the combined knowledge, skills, abilities, and knowledge that exist within a community. Higher social capital has been linked with a number of positive social outcomes such as better public health, lower crime rates, and more efficient financial markets (Adler 2002).

Understanding how communities solicit support, participation and knowledge sharing within these applications can be described through the spending or sharing of social capital through different forms of social ties. The relationships between individuals can take three forms of "ties" within social networks; bonding, bridging, and linking. It is through these ties that social capital flows and is accessed by community members. The strength or amount of capital that can be accessed through these ties is "…*a combination of the amount of time, the emotional intensity, the intimacy, and the reciprocal services which characterize the tie*" (Granovetter 1973). Bonding social capital describes the social ties between homogenous

individuals, such as immediate family and close friends. Bridging social capital is accessed through the indirect connecting of individuals across communities via a bridging relationship between two social groups – friends of friends, colleagues. Linking social capital refers to the affordances of a relationship between dissimilar individuals, outside of existing friendship networks whom can access positions of authority. These relationships have varying levels of strength depending on the social proximity of the individual and the differing affordances of varying types and strengths of ties. Granovetter proposes that individuals benefit from a number of 'weak' bridging and linking ties (Granovetter 1983). These weak ties offer greater prospects of leveraging support from outside of an individual's immediate homogenous social network. Granovetter provides the example of employment where an individual can access a greater number of tertiary friends-of-friends through 'weak' bridging and linking social ties that would not have otherwise been offered through the bonding social ties of immediate friends and family. More recently, Online Social Networks have begun to augment the acquisition and maintenance of social capital through supporting easily maintainable, larger, and more dispersed online social networks upon which individuals can more easily spend and acquire social capital (Resnick et al. 2000; Wellman et al. 2001). Indeed, Ellison *et al* (Ellison & Gray 2013) explored the perceived change in access and acquisition of social capital through surveys of 800 college students in order to understand how usage of the social network correlated with the perceived levels of access to social capital. Findings suggested that increased use of Facebook correlated strongly with the perceived increase in social capital accumulation for all three types of social capital (bridging, bonding, and linking) and played an important part in lowering the costs of maintaining relationships. Ellison *et al* also propose that Facebook enables easier conversion of *latent ties* – ties that are 'technically possible but not activated socially' – into *weak ties* for the purposes of increasing opportunities and access to networks outside of their own.

2.3 Commissioning the Crowd

With the formation of the web, we have observed incredible feats of collective action that have been facilitated by both online platforms and online communities. These include technological and conceptual paradigm shifts such as the Open Source Software movement and the contributions from thousands contributors that constitute the collective knowledge of Wikipedia. These forms of technology have seen the creation of new models of online participation that focus on the premise of engaging large numbers of individuals through

democratic, free and open systems that lower the barriers to engaging with technology that supports the transfer of knowledge and skills. These concepts underpin a collection of crowd-commissioning research areas such as; Crowd Sourcing, Citizen Science, and Crowdfunding that are discussed in more depth in chapter 5. It is from these principles that the concept of community commissioning platforms draws upon within the case studies.

2.3.1 Open Source

The Open Source movement is considered to be a fundamentally new way to develop software that initially attempted to prevent corporate monopolies controlling software and hardware innovation. Initially proposed by the Free Software Foundation, the focus of the Open Source movement was on the freedoms of software creation, use, and reuse by others in a collaborative and public manner. In order to support this model of software development we have seen the rise in community platforms such as GitHub[5] and SourceForge[6] that support CoPs around the collaborative development of software. These services enable developers to have a "virtual presence" and an identifiable community within which to engage that encourages visibility of open source projects. Although contributing development time and efforts to open source software appears purely altruistic Rossi *et al* (Rossi 2006) demonstrate in their literature review that these efforts more akin to a complex spectrum of intrinsic and extrinsic motivations. Rossi *et al* (Rossi 2006) propose that "*enjoyment of programming represents only part of the intrinsic motivation to contribute to Open Source systems*" and that the sense of "*obligation and community-based intrinsic motivations constitute an additional element of the picture*". This need to belong to a group is not too distant from the initial discussion made by Tonnies (Ferdinand & Price Loomis 1957) whereby the need to belong within a community is a clear motivator for participation. It is this sense of community and the enjoyment of the practice that constitutes an important part of understanding the successes of Open Source software. Extrinsic motivations include gratification from overcoming a complex task – "*scratching an inch*" - as well as the reputation and status associated with peer recognition that may lead to the delayed effect of indirect reciprocity – inclusion in other core development teams, job offers, or support for their own projects, stemming from their initial actions.

[5] https://github.com
[6] https://sourceforge.net

However, if accruing reputation was the sole incentive Weber (Weber 2000) points out that there would be more direct challenges to project leader's authority and an increase in "strategic forking", resulting in reoccurring divisions within development teams. It is understandable that "*User needs*" (Rossi 2006) strongly explains why developers create new functionality for Open Source projects, given the low costs to developing new functionality and the benefits of the resulting functionality to the initial developer. Despite the differing motivations behind participating Lankani and Wolf (Lakhani & Wolf 2005) concluded that "*individuals may join* [open source teams] *for a variety of reasons, but no one reason tends to dominate the community or cause people to make distinct choices in beliefs*". However, Lankani and Wolf (Lakhani & Wolf 2005) highlight that learning and developing new skills, social motivations such as "*participating in a new forms of cooperation*" and "*sharing knowledge and skills*" were often reported by Open Source contributors. Supporting this practice of knowledge and skills sharing, is the underlying principle of transparency of the process, people, and resulting outputs derived from Open Source software. Transparency allows for both learning and accountability through inspection of the underlying codebase and encourages trust and knowledge to be transferred between individuals. Raymond (Raymond 1998) focuses more on the technical achievements resulting from transparency and defines "Linus's Law" – "*greater code transparency leads to increased code inspection, resulting in superior software*" (Raymond 1998). This is often the case within software security as evidenced by the recent Heartbleed vulnerability[7] found in OpenSSL – a widely adopted open source cryptography library that was subsequently found and fixed by security researchers. However, the notion that anyone could potentially discover these types of security vulnerabilities or write new code to develop features is beyond the technical capabilities of every day citizens; this process still requires a high level of technical capability and understanding that comes from extensive domain expertise - something that is simply not shared by members of the general public.

Although open source software has principles of non-hierarchical development structure, Dabbish *et al* (Dabbish et al. 2012) demonstrate that hierarchies exist based upon previous

[7] http://heartbleed.com

actions that inform an individual's level of reputation and trust within the community. This is also observed by Mockus *et al* (Mockus et al. 2002) who studied and compared two largescale open source projects (Apache and Mozilla Firefox) in order to investigate how potentially large geographically distributed, groups of open source developers can create enterprise software. Mockus *et al* (Mockus et al. 2002) observed that small collection of ~15 to 36 core developers authored ~80% of the project codebase and became more senior and central to the vetting procedure of accepting new code. This pattern has been observed across multiple studies (Ankunda 2011; Rossi 2006; Krishnamurthy 2002; Robles 2004), and follows the Pareto Principle – 80% of the effects are explained by 20% of the cases (Ankunda 2011). This is perhaps understandable given that a project must be started by a single individual. However, the principles that Open Source projects maintain a flat hierarchical structure and promote open contribution to a shared codebase would appear to be more of an ideal than an actuality within largescale Open Source projects.

2.3.2 Open Data

As governments begin to transition to digital solutions for storing data about their citizens and services, a wealth of data has now, in principle, become more accessible and transferrable between citizen and state. This relatively recent transition has been coined as the Open Government Data (OGD) initiative[8] – a principle that attempts to encourage public oversight and transparency of Governmental actions and decisions through the release of datasets held by public services and government departments. The UK Government believes that "*opening up [Government Data] will empower citizens, foster innovation and reform public services*" (Government 2012). The datasets that have been released can be defined as; geographic mapping and environmental, society and health data, as well as expenditure and investment by the Government. In order to release these datasets, the Government have developed online Open Data portals, such as Data.Gov.UK[9] (UK Government 2016), where citizens can search, access, and download government datasets themselves. This format has inspired over 120 international governments to take similar action in opening their datasets for public oversight[10]. However, the releasing of these datasets is problematic from both a socio-political

[8] https://opengovernmentdata.org/
[9] http://data.gov.uk
[10] http://index.okfn.org/place/

and data inclusivity perspective. Utilizing these datasets requires both knowledge of governmental processes of data collection and analysis as well as the technical understanding of how to access and comprehend the dataset being accessed. The Government's role as both data collector and data provider is problematic in that citizens are only presented with data that the Government itself has deemed of interest and acceptable for publicly release. Despite this, accessing additional data held by the Government remains possible through the submission of Freedom of Information requests (FOI) and allows individual citizens to make requests for governmental data if deemed reasonable by the data controller. In performing these requests *individuals* may be able to access data that might not have otherwise been made public by the Government, however, the results of this process are not made publicly accessible. There also remains a difficulty in sharing this data between interested parties who would also benefit from accessing the data. In response to this issue, platforms such as WhatDoTheyKnow[11] support citizens in creating, submitting, and sharing responses to FOI requests. The use of these services provides citizens with a structured approach to interacting with the complex process of requesting government data and simplies the process of accessing existing records. The platform also provides a web accessible threaded narrative that improves visibility of both the process of requesting this data as well as the results of the request. Through making the request publicly visible the data providers are encouraged to respond in an accurate and timely manner.

2.3.3 Open Knowledge

The principles of Open Source have also been applied to knowledge, works, and data and is defined by the Open Knowledge Foundation as; "*Open data and content [that] can be freely used, modified, and shared by anyone for any purpose*"[12]. Wikipedia is a prime example of the collective capability of the crowd, and is considered as the "*largest and most popular general reference work on the internet and is ranked among the then most popular websites*" (Wikimedia 2016). Wikipedia is based upon an egalitarian principle that any contributor (Wikipedian) can contribute knowledge to an online, shared, encyclopaedia. The depth and richness of Wikipedia is achieved through the vast collection of networked objective knowledge in the form of self-referential linking between articles. Despite the fact that

[11] https://whatdotheyknow.com
[12] http://opendefinition.org

content can be contributed and edited by anyone it is perhaps surprising that Wikipedia has been found to have similar accuracy and quality to traditional print encyclopaedias (Giles 2005) and demonstrates that this form of open participatory system is a sustainable and valid method of creating accurate objective knowledge. As a publishing concept, Wikipedia has led to a multitude of Open Source and proprietary systems being developed for use in various domains such as; education (Parker et al. 2007) as a teaching tool and learning environment for children, within business (Majchrzak et al. 2006) to improve organizational processes, and in Journalism as a reliable source of participatory media (Lih 2004). However, engaging with the Wikipedia service is not without complications, particularly around editorial control and the complexities of becoming a trusted contributor. The model of freely accessible and open sourced knowledge can also be problematic in determining who has access to edit and view knowledge as well as what is written and from who's perspective. Given that anyone has access to edit Wikipedia, vandalism and spam is kept to a surprisingly maintainable level (Geiger & Ribes 2010). This is achieved through the adoption of editorial policies (social norms) and detection algorithms in the form of bots. Early research demonstrated that bot edits only accounted for 2-4% of all edits in 2006 (Kittur et al. 2007) however (Geiger 2009) demonstrate a clear increase in the use of editorial bots that account for more than 16% of all edits within a similar period later on in 2009. Despite this rise in automation the evidence clearly demonstrates the manual process of editorial control being enacted by real people. Initial research (Kittur et al. 2007) suggests that within the first five years of deployment, Wikipedia was administrated by 967 users who averaged around 12,280 edits each. This small minority of 'elite' administrators accounted for almost 59% of total edits within the first two years of Wikipedia being launched alone however (Kittur et al. 2007) demonstrate a clear decline in the total percentage of edits over the next four years, until 2006, with edits made by administrators falling to around 30% of the total number of edits overall.

2.3.4 Crowdfunding

Alternative commissioning models for entrepreneurs to gather capital through the web is currently underway through the deployment of crowdfunding platforms. These large-scale online platforms enable individuals or organisations to create campaigns that can reach a vast number of people who can choose to donate small amounts to the campaign creators in order to raise equity to commission for-profit, artistic, cultural, or social ventures. Schwienbacher *et al* (Schwienbacher & Larralde 2010) define crowdfunding as "*an open call, essentially*

through the Internet, for the provision of financial resources either in form of donation or in exchange for some form of reward and/or voting rights in order to support initiatives for specific purposes". Platforms such as Kickstarter[13] allow for single individual to propose a concept to be funded by the crowd. Importantly, "backers" – those who make a pledge – do not directly own any part of the resulting venture. Ownership of crowdfunding campaigns remains firmly within the hands of the campaign creators who can ultimately make the decisions of where and how the capital is spent. Hui *et al* (Gerber et al. 2009) demonstrate that in addition to raising funds, crowdfunding also offers campaign creators the ability to engage directly with their audience and raise awareness of their concept. In future work Hui *et al* (Hui et al. 2014) highlight that campaign creators also often rely upon a distributed networks of team members that possess various skills and knowledge of the crowdfunding process and leveraging support from communities. Indeed, Muller *et al* (Muller et al. 2016) discuss the importance of collective social capital afforded by small teams or "co-proposers" in gathering sufficient "backers" behind projects in corporate crowdfunding platforms. This increase in social capital afforded by the inclusion of co-proposers in publicizing the campaign had a direct effect on the likelihood of a successfully funded campaign.

2.3.5 Crowdsourcing

With large numbers of individuals interacting online it has been possible to harness the collective power of willing participants to complete tasks for either little or no monetary reward. Howe and Robinson define crowdsourcing as "*the act of a company or institution taking a function once performed by employees and outsourcing it to an undefined (and generally large) network of people in the form of an open call. This can take the form of peer-production (when the job is performed collaboratively), but is also often undertaken by sole individuals.*" (Howe 2006). Infrastructure to support large scale deployments of crowdsourcing tasks have begun to immerge. Services such as Mechanical Turk[14] (MTurk) support organisations, or "requesters", in distributing configurable Human Intelligence Tasks (HITS) or micro-tasks to large quantities of (low) paid crowd-workers in a timely manner. Researchers in favour of conducting crowdsourced studies emphasize the ability to quickly recruit diverse and low-cost workers resulting in cost effective theory and experimentation

[13] https://www.kickstarter.com
[14] https://www.mturk.com

cycles (Mason & Suri 2012). Researchers from Psychology (Buhrmester et al. 2011), Economic Studies (Paolacci et al. 2010), and Political Science (Berinsky et al. 2012) have determined that MTurk can provide similar levels of diversity as US citizens and prevent sample biases found in traditional sampling methods such as Internet samples and American college cohorts. However, due to the low rates of pay suggested by Ross *et al* of less than $2 per hour (Ross et al. 2010) questions are being asked about the ethical and legal implications of conducting such research (Felstinerf 2011).

Studies conducted using MTurk have demonstrated that the wisdom of the crowd is capable of performing to a similar level to that of experts in tasks such as; audio transcription (Marge et al. 2010), text translation (Zaidan & Callison-Burch 2011) and natural language processing (Snow et al. 2008). Crowdsourcing has also leveraged the unique capability of humans to classify images with textual descriptions for the purposes of machine learning and image processing. The ESP Game (von Ahn & Dabbish 2004) uses elements of game design to encourage and reward players in providing their time to the classification problem. Ahn *et al* also developed CAPTCHA (Von Ahn et al. 2003) and ReCAPTCHA[15], a challenge-response test that determines if the interacting user is human through prompting for a response to a distorted piece of text displayed to the user that only a human could decipher. In these latter examples the human brain's innate ability to observe patterns and problem solve are used to improve image processing algorithms whilst rewarding the user with either rewarding gameplay or additional security.

Crowdsourcing projects such as OpenStreetMap[16] have also been created to allow for free and open source alternatives to proprietary mapping. However, researchers (Warren 2010; Chambers 2006; Haklay 2010) highlight that mapping efforts primarily focus on more affluent geographic areas who have access to the technology to support mapping efforts resulting in the under-mapping of more rural and deprived areas. The ownership of maps and technologies denoting boundaries is problematic and recent attempts have been made to democratize access to these forms of technologies. Warren (Warren 2010) developed low-cost mapping tools that enables "activist cartography" - citizens collecting geospatial data for the

[15] https://www.google.com/recaptcha
[16] https://www.openstreetmap.org

purposes of contestation and activism around the 2010 BP oil spill. In this model, existing narratives of official data sources are called into question through citizen activists engaging in the collection of their own data, using low cost toolkits to evidence and contest the status quo of information.

2.3.6 Citizen Science

Previously, research was strictly confined to the domain of academics with research being designed, analysed and disseminated by a select group of individuals. Citizens engaging within this research process typically supply their own data to researchers for analysis. This can be seen in the collection of scientific data through willing volunteers for research projects around understanding environmental data, such as bird migration (Royal Society for the Protection of Birds 2016) and allows researchers to span vast geographic areas that simply would not have been possible by an academic research team. This method of engaging citizens in data collection for scientific purposes is known as Citizen Science – "*making none experts an integral part of the scientific process*" (Bonney 1997). In this method volunteers with interests in the research topic at hand are willing to engage in the process of collecting data, unlike crowdsourcing which sees low paid workers completing tasks as a transactional affair between requester and worker.

However, Irwin (Irwin 1995) proposes that citizens should be considered more than simply human capital but rather as co-developers of scientific policy making themselves who both have the democratic obligation of engaging in this process and will inevitably live with the consequences of the research outcomes. Lewenstein (Lewenstein 2004) extends this definition to include the scientists themselves and their duty to disseminate scientific findings beyond the academic "public knowledge" channels of journals and conferences. Recent research has begun to redefine this relationship, using technology to enable the inclusion of citizens within research as both instigators and facilitators of projects. Platforms such as Sensr, presented by Kim *et al* (Kim et al. 2013) enable citizens to view, propose, and engage with citizen science research projects through a native mobile application that can be configured through a web interface for the purposes of citizen-led data collection. The Sensr platform focuses on maintaining a single mobile application that can be accessed by a citizen in order to explore possible with which to engage. In this mode, the deployment requires researchers to maintain and sustain the platform in order for the service to remain available. Similar tools have been

developed to remove the technical limitations of deploying and configuring these forms of services for use in organizational contexts.

2.4 Summary

This literature review has focused on research surrounding technologies related to the concept of community commissioning platforms. It has highlighted the existing research concerned with how communities can be described through their interactions and practice, how and why they continue to reciprocate actions around shared issues, as well as motivating communities for a purpose. The research presented in this chapter demonstrates the ability to mobilize large crowds around shared matters of concern. On one extreme, we have Open Source Software development in which a small group of experts have the professional and technical knowledge and time to collaboratively produce software artefacts that would not be technically capable by a typical citizen. At the opposite end of the spectrum, we are able to commission and harness the computational power of crowds for the completion of micro tasks that are of limited interest to the crowd worker. In the latter, there are ethical implications to consider in the commissioning of crowd workers in this manner, centred around below average levels of pay and the exploitation of particular groups of people. The workers are seldom given the opportunity to observe the results of their labour and understand the implications of their efforts. Citizen Science sits between the two ends of this spectrum, whereby both highly technical citizen scientists are able to commission and deploy their own scientific studies and citizens can also be employed as data collection points for more foundational research tasks.

However, none of these approaches facilitate the collective action by groups of ordinary citizens within a community of practice for the purposes of creating their own shared information resources. The Wikipedia model is perhaps best placed to provide the infrastructure for creating community driven information resources. However, the focus of the publishing model is on the collection of objective human knowledge around a broad spectrum of topics. The commissioning and identification of experiential data, for both a specific context and relevant for a community of practice, does not currently follow the Wikipedia publishing model. It would appear that the research identified here is conducted by either highly skilled and knowledgeable citizens (i.e. Open Source, Citizen Science), or performed as a low paid micro-task by a crowd worker (i.e. Crowdsourcing, Wikipedia) – leaving an opportunity to explore alternative technologies that support communities of practice in

creating their own community established information resource. These new forms of community commissioning technologies, explored within the latter case studies within this thesis, provide the ability to publicly identify community issues through campaigning mechanisms - providing visibility to a community issue as well as validating the need to design for this issue within the community. This enables us to operationalize consensus around the issue as well as structure and facilitate interactions between willing community members in order to overcome the identified community issue. As designers of these technologies, we must be mindful of the power structures that begin to form in the commissioning and design of these civic technologies and ensure that we lower barriers to participation so as to enable contributions from all community members.

In order to explore community commissioning further, this thesis presents two case studies, from varying contexts, that have taken separate approaches to the design and development of technologies to support commissioning practices. This approach explores information commissioning within the context of commissioning community driven health information systems through engagement with three local community breastfeeding support groups. This was explored further through the design of an online platform to support citizens to commission community driven information resources in the form of location based rating and review mobile applications. Within each of these contexts varying levels of control are afforded to a number of different actors around the design, development, and adoption of the supporting technologies.

Chapter 3. Motivation and Design of FeedFinder: A Community Driven Breastfeeding Information Resource

3.1 Introduction

This chapter introduces *FeedFinder*, a location based review mobile application that supports mothers in the creation of a community driven health resource around breastfeeding friendly locations. The technology was developed through a user centred design process with new mothers in the North East of England in order to promote breastfeeding in public within the North East through the sharing of positive breastfeeding experiences. This case study is explored in two parts; a discussion supporting the motivation behind developing community driven information resources within a breastfeeding context, and a quantitative analysis of the survey data collected through continued deployment of FeedFinder to understand how the community use and derive value from the data resulting from the application. The concept of FeedFinder and the design process have been published at CHI'15 (Balaam et al. 2015) and a qualitative analysis of the community content is due to be published in the Open British Medical Journal (Simpson et al. 2016a). The results presented in this case study focus on understanding the first 19 months of FeedFinder usage within the United Kingdom through a sustained in-the-wild deployment. Importantly, the technology continues to be deployed in the wider world and exists as a rich resource for new breastfeeding mothers to draw upon in supporting breastfeeding in public.

3.2 Breastfeeding in Public

Breastfeeding is considered as an important factor in promoting positive health benefits for both the mother and child. Due to these health benefits UK women are advised to exclusively breastfeed for the first six months and to supplement additional food for at least a year (McAndrew, F., Thompson, J., Fellows, L., Large, A., Speed & Renfrew 2012). The 2010 Infant Feeding Survey (McAndrew, F., Thompson, J., Fellows, L., Large, A., Speed & Renfrew 2012) indicates that within the UK, 69% of women continue breastfeeding their infant at 1 week, 55% of women continue to breastfeed after six to eight weeks, and only 34% of women continue to breastfeed up until the recommended 6 month period. The survey also shows that working women with managerial and professional occupations were more likely to breastfeed (90%), than women who have never worked (71%) (McAndrew, F., Thompson, J.,

Fellows, L., Large, A., Speed & Renfrew 2012). A recent poll conducted by Public Health England shows that 60% of women try to hide their breastfeeding practice in public, with over a third (34%) feeling embarrassed or uncomfortable and 21% of mothers feeling that people do not want them to breastfeed in public. Within British culture breastfeeding is seen as an intimate and personal experience and as such is not appropriate for public consumption (Boyer 2011). Unfortunately this has resulted in instances of stigmatization of breastfeeding mothers in public on social media[17][18]. This is perhaps due to a lack of breastfeeding representation and support within TV and print (Henderson et al. 2000; Sayers 2014). Internationally the UK is below the recommended breastfeeding levels set by both the World Health Organisation and the National Health Service (McAndrew, F., Thompson, J., Fellows, L., Large, A., Speed & Renfrew 2012). With low levels of breastfeeding in public, breastfeeding has become viewed as a less desirable option to mothers, even more so for those from socio-economic groups where breastfeeding is not the norm (McIntyre et al. 1999). Understanding that this is an ongoing issue within the UK, FeedFinder was developed in an attempt to encourage new mothers to feel confident in breastfeeding their child in public through sharing places where positive breastfeeding experiences occur.

3.3 Designing FeedFinder

The initial concept of FeedFinder was derived from previous engagements between the research team[19] and local breastfeeding groups around more general training resources for breastfeeding mothers. The women within the support groups often discussed previous negative experiences of breastfeeding in public. This is perhaps not unsurprising given that the North East of England have the lowest rates of breastfeeding within the UK, with only 31.9% of women breastfeeding after the first six to eight weeks, compared to the national average of 55% (McAndrew, F., Thompson, J., Fellows, L., Large, A., Speed & Renfrew 2012). Indeed, Pain *et al* (Pain et al. 2001) highlight that breastfeeding in the North East is

[17] http://www.bbc.co.uk/news/uk-england-london-30359606
[18] http://www.bbc.co.uk/news/uk-england-stoke-staffordshire-26519660
[19] The research team consisted of Dr Balaam, Selina Sutton, and Andrew Garbett. Together we designed the workshop tasks, conducted and analysed the workshop interviews, and designed and developed the FeedFinder application.

very rarely seen in public and is strongly correlated with socio-economic factors, demonstrating a clear disparity in breastfeeding uptake between areas of affluence and poorer areas within the city. Fortunately, the National Health Service is aware of this issue and provides regular local support sessions where training classes are hosted by nurse practitioners who specialize in midwifery and mothers have the opportunity to socialize and share support between each other. This provided the research team with an initial point of contact with which to begin designing with. We attended four of these support sessions that were located within Newcastle and the surrounding suburbs. Through these support sessions we engaged with 21 new mothers with whom we conducted two design tasks that explored women's experiences of breastfeeding locally. The first of these design tasks was a mapping exercise in which we enquired about physical locations of breastfeeding experiences and encouraged mothers to discuss examples of their positive and negative experiences in these locations.

The second design task focused on highlighting the experiential qualities of these locations and prioritizing them from most important to least important. The tasks were designed to be lightweight and relatively quick to complete in an effort to not overburden mothers who were also caring for their child. This resulted in card based interactions that the research team could write, pick, and place upon a map or prioritize on behalf of the mother. Through conducting these workshops, we began to understand the context of the application's design and the potential users of the system. This allowed us to take a user-centred design process in creating an initial design. We also drew upon the design workshops in order to derive both the desired functionality as well as the rating criteria that would be important to women sharing experiential data around breastfeeding. A series of interactive wireframe mock-ups were created in order to evaluate a potential prototype system and illustrate the functionality to potential users of the system. We approached six women from our initial design workshop and asked them to perform a 'think-aloud' walk through of actions, such as adding a venue, leaving a review and so on in order to discuss potential usability issues of the prototype's functionality. Once some of the issues were highlighted we made a number of design iterations in order to achieve the final mobile application.

Our final prototype was a mobile application based service, available for both iOS and Android, that allows users to browse suitable venues for breastfeeding on a map, view a given

venue along with user reviews and ratings for 5 categories; Comfy(ness), Clean(liness), Privacy, Baby Facilities and Average Spend. The application makes use of the GPS sensor in order to centre on a user's location and presents nearby community added venues. Users can also add new venues to the map and leave reviews on a given venue. The application is populated with venues and review that have been contributed entirely by the breastfeeding community.

3.4 Design Workshop

This section describes the design workshops that led to the design of the FeedFinder application. These findings have been explored within a peer reviewed publication and are only briefly presented within this chapter in order to identify the motivation and design process behind the creation of FeedFinder. The focus therefore, is on identifying the feasibility of developing a community driven health resource as well as exploring novel methods of quantitative analysis of a location based review service. The creation of FeedFinder also prompted the concept of case study 2, App Movement, a more generalized commissioning platform for location based review mobile applications.

Figure 1. An image showing the design activities; mapping salient breastfeeding experiences in the city and prioritizing qualities of breastfeeding environments

Within the initial design task, we asked mothers to identify locations where they had publicly breastfed and place a marker on a physical map of the local area. The research team used this

as a prompt to discuss their positive and negative experiences of breastfeeding in public to understand some of the concerns they had around feeding in public. Our discussions with women at the breastfeeding support groups often highlighted issues around anxieties about breastfeeding in public and mothers commented on the initial feeling of embarrassment when breastfeeding publicly for the first few weeks however a number of mothers mentioned that "*you get over that really quickly, within the first few weeks*". Women also strongly identified that they felt a sense of stress relating to these first few weeks around finding private spaces to breastfeed *"What am I going to do, where am I going to go and that's another anxiety you've got to get over and not only have you got to make sure they latch on properly […] you're trying to go through a mental checklist and the problem of finding somewhere and then thinking are they going to let me, is it going to be alright?". The mothers in the workshop also felt embarrassed about overcoming the logistical challenges of navigating restaurants and cafes with a baby* "*...there's nothing worse than banging into every table and chair going...*". The women frequently commented on only visiting places that had baby changing facilities as they might also be more accommodating to breastfeeding in their premises.

Within our second activity mothers were asked to identify and prioritize important qualities of places where they felt positive experiences of breastfeeding occurred. This was achieved through a card sorting exercise, with 14 initial cards being designed by the research team that included a single word that represented a quality or feature with an associated image as a background. The starting cards that were given to the mothers were; clean, open, bustling, stylish, convenient, baby facilities, friendly, comfy, familiar, privacy, spacious, affordable, entertaining, and calm. Mothers were prompted to place the cards within a circular target with more important qualities or features towards the centre and less important qualities or features towards the outside (Figure 1. An image showing the design activities; mapping salient breastfeeding experiences in the city and prioritizing qualities of breastfeeding environments. As they placed the card the researcher used this as an opportunity to engage the mother in discussion around the placement and quality. Mothers were also given blank cards for them to record any other features that were important factors in positive breastfeeding locations. This design task identified that the five most important qualities were Comport, Cleanliness, Privacy, Baby Facilities and Average Spend during visit which were incorporated into the final design of FeedFinder.

Figure 2. Worldwide map showing all venues contributed by the FeedFinder community.

3.5 FeedFinder Overview

The FeedFinder application was launched in July 2013 and currently serves over ~11,500 mothers worldwide who have contributed ~3,600 experiential ratings and reviews for over ~3,500 breastfeeding locations. The application was initially launched with breastfeeding support groups in the North East of England who promoted the application via word of mouth. Subsequently, the application has grown, independent of promotional efforts by the research team, and continues to be promoted by the efforts of the FeedFinder community alone. The research team also hosted a FeedFinder promotional website[20] that outlines the overall research and people involved as well as provides an interface to explore the mapping data along with associated category tags. The FeedFinder project received local news coverage[21] online and on the radio (BBC Newcastle). The project was also featured as an EPSRC social impact case study[22] and selected as a finalist for the Rosalind Franklin App Competition[23].

[20] http://feed-finder.co.uk
[21] http://www.bbc.co.uk/news/uk-england-tyne-23503384
[22] https://www.epsrc.ac.uk/newsevents/events/connectednation/
[23] http://www.rfappathon.org/

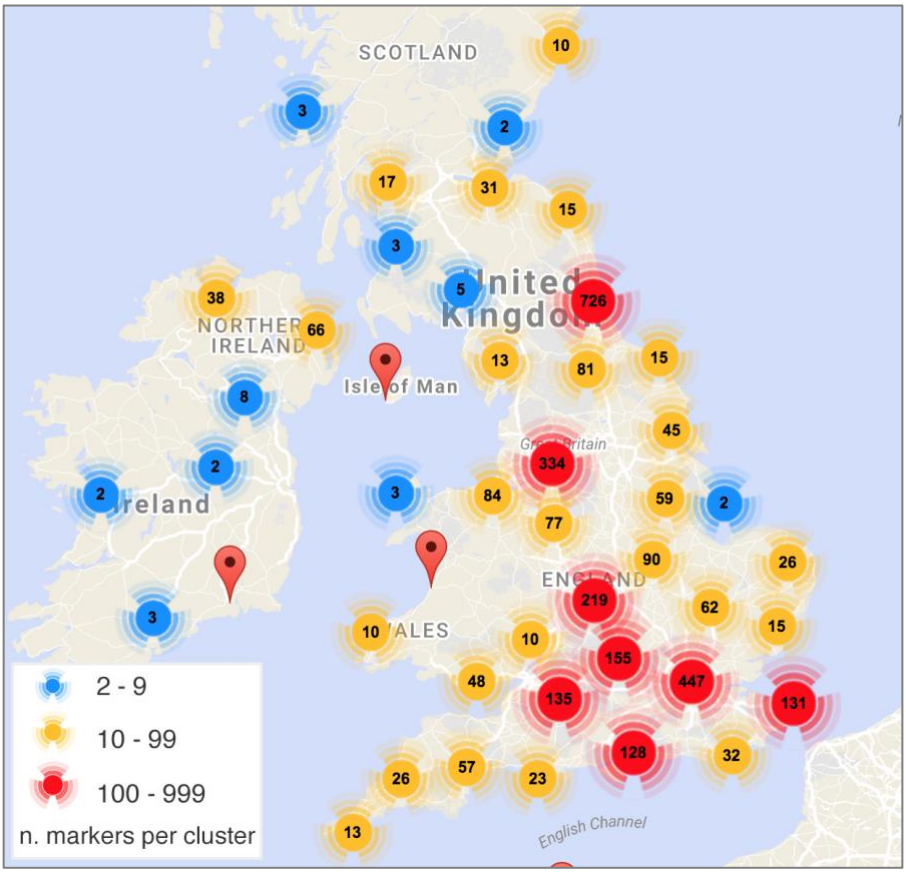

Figure 3. UK map showing all venues contributed by the FeedFinder community.

FeedFinder has been widely adopted in the UK (Figure 3) most prominently in the North East of England. Further afield FeedFinder has also seen adoption in western Europe and North America.

3.6 FeedFinder Functionality Walkthrough

This next section describes the functionality of the FeedFinder application that was available during the initial release and quantitative analysis. However, upon developing the App Movement platform (see case study 2, chapter 6) the application was transferred over to the new codebase which includes significant improvements and new functionality around sharing, moderation, and searching for venues. The FeedFinder application was made available through both the Google Play Store [24] and Apple App Store [25]. A website [26] was also

[24] https://play.google.com/store/apps/details?id=com.culturelab.feedfinder

[25] https://itunes.apple.com/gb/app/feed-finder/id672237934

developed that provided participants with information about the study of the data as well as the contact details of the research team. The website also provides a simplified analytics interface that presented the data contained with the FeedFinder application through an interactive map that displayed the locations of venues, average review and venue count information, as well as the descriptive tags associated with the venues that were provided through the Foursquare Application Programming Interface (API) [27].

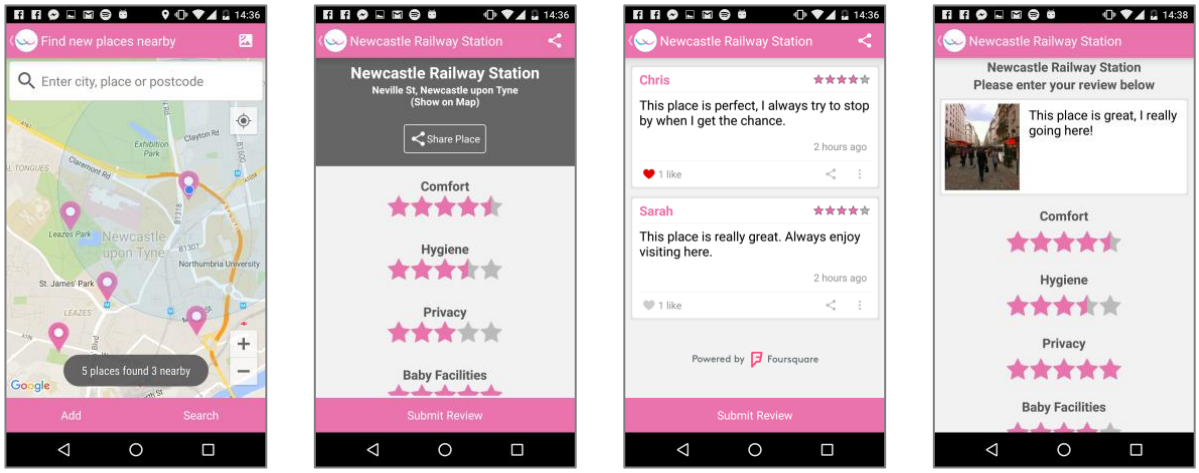

Figure 4. FeedFinder Android application to rate and review breastfeeding friendly locations

3.6.1 Initial Launch

Upon the first launch of the FeedFinder application the user is prompted with a consent screen that informs them about the motivation behind creating FeedFinder, potential collection of their data and the details of the researchers within the project. Included within FeedFinder is a survey that is shown to the user four weeks after initial use. Within the short survey, users are asked to rate how happy they are with the application, whether the application has helped them to find a place to breastfeed in the last week as well as an open text field that allows for any additional comments. The data from this survey is reported upon in the analysis section of this chapter.

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[26] http://feed-finder.co.uk

[27] https://developer.foursquare.com

3.6.2 Searching for venues nearby

When first using the FeedFinder application the user is located via GPS and presented with a map containing nearby marker locations that have been added by other community members and upon tapping this marker, the user is prompted to register or sign into an existing account. This subtle design choice was made so as to both demonstrate the utility of the app and quality of localized data to the user before prompting the user into investing their time in registering an account with the FeedFinder service. Presenting results from the initial search request posed a number of problems in relation to quantity and proximity of venues, and the trade off with performance and presenting an overview of the data. Early on, requests were limited to venues within a 1mile radius however this typically led to a small number of venues being presented to the user, which led to confusion over how many venues there actually nearby. Therefore, we also explored a bounded box query that used the bounds of the user's map viewport to search for available venues. However, this presented two problems; slow performance on mobile when zooming out to cover whole countries and continents, and the inability to discover venues just outside of the viewport that were nearby. This led to another design decision to present these additional nearby locations outside of the viewport in order to encourage searching around the user's location. This was implemented through a notification feature that presented an indication of how many venues are within the viewport but also how many venues are outside of the viewport (i.e. 15 venues found, 5 nearby), see (Figure 4). We also explored a minimum venue count threshold that expanded the search radius until at least 10 venues were visible within the viewport.

3.6.3 Adding Venues to the map

Users were able to add venues to the map by tapping the 'add new venue button' within the map exploration screen. This would present the user with an autocomplete search box that used the Foursquare Search API to locate nearby businesses and provide a more contextual search within the local radius derived from the current user's location. This provided us with high quality venue data that included descriptors of the venue as well as images from the Foursquare service to enhance the venue information. Although we were able to use the user's current location to fetch possible search results from the Foursquare API, we are not able to predict the intentions of the user when adding a venue. The venue could either be nearby (within a few miles) or in a completely different country which limited us in pre-caching the results. The Foursquare API also required a location and a maximum radius of up to 100,000

meters to perform a search request that prevented us from searching across the whole of the Foursquare API dataset. This issue of location intentionality posed design complication that was overcome by allowing users to manually select a location prior to searching. This was also the case if the search box yielded unsuccessful results. This manual entry screen presented a map view with a set of crosshairs that initially focused on the user's current location. From here the user was able to place a set of crosshairs on the desired location and pressing 'add venue here'. The user could then name the venue and was prompted to leave a review. In order to encourage users to review venues, all new venues required the user to leave a review after creating the venue.

3.6.4 Exploring venue information

When selecting a marker from the map the user is taken to a venue screen, within this view the user can see descriptive information about the title, address, and if changing facilities available. The venue information also shows the average review scores of the five available categories; Comfy(ness), Clean(lines), Privacy, Baby Facilities and Average Spend and the associated community comments related to the venue. At the bottom of this view the user can tap 'Leave Review' in order to proceed to the review screen and leave a review of the selected venue.

3.6.5 Reviewing venues

When reviewing a venue, the user is prompted to write a short review relating to their experience of the venue as well as rate the venue from 0 – 5 stars and quantity on the associated rating options that were derived from the previously mentioned design sessions, these were; Comfy(ness), Clean(lines), Privacy, Baby Facilities and Average Spend. This information is then posted to the database and presented in subsequent venue requests when viewing venue information.

3.7 Technical Design

The FeedFinder mobile application comprises of three parts; the mobile application (Android and iOS), a RESTful web API, and a database to store and retrieve the community content. The mobile applications are native mobile applications (Android written in Java, iOS in Objective C) in order to ensure the quality and performance afforded by a native mobile application. An initial prototype based upon a mobile web app (i.e PhoneGap) proved to be of

poor performance when interacting with both the GPS and interactive map. In using a RESTful API, it was possible to log each request being made within the mobile app, along with any parameters that are associated with the request. For example, these might include location of user performing the request, the venue being browsed by a particular user, each search request performed by the user and so on. This log data allowed for the observation and analysis of the characteristics of user behaviour within the FeedFinder application which is discussed later in this chapter.

3.8 Survey Analysis: Understanding experiences of using FeedFinder

Within the initial release of FeedFinder we included a brief survey consisting of three questions and an open comment section. This survey was presented to the user after four weeks of use in order to gain insights into how women were interacting with FeedFinder. Within the survey mothers reflected on both the functionality of mobile application but also on the process of engaging with this form of application. Participants were asked the following questions; (Q1) How happy are you with the application? – ranging from 0 – 5 stars, 5 being very happy and 0 being very unhappy (Q2) Would you recommend the application to a friend? – Yes or No response (Q3) Has the application helped you find a place to breastfeed in the last week? – Yes or No response. The survey also included an open text area within which they could openly express themselves. This qualitative data has been thematically analysed (Braun & Clarke 2006) in order to identify themes within the comment data.

3.8.1 Data Overview

The survey was released with the launch of the initial version of the application with the first survey being completed in August 2013 and the most recent survey response completed in May 2016, a period of ~32 months. During this period 814 unique responses were recorded of those responses 134 participants responded with a comment. Unfortunately, the survey design did not confirm ratings of zero stars when presenting Q1 and as such a 33% of responses contained zero stars (n=265) and the median average rating was 3 stars. However, excluding those ratings of zero stars highlights a median average of 3.4 stars, with the majority of all participant responses (52%) rating the response to Q1 as 3 stars and above. The majority (63.51%) of participants said that they would recommend FeedFinder to a friend (n=517) and 48% of all responses (n=396) showed that participants had used the application to find

breastfeeding locations in the last week. The comments recorded (n=134) were typically quite short (Min. 1, Max. 67, Mdn=18 words) which is perhaps unsurprising given that this survey was presented within the application and had to be typed on a mobile device.

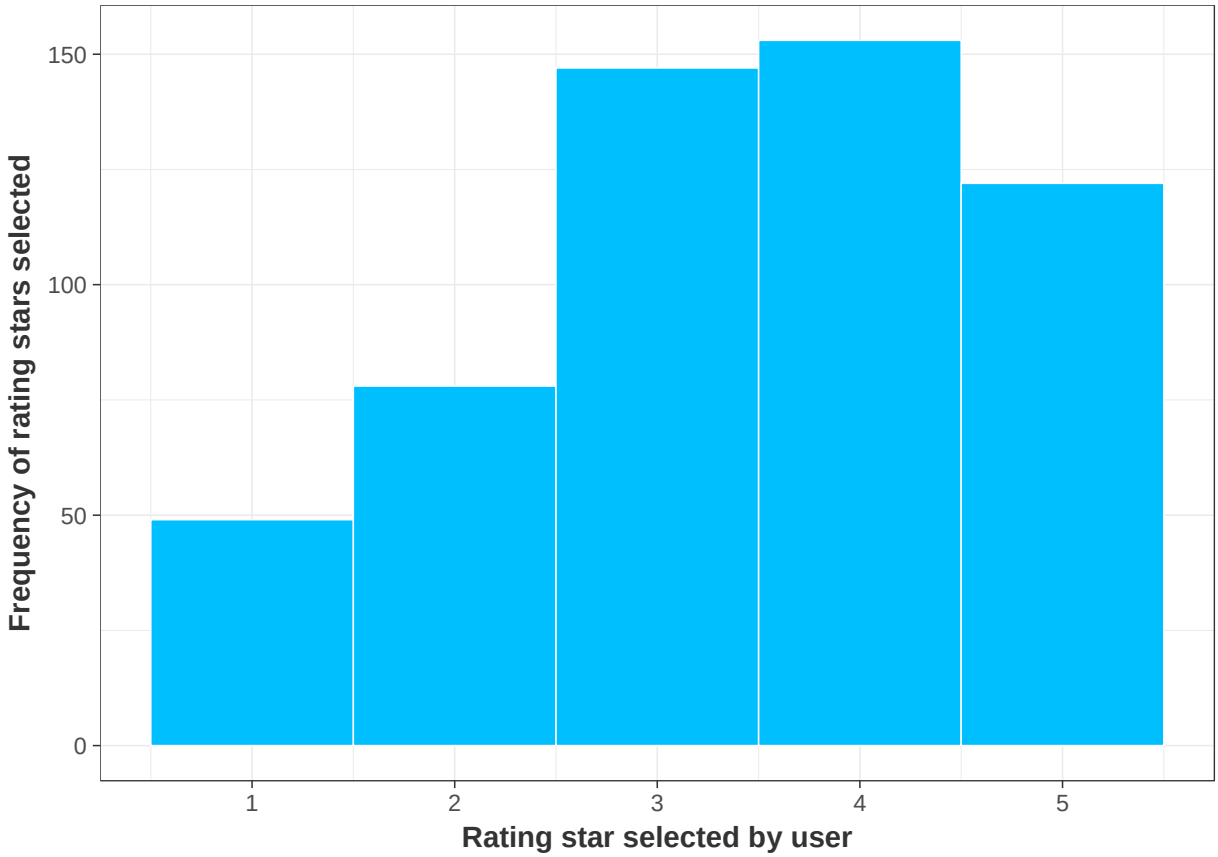

Figure 5. FeedFinder survey responses to Q1. How happy are you with the application?

	Yes	No
(Q2) Would you recommend the application to a friend?	517 (63.51%)	297 (36.49%)
(Q3) Has the application helped you find a place to breastfeed in the last week?	396 (48.65%)	418 (51.35%)

Table 1. Percentages of Yes, No responses in survey responses for Q1 and Q2

3.8.2 Thematic Analysis

The open comments within the survey responses (n=134) were thematically analysed and upon the first coding session, produced 66 unique codes (Appendix A). Upon further analysis

these codes were reduced into 25 codes (Table 2) that were grouped into six themes; Breastfeeding Advocacy, Data Expectations, Motivations for use, Search strategies, Promotional awareness, and Technical issues and features. This next section discusses these six main themes that emerged from the data, supported by quotes from the survey responses.

Breastfeeding Advocacy	**Data Expectations**	**Motivations for use**
Confident breast feeder	Inaccurate locations	Useful
In support for others	Expectations of	Potential for Technology
Motivated contributor	contribution	Motivations for use
Advocacy	Expectations of pre-	Regular use
Breastfeeding Healthcare Worker	population	Male users
	Limited use	
	Facilities	
Technical issues and features	**Search Strategies**	**Promotional awareness**
Technical issue	Pre-emptive usage	Promotion
Map Interaction issue	Planning behaviour	
Contributing places interaction		
Reviewing interaction		
Usability		
Feature Request		

Table 2. Codes and themes from thematic analysis of FeedFinder surveys

3.8.3 Breastfeeding Advocacy

There was a strong sense of breastfeeding advocacy within the survey responses that encompassed a number of different motivations for continued contribution towards these forms of community driven health resources. The motivations centred mainly around altruistic notions of supporting the community and other individuals in similar circumstances as evidenced by comments such as *"I am happy to bf [breastfeed] my 22 month anywhere but will review places to aid new bf mothers or mothers that are more nervous to feed in public".* After a period of breastfeeding more publicly and using FeedFinder it was apparent that mothers had grown in confidence and wanted to encourage similar positive experiences within the community - *"I used the app more when my baby was new born, now my baby is 4-5 month I am more confident and feed where ever I want! I think it's great for more nervous*

mothers so will still review places for them". Within some of the survey responses there was a sense of obligation to reciprocate contributing behaviour - *"Was fabulous in first few weeks when I was nervous of feeding in public but feed everywhere now so am guilty of not posting and updating for others"*. The contributions of locations within FeedFinder were also a contentious issue due to the framing of the application around "suitable places to breastfeed" and a few mothers commented on the importance of highlighting friendly breastfeeding locations rather than "appropriate" places to breastfeed, as evidenced by one mum *"I am looking to add Breastfeeding friendly venues not search for an appropriate place to feed. Great app, well done to everyone involved in keeping it active!"*. There was a subtlety in the way some mothers were encouraging breastfeeding in all public places rather than focusing on hiding mothers away to feed "discretely", taking a more activist approach to change social norms of breastfeeding through encouraging greater numbers of breastfeeding women in given locations. This was particularly evident in the following comment;

"If someone was nervous about feeding in public and found confidence in others feeding at a location without issue then that's where this would be handy. For this reason only I've added some locations. But I hate the idea of acceptable places to feed, if your baby wants feeding then it's fine to feed them, wherever, whenever. Focus on baby and be proud of what you're doing"

Breastfeeding awareness and advocacy was also apparent in more official forms with a number of breastfeeding support workers being very supportive of FeedFinder and who used the application as a tool for educating new mothers and alleviating fears of breastfeeding in public within their support groups - *"As a breastfeeding worker, I use this app to show new mums how easy it is to find a decent place to feed, especially if they are worried about public feeding. It's a great local app!"*.

3.8.4 Data Expectations

The data within FeedFinder changed considerably over the duration of the deployment due to the community driven nature of the information resource. It was apparent that experiences with data sparsity within the initial launch of FeedFinder frustrated some individuals *"Not very good to be honest, takes too long to load and doesn't list everywhere you can find a private space to feed"*. There were clear expectations by some members of the community

that the development team should pre-populate the application with well-known breastfeeding locations prior to the release. Although it would seem that community driven aspect of FeedFinder was perhaps missed by a few mothers altogether *"There are far too few reviews for this app to be useful. Many more should have been added prior to the app being released. I think I have added more reviews than the app builders!!"*. However, even when members were aware of the community driven aspect they felt that the developers, at a bare minimum, should have populated the app prior to its release;

"I love the idea but there's no places listed! Would have been much better if you'd done some research and pre populated it with a few of the obvious places in advance. Mothercares, mamas and papas, John Lewis etc. You shouldn't just rely on user submissions as people won't use an app with no content. Hopefully it'll have more content soon though."

This is a uniquely challenging problem in that these locations could have been added to FeedFinder but it would not have been possible to physically visit and review each of these locations. Indeed, FeedFinder was designed on a premise that a partially populated map containing both venues and reviews from breastfeeding mothers would solicit a greater response than a fully pre-populated map containing no community reviews. This trade-off between data sparsity and data quantity motivated mothers differently, with some mothers feeling more highly motivated to contribute despite limited use in their area *"I live in Essex and because the app is new not many locations have been added so far. However it is a great start and I will start adding locations"* - *"There is not much input in my area. going to add my own places and share with the other mums in the hope of beefing up the data!"*. These comments represent a small number of core users who feel compelled to contribute regardless of the current limitations of the application early on, with similar results in the quantitative analysis in the next chapter. Perhaps unsurprisingly this data sparsity also negatively impacted the motivation to contribute towards a fledgling application, with a large number of mothers echoing a similar sentiment - *"There's one place in the whole of Leicestershire!! I don't see the point in using it anymore and will uninstall it. I can't believe nobody uses it so it clearly just doesn't work."*. Clearly there is a divide in how data sparsity effects levels of motivation between different individuals and it would seem that those members who could see the potential support offered by the application felt more compelled to contribute than those who only saw FeedFinder as a resource to make use of rather than sustain.

There was also an expectation of temporality and timeliness of the data in that it would be up to date and timely *"I really like the concept of this app but there's a number of breastfeeding friendly cafes in town that aren't include, popular chains like cafe Nero, Costa, Starbucks. Also, one of the 2 original shown (mothercare) had closed down several weeks ago."*. Although this issue was only raised by one individual it is an important challenge to overcome given that FeedFinder now contains two years of community contributions and as such is perhaps not entirely timely and current as one might expect. Within the initial launch of the application, mothers had no method of reporting inaccurate or out of date knowledge and as such some initial data is out of date. The further improvements, and subsequent change over to the App Movement platform (discussed in chapter 6), enabled members to report potential issues with venues and reviews. Although not explicitly expressed in the survey responses there is also an issue of businesses responding to the reviews within the FeedFinder application with improvements made by the business owners that are perhaps not reflected by the reviews made prior to the changes.

3.8.5 Motivations for use

Within the survey responses it was possible to see that the majority of mothers could see the potential for FeedFinder to benefit the breastfeeding community, despite initially low rates of adoption and contribution - *"Easy to use app and has helped me to locate breastfeeding friendly locations. Would benefit from further reviews and more locations however I understand this requires user feedback."*. Reponses often spoke about how FeedFinder initially helped new mothers feel comfortable with breastfeeding in public and has now become less used as they became more comfortable *"I haven't needed to locate anywhere in the last week but before then it has been very helpful. Thank you, it's just what we need"*. This drop in sustained adoption is a unique problem when creating technologies to support mothers in gaining confidence to breastfeed in public due to the fact that on one hand we as researchers want to encourage mothers to become independent and feel confident without the need for FeedFinder but on the other hand also need the community to continue to adopt the technology to support other community members.

Interestingly our initial expectations of gender and use of FeedFinder were challenged by one survey response *"App is on my partner's phone and was only used during his paternity leave,*

seems like a good idea.”, with a father using FeedFinder as an information resource for baby friendly locations.

3.8.6 Search Strategies

The way in which the community engaged with searching and contributing within FeedFinder differed between; on-demand use, planning behaviour, and pre-emptive expectations. Our initial expectations of FeedFinder were of mothers using the application to search for locations nearby whilst they were visiting the local area however it would seem that this is not the case with on-demand use being discussed by only one response - “*have used to double check suitability of cafe and when had to change plans at the last minute.”.* Indeed, this finding correlates with the quantitative analysis within which on-demand use was found to be typically quite low. However, the majority of comments regarding search behaviour discussed how mothers used FeedFinder as a tool as part of their prior planning process for visits to the local area. The expectations of mothers when using the application was that they were required to be at the location to leave a review. This was most likely due to the map initially focusing on their location when it is first launched and only presenting nearby results within their neighbourhood rather than local businesses further afield. The mothers would then have to pan around the map performing additional search requests within the vicinity of where they had been in order to identify the venue that was visited. This process was less than ideal and demonstrated that searching for nearby locations was something that was not clearly conveyed, as one respondent suggests *“Wishes that you could add places once you are home, I've been to a few places and when I've went to leave feedback haven't had a phone/Internet signal but was unable to rate once I had left the place, which is a shame!” – “It is frustrating that you can't view places that are not near your current location without zooming right in” - “Would be better if I could search for where I'm going to not just where I am at the time”*. Due to this issue of searching for locations within the application a search box was added to the main map screen that allows for the searching of locations, businesses, and street names.

Interestingly, around ten mothers responded with pre-emptive expectations of using the app in support of their breastfeeding experience prior to the birth of their child - *“I haven't had my baby yet so haven't needed to use the app, however I will definitely use it when I have had the baby!”*. This group of users were obviously preparing for the arrival of their child and had found the app on the app store or had been recommended to download it by a friend, as one

respondent demonstrates *"I am expecting my first baby in the next few weeks so intend to be using this much more over the next six months or so. it was recommend to me. great idea!"*.

3.8.7 Technical Issues and Features

During the deployment of FeedFinder it was unfortunate that there were a few technical issues with uptime and SSL certificate validation that meant the API driving the application was unavailable for short periods of time resulting in issues around presenting data, searching and adding venues, and leaving reviews – *"The app is slow to respond when adding a feeding place or completely crashes which means having to start again. […]"*. Survey responses also uncovered a number of usability issues within the application and called for additional features to help them navigate within the application, such as list views, search boxes, and venue types and filtering mechanisms - *"Very difficult to navigate. States how many locations but does not give a list of places, you have to zoom around a map to try and discover yourself where is bf friendly."* - *"initially was unable to get this app to work. think app is brill idea but would prefer a filter on app so i can quickly find dedicated nursing areas (eg john lewis in newcastle)- curently have to read reviews to determine this".* Within the initial launch of FeedFinder it was not possible to remove or amend reviews that were made and as such mothers were concerned they had left inaccurate review ratings - *"There is no way to correct your star rating, I mistakenly didn't give any stars and so the place I visited looks like has a poor rating. Could do with being able to amend your own review."*. In response to this issue, we added additional functionality in order to allow users to delete and resubmit venue reviews.

3.8.8 Promotional Awareness

Although the research team made efforts to publicize and promote FeedFinder we also saw strong indications that personal recommendations were the prevalent form of promotion of the application - *"I am expecting my first baby in the next few weeks so intend to be using this much more over the next six months or so. it was recommend to me. great idea!"*. We saw this within the local breastfeeding support groups within the North East especially, with mothers interacting with the application before the birth of their child - *"My baby isn't here yet so haven't fully utilised the app but have told loads of people about it and expect it to be a lifesaver. Thanks!"*. Given that FeedFinder was a community driven project, the community did indeed highlight their expectations around commitment and engaging with the project.

However, there were also expectations by some members of the community that the research team should be using traditional advertising methods to promote FeedFinder -*"I feel it needs to be advertised more so that it is updated properly to reflect What's out there so mums everywhere don't have to feed in the car when they cant find anywhere to sit down comfortably and warm"*. Reflections such as these demonstrate that existing models of consumer behaviour was also evident within the community. Indeed, responses often included advice on potential outlets for promoting FeedFinder, both online and offline as well as advocacy and support groups – *"This could be an amazing app with a bit more development. Have you approached possible partners eg NCT, La Leche League, Netmums?".* These calls to share and promote FeedFinder with other organizations was a clear indication that these mothers highly valued both the information within the application and the community around the application. Others wanted to use the collective strength of breastfeeding support groups as a mechanism for publishing - *"think this application will be great once more breastfeeding mums update it with more places. perhaps need to contact breastfeeding support groups to promote it more and get the mums there to update"*. As mentioned previously, we also saw a number of breastfeeding support workers responding to the survey who adopted FeedFinder as part of their educational training with new mothers - *"I am a breastfeeding supporter and plan to recommend this app to parents and parents to be that I meet"*.

Only two survey responses included requests for additional functionality around organising and promoting local meet ups, specifically around breastfeeding advocacy and support - *"Could you include breast feeding groups meetings / bf cafes etc?"*. Initially these requests were overlooked by the research team, however we began to see a pattern emerge around using venue reviews for the purposes of arranging social gatherings, educational workshops, and support groups in breastfeeding friendly venues. Further thematic analysis of the qualitative review data (Simpson et al. 2016b) demonstrated that this often occurred throughout the UK and that there is a clear motivation to use FeedFinder as part of a promotional tool to organize social events and local meetups. These were either events that occurred weekly or one off promotional events by business owners and comprised of leaving a review on the venue as a way of publicizing potential events.

Sentiment of comment	Example response	Codes assigned
Positive	*"As a breastfeeding worker, I use this app to show new mums how easy it is to find a decent place to feed, especially if they are worried about public feeding. It's a great local app!"*	Breastfeeding Healthcare Worker
	"I live in Essex and because the app is new not many locations have been added so far. However it is a great start and I will start adding locations"	Motivated contributor, Limited use, Potential for Technology
Negative	*"There are far too few reviews for this app to be useful. Many more should have been added prior to the app being released. I think I have added more reviews than the app builders!!"*	Promotion, Limited use, Expectations of pre-population
	"There are far too few reviews for this app to be useful. Many more should have been added prior to the app being released. I think I have added more reviews than the app builders!!"	Promotion, Limited use, Expectations of pre-population
Neutral	*"According to my app there is nowhere to breastfeed in Wallsend"*	Limited use, Expectations of pre-population
	"Info was a little limited last time I logged in, so haven't used very much, but this will only increase as more people use the app."	Potential for Technology, Limited use

Table 3. Illustrative examples of survey responses with sentiment and codes assigned

3.9 Summary

FeedFinder offers mothers the ability to contribute data of their lived experiences and share knowledge with other breastfeeding mothers. The collection of real-time, in situ, real-world data provides a unique perspective of actual unbiased interactions with the system that is afforded by exploring interaction data from within a community driven information system. FeedFinder offers a simple rating and review service for breastfeeding mothers to locate breastfeeding friendly locations. FeedFinder is sustained and supported by User Generated Content (UGC) from breastfeeding mothers and it was important to leverage enough localized support from nearby community members in order to overcome the cyclical cold start

problem wherein value is only derived from mass contributing behaviour but is not achieved by systems with limited content and thus these systems fail to motivate further contributing behaviour due to a perceived lack of value to the user. In order to overcome this issue, FeedFinder was bootstrapped with content that was provided during the initial design consultation with the breastfeeding support groups. The focus in this instance was to promote growth through focusing on localized areas in order to prompt others into deriving value from the information resource and encourage individuals to create content within the application.

The resulting data from FeedFinder is currently being explored as a tool to enable data driven service provision by NHS healthcare professionals, where practitioners with limited funding for breastfeeding healthcare provision can take a more target approach to identify and deploy necessary healthcare practitioners with full effect using the data derived from this form of technology. The data within FeedFinder can also be used to as a tool to promote change within local business to encourage positive breastfeeding experiences within their own establishments through two distinct approaches; incentives for business owners, and as evidence to support policy change. Local businesses have a vested interest in promoting custom within their premises which can be achieved through a 'TripAdvisor' style effect that encourages businesses to become more breastfeeding friendly by observing and responding to reviews left by the community. The second approach to utilizing this data focuses on using FeedFinder to identify common themes within review information for the purposes of deriving a set of best practices for business owners. These themes could be utilized by NHS healthcare professionals to inform educational materials or evidence as part of the formation of policy to enact change within local business.

Chapter 4. FeedFinder Analysis: Towards Understanding Community Behaviour

4.1 Introduction

HCI Researchers are increasingly aiming to deploy and develop applications 'in-the-wild' in an effort to gain insight into the genuine adoption and appropriation of technologies in the wider world, outside of the lab. In contribution to these efforts this chapter presents an analysis of FeedFinder over a 19-month deployment with over 4055 users who have contributed towards a valued community driven health resource to support women breastfeeding in public. The analysis, conducted by the research team [28], attempts to understand the user behaviours during application use as well as the sociodemographic information around mapping behaviour and general use of the FeedFinder application. Performing this analysis is achieved through the observation of Application Programming Interface (API) logs that were collected during application usage. The logs were segmented into sessions of use in order to describe the typical behaviour of a user during application use. It was then possible to cluster user behaviour within these sessions to understand the different types of actions performed within a single session. Using this approached identified three distinct modes of engagement that can be described as; seeking, exploring and contributing behaviours. Understanding how and when mothers were interacting with FeedFinder provides us with deeper contextualized knowledge when designing features that encourage engagement such as prompting users to leave reviews, add new venues, or find similar locations. This is also possible due to the spatial nature of the data that can be understood through various data sources such as OpenStreetMap to identify the nature of the area, namely residential, industrial, commercial, as well as the sociodemographic factors that describe levels of deprivation through the Index of Multiple Deprivation (IMD)[29]. Using these datasets, it was

[28] The research team consisted of Dr Robert Comber, Daniel Jamison, Dr Aftab Khan, and Andrew Garbett. Together we formulated the research approach, prepared the dataset, and performed the analysis.

[29] The Index of Multiple Deprivation is the official measure of relative deprivation for small areas in England and Wales as defined by the Office of National Statistics operating within the United Kingdom.

possible to identify that users pre-emptively search for locations as opposed to searching "on-demand" for the majority of observed sessions. The results also suggest that mothers typically map more deprived areas than affluent areas, suggesting the desire to map out locations where breastfeeding is not the norm in order to alleviate anxieties of breastfeeding publicly.

4.2 Methodology

The aim of this analysis is to quantitatively define user behaviours in the context of a location based rating and review mobile application. For this purpose, data was collected over a period of 418 days between July 2013 and September 2014. Within this time 4055 users registered with the FeedFinder application. The data is in the form of Application Programming Interface (API) transactions that were logged in the server code which handles communication between the mobile application and the server logic. These transactions are logged for actions such as opening the application, registering an account, logging in, searching for venues, viewing a venue, adding a venue and leaving a review. Within these actions it is possible to identify specific users as well as the parameters within the action e.g., latitude and longitude of a search request. From this transaction data it is also possible to differentiate between requests made using either the iOS or Android application. An overview of the dataset can be seen in Table 4.

Data	**Android**	**iOS**	**Total**
Users	873	2055	2928
Sessions	2296	5279	7575
Reviews	385	541	926
Added Venues	368	629	997
Transactions	14726	51849	66575

Table 4. Total number of users, sessions, reviews, venues and transactions within the restricted FeedFinder dataset

Observing single interaction events within the transaction data is limited to the actions that are available to the user. In order to provide an overview of these user interactions over a period of use, a number of transaction logs were condensed into a session of use that described the actions taken by the user, descriptive statistics about the state of the application, as well as the timings of these events. Although each transaction was logged using the API defining the start

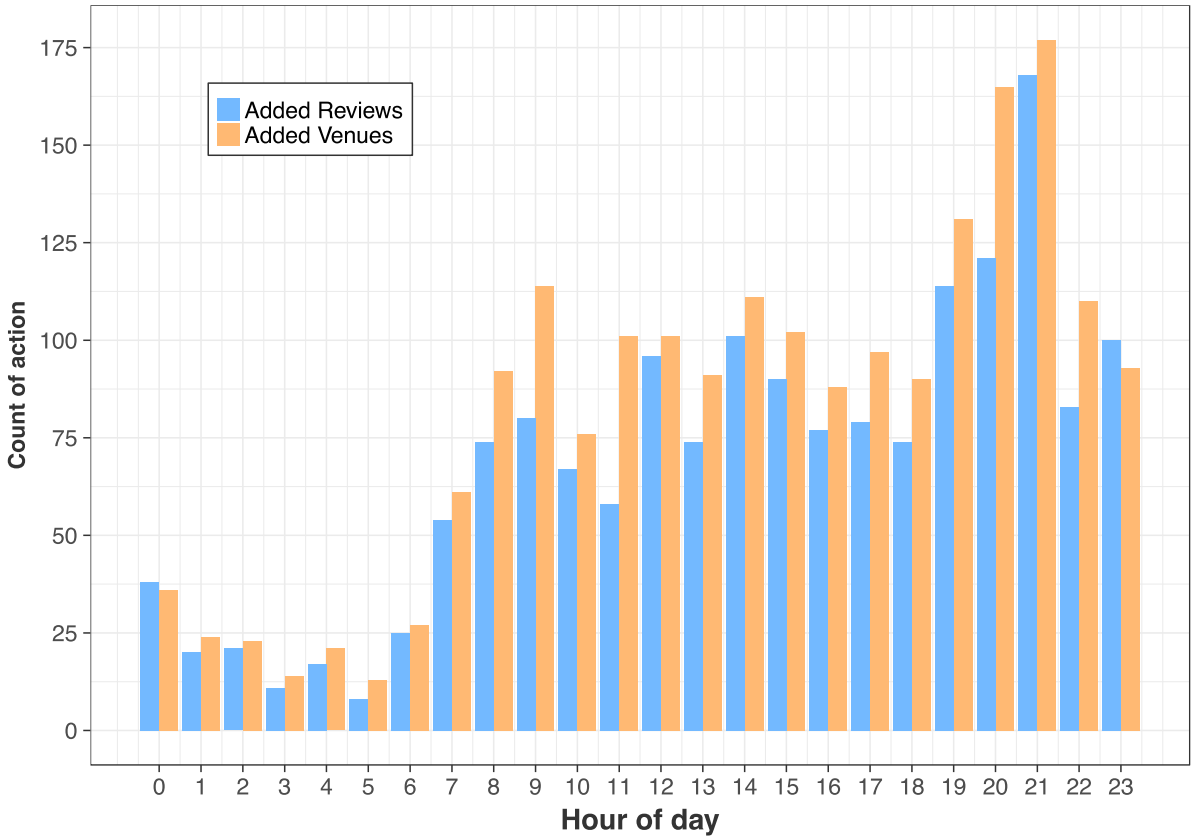

Figure 6. Session feature distributions for submitting reviews (SF6), adding a venue (SF5) throughout the day

and end of a session is problematic in that the user does not explicitly start or finish a given session. The application was designed to perform an initial log transaction that indicated that the application had been opened however it was found that relying on this initial request was not always as accurate as presumed given that mobile applications can be held in a paused or background state while not in use and then reinitialised once requested. Therefore, two conditions were used to define the start and end of a session, these were; identifying an initial request that was performed when starting the application, and reaching a given threshold duration between completing two transactions. In the latter case a new session was defined if two transactions made by a single user were greater than 30 minutes apart. Once these sessions were defined, further processing was required to calculate representational features for a given session using the API transaction logs (see Table 4).

4.3 Data Overview

In this section we discuss the typical usage statistics of the FeedFinder application. shows the total number of sessions, reviews, venues viewed and added in the dataset

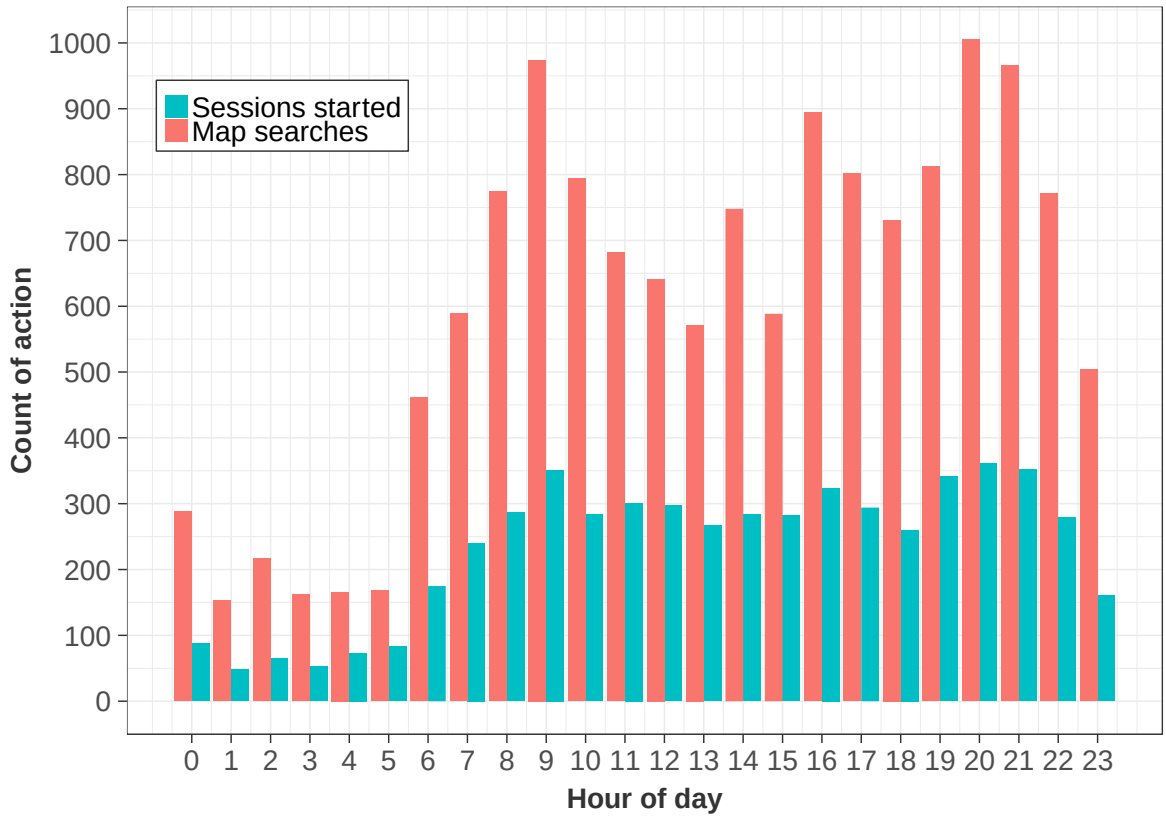

Figure 7. Session feature distributions for sessions and map searches (SF2) throughout the day

according to the hour at which the action was undertaken. This section also presents descriptive statistics of user behaviour such as; usage patterns at differing times of day, duration of sessions, description of actions during an average session of use, and types of venues added and explored during use. This section also discusses the use of the IMD dataset in order to understand the sociodemographic factors that may have impacted upon application usage.

4.3.1 Temporality of use

Figure 7 allows us to understand the times of day that participants make use of the application. From the histogram, it is apparent that map search behaviour peaks 4 times during the day around 9am, 12pm, 5pm and then 8pm. The application usage in the morning reflects pre-emptive searching to locate a venue to visit later in the day. We discuss this later in our analysis section. Similarly, the two peaks (12pm and 5pm) in map searching is most likely due to users attempting to find a venue whilst out and about in their local area. At 9pm the majority of reviews and venue submissions take place suggesting that participants exhibit a post-visit contributing behaviour. Usage later on in the evening could also have the purpose

of finding a venue for the following day. The highest usage for all actions appears to be towards the late evening, between 7pm and 9pm. This is in line with similar timings observed by

Böhmer et. al. (Böhmer et al. 2011) along with constant usage throughout all hours of the day in a similar fashion. This may also be the period when mothers have the most time to themselves to explore the application. Participants also interacted with the application for extended periods of time during each use and for a much greater period of time observed by existing research. During each session of use the average session duration for all participants was 164.14 seconds (~3 minutes). Interestingly, participants spent longer using the FeedFinder application than the 71.56 seconds average application usage duration observed by (Böhmer et al. 2011).

4.3.2 Understanding the typical user

Over the duration of the study, participants had on average 2.6 sessions over a period of 25 days. However, those participants that interacted with the application on more than a single day exhibited a greatly increased level of engagement with an average of 4.16 sessions over an average period of 53 days, accounting for around 48% (1366 users). Within sessions users could perform a series of actions, these can be described as performing a map search, viewing or adding a venue and leaving a review. During a session participants performed on average 7.37 actions. The largest session observed contained 80 user actions, including 53 map search requests, viewing 27 venues and lasting 27 minutes. We found that 16.3% (475) of participants added at least 1 venue, typically adding 1.38 venues within their total usage of the application. A similar figure of 13.7% (399) of participants contributed at least 1 review and those users on average contributed 1.42 reviews in their lifetime of using the application. Participants viewed an average of 1.45 venues and performed 5.2 map searches per session. This high number of map searches in comparison to the number of venues explored suggests an imbalance in the content available to users. However, 77.5% of sessions had at least 10 venues visible to the user when performing a map search. Users on average search 1.17 miles from their initial map search, suggesting focused search behaviour.

4.3.3 Mapping the venues

The application made use of the Foursquare API that was also able to categorize venue types that were added in the application. Using the Foursquare venue categories, four types of venues that were added most often in the application were Coffee Shops (108), Cafés (95), Pubs (82) and Department Stores (74). These locations are what might be thought of as typical locations in the daytime where people gather socially. Given prevalence of these four categories it is to be expected that these venue categories also received the highest numbers of reviews. The most reviewed venue categories were Department Stores (119), Coffee Shops (95), Cafés (87) and Pubs (60). Venues were viewed on average 7.98 times with the most viewed venue being viewed 114 times. The most viewed venue category was that of Department Store, followed by Mall, Deli and Café.

4.3.4 Index of Multiple Deprivation

The Index of Multiple Deprivation (IMD) refers to the official measure of relative deprivation for small areas in England and Wales, as outlined by the Office of National Statistics (ONS). These areas are defined as Lower Super Output Areas (LSOAs) that contain an average of 1,500 residents within any given boundary. There are 32,844 LOSAs that are ranked between 1 (most deprived) to 32,844 (least deprived) using seven domains to produce an overall relative measure of deprivation. These domains are; Income, Employment; Education, Skills and Training, Health and Disability, Crime, Barriers to House and Services, and Living Environment. This ranking metric allows for the direct comparison between different neighbourhoods within England and Wales based upon a normalized deprivation measure.

4.3.5 Data Limitations

Unfortunately, during the first 51 days of the deployment an error in the logging of the API request resulted in specific parameters related to browsing venues being omitted. The effect of this issue is that it was not possible to determine the user performing the request and as such 1127 users who registered within this time period have been excluded from these results.

4.4 Analysis Methodology

In this section we discuss our analysis of participant interaction behaviour within the application and the associated geographic context in which this behaviour is observed. The adoption and usage of the application differs between individuals however common

behavioural patterns would be expected to emerge over time. In order to explore if generalizable behaviours exist within the dataset we analyse all participant behaviour exhibited within the lifetime of the study and derive descriptions of typically observed

Session Feature #	Session Feature Description
SF1	Session duration in seconds
SF2	Total number of map searches performed
SF3	Total number of venues a user was exposed to when interacting with the map
SF4	Total number of venues viewed
SF5	Total number of venues added to the map
SF6	Total number of reviews submitted during the session
SF7	Total number of reviews a user was exposed to when viewing the first venue of the session
SF8	Total number of reviews a user was exposed to during the session
SF9	Average number of reviews per venue that a user was exposed to during the session
SF10	Average number of venues a user was exposed to for each map search during the session (if user performed multiple map searches)
SF11	Search area radius (the maximum search distance from origin)
SF12	Average search distance from origin
SF13	Search duration (time between the first and last map search in a session)

Table 5. Description of session features within sessions of use

behavioural patterns. We also explore the geographic nature of our dataset through the identification of home locations and the use of the Index of Multiple Deprivation (IMD). We begin by examining user behaviour for our entire dataset through collating participant interactions into sessions of use. This session-based approach allowed us to condense interactions into session features such as number of map searches performed, number of venues viewed and number of reviews contributed. Using this data, we can then define a participant's behaviour within each session. Within our analysis of sessions, we present and discuss three types of behaviour that were observed, these are defined as contributing, exploring and seeking. We also begin to understand the geographic nature of our dataset through the use of the IMD. These geographic boundaries allow us to compare the sociodemographic factors that contribute to the way in which the community adopted the

technology. We do so by analysing how and where participants choose to map and the impacts of these actions on the adoption rates.

4.4.1 Defining Session Features

The analysis is based upon collections of explicit and implicit actions and data that are segmented via a rule based approach to form sessions of use. These sessions are condensed into a single row containing a number of features, see Table 5. These features summarize the overall actions performed by the user through observing both explicit and implicit interactions. Explicit interactions are defined as actions undertaken by the user directly, such as; total number of search requests [SF2], total number of venues viewed [SF4], total number of venues added to the map [SF5]. These features provide an overview of the explicit interactions by the user in order to describe the direct interactions between user and system. The session data also includes implicit data that is defined as computed or implied information that demonstrates the state of the system during session use such as; total number of venues visible during use [SF3], distance from initial search location [SF12], and time between first and last search request [SF13]. These attempt to convey the status of the system and the possible effects on user behaviour during use.

4.5 Session Cluster Analysis

After the data was segmented into sessions of use it was then possible to explore patterns and trends within these sessions using machine learning. The approach taken required a standard unsupervised machine learning approach given that the data did not contain predefined user types or session type labels. This led to the exploration of two clustering techniques, hierarchical clustering (Johnson 1967) and *k*-means (Lindsten et al. 2011). Hierarchical clustering (Johnson 1967) uses a greedy approach in which clustering choices are made based upon the pair of data points that minimize the distance (between the cluster centres and data points) the most. As a result of this behaviour, an early poor decision is unable to be fixed later and as such leads to poor results (Lindsten et al. 2011). Therefore, the analysis used *k*-means clustering (Macqueen 1967), which is a well-established and powerful tool for cluster analysis. The *k*-means iterative algorithm initialises *k* clusters throughout the data and then makes a first assignment for each data point using a similarity metric such as the Euclidean distance. The cluster centroids (the centre points of each cluster) are then updated as the mean of all data points belonging to each cluster. The process is then repeated with the aim of

finding a point in which the centroids do not change. Using the *k*-means algorithm highlights natural groupings of different session types. The value of k was calculated using the mean

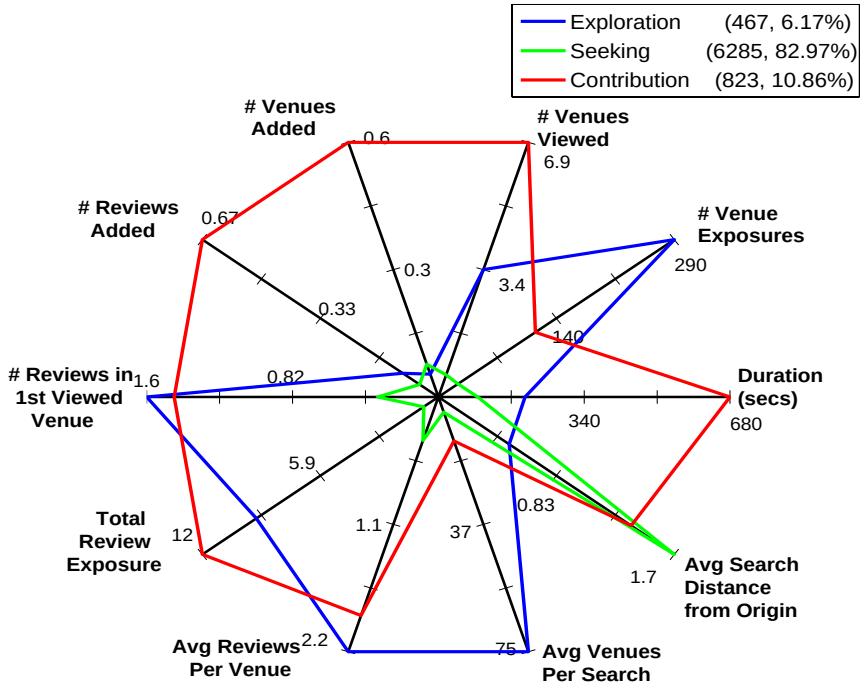

Figure 8. Session clusters show three distinct patterns of use; Exploration, Seeking, and Contributing

silhouette values (highlighting the separation between clusters) for a range of values of k (*k*={2-9}) and the ideal number of clusters found for session clustering within the dataset was 3. The results of the cluster analysis are highlighted in Figure 8 and shows three substantially different clusters. These can be seen using spider plots (Figure 8) that presents the maximum values on each session feature (represented by the 10 axis) and allows for the direct comparison between differing clusters within the same plot. Three distinct clusters formed around the 10 features used in the analysis which have been inferred as three distinct behaviours. These clusters are described as seeking, contributing, exploring types of behaviours and account for 82.97%, 10.86% and 6.17% of sessions observed respectively. The quantity of differing session types and the overlap between these clusters is represented in Figure 8 and shows that seeking behaviour is most often observed within the dataset.

4.5.1 Contributing

Within the session analysis there were sessions that demonstrated a distinct form of contributing behaviour. This interaction behaviour is defined as submitting a high number of reviews and venues, and consequently exhibits prolonged session durations. Clusters

displaying contributing behaviour are also defined by a much longer average session duration (~11 minutes) than the two other identified clusters. This is most likely due to the increased time taken to complete the review and venue addition process which is inherently a lengthier process than browsing venues and reading reviews. Contributing behaviour is an important factor in sustaining a community driven information resource however given that this action requires high levels of engagement from community members rather than passive consumption, it is perhaps not unsurprising that this form of behaviour accounts for only ~10% of sessions that exhibit contributing behaviour. The contributing session type is also associated with the highest number of review and venue contributions with 59% of all reviews and 49% of all venues added to the map being attributed to the identified contributing behaviour cluster. Interestingly those users who engaged in a contribution behaviour were often presented with a much lower average (~14 venues per search request) than the two other behaviour clusters observed suggesting that contributing users were more likely to contribute when the map was less densely populated. Within the descriptive statistics, presented previously, it was found that the majority of reviews occur during the late evening. Our initial speculation of reviewing behaviour being a post-visit occurrence can further be confirmed by the increase in average search distance from origin. This increase in search distance demonstrates that participants had to pan away from their current location and perform additional searches in order to locate the venue they wished to review.

4.5.2 Exploring

Exploration sessions are those in which the participants typically explore a substantially higher number of venues within a relatively small search area. This behaviour of exploring venue information (i.e. tapping the map marker and viewing the venue) is also completed over a much longer period of time in comparison to seeking behaviour but substantially shorter than contributing sessions. Perhaps more interestingly, this exploring behaviour also correlates with a high average number of reviews per venue (2.2), suggesting that participants who observe the contributions of others results in an increased level of engagement and exploring behaviour. The higher level in the number of reviews the user was exposed to, as well as the longer session duration, would suggest that participants who are “exploring” are taking the time to browse more venues and read more reviews. Participants are also exposed to a much higher number of venues, with an average exposure of ~286 venues per session, within a confined area, resulting in a reduced number of search requests. This type of

exploring behaviour can be expected to correlate strongly with the high number of venues available to explore. Although contributions were made during these types of sessions they were focused on reviewing rather than adding new venues. Participants contributed a relatively few number of reviews in comparison to the contribution session type, contributing ~5% of reviews and ~2.5% of venues. This could be the result of already being exposed to high levels of venues and reviews left by others and thus decreased motivation to leave yet another review in the already well reviewed venues.

4.5.3 Seeking

Sessions within this cluster typically resulted in very low engagement in regards to contributing or exploring behaviour. A *seeking* session typically exhibits a much greater search distance from origin with low levels of contributing behaviour and the lowest average number of reviews or venue exposure. This type of behaviour is exhibited during the majority of user sessions, with ~83% of all sessions observed being attributed to the seeking cluster type. The majority of sessions can be attributed to this behavioural type and may be symptomatic of both the relative infancy of the dataset behind the application and its dependency on the growth of community contributions. This behaviour is akin to *Lurkers* (Nonnecke & Preece 2000) who are described as the silent majority who interact very little or not at all within online communities. Within the limited number of venue interactions that participants experienced, venues typically included a relatively sparse number of reviews. Understandably it would seem that fewer interactions with venues and reviews directly correlate with the low contributing type of behaviour. That being said, participants did actively engage in seeking behaviour and continued to seek, far greater than explorative type behaviour, outside of the initial search area for an extended period of time. However, this is most likely due to the low number of venues being displayed to the participant when performing map searches.

4.6 Pre-emptive Vs. On-demand Search Behaviour

The expectations around search behaviour when using a location-based rating and review mobile application in this context are currently unknown. The initial temporal analysis in regards to the times of day in which the application was used (Figure 7) suggested that participants used the FeedFinder service, from home, as a pre-emptive planning tool to find locations they may wish to visit later in the day. However, it can also be expected that on-

demand search behaviour would be observed within the dataset, behaviour that can be described as users who are away from home perform a search of the immediate vicinity rather than searching over extended distances in a planning type of behaviour. This type of use is envisaged as on the spot searching for venues nearby when a mother needs to breastfeed their child expectedly. In order to determine the search patters of users within the application both the current location of the user performing the request and the location's context (i.e. residential, commercial, industrial) must first be identified. Once all search requests have been categorized into different location types it is then possible to identify clusters of residential search requests that provide us with an approximation of the user's home location. This data can then be correlated with the times of day to demonstrate where search requests originate from and identify if the user is searching within a residential location (i.e. at home, late in the evening) or on-demand (i.e. within a commercial location, during the day). This can be achieved by observing the geo-spatial coordinates that have been captured within the log data when both initially opening the application, and performing subsequent search requests. The current location of the user is defined by the initial search request when opening the app. This is location is defined as the *session origin* and referred to throughout the proceeding analysis.

4.6.1 Defining a Home Location

In order to identify home location each user's session origin was grouped into similar clusters using a rule based approach. These rules are based upon an interpretation of the data and used to approximate home locations. Within this process users who only have 1 session of use have been excluded as it is not possible to confidently identify a home location. The conditions to identify a home location are as follows:

I. Users require more than 1 session of use.
II. Users require a single cluster of initial session origins within a radius of 50 meters[30].
III. Session origins that were observed between the hours of 7pm and 7am.

[30] US Federal Communications Commission mandate (http://www.fcc.gov/e911) requires location technologies to determine a caller's location within 50 metres for the purposes of emergency services.

Applying these conditions to the dataset yielded 173 home locations however a number of users had multiple session origin clusters within different areas. In order to determine the most likely home location within these remaining areas it was possible to utilise the OpenStreetMap platform (OSM) in order to identify locations that reside within *residential* areas. A further 121 locations were identified as residing within *residential* areas and as such these locations were marked as home locations. Those locations that could not be identified through the OSM platform as being residential were annotated by the research team using a custom crowdsourcing interface developed for this purpose. The tool displayed the location on a Google Map and presented a Google Street View of the given location. The researcher was then asked to select from three possible location types; (i) Residential, (ii) Commercial or (ii) Other. From this process an additional 140 home locations were identified. In total this three staged approach yielded in a total of 434 home locations being identified within the dataset.

4.6.2 Search Behaviour Analysis

To determine if a session is classified as a pre-emptive or on-demand search request, the search origin must be first identified as residing at either a home or other location. Those users who make a search request whilst residing at home are assumed to be searching pre-emptively, as they are not travelling within a commercial area. Those sessions that originate outside of the home location are assumed to be either (i) on-demand, or (ii) pre-emptive in search behaviour. On-demand sessions can be described as a search pattern that exhibits a confined search area nearby given that the user aims to find a location to breastfeed in the immediate vicinity. In order to calculate an approximation of this confined search area it is assume that breastfeeding mothers are unlikely to walk further than 20 minutes to visit a venue given they may have a hungry baby to attend to. Therefore, a threshold radius of 1.67 km is based upon a 20 minute walking distance and the average human walking speed of 5 km/h (Bohannon 1997). Search distances below this threshold are classified as on-demand given the immediate proximity to the user. After applying these conditions to the dataset it was found that on-demand search behaviour accounted for only 20.83% of all search behaviour. The majority of search behaviour, 79.17%, of search requests were identified as pre-emptive search behaviour. This strongly suggests that breastfeeding mothers exhibit a planning-oriented search behaviour to identify potential breastfeeding locations whilst at home. In order to explore this assumption further the initial clustering conditions were

removed so that all search requests could be used in a broader analysis. Removing these initial conditions, it was possible to identify search requests as home location if they were made between the hours of 7pm and 7am (overnight) and resided within a residential area. The

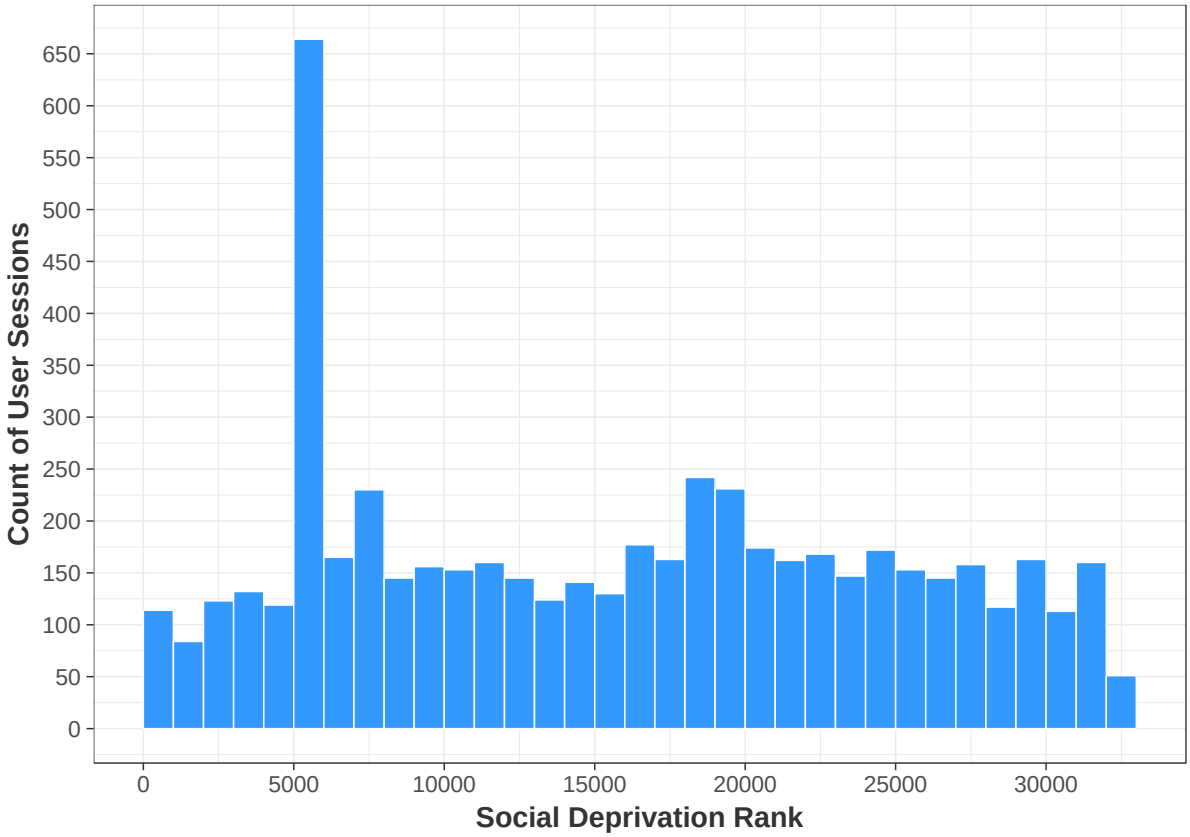

Figure 9. Distribution of Social Deprivation Index rankings of the areas in which activity was observed

remaining requests, outside of a residential area between the period of 7am and 7pm were then defined as not at home. Using this approach, it was found that pre-emptive search behaviour was still the majority behaviour with 63.65% sessions exhibiting pre-emptive search behaviour and 36.35% of sessions exhibiting on-demand search.

4.7 Sociodemographic Factors of Mapping Breastfeeding Locations

Family, close friends, and the wider community in which women live contribute towards the decision to breastfeed publicly (May 2006; Nelson 2006). Therefore, it is important to understand the socio-cultural context within which mothers interact with FeedFinder in order to determine the motivations behind engaging with the application. As mentioned previously, average breastfeeding rates within the UK are far below the levels set out by the World Health Organisation and the National Health Service (McAndrew, F., Thompson, J., Fellows, L.,

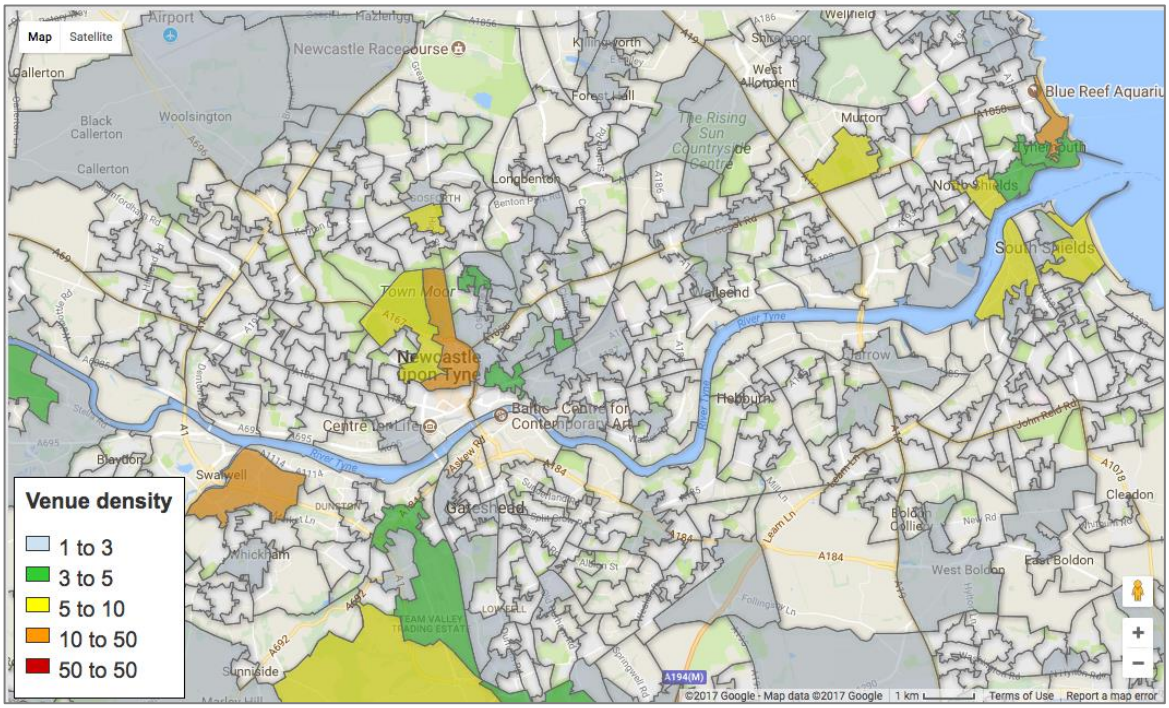

Figure 10. Venue density map of the North East showing areas mapped by of FeedFinder

Large, A., Speed & Renfrew 2012). Within the North East breastfeeding rates (31.9%) are far below the national average (55%) with some of the lowest rates within the country and correlates strongly with socio-economic factors within inner city areas (Pain et al. 2001). Indeed, Newcastle upon Tyne is ranked as the 40th most deprived local authority out of 433 local authorities (Government 2011) and where only 31.4% of women breastfeed their child after 6 – 8 weeks, below the average breast feeding rate of 55%. Given this, we wanted to understand how the correlation between lower rates of breastfeeding within areas of high deprivation effected the adoption and user behaviours observed within the FeedFinder application.

Although it is not possible to directly correlate the FeedFinder service as having a direct impact on breastfeeding statistics, it is possible to begin to understand the demographics of those users who interacted with the application and how it may have promoted breastfeeding in areas within areas of lower breastfeeding rates. To achieve this the Index of Multiple Deprivation and NHS Breastfeeding Rates within England (2012/2013) were used to explore the behavioural data captured during FeedFinder usage. Within the FeedFinder dataset activity was observed across 3009 Lower Super Output Areas, containing an average of 0.52 venues, 0.85 users and 2.24 sessions per Lower Super Output Area. The mean Index of Multiple Deprivation Rank (IMDR) is 15671 (± 9070), median IMDR is 15809, minimum IMDR is 6

and max is 32477. Figure 9 shows the distribution of IMD rankings of the areas in which session origins were observed. From this figure it is possible see that there is a slight increase of more deprived areas that appear in our dataset. This suggests that on average the community used the application in more deprived areas rather than affluent areas.

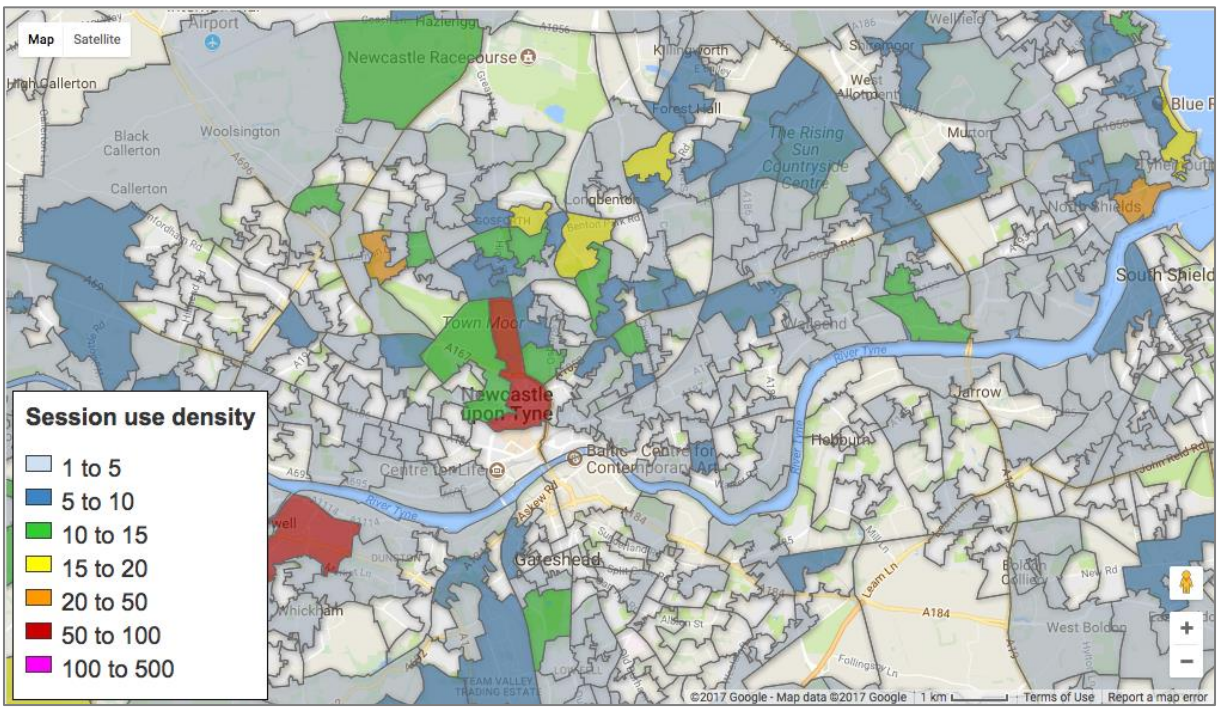

Figure 11. Map of North East of England showing density of FeedFinder session origin locations

4.7.1 Understanding the Mapping of Locale

Existing research of crowd sourced mapping (Quattrone et al. n.d.; Thebault-spieker et al. 2015; Mashhadi et al. 2013) demonstrates that efforts generally focus on areas with higher population density with affluent areas more likely to be mapped with higher accuracy than areas with greater levels of deprivation. Stephens (Stephens 2013) also suggests that adoption of platforms such as OpenStreetMap and Google MapMaker is not uniformly distributed between genders with young (<25 years), educated (degree level), males participating more often in the mapping of locales. Although this gender imbalance is not directly related to the FeedFinder community it demonstrates that existing mapping practices are not entirely without biases. In the context of FeedFinder, which is directed towards a female audience, the analysis focused on understanding how factors of affluence effected mapping behaviour within a community driven health resource. In order to explore this notion further it was possible to utilize the geospatial data associated with added venues and calculate the IMD rank accordingly. The results from this analysis can be seen in Figure **12** that demonstrates a higher number of venues have been added in more deprived areas where breastfeeding rates

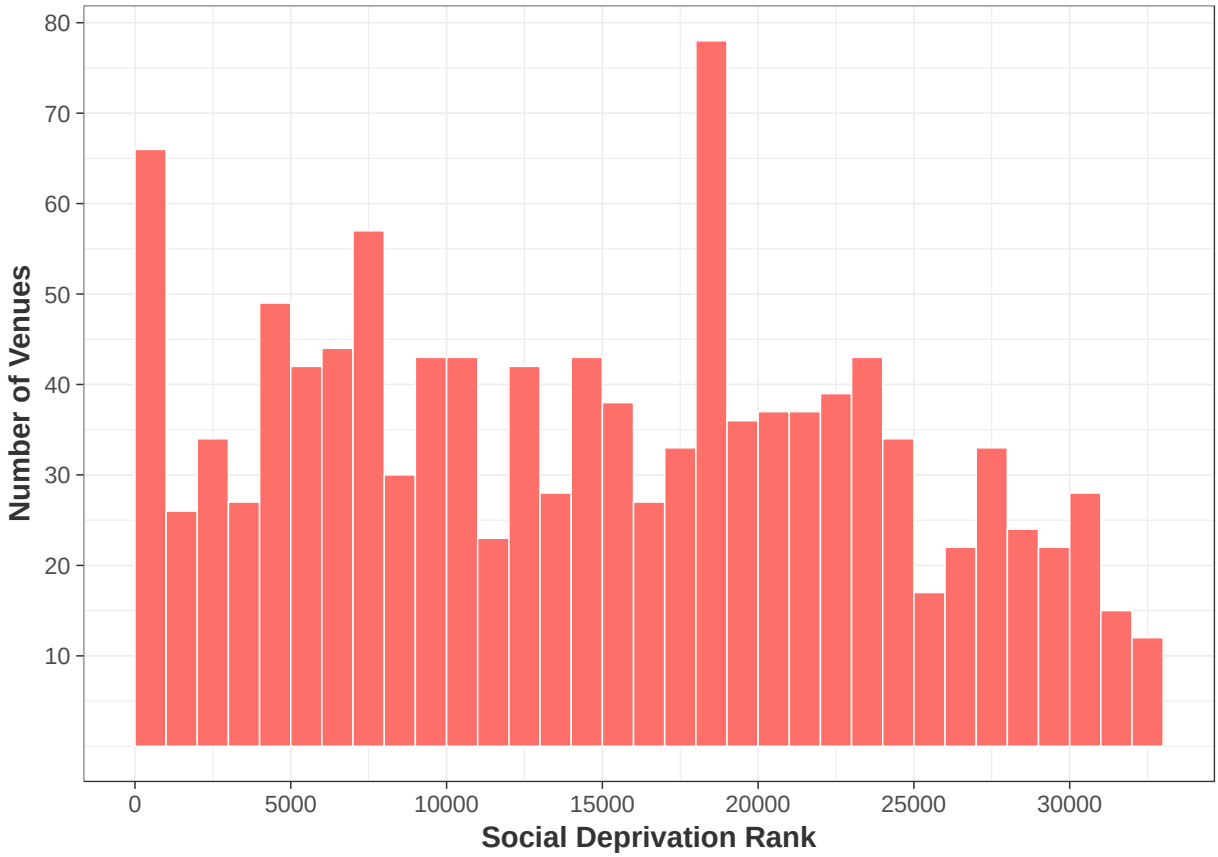

Figure 12. Distribution of Social Deprivation Index rank for contributed venues and associated breastfeeding rates after 6-8 weeks

are typically lower. Conversely, those areas that are more affluent and have higher rates of breastfeeding have a lower number of venues being added by mothers. In contradiction to existing research around crowd mapping, the analysis suggests that deprived areas are mapped more often than more affluent areas. There are two possible explanations as to why this may be the case. Firstly, commercial retail premises are more likely to reside within inner city urban areas (Pateman & Statistics 2010) and as such the mothers are simply mapping areas that they regularly visit or are available to them (i.e. visiting restaurants within inner city locations). However, evidence also suggests that 98% of the most deprived LSOAs in England are urban areas (Government 2011) which is somewhat surprising given that 80% of the population reside within these urban areas (Pateman & Statistics 2010). Secondly, existing studies have shown that mothers experience social anxieties around breastfeeding in public (Boyer 2011), coupled with the fact that there are lower rates of breastfeeding in deprived areas, it may be that mothers feel the need to map out these locations as a way of mitigating their anxieties around breastfeeding in public. With a list of readily acceptable places to

breastfeed in an area, within which breastfeeding is not the norm, it would be understandable that mothers may seek support from FeedFinder in this manner. This would also explain why on average we see sessions of use originating in more deprived areas that have been identified as home locations, further suggesting the dataset includes those mothers in deprived areas where breastfeeding is not the social norm.

4.7.2 Discussion

This case study contributes to the growing body of large-scale deployments of mobile applications in the wild and provides insights into understanding behavioural analytics en mass. The analysis focuses on understanding user behaviour at session use level in order to understand generalizable behaviour within a location based review service around breastfeeding in public. Drawing upon the analysis of over 66500 transactions in over 7500 sessions, the findings suggest that sessions of use can be clustered according to seeking, exploring, and contributing types that are indicative of the user behaviour observed within the FeedFinder application. Underlying these cluster demarcations are factors concerning content exposure, durations of use, in-app search distance as well as others. Understanding the search behaviour of users by identifying home locations through a condition based approach that incorporates location, temporality, and tertiary data (OpenStreetMap) in order to identify and differentiate between two search patterns; on-demand and pre-emptive search. Using the IMD dataset it has also been possible to explore the sociodemographic factors that encourages women to map their locale in different contexts. Both the search pattern behavioural analysis and the IMD data analysis correlates with initial findings from the previous chapter (see survey analysis) suggesting that mothers exhibit planning behaviour when intending on breastfeeding in public which can be seen in the majority of search sessions (~63%) exhibiting the pre-emptive search behaviour and the mapping of less affluent areas where breastfeeding rates are at their lowest. This approach to deployment and methods of the behavioural and demographic analysis explore the implications of large-scale, in-the-wild deployments utilising mobile technologies.

4.7.3 Content-Contribution vs. Consumption

The vast majority of sessions in the dataset are typically of the seeking behavioural type, where users are exposed to few venues and consequently perform searches over a wider area. This form of behaviour may be representative of the relative youth of the application and the

need for maturation in the community-contributed data. Nonetheless, the data presents significantly greater proportions of user-contributions than those identified in similar studies of online digital health networks (van Mierlo 2014). Instead of a distribution of user-participation to a 1% rule of super-users, contributing users account for a much larger percentage (7.36%) of the total user base. There are a number of possible explanations for this, such as the openness and low barriers in contributing and exploring the information, the increased personal relevance of the data derived from the delivery of in-situ and contextually relevant information in mobile form, or as the survey analysis shows; a sense of obligation to contribute and support mothers experiencing similar concerns.

4.7.4 Understanding Communities

Understanding the behaviour through the logging of vast quantities of users data is a challenging task that, requires complex techniques to interpret. The session based cluster analysis presented three distinct user behaviours that required the interpretation and description of results achieved through unsupervised machine learning. Although this describes the functional aspects of user behaviour - *what* are users doing – this session clustering analysis approach excludes the geospatial and sociodemographic context within which FeedFinder exists - *why* are users interacting in this manner and *whom* is engaging with the technology. Taking this approach also led to the asking of *how* and *where* are our users interacting with FeedFinder that is highlighted through both the descriptive statistics and search behaviour analysis. Without the understanding of the cultural complexity of breastfeeding in public and the social norms of breastfeeding in public within deprived areas, derived from the IMD, it may not have been possible to account for such high levels of pre-emptive search behaviour and initial mapping of more deprived areas. In taking this approach it has been possible to delve deeper into the societal fabric that constructs and limits community behaviour, and in doing so it has been possible to begin to untangle the complexities of large-scale deployments and the associated data created by community driven technologies.

4.7.5 Summary

This chapter presents an analysis of FeedFinder, an in-the-wild deployment of a location based rating and review mobile application that enables breastfeeding mothers to rate and review locations added by the community in regards to the suitability of a breastfeeding

location. The study collected data over an extended period of over 19 months and saw high levels of adoption and engagement with a community driven health information resource. Contrary to existing research around contributing behaviour within crowd sourced mapping communities (Quattrone et al. n.d.; Thebault-spieker et al. 2015; Mashhadi et al. 2013) the analysis highlighted that within the FeedFinder application, deprived areas are mapped more frequently than areas of higher affluence and higher levels of activity were observed within more deprived areas. This is attributed to two elements; mapping of urbanized locations where commercial areas exist, and the anxieties of breastfeeding women when visiting areas where breastfeeding is not the social norm. The findings from the survey analysis and overall high levels of adoption demonstrate that research deployments can and do have a real impact on the lives of participants. Through designing grassroots led community information resource it has been possible to provide the breastfeeding community with the means to support their own community and as a result, the FeedFinder application has seen continued adoption and use.

Chapter 5. Towards New Models of Participation

5.1 Introduction

The deployment of a community driven health resource, discussed in the previous chapter, identifies a need for communities to be able to engage with these forms of knowledge sharing platforms. However, this process of identifying a niche community, co-designing possible technological solutions, developing a novel technology, deploying the technology, and finally analysing the resulting output is an extremely research intensive endeavour. Undertaking research in this manner requires that researchers are the primary driving force behind the inception of these forms of technologies and is ultimately limited by the scope of the research team behind the initial concept. In order to encourage a more citizen-led approach to identifying and designing for a community issue this initial barrier must be addressed. Incorporated within a citizen-led approach to these technologies is also the ability to encourage discussion and participation between citizens and public officials through new models of information and technology commissioning. As observed within the Open Data movement, citizens are now able to delve deeper into the inner workings of Government through platforms such as Data.Gov and Freedom of Information Requests using services such as WhatDoTheyKnow. Indeed, an increased number of citizens are adopting and contributing to alternative data sources, such as FixMyStreet, through which to identify issues of public concern in order to afford greater transparency to the results of local government. These new forms of civic technologies begin to offer citizens the ability to take a more citizen-led approach to identifying and understanding public issues. However, there is a gap between retrospectively observing public data and the creation of tools to support data collection, discussion and participation within communities.

This chapter initially presents a discussion of existing commissioning practices that spans across a range of technologies and concepts around citizen-led information commissioning for a civic purpose. Reflecting upon these existing practices, it is possible to understand the current boundaries and limitations of these approaches and this chapter is used inform a framework for community commissioning (chapter 8) and the design of a novel commissioning platform (chapter 6).

5.2 New Models of Civic Participation

Engaging citizens in the commissioning of information is uniquely challenging problem that has been explored by researchers in the form of civic technologies such as; cycling in the city (Le Dantec et al. 2015), highlighting public issues with FixMyStreet, and civic consultation through physical devices (Crivellaro et al. 2015; Korn & Voida 2015). The important factor embedded within these systems is a shift in the way citizens interact with organisations of the state through data commissioning, collection and interpretation. The existing practice of data commissioning can be seen as a more transactional model of citizens requesting information from authorities and receiving a response in a one to one manner. This transition can be observed in the Open Government Data movement, that focuses on data transparency in order to enable citizens to hold to account the actions of government departments. Within this interaction the governing body acts as the creator, producer, and publisher of data that holds themselves to account and calls into question the actual levels of transparency offered. Accessing and interpreting this data requires both technical knowledge and skills as well as awareness of both the dataset and policies in place in order to understand the operational context.

Similar existing government services focus on simply relaying data to its citizens through online services. Citizen participation with these online government services is limited, at best, to commenting on the value of the service or dataset available, as seen within the NHS choices or Data.Gov.uk services. In these instances, the commissioning of information, datasets, or services remains firmly in the hands of the policy makers rather than the citizens whose lives these services may affect. However, we now observe new efforts to engage citizens in the ideation and commissioning of information through platforms such as WhatDoTheyKnow, an online platform to publicly perform Freedom of Information requests (FOIs) in relation to government data. Within this platform FIO transcripts of requests, responses, and resulting datasets can be observed and used by others. Although the process of FOIs has been available for a number of years through the Freedom of Information Act (2000), the mechanism of performing these requests has been altered by the WhatDoTheyKnow platform through a more structured and transparent process. The platform allows for the aggregation of FOIs in order to create an alternative and more transparent reflection upon the questions being asked of government as well as evidence responses of

government and the requests being made. In effect, this service offers citizens the ability to publicly commission data through FOIs and share the results of both the FOI process and associated data amongst other interested citizens. Through making visible this process of FOI requests, other citizens are able to understand the language, content and context of a successful request. Citizens are also provided with examples of high quality public official responses, providing an opportunity to learn how to ask appropriate questions of government in a manner that will solicit the most accurate and desirable response. The result of this is a more informed society through a more relational and participatory approach to civic engagement.

Similar to the notion above, the government now offer a parliamentary petitioning platform (https://petition.parliament.uk) that encourages citizens to campaign for issues they would like to see discussed in parliament, an action that would have previously only been achieved through advocacy groups or writing to a local representative. The petition platform has seen the creation of over 22,000 campaigns with the ten most signed petitions achieving between 230,000 – 4,000,000 signatures[31]. Online petitioning has made petitioning more publicly accessible and broadens the debate outside of the initial campaign, providing an online presence that citizens can refer to and share with others. The government response to these petitions is also made publicly accessible through the transcribed Hansard records as well as videos of the debate in government, where available. These services offer an alternative approach to encourage participation in the commissioning of both data and action and has transitioned from the existing model of transactional government to a more relational model of interaction between citizen and government. In a relational model, citizens have the ability to engage in the commissioning of data and services in a more public and transparent manner in order to encourage participation and discussion between both peers and government. Included in these interactions is the ability to disseminate a more coherent and transparent campaign that is easily accessible to the public allows for the formation of an interested parties around the issue at hand who are able to drive the campaigning process.

[31] https://petition.parliament.uk/petitions

The adoption of these technologies is a clear indicator that conducting this relationship online requires a certain level of structured process and mediation that is afforded systems designed specifically for this task. Looking more closely at these platforms (WhatDoTheyKnow, FixMyStreet, TheyWorkForYou, WriteToThem), the focus is on structuring and supporting this relationship between citizen and government through novel approaches to commissioning information as well as the presentation of existing and freely available datasets in a more structured and easily digestible manner. These forms of technology encourage the sharing and dissemination of collective knowledge and support civic action in a manner that is decoupled from government. The commissioning and generation of the data from these interactions is either carried out by the state, in the instance of the Data.Gov.UK platform or in response to FOIs held by a third party such as WhatDoTheyKnow or council-run FixMyStreet instances. However, in these instances the collection, processing, and analysis of the data continues to be provided *to* citizens rather than *by* citizens themselves, which would allow citizens to create alternative data sources to challenge and evidence issues. Achieving data commissioning and collection requires the development of technological infrastructure to commission, collect, and disseminate this information amongst citizens.

5.3 New Models of Peer-to-Peer Production in the Sharing Economy

Existing hierarchies of citizens as passive consumers are beginning to transition towards new models of shared, citizen-led, consumer production of goods, and services comprised of distributed and decentralized crowds facilitated by third party commercial platforms. With the adoption of these services, citizens are beginning to leverage their own assets (knowledge, skills, and physical assets) for the purposes of provisioning their own products and services, facilitated through the creation platforms and infrastructure by the commercial sector whom offer ease of access, scale of provision, and visibility within a marketplace as part of the cost of engaging with these services. This peer-to-peer model of consumer driven production has been described in various terms, including the Sharing Economy, Peer-to-Peer production, and Collaborative Consumption (Botsman & Rogers 2011).

Botsman & Rodgers (Botsman & Rogers 2011) identify the transition through the perspective of shared ownership and consumption and define the term Collaborative Consumption as "*the peer-to-peer-based activity of obtaining, giving, or sharing the access to goods and services, coordinated through community-based online services*" (Botsman & Rogers 2011). This

concept has been discussed in regards to collaboration online for the purposes of social commerce and resource sharing (Hamari et al. 2016), and can be seen in examples such as Couchsurfing[32] which is premised on the collective understanding of utilization of underused resources that centres on the notion of goodwill and indirect reciprocity – offering your home for free as part of a shared network within which you may also utilize other's whilst travelling. These initial notions of reciprocity and altruism are the initial foundations of the Sharing Economy. However, Sundararajan (Sundararajan 2016) discusses the Sharing Economy as terms around capitalizing on underused assets for the purposes of financial gains within a global market of peer-to-peer production and consumption. Indeed, Sundararajan's (Sundararajan 2016) discussion on the Sharing Economy is mainly focused on the economic benefits and affordances of changing the fundamental hierarchical structure of the workforce within the creation of goods and services. The emergence of new peer-to-peer economies offer potential increase in economic growth through the change in perspective of how we fundamentally share skills, time, and assets with peers. Existing practices of individual ownership often means assets are underutilized, whereas shared ownership and on-demand usage of "things" allows key stakeholders to maximize usage to full capacity. Existing models of centralized industry where corporate producers supply goods and services to paying consumers, whom have limited interaction around facilitating how these services are supplied, is transitioning into a more citizen and consumer led distributed crowd-based network within which the supply of goods, labour, and services is driven by non-professional citizens.

Currently platforms such as Uber[33] - a ride sharing platform for connecting drivers with customers – and Airbnb[34] – a marketplace for finding and renting physical spaces - enables citizens to become independent vendors of their own assets and facilitates the financial transaction between citizen and paying customer. These large-scale platforms maximize the opportunity for citizens to engage with a marketplace of peers and increase potential customers through improved visibility within a wider market. The logistics of communicating with peers, facilitating transactions, and managing the legalities of providing custom is a compelling incentive to engage with the sharing economy through these platforms. Similarly,

[32] https://www.couchsurfing.com/
[33] https://www.uber.com
[34] https://www.airbnb.com

platforms enable individuals to capitalize on their own skills, time, and assets, and potentially provides the opportunity for an increase in flexible employment. The UK Government recently commissioned an independent review of the potential effects upon the UK economy and legal systems to support the sharing economy (Wosskow 2014) and has since announced that the Government "*wants to ensure that Britain is the global centre for the sharing economy, enabling individuals and businesses to make the most of their assets, resources, time and skills through a range of online platforms*." (Government 2015). The EU Commission have also published a similar report (Vaughan & Daverio 2016) that identifies the positive impacts of the Sharing Economy within Europe and urges public officials to consider the "*deep socio-economic trend that is fundamentally changing the way we live*" before establishing regulatory frameworks that could inhibit the potential growth of this new economic model.

Given that these platforms are capable of facilitating and capturing interactions between people, spaces, and assets there is incredible potential for using this data to better understand the impacts of these interactions within wider world. Data supplied by Airbnb could potentially be used to better understand the rental property market and better understand the housing crisis, minimizing vacant properties, and maximizing occupancy. Likewise, data collected by Uber taxi drivers could provide insights into the transport demands of the population and identify inefficiencies of road networks and public transport. Both examples reviews here are for profit, thus the data generated are analysed in order to improve commercial gains, rather than solving social issues. In response to this lack of transparency activist projects such as InsideAirbnb[35] have attempted to liberate data from these platforms through web scraping in order to create publicly available datasets which could in turn reveal the effects of Airbnb on local communities and economies.

There has also been critical reception of Sharing Economy platforms, suggesting that they operate at the expense of worker's liberties, with protests from Uber drivers about fluctuating rates of pay[36], unfair immediate dismissals of Uber Drivers and delisting Airbnb hosts[37], lack

[35] http://insideairbnb.com
[36] https://www.theguardian.com/business/2016/aug/26/uber-ubereats-drivers-vow-to-take-pay-protest-to-london-restaurants

of provisioning of basic workers' rights[38] to holiday and sick pay[39], and failure to ensure safety standards of service users and workers alike[40]. Similarly, operating within a deregulated legal framework has led to protests from existing industries, such as officially recognised and licensed taxi drivers and hoteliers, whom are facing greater levels of scrutiny and regulation than Sharing Economy platforms. These existing industries see this will simply be priced out of the market due to the associated costs of complying with regulatory requirements, leading to a monopoly of Sharing Economy platforms. In reaction to this issue, some governments have begun to take legal action against deregulated Sharing Economy platforms in an effort to preserve workers rights[41][42].

However, alternative approaches that focus on a more distributed and collective ownership have begun to emerge. Scholz (Scholz 2014) introduces this concept through Platform Cooperativism wherein "*worker-owned cooperatives could design their own apps-based platforms, fostering truly peer-to-peer ways of providing services and things*". Within this model commodities and services are provided *by*, *for*, and *to* the benefit of the cooperative and removes the dependency upon the need for large centralized platforms, the middlemen, to facilitate interactions between peers. Scholz (Scholz 2014) calls for a more distributed network of independent platforms that facilitates peer-to-peer production and consumption within a more democratised, collectively owned, and fairer distribution of wealth derived from the collective actions of the community. Scholz's vision of the Sharing Economy, albeit somewhat idealistic, does provide a set of principles that one can derive values from. The focus on fairer delivery and access to both the infrastructure and associated data within these services, suggests that we as researchers should consider our own approach to developing centralized ecosystems. Within our own research, we should consider how we might offer communities these systems to be appropriated as standalone platforms without researcher intervention.

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[37] http://www.bbc.co.uk/news/business-35574971

[38] http://www.independent.co.uk/news/business/news/uberisation-provides-paid-work-for-five-million-as-britons-embrace-the-new-self-employment-a6875786.html

[39] http://www.bbc.co.uk/news/business-36843386

[40] https://www.wired.com/2016/03/uber-lyft-can-much-keep-drivers-safe/

[41] https://www.independent.co.uk/news/business/news/uber-shut-down-business-denmark-taxi-law-regulation-a7654571.html

[42] http://uk.reuters.com/article/us-airbnb-new-york-idUKKBN13S03U

Benkler (Benkler & Nissenbaum 2006) introduces the concept of Commons-based Peer Production that describes a more distributed and social production process whereby large numbers of non-hierarchical, decentralized collaborations between individuals can produce unified intellectual work afforded by internet technologies. These principles can be seen within the Wikipedia model of information commissioning and focuses on the creation of information through large-scale online platforms that facilitate the collaborative consumption and peer-production of shared collective knowledge. The publishing mechanism of wikis focuses on creating a decentralized, peer-to-peer model of production that leverages the affordances of online social interactions to maintain editorial control and promote content creation and consumption. The achievement of capturing and disseminating the world's knowledge have been facilitated through interactions between peers and leverages the affordances of online platforms that are capable of enabling these interactions at scale. Embedded within these principles is a notion of altruism and indirect reciprocity for the purposes of sharing freely accessible peer-produced consumption of creative and collective knowledge.

Looking more closely at the research presented within this thesis (chapter 3) these principles of peer-to-peer knowledge production have been employed in the development of the FeedFinder application. The FeedFinder project has demonstrated that a peer-to-peer model of a citizen-led information resource can work to positive effect, with data being of value to both the community around the information resource, the wider cohort of healthcare professionals, and the research team through exploring the resulting data. Utilizing mobile technologies allows citizens to share data in real-time, in-the-wild, using location and proximity to provide a rich understanding of the community within which they live. The focus on mobile applications also provides researchers with genuine lived experiences and real insights into how these resources became established within the wider world, and presents opportunities for contextualized analysis and understanding of these information systems (chapter 4).

Similar to sharing economy platforms the underlying data contained within these interactions have the potential to provide insights into practices and trends within the data that would otherwise not be achievable without engaging with a platforms based approach. Within the FeedFinder application, implementing the technology required that researchers led the process

of identifying a niche community, co-designing a technological solution, developing and deploying the technology, and finally analysing the resulting output. However, conducting research in this manner is an extremely research intensive endeavour that requires researchers to be the primary driving force behind the inception of these forms of technologies that are ultimately limited by the scope of the research team behind the initial concept. In this mode citizens are the driving force behind creating and disseminating their own lived experiences with one another but are limited to the bounds of the information resource created by the research team. Therefore, it became apparent that this framework of peer-to-peer information creation could achieve a similar effect for similar applications in other contexts and the affordances of the underlying FeedFinder technology could be adapted for developing similar applications. Although identifying these different domains would be labour intensive, the notion of enabling citizens to take a leading role in the commissioning of these information resources allows for a more targeted approach when identifying communities who could engage and benefit from similar information resources. Embedded community members are well placed to identify the issues, solicit engagement, and mobilize support within their own communities for the purposes of contributing and sustaining a similar community driven information resource. As identified by similar civic data commissioning platforms, encouraging interaction with this process of commissioning can be achieved through structured participation afforded by online participatory platforms.

Existing research within HCI has begun to explore the concept of citizen-led creation of tools for data collection within the context of Citizen Science (Kim et al. 2013; Newman et al. 2011; Hartung et al. 2010; Sheppard 2012). Although this approach is not explicitly defined as the practice of community commissioning, there are similarities in the underlying concept of engaging citizens in the ideation of shared community concerns and the automation and development of tools to support data collection using crowds. However, citizen science projects are often criticised as being another method of employing cheap labour for the purposes of data collection by researchers (Lawrence 2006; Woolley et al. 2016) rather than as part of a bottom up approach for citizens to engage in scientific research. The resulting data collected by citizen scientists often requires academic analysis by trained research professionals who produce publications within the realms of academia that are inaccessible by the general public. Although the data is being collected by citizen scientists there are issues of accessing the dataset as well as the resulting analysis in the public domain. Within the

examples presented in the next section it is possible to look more closely at the design of the underlying technologies and critique the affordances of these various approaches for the purposes of leveraging these strengths to inform the design of a more generalizable platform that enables the creation of peer-to-peer information resources.

5.4 Existing Technology Commissioning Approaches

Within research (Kim et al. 2013; Hartung et al. 2010; Zaman & De Meuter 2015) a number of tools have been developed that incorporate citizens within the process of research and enable them to commission their own data collection tools using a variety of mobile applications and web platforms. However, the development of bespoke mobile applications for use in any context is a technologically difficult task due to the complexity and variance of possible solutions. The commissioning of mobile applications as information resources currently requires technical skills, knowledge, and financial resources to design, deploy, and maintain. Due to these constraints the majority of citizens are unable to engage in the process of commissioning technology.

In an academic research context, the process of identifying a niche community, co-designing possible technological solutions, developing a novel technology, deploying the technology, and finally analysing the resulting data is an extremely intensive endeavour. In order to overcome this issue there have been a number of approaches to incorporate citizens in the design and development of technologies in different contexts, each with various trade-offs of the resulting method. For example, citizen science researchers have attempted to encourage citizen participation within the process of data collection through the deployment of technologies that centre around enabling this practice. Citizen science tools such as wq.io (Sheppard 2012), OpenDataKit (ODK) (Hartung et al. 2010), Sensr (Kim et al. 2013) and CitSci.org (Newman et al. 2011) enable citizens to commission their own projects using either a single configurable mobile application, or reusable self-hosted web based application framework that is reconfigured and deployed for each project. In addition to citizen science, Pokress *et al* (Pokress & Veiga 2013) have developed “App Inventor” that utilizes a drag-and-drop visual programming approach to designing and building flexible mobile applications for Android.

The examples presented within this section (Table 6) can be best described as using two approaches; the release of self-hosted tools (toolkits), and the deployment of centralized infrastructure to support the creation of technologies within an ecosystem (platforms). These two approaches affect both the affordances of the technical outcome as well as the sociotechnical factors of system use, such as; facilitating and coordinating online participation, democratization of the overall commissioning process, creating and demonstrating demand behind the idea, visibility of the resulting output, and engaging a community to support and sustain the resulting information resource.

	Mobile Application Development Platforms						
	wq.io	**OpenDataKit**	**CitSci.org**	**MIT App Inventor**	**Sensr.org**	**DisCoPar**	**App Movement**
Features	Toolkit	Toolkit	Platform	Toolkit	Platform	Platform	Platform
Mobile App Technologies	HTML5 Web app	Native Java Android app	Native Android, iOS app	Native Java Android app	Native iOS app (webview)	HTML5 Web App	Native Android, iOS app
Standalone App for each project	Yes (Web app)	No (project within ODK app)	No (project within CitSci.org app)	Yes (native app)	No (project within Sensr.org central app)	Yes (Web app)	Yes (full native app)
Available in App Store	Yes	Yes	Yes	No	Yes	No	Yes
Server Technologies	Apache, Python, PostgreSQL	Google App Engine, Tomcat, MySQL, PostgreSQL	Microsoft IIS, ASP.NET	Google Web Toolkit (Java), HTML5	Apache, PHP, MySQL	Ruby, PostgreSQL	Apache, PHP, MySQL
Hosting	Self-hosted	Self-hosted	Hosted by CitSci.org	Hosted by App Inventor and self-hosted	Hosted by Sensr.org	Hosted by DisCoPar.net	Hosted by App Movement
Programming Knowledge	High	Medium	None	High	None	None	None
App Development Process	Local dev, external hosting	Local dev, external hosting	Web app builder interface	Web app builder interface	Web app builder interface	Web app builder interface	Web configuration interface
App Updates	Live updating (self-hosted web app)	Live updating (XLS, web form, and Google Sheets)	Live updating (web app page builder)	Recompile and update app in app store	Live updating (web app page builder)	Live updating (web app page builder)	Recompile and update app in app store

Table 6. Comparisons of existing mobile application development platforms and underlying technologies

The citizen science platforms (Table 6. Comparisons of existing mobile application development platforms and underlying technologiesand their various approaches have solicited varying levels of support and differing types of engagement with the wider public. Platforms such as CitSci.org has engaged over 3,890 volunteers who have created 449

projects around an array of natural science related projects such as bird migrations, tree measurements, and water monitoring. Whereas the ODK platform provides healthcare professionals and government workers with identifying societal issues and crisis mapping in developing regions due to the flexibility and low barrier to entry with engaging and deploying the technology (Brunette et al. 2013). Sensr, wq.io are more focused towards use as data collection platform for citizen science sensor deployments, however these projects no longer seem to attract the large communities that once used these services. Whereas the MIT App Inventor is continues to be used to teach programming to students in American high schools (Bau et al. 2017).

5.4.1 Designing for Technical Literacy, Infrastructure, and Flexibility

The development of mobile applications currently requires a high level of technical expertise and as systems designers, a choice must be made between placing this responsibility upon technical non-professionals (citizens) or placing it upon system developers either through directly engaging with the development of an artefact or creating systems to support citizens in the reconfiguration of existing applications that leverage a more automated development processes. There are also hybrid approaches to this development process where citizens engage directly with the technical development of mobile applications through a simplified development environment. The App Inventor platform (Pokress & Veiga 2013) utilizes this approach and incorporates a drag and drop interface builder, simplified programming language (Scratch Blocks), and automated compilation that prohibits distribution via the Google Play Store. Such approach is intended as a way of educating emerging software developers through a simplified programming language and does not afford high levels of complexity (e.g. single screen application) or integration with external web services (unless through pre-specified App Inventor APIs). Although this approach provides citizens with a level of autonomy and educational experience, the simplification of the process reduces the opportunity for the purposes of large scale infrastructure to support peer-to-peer knowledge production.

Providing citizens with the toolkits – standalone collections of tools and services - to develop mobile technologies, such as the wq.io and ODK, provide greater levels of autonomy and flexibility of the resulting output but within a more constrained design and development environment. These toolkits are conceptualised as ways to repurpose existing technical

frameworks that enable citizens to perform a restricted set of actions through a series of standardized and configurable template applications for the specific purpose of data collection. Taking this approach allows citizens to appropriate existing off the shelf research toolkits in order to create a more tailored solution but with the drawback of citizens requiring greater levels of technical expertise. In using these toolkits, citizens must be prepared to install, host, and develop an application in order to realise and support its deployment. This raises the issue of access to infrastructure and associated costs – issues that must be addressed at the onset, in order to sustain and scale these forms of deployment. There are also issues around the administration of these projects that require a dedicated team that must continue to engage with the project in order for it to continue to be deployed. Although an alternative perspective of this approach is that the development team of the underlying toolkit are not directly responsible for the deployment of the community-led systems and as such, this model promotes decentralization and customization of infrastructure that is not dependant on the research team. This is seen within Open Source software whereby developers can "fork" projects, actively encouraging further development of the existing project. Similarly, this approach also allows more technically literate citizens to create bespoke functionality in response to their own needs and where possible, contribute to the underlying toolkit codebase for the benefit of other communities using the toolkit. The principle of this model is that the project does not rely upon a single institution, team, or individual to maintain the project and thus promotes longevity and utility of the underlying technologies.

This approach is similar to Scholz's platform cooperativism model (Scholz 2014) and focuses on a decentralized infrastructure approach to ensure the resulting technology remains within the community who initially commissioning the resource, providing flexibility, customization, and ownership of the artefact but at the cost of requiring high levels of technical expertise, resources and infrastructure to maintain and support the resource. Given that these toolkits must first be available before citizens can utilize them, there is a disconnect between citizens being able to highlight community issues and researchers identifying and understanding the needs behind a technology. This responsive process offers limited support in comparisons to citizens directly commissioning, proposing, or requesting additional, more tailored, toolkits that better suit their own needs.

Alternatively, citizens can engage in the commissioning of projects through pre-configured and centralized platforms that focus on abstracting the development process and lowering the barrier to entry to engaging in the process of commissioning. Research platforms such as CitSci.org and Sensr.org provide citizens with the ability to create their own data collection tools for the purpose of Citizen Science. These platforms provide citizens with the ability to design "projects" through a web based drag-and-drop builder interface in order to limit the scope of the data collection interface to a set of core features and functionality that have been developed and tested by the platform's development team. The result is a more focused application that is designed for a specific purpose but at the expense of flexibility and configuration. Looking more closely at the examples in Table 6, this process has been explored through the creation of web application interfaces contained as projects within centralized citizen science mobile application and contained within an associated ecosystem (such as CitSci.org). Deploying these projects is a matter of creating a project using the web platform's project builder interface and then accessing the resulting project application through a single shared, platform specific, citizen science mobile application. In this mode the project is contained within a platform and provides citizens with low barrier to entry through minimizing the technical complexity of building an application using the web and builder interface at the cost of reducing the applications flexibility and customization. However, as part of creating the interface using a web interface it is possible to offer cross-platform support without extensive development required by the platform developers or citizen project team. Unlike native applications that require recompiling and re-releasing, a web application approach also allows for interfaces to be remotely reconfigured (server side) once the application is "live" within the platforms ecosystem mobile application, allowing citizens to respond to potential interface usability or data collection issues without requiring input from the platform's development team. Similarly, the ODK toolkit facilitates high levels of flexibility when developing and modifying content within the application during the application's deployment. This is achieved through remotely configuring tabular spreadsheets, such as Excel or Google Sheets, that alters and arranges the content within the mobile application. Although the flexibility of the options within the activities are very restricted, essentially presenting and modifying data collection forms within the application, this abstracted interface building technique allows for the application to be much more responsive and dynamic without the requirement of high levels of technical literacy. Engaging citizens in this platforms approach also abstracts the complexities of hosting, deploying,

maintaining, and developing the platform and associated projects but at the expense of centralization of critical infrastructure, preventing citizens from developing their projects further and relying upon an existing research or development team around the platform in order for the project to continue to exist.

5.4.2 Designing for Visibility, Adoption, and Transparency

The community driven and collaborative nature of these technologies depend upon an underlying community to contribute and sustain the resulting information resource. Each of the citizen science research projects (Table 6) are governed by both the constraints of the technical system architecture as well as the overall affordances of the system and interaction design around the platform or toolkit and play an important role in the overall visibility, adoption, and transparency of the resulting community commissioned technology. Within these research projects, the two approaches (toolkits vs. platforms) also impact upon the levels of adoption and engagement within the commissioning process. These issues can be understood in relation to three distinct temporal phases; the initial process of commissioning the concept and establishing the technology (commissioning phase), adoption and deployment of the technology (deployment phase), and the sustained engagement and understanding of the resulting artefact (engagement phase).

Commissioning

Within the initial commissioning phase, the community must initially identify and discuss the shared matter of concern that can be addressed by the commissioned technology. Within each of the projects identified (Table 6) this initial phase is placed upon a single individual rather than as a collective that encourages a more transparent and deliberative process for initially identifying the problem domain. The toolkit approach (wq.io, ODK) requires that an embedded community member possesses the relevant skills to locate and deploy the most suitable solution to the problem. Similarly, within the platforms approach (Sensr.org, CitSci.org), a single project creator becomes the sole creator of a citizen science project for use by the community. Given that the resulting output requires the support and engagement from the community, this lack of transparency prohibits the documenting, sharing, and discussion of ideas around the effects or configurations of the commissioned artefact. Within the platforms identified, this process is similar, however through the centralization of projects citizens are provided with an overview of existing campaigns, allowing them to reflect upon

both existing successful and unsuccessful deployments. This also prevents duplication of efforts for a given problem domain but also provides a clearer understanding of the overall process and resulting technological outcome. This ability to reflect and learn from existing practices is an important factor in educating project creators and informs expectations regarding the process and functionality of the resulting technology. This is especially important given that the majority of individuals are likely to have limited experience in deploying large-scale citizen science projects in this manner.

Deployment

When attempting to engage large populations of citizens with community-led projects, some form of online presence is required in order to promote the existence of these projects. Within a toolkit approach, such as ODK and wq.io, this aspect of branding and awareness must be established by the citizens themselves around the deployment and requires elements such as a website and promotional materials in order to present and encourage adoption of the technology. Within these two toolkit examples these issues have been overlooked and no support is offered in establishing an online presence, both on the web through project websites, or within the associated app stores. The platforms approach taken by CitSci.org and Sensr.org at least provide an initial level of support for developing an online presence. This is achieved as a project overview page for each individual project within the associated ecosystem and can be customized with text by the project creator. This provides newcomers to understand the context of the project as well as manage the expectations around required levels of commitment with the project. CitSci.org also provides an overview of the current levels of engagement through presenting recently collected data from the community. Providing the project within the context of the platform in its entirety it is possible for citizens to observe the levels of participation as a whole. As such, being able to demonstrate the levels of engagement with both the citizen-led project and the overall platform is an important factor in deciding upon investing your own time and effort into engaging with these projects. Maximizing the potential for engaging citizens in the process of citizen science requires that new participants are recruited to support projects. As part of a centralized platforms approach, this overview of existing project also presents opportunities for citizens to engage with additional projects that they may not have otherwise been aware of and therefore could choose to engage with. Similarly, this provides additional opportunities to engage citizens in the commissioning of new citizen science projects that have not yet been created.

The architecture behind platforms such as CitSci.org and Sensr.org allow users to create web applications that are presented as projects within a single, centralized mobile application on the Google Play or iOS App Store. The resulting application developed by the user can best be described as a project contained within the ecosystem of the CitSci.org or Sensr.org platform. This means that users must download the CitSci.org or Sensr.org mobile application in order to access and interact with their data collection tool. This model of web-based mobile applications made visible within a single centralized application is a trade-off between the visibility and architecture complexity. In centralizing the projects within a single application, new users must first be aware of both the project and the associated platform in order to begin engaging with the technology. Arguably, this inhibits the visibility of the application due to the lack of visibility within the Google Play Store and Apple App Store, thus preventing other members of the general public from engaging with the application, reducing the visibility of the project overall.

Engagement

The continued usage over time provides the opportunity for reflecting upon both the data collected during a continued deployment as well as the interactions with the underlying technology over time. Within the examples presented in Table 6 there have been a number of approaches to accessing the data contained with these applications as well as limitations placed upon collection and presenting this data. Platforms such as CitSci.org, Sensr.org, provide open access to citizens viewing the projects, with a basic overview of the data collected as well as the ability to export the datasets for personal use. A basic analysis also shows averaged data as well as chart representations of the data in aggregate form. Similarly, ODK allows for data collection to be directly downloaded as CSV files for the project creator, but does not offer a public facing service for general consumption of the data. Given that these services have been designed to enable citizens to collect and understand their environment better, there are limitations within the design of these services in the presentation and analysis of the data which impacts upon the levels of transparency in regards to accessing and analysing the data. It is also not possible to access metrics and analytics around the community who are engaging with these technologies. In providing this access and usage data it would be possible to begin inferring levels of engagement and usage behaviours within the application similar to the analysis in chapter 4.

5.5 Summary

As demonstrated throughout this chapter, the role of citizens in the wider world is transitioning from a model of passive consumption into the more active role of producer and contributor of knowledge, skills, goods, and services. The role of citizens within wider digital society has become increasingly more participatory, facilitated through both the legislative process of Open Government Data as well as other third party civic platforms that invite citizens to engage in commissioning of government data, production and sharing of information around local issues, and challenging legislation through online petitions. Existing transactional models of delivering public services without engaging in meaningful dialogue with local citizens is beginning to transition into a more relational model of service provision that focuses on a more deliberative and participatory process. These services are being supplied by the Government and third party organisations in an effort to promote critical reflection and increased engagement with these digital services. The underlying principles of transparency, participation, and openness, are embedded within the principles of collective action in the form of commons-based peer production (Benkler & Nissenbaum 2006) and can be seen in projects such as the Open Source movement, Wikipedia model of peer-to-peer knowledge production, and the emergence of the Sharing Economy. Within HCI, efforts have been made to facilitate citizens in participating with science projects through the creation of platforms and toolkits that facilitate the creation of projects and technologies for the purposes of data collection. This transition has been afforded by the infrastructure developed and delivered through the internet and has seen unprecedented levels of collaboration through mass participation in the form of crowd workers and citizen producers.

Whilst the platforms and toolkits outlined in this chapter allow individuals to engage with technologies to support shared issues, they are still very much a top-down transactional model of participation as opposed to a truly citizen-led approach in the commissioning technologies. These existing models of consumption and production are being challenged through new models of citizen participation and these implications have not yet been explored for the purposes of community-led commissioning of new services and supporting infrastructures. The next chapter explores this notion further and proposes a novel approach to commissioning citizen-led technologies that focus on a more bottom up and relational approach, with an emphasis on engaging communities in a collaborative and deliberative

process for the development of community-led services. This next chapter presents these concepts in action through the delivery of a community commissioning platform, known as App Movement, that enables communities to collaboratively design and automatically generate mobile applications around location based review services.

Chapter 6. Designing Community Commissioning Platforms at Scale

6.1 Introduction

This chapter presents App Movement – a community commissioning platform that enables communities to propose, collaborative design, and automatically deploy mobile applications for the purposes of peer-to-peer knowledge production. The design, development, and deployment of App Movement leverages the concept of community commissioning and provides a real-world context to reflect upon. This chapter is structured in two parts with an initial overview of the App Movement service and then an in-depth discussion around the service design and resulting observed behaviour. The design and development of App Movement has been an iterative process that was reflected upon throughout continued deployment and as such, there have been a number of changes made overtime in response to issues that have been identified through service use. Therefore, this discussion also centres around the design choices made during development of both the platform and the associated mobile app templates and documents both the technical and socio-technical challenges of developing this form of technology.

6.2 Community Commissioning in Context

In chapter 5 citizens are prompted to transition from the role of passive consumer to a more active role of co-producer of goods and services. Importantly, in this model the researcher is removed from the process of setting the agenda within which the deployed technology operates. This provides embedded community members with the opportunity to identify potential application areas themselves and engage the community in a more deliberative process of identifying both the expected operational context of the application and the overall design in regards to features and functionality. However, to achieve this communities require the technical knowledge, skills, and resources to develop and sustain suitable technologies as well as the mass engagement to drive and sustain the artefact. In response to these issues this chapter explores how to facilitate a more community-led approach to developing information resources that can be proposed and designed by communities themselves rather than through a researcher-led approach. This has been achieved through the development of App Movement, an online platform that enables communities to propose, collaborative design, and automatically generate community-commissioned mobile applications for peer-to-peer-

knowledge production. The platform removes the resource constraints (technical knowledge, skills, and infrastructure) and enables communities to engage in the process of commissioning shared information resources. Embedded community members (initiators) begin by creating campaigns in response to a community need, gather support from community members, and engage the community in a semi-structured design consultation. This process is hoped to reduce the technical constraints of creating technology through an automated build process. The platform uses a templating approach to developing mobile applications and provides communities with configurable and customizable mobile app-based information resource. Currently the system provides users with the ability to create a location based review service, such as FeedFinder or Trip Advisor, that enables communities to rate, review and add locations to a shared mapping mobile application.

The platform encourages a grassroots approach to identifying community issues and provides the tools necessary for communities to establish their own community driven information systems. This approach attempts to remove the technical barriers to app development and provide a democratic process in which to engage a community in the design of these forms of technology. Through removing this technical barrier and scaffolding the process of commissioning it is hoped that the platform might engage those communities who might not typically engage with the commissioning of technology. The result of this is the deployment of an ongoing service which can be explored further as communities begin to establish their own information systems in the future. In this model of commissioning researchers do not play an active part in the promotion of the concept and simply provide the community with the means to promote the idea themselves.

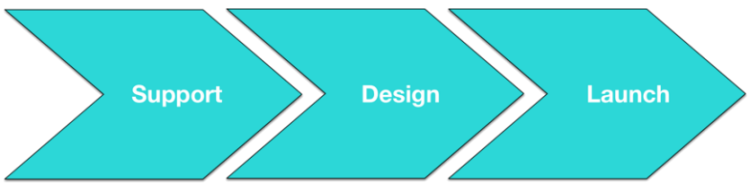

Figure 13. The App Movement commissioning process

6.3 App Movement: The Process

App Movement consists of a three phase process; Support Phase, Design Phase and Build Phase that a movement transitions through as time progresses and targets are met. Within

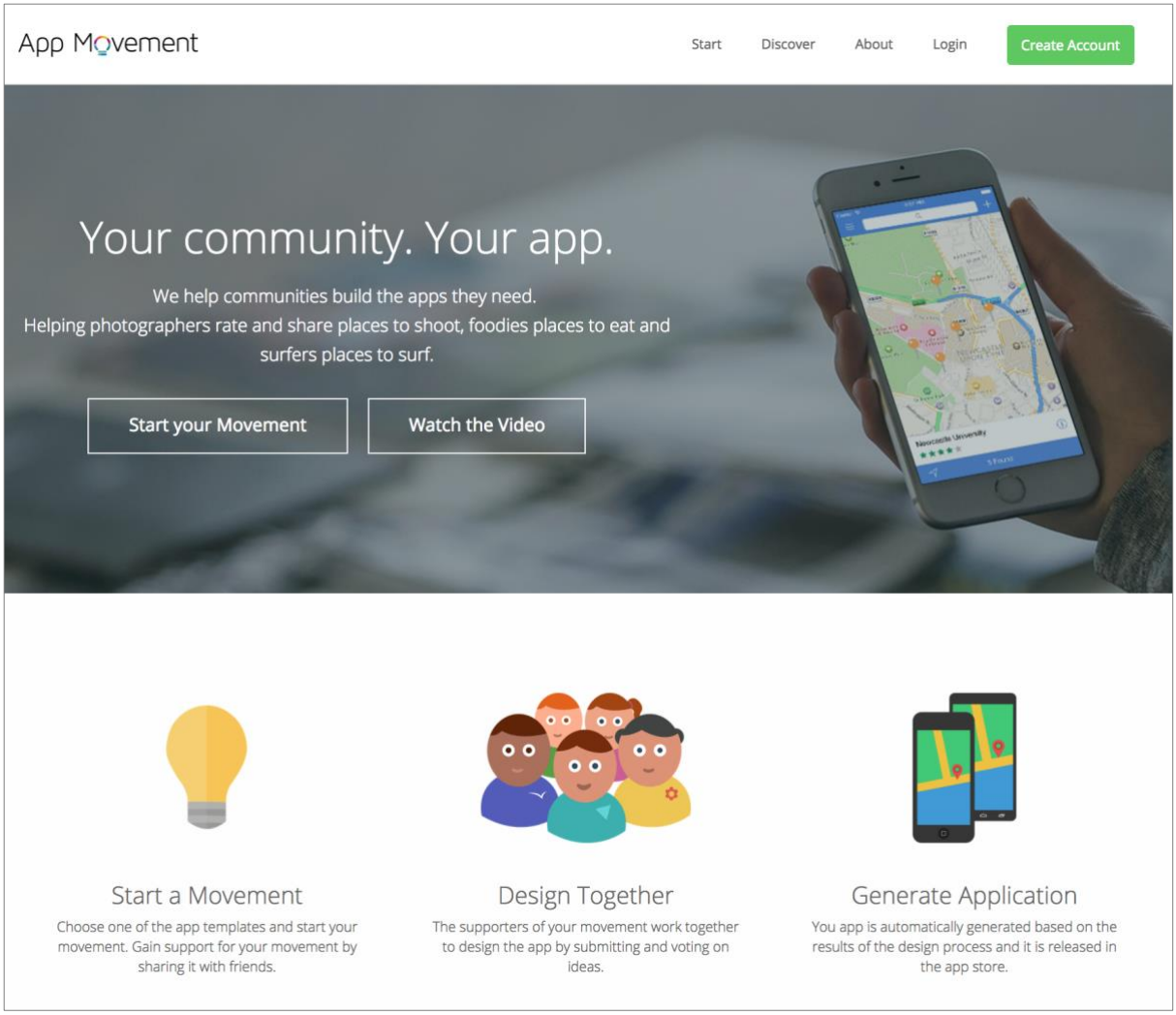

Figure 14. App Movement service landing page

each phase the community is prompted to interact with the movement either through promoting a campaign page, contributing ideas to an app's design, voting on submissions, downloading the app and finally publishing content within the app. Throughout the process the community can also participate in discussion around the campaign idea, overall design and specific design tasks. The App Movement platform begins by allowing a campaign creator (*initiator*) to establish a campaign page, known as a movement, in the form of a Kickstarter[43] or Change.org[44] style campaign page. The campaign page serves as the means by which campaign creators can communicate their community resource concept and promote the idea to others. The campaign page presents the supporter target, campaign deadline, and

[43] https://www.kickstarter.com
[44] https://www.change.org

current phase of the movement (support, design, or launch phase). Fellow community members (*endorsers*) are able to pledge their support to the campaign and in doing so they receive a number of email notifications, such as campaign updates posted by the movement creator, as well as gain the ability to vote and contribute their ideas within the design phase. Much like crowdfunding platforms, the campaign must achieve a fixed target number of supporters to confirm there is a real demand behind the idea. This target is intended to ensure that the app will have a sufficient number of users who are ready to contribute content and promote the app. Once the app has reached its target it enters the design phase whereby supporters can contribute towards the app name, colour scheme and rating options as well as vote on submissions made by other members. This democratic process allows every community member to have an equal say on the final app's final design. After this phase is complete the idea moves to the final phase where the mobile app is automatically generated using the design features voted for by the community. Once this build process has been completed, using automated build scripts, the platform publishes the community designed mobile applications to the Apple App Store and Google Play Store. When the apps have been released anyone can download the application and contribute to the content within the app. The result of this is the establishment of a community driven information resource that can be used freely by the community.

This next section presents two parts an overview of the tasks and workflow within each phase of the App Movement commissioning process (Support, Design, Launch). Each phase is then revisited to discuss the design decisions that were made and how some of the technical and design challenges that were addressed during the ongoing deployment of App Movement.

6.3.1 Support Phase

Users begin by creating a movement (campaign page) wherein they are prompted to enter a title, short and full description of the idea and select the *app template* from a series of existing options. When users start a new movement, they are taken through an on-boarding process that prompts them to invite, in their own opinion, the most influential community members who will subsequently receive an email containing information about the newly created movement. We feel it is important for the creators themselves to identify these important individuals to facilitate a truly bottom up approach. Once the movement has been posted on the platform the user must then gather support from 150 other community members within a

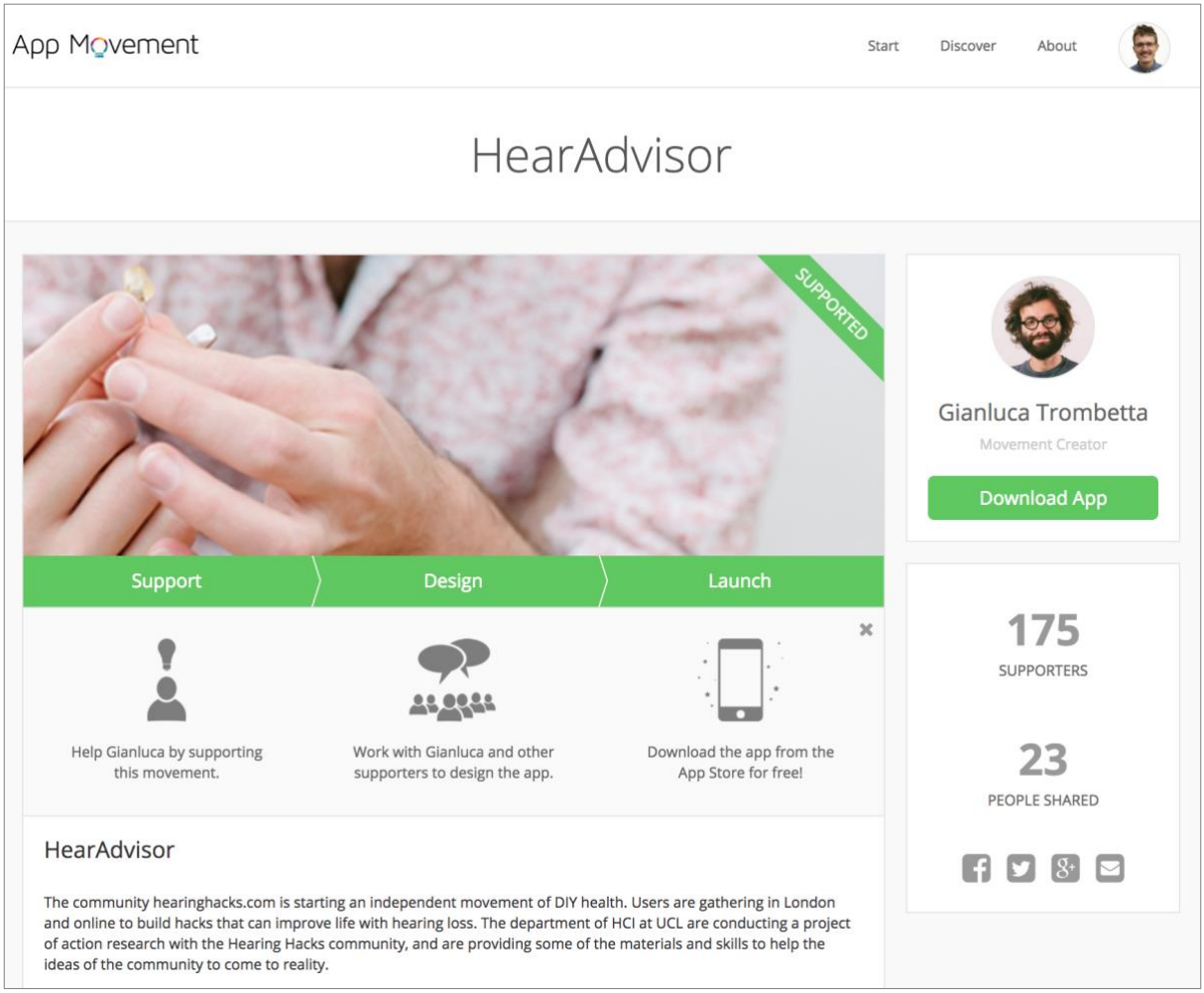

Figure 15. Campaign page for the HearAdvisor campaign

14-day period. In order to support the movement, new users must visit the movement page and simply click the support button to register their support. The user will be presented with a modal popup in which the App Movement platform and process is described and the user is made aware that they will be invited to contribute to the design of the application. They are also made aware that they will receive email updates, every 7 days, about the progress of the movement. In order to verify the authenticity of the supporter users are asked to complete a reCAPTCHA[45]. Prior to this the user must register with the platform using a simplified inline registration form within the support modal that requires a full name, email and password. Once the user has supported the movement they will be sent an email welcoming them to the App Movement platform and providing the movement details. The user will then receive

[45] https://www.google.com/recaptcha

email updates letting them know important information about the progression of the movement.

Users can engage in discussion on the movement page using the comment system at the bottom of the page. The comment system allows users to vote comments up or down as well as reply to a specific comment. The supporters also have a series of share options to share their campaign on Facebook, Twitter, Email and Google+. When the user shares the campaign link they share a unique code that allows the platform to track the click through rates and referral details of the requests to understand where the link was shared online. After the 14-day support period has passed and the supporter target of 150 supporters has been achieved the movement progresses into the design phase. Supporters are sent an email inviting them to the design area where they can contribute ideas and vote on other user contributions. It is possible for the supporter target to be exceeded during this period. If the target is not met, supporters receive a notification telling them they failed to reach the target number of supporters and the movement page is set to unsuccessful. The movement continues to be listed on the platform however no further users can support the idea.

6.3.2 Design Phase

After the support phase has been completed, the movement progresses into the design phase for the next 14-days. The design area is accessible to the supporters via the movement page. The design area (Figure 16) provides users with a series of design tasks wherein supporters are able to contribute their ideas for customizable elements of the application such as app name, icon, colour scheme, rating options and map marker pin style. A design task (Figure 26) comprises of two components; an interface showing existing contributions and a submission interface in which the user can contribute their own ideas. Contributions are listed as tiles with up and down arrows and the current vote score, calculated by number of up votes subtracted from the number of down votes, negative vote scores are possible. When viewing the design task the contributions are listed in created date time order and are not ranked by vote score to avoid popular contributions gaining a disproportionate number of votes due to their popularity and position. Users can contribute any number of submissions for appraisal by the community. Users can contribute their own ideas as well as vote up or down on contributions made by other users. Users cannot vote more than once on each contribution and cannot vote on their own contributions. All

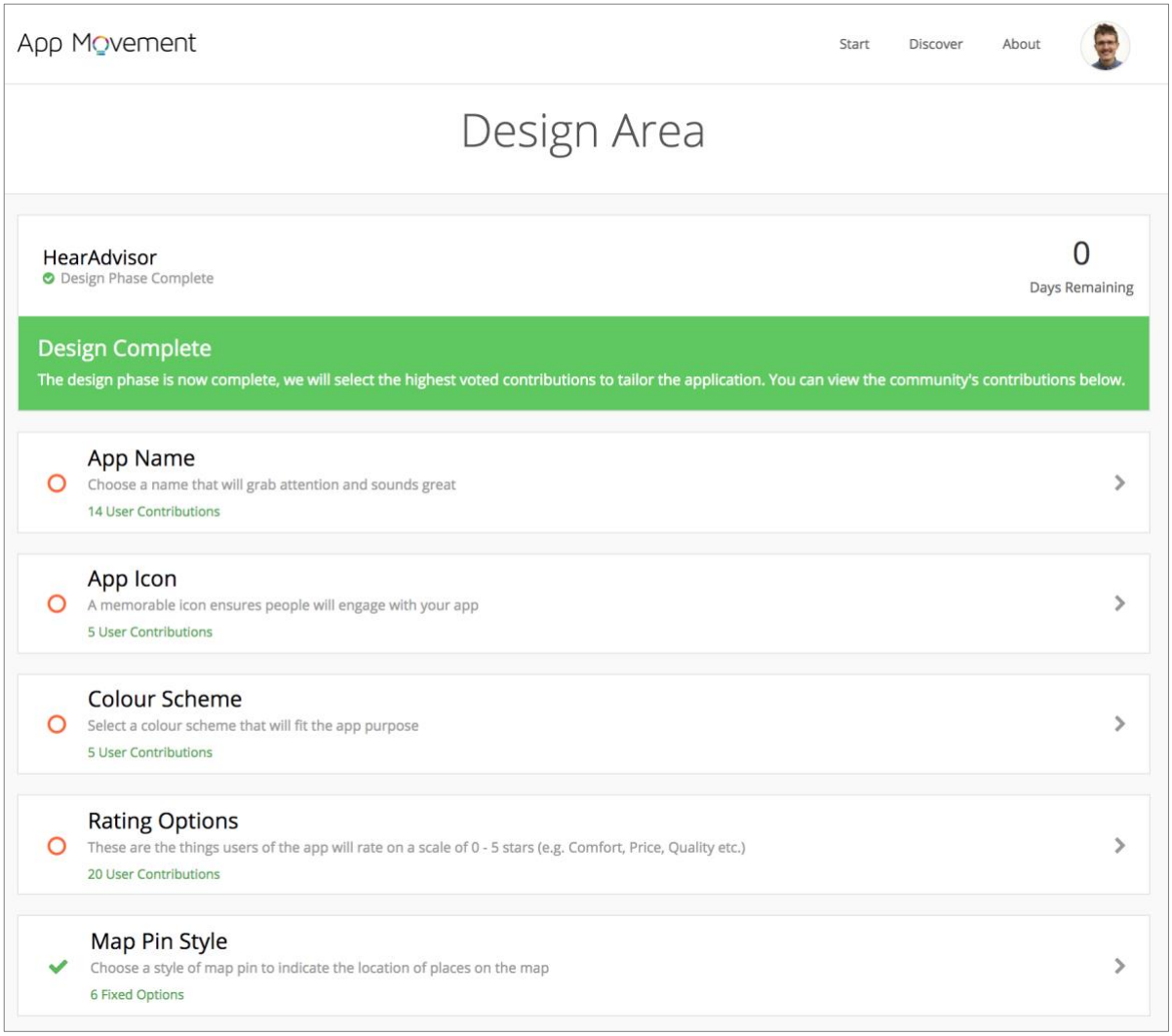

Figure 16. Design area for HearAdvisor campaign

contributions and votes are displayed anonymously. The motivation behind anonymous contributing and voting was to encourage a candid response from users. Suler et al (Suler 2004) define this as the online disinhibition effect which is afforded by the opportunity to separate an individual's actions online from their in-person lifestyle and identity.

Tasks such as contributing an app name and rating options are freeform text entry inputs. When contributing a colour scheme the user is presented with a live preview of the app and a colour picker palette to select from (Figure 27). The user can select colours for specific elements in the app depending on the app template. In the instance of a location based rating and review app the user can select the primary colour, rating star colour and marker pin colour. Users can also submit images to be used for the final design of the app icon. Within

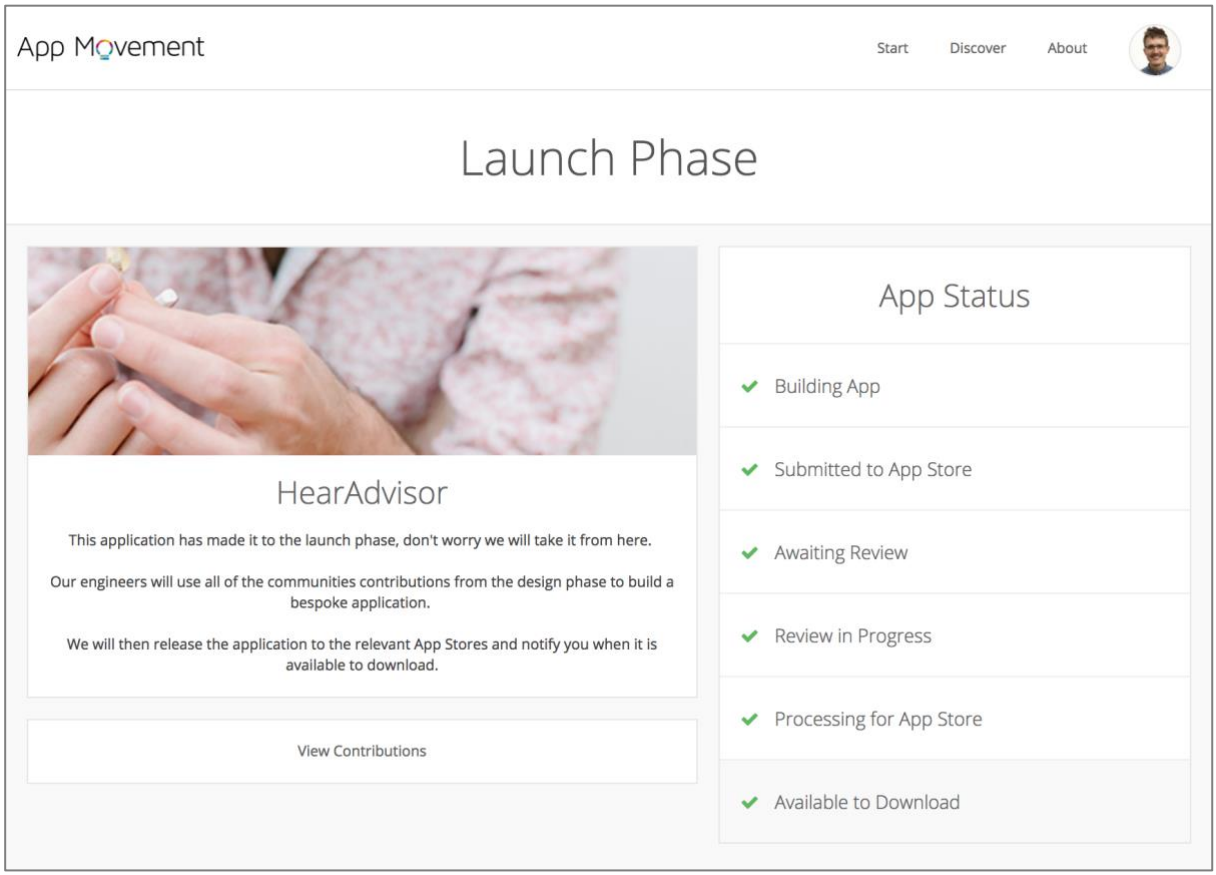

Figure 17. HearAdvisor launch page showing current progression of automated application build

each design task and the design area overview page users can engage in discussion about a given design task or the overall concept of the apps design. After the 14-day design phase period has passed the highest voted contributions are used as the customized elements in the automatic generation of the mobile application. Incomplete design tasks were an issue in a few instances, typically the design of an app icon. Currently the movement creator is contacted by the platform administrators to work in collaboration with designing a final launch icon. Understandably a more sustainable solution is required. Our initial design did not allow for new supporters while the campaign was in the design phase, however we realized that we needed to revise this due to low levels of engagement. This led to the redesign of the process in order to allow for support during the design phase and maximize the potential for participation within the design phase.

6.3.3 Launch Phase

Once the design phase has been completed supporters are presented with a launch status indicator that provides feedback on the current status of the movement; building app,

submitted to app store, awaiting review, processing for app store and available to download. Within the build phase the native iOS and Android applications are generated using automated build scripts and the highest rated contributions from the contributions from the community. These automated build scripts account for almost all of the build process. The only manual aspect of deploying the apps is the creation of the app store listing page on the App Store and Google Play Store. However, the platform generates a generic block of text for an app's description and title derived from the contributions made in the design phase.

Once the applications have been built they are submitted to the Apple App Store and Google Play Store to undergo the verification process. Typically, the build phase duration is 10-days due to the delay in the Apple App Store review process. However, the actual build process takes a matter of minutes to complete. Once the applications have been listed on the Apple App Store and Google Play store the supporters receive an email notifying them of the available application. The mobile application is then available for both the members of the community and the general public at no cost. The movement continues to be listed on the App Movement platform as launched, with a "launched" status and links to the app stores. The movement page also ensures transparency in the design of the app with the design area available to view by the general public, including the discussions between the endorsers and creator at the time.

6.4 App Movement Architecture Overview

The App Movement ecosystem consists of three development stacks; external services, App Movement platform (Web and Mobile), and the automated mobile application build tools (Figure 18). The App Movement platform is a web based application written in PHP (using the CakePHP framework) with a series of MYSQL databases and RESTful Application Programming Interface (API) for communicating between database and mobile apps. The main App Movement web platform runs from a centralized database with each generated mobile application utilizing its own independent database enabling us to scale the App Movement platform horizontally as required. The automation of the campaign process is a series of API endpoints that are regularly called by a cron job to manage campaign progression, send email notifications (depending upon campaign state), and is responsively driven by application settings stored in the database to maintain campaign states (meeting supporter targets, expiring campaign etc). Users are able register with the App Movement

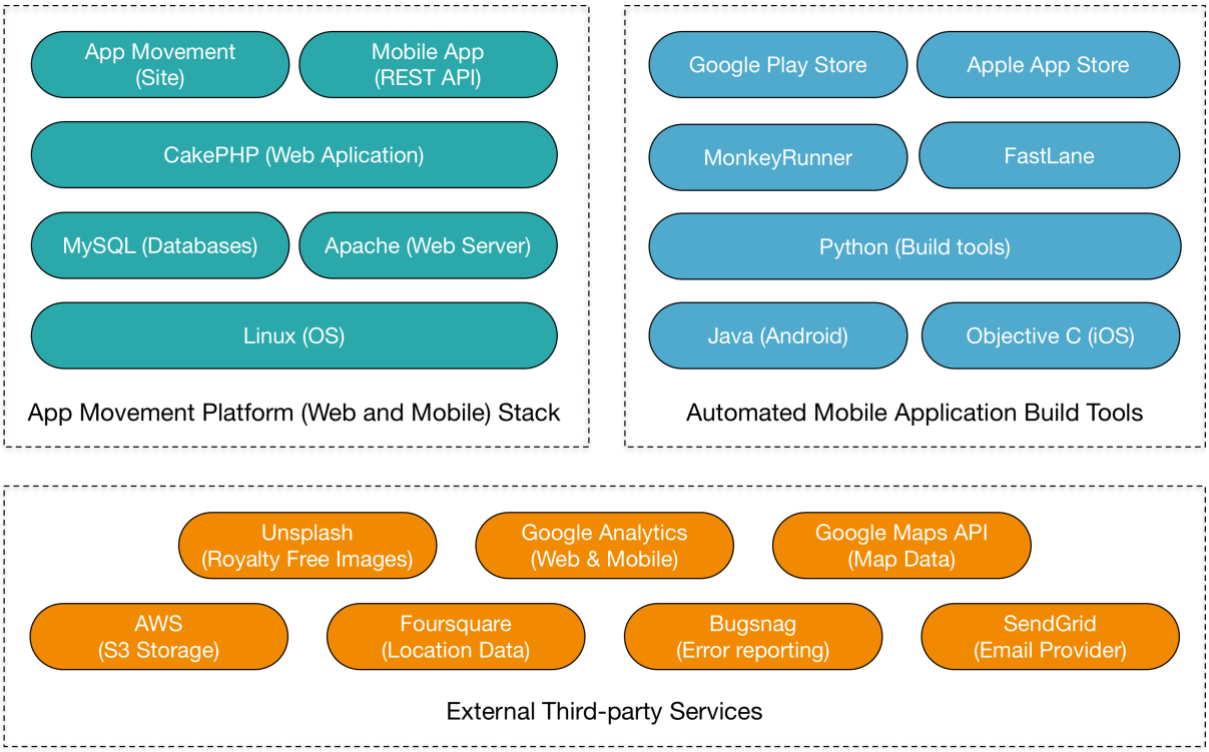

Figure 18. App Movement Service Architecture

platform through either the website or any of the generated applications. Users are then able to access the App Movement platform and all generated mobile applications through a single sign-on user account.

The mobile applications communicate with the App Movement platform via an API. The API has been designed with a core set of endpoints for authentication and setup functions, with a separate set of endpoints capable of handling different templates, applications, and app versions. Each generated application uses a unique identifier, along with user credentials to access specific results on a per application basis. This allowed for a single API to serve multiple applications of the same application template.

The automated build tools consist of python scripts for the automated build process that use versioned instances of native iOS and Android app templates written in Objective C and Java respectively. The publication of applications uses a combination of MonkeyRunner to automate screenshot clients (Android) and FastLane to perform a similar build process (iOS). This automation process also uses a number of developer API endpoints to configure the dynamic aspects of the mobile applications. The applications are generated using the python

build tools and then digitally signed to allow them to be manually uploaded to the relevant Google Play and Apple App Stores.

Several external services are used to support the App Movement service and improve scalability and reliability of the service. External storage (Amazon S3)[46] provides external storage for user-generated content on the App Movement service (web and mobile), as well as offsite backups of each database instance per application and for the central App Movement service. SendGrid provides a reliable email delivery service for delivering large volumes of email notifications that are generated by the platform and delivered to campaign supporters. BugSnag provides web application error reporting to determine build issues within the platform. Google Analytics provides insights into the platform visitor metrics as well as a per mobile application analytics reporting. The Unsplash API provides users of the service with searchable and royalty free images for use in campaigns. Lastly, Foursquare provides location data for nearby venues in the location-based review application template, as well as photos (if available) for the venues contributed by the community.

6.5 Designing App Movement

The App Movement platform incorporates several design elements that attempt to encourage citizen participation with the three-phase commissioning process. Alongside these design elements are also a set of embedded values around subjects such as; transparency, privacy, and security. The design of App Movement has been an iterative process within which core features and processes have been altered in response to ongoing citizen engagements with the platform and are discussed in this next section that is discussed in terms of the three phases; Support, Design, and Launch phase.

6.6 Support Phase

The initial phase in the App Movement process begins with embedded community members identifying a community need, establishing a campaign, and gathering support around the concept to contribute and sustain the resulting community driven information resource.

[46] https://aws.amazon.com/s3/

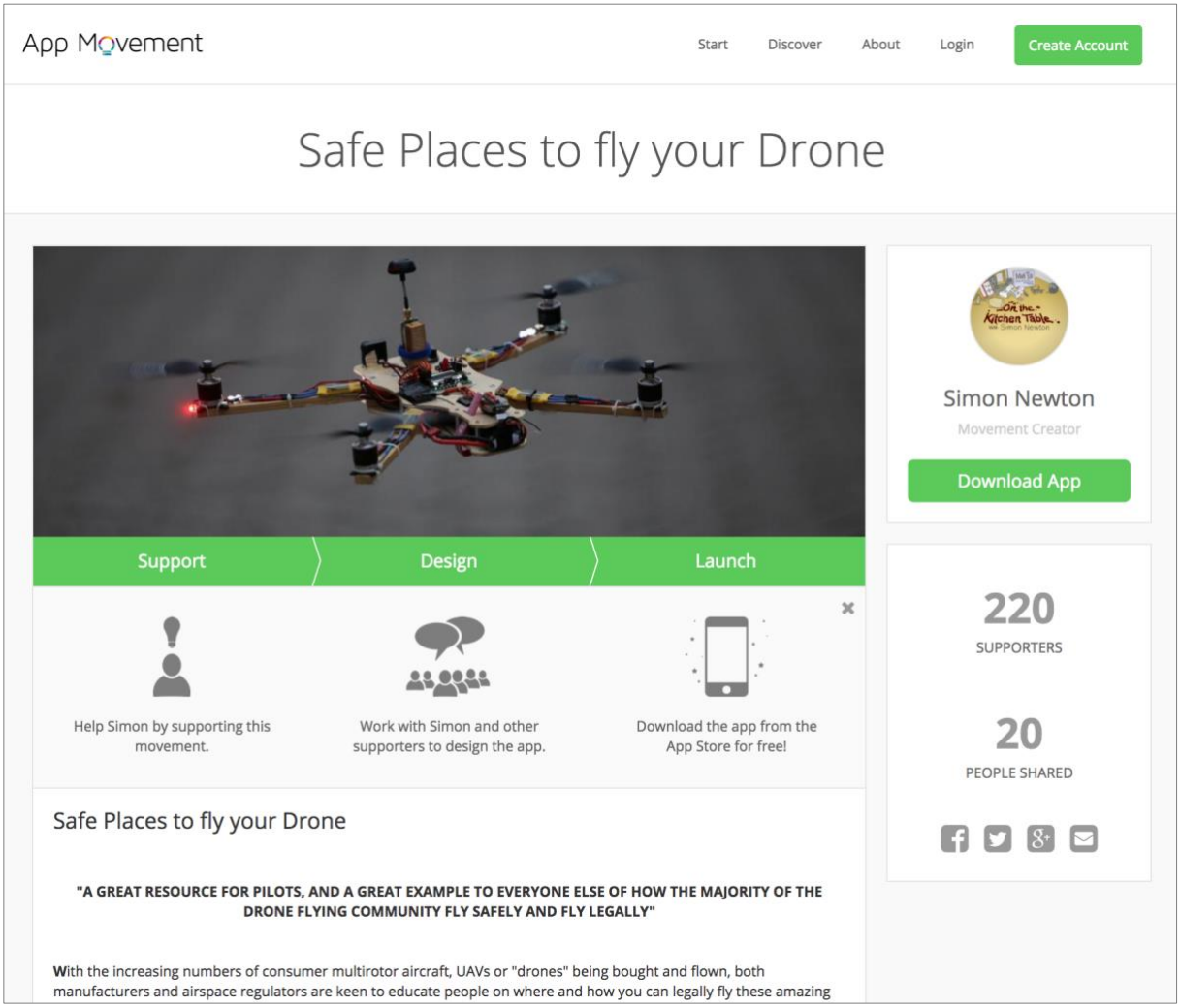

Figure 19. Drone Zones campaign page providing an overview of the campaign message and currently levels of support

6.6.1 Campaign page overview

The campaign page comprises of seven elements; campaign description, call to action, campaign analytics, campaign creator details, campaign updates, campaign progression menu, and discussion section (Figure 19).

Campaign description - outlines the concept behind the campaign, community issue that the technology addresses, and desired target audience.

Call to action – visitors are prompted to register and support new campaigns or access the design area (if in the design phase)

Campaign analytics – provides an overview of the number of supporters registered with the campaign, unique supporter 'shares' who have used the social network action buttons below.

Campaign progression menu – identifies the current phase of the campaign (support, design, launch) and links to the design area and launch overview pages.

Discussion section – allows registered users to post, reply, and vote (up and down) on comments related to the campaign.

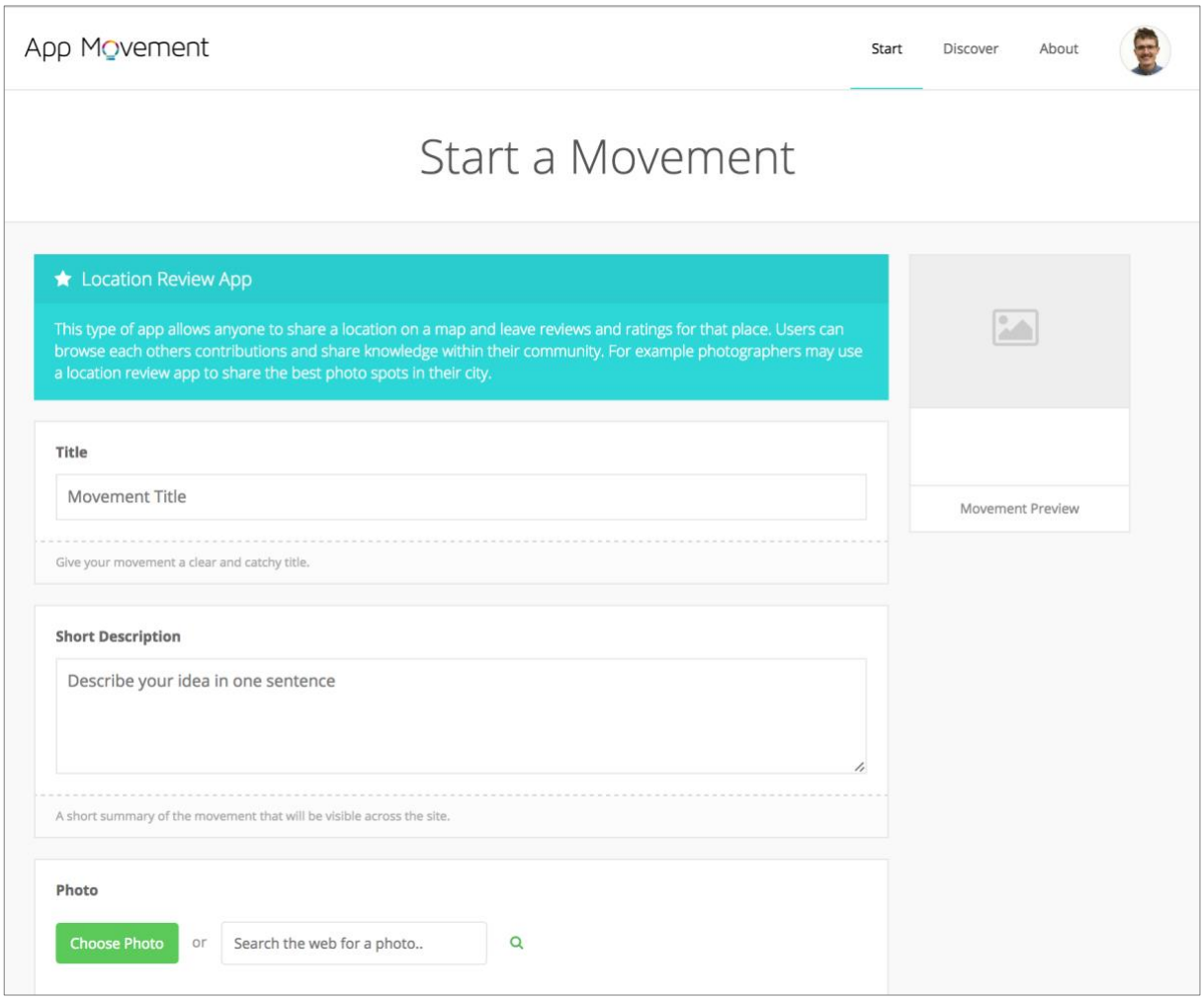

Figure 20. Creating an App Movement campaign

6.6.2 Creating a Movement

When initially creating a movement, users were taken to a single page form that required four elements; campaign title, short description, campaign photo, and campaign overview. In this

first iteration of the start movement step users were required to select their 'app template' (at the time only a location based review template was available). Displayed alongside this selection option were example, greyed out app templates as well as a 'suggest a template' option. Once selected, each of these options displayed a modal and displayed a message describing the template but also explicitly stating that the app template was not yet available. It was hoped that data could be derived from the desired templates using the click through data and the suggestions made by campaign creators however this feature resulted in extraneous campaigns being published given the confusion of currently available app templates. Due to this, the template selection panel was removed and replaced with information about the currently available location-based review template.

6.6.3 Lowering barriers campaign creation and reducing copyright infringement

As part of the campaign creation step users are required to select or upload a header image to personalize their campaign page. In doing so, we were actively encouraging campaign creators to consider the branding and presentation style of the campaign page and, consequently the audience, from whom support was being requested. We were often asked by campaign creators if it was acceptable to use existing branding from their respective community and we were very supportive of this decision as we wanted communities to adopt the technology for use within their own community as well as leverage the brand awareness to reassure supporters of the authenticity of the campaign. Although this was the case for the many of the campaigns, the remaining campaigns often selected poor quality, copyrighted images taken from the internet and used on the campaign pages. This resulted in the App Movement 'discover' (campaign overview) page becoming filled with poor quality content that contained images of questionable copyright infringement. In order to resolve this issue, an additional campaign header image search feature was added in the start movement step that allows users to quickly find high resolution, royalty free images using the unsplash[47] service. Integrating this feature directly within the campaign creation page aimed to remove the technical and design literacy required to produce a visually appealing campaign page as well as encourage use of royalty free content, reducing possible copyright infringement.

[47] https://unsplash.com

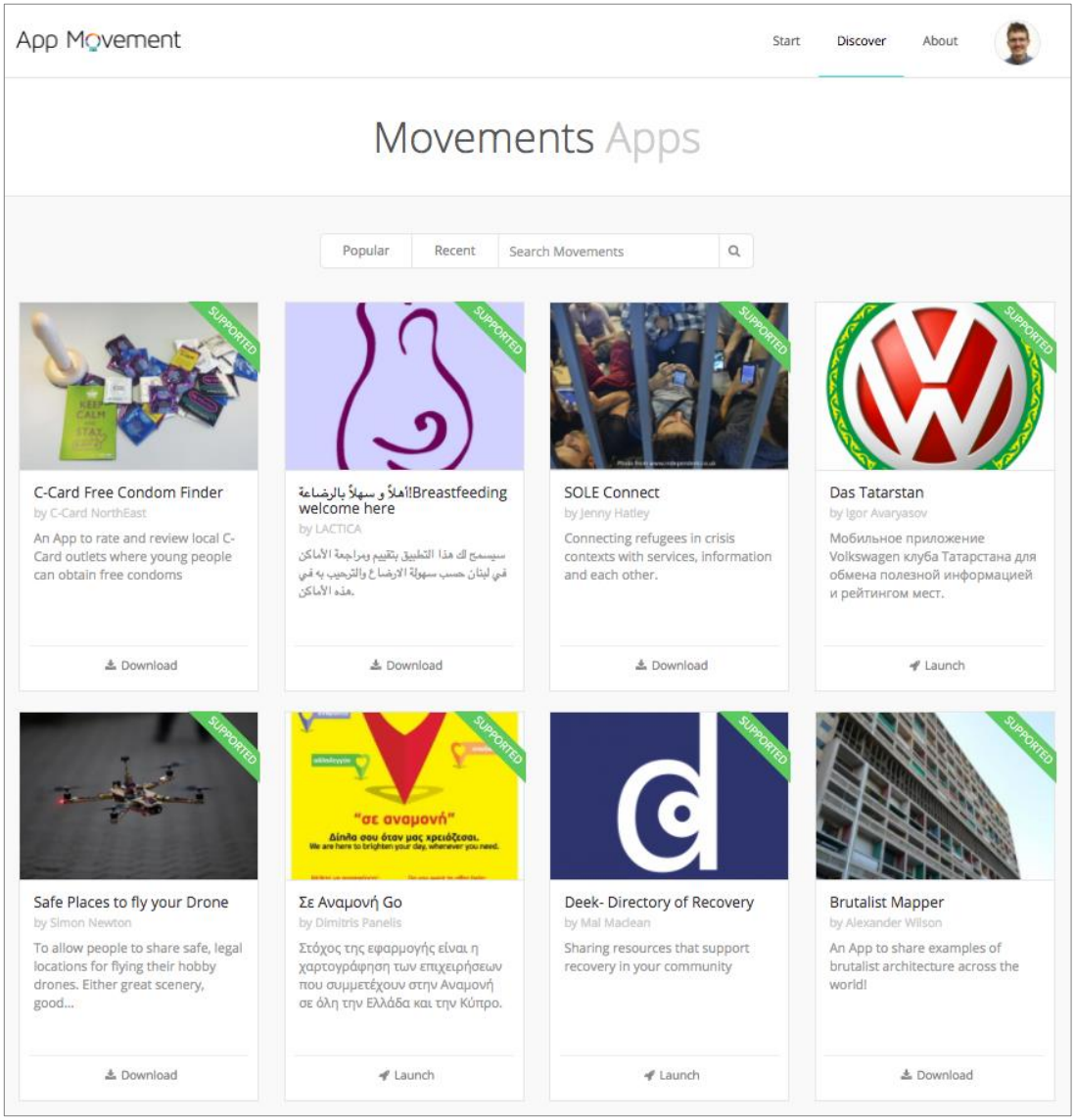

Figure 21. An overview of active campaigns in the Discover area

6.6.4 On-boarding and bootstrapping support

After completing the campaign creation step, the campaign creator is presented with an invitation screen that allows them to personally invite other community members to support the campaign. Having this screen after the initial start movement page places an emphasis on the importance of sharing the campaign with others to achieve the supporter target. This interface provides the campaign creator with the ability to invite an unlimited number of supporters.

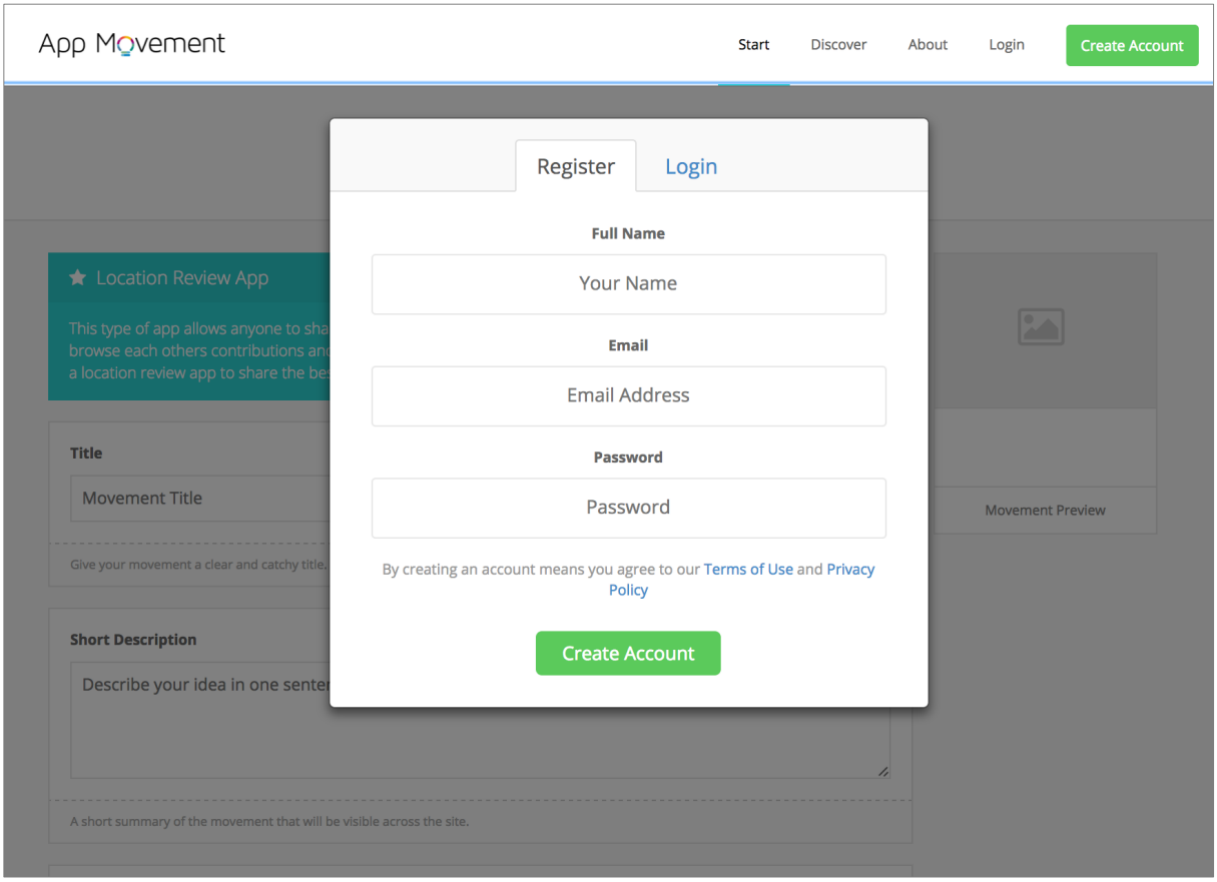

Figure 22. Presenting the create campaign page with modal overlay to afford transparency

6.6.5 Transparency of campaign process

Initially the campaign creation page was only accessible to users that were registered and signed in with the App Movement service. After observing the logs, it was clear that visitors were accessing the campaign creation page to explore the App Movement process further and before they committed time and effort in creating a campaign. However, as this as this step required authentication, the clear majority of visitors were simply redirected to a login page and therefore were not proceeding with registration or campaign creation. To encourage greater transparency of the process, the start movement page was modified to allow unauthenticated users to access the page but with a login modal presented in the foreground, above a greyed-out page overlay that allowed for the start movement process to continue to be visible in the background (Figure 22). This approach to encourage a more open and transparent process has been adopted throughout various areas of the App Movement service (campaign creation, support phase, design tasks) and attempts to maximize engagement through providing visibility of our expectations of the user in the processes required to engage with the service.

6.6.6 Modifying the Campaign Message

The initial campaigns were created in collaboration with community leaders who we contacted to explain the App Movement process. This provided an opportunity to more formally define a targeted and clear proposal that was listed on the campaign page and ensured that grammatical errors and typos were fixed before launching the campaign. The initial version of the platform provided no ability for campaign creators to make their own edits to the campaign page, which resulted in the development team being asked on several occasions to make manual edits of the database record on behalf of the campaign creators. However, once the platform became more widely adopted it quickly became apparent that the ability to edit the campaign page without the intervention of the development team was required. Although the functionality to edit the campaign page is trivial, providing this ability to the campaign creator prompts a number of potential issues around trust and transparency in the progression and support behind the campaign. The initial concerns were around creators subverting the support phase process by gathering support from a community with an initial campaign message and then changing the language and purpose of the campaign once the supporter target had been achieved. The result of this would have been an abuse of trust and subversion of the commitment from the supporters behind the initial concept for personal gain. Arguably this could be negated by the fact that the initial supporters behind the concept would have simply disengaged with the process, resulting in limited design task contributions and a reduced uptake of the final application.

A possible solution to this issue would be to provide transparent editing process similar to that of Wikipedia, whereby a version history of the campaign message is made transparent, and supporters would be prompted to confirm their continued support or withdraw from the process after each edit had been made. However, this would have potentially meant that hundreds of supporters would be prompted to amend their support preference for each change made by the campaign creator. Arguably this would have resulted in an overly complex process that becomes burdensome for the supporters due to the high levels of engagement required to maintain their support throughout the campaign. Similarly, the high volume of notifications sent to supporters might have been perceived as ‘spam’ emails and therefore negatively impacted upon engagement. This high volume of communication would have also devalued the importance of future emails sent by the platform and eroded the user trust in the

system in regards to abusing the communication channel between the two parties. To prevent this issue, the design decision was made that allows creators to edit the campaign content (short and long description, photo) if there are five or fewer supporters of the campaign. After which, the campaign message cannot be directly edited by the campaign creator. Taking this approach offers a trade-off between reducing supporter complexity (overburdening supporters with the task of reaffirming their support) and preventing campaign creators from subverting the support phase process for their own gains. It should be noted however, that in the current iteration of the App Movement platform any changes made to the campaign page are not made visible to the supporters. It is also possible to delete the movement within this same time-period whereby the campaign page is removed from the discover page and becomes inaccessible.

6.6.7 Target Setting and Campaign Durations

As part of the commissioning process campaign creators must accrue a target number of supporters within a specified timeframe. The goal of this design decision was to ensure that proposed campaigns were of value to community members and as such, engaging a target number of community members demonstrates the levels of support behind an idea as well as ensures there are enough community members to adopt and sustain the commissioned resource after it has been produced. Cheng *et al* (Cheng & Bernstein 2014) discuss this as *activation thresholds* – "*explicit manifestation of the threshold point described in models of collective behaviour, where the benefits of participation begin to outweigh its drawbacks*". Using this approach, campaigners minimize the risk of investing time and resources in ideas that are unlikely to become adopted by the community. Through making visible the demonstration of support behind a concept on the campaign page, it is hoped that others are encouraged to invest in participating with others around the idea.

Condition	Supporter Target	Support Phase Duration (days)	Design Phase Duration (days)
C1	50	30	14
C2	250	14	14
C3	150	14	14

Table 7. Changes to campaign supporter targets and phase durations

Alongside the supporter threshold, there were also constraints placed upon the duration within which this support could be accrued within the support phase and the period within which contributions could be submitted within the design phase. The impacts of these constraints on the success or failure of movements were explored through several changes made to both the initial supporter target and campaign duration (Table 7). Initially App Movement was configured to operate on a threshold of 50 supporters within a 30-day support phase and a 14-day design period (C1). However, we found that campaigns were more than capable of gathering support from 50 community members within the first 24 hours, resulting in an intensity of promotion and supporting activity only to be delayed by a protracted support phase (30 days). The result of this was that supporters had lost interest in the campaign and therefore resulted in limited participation within the design phase. In response to this the supporter target was increased to a threshold of 250 supporters within a much shorter period of 14 days (C2). This figure was derived from of 4 the most supported and successful campaigns (C-Card Condom Finder, Breastfeeding Welcome, SOLE Connect, and Das Tartastan) that all exceeded at least 275 supporters. The vast increase in supporter requirement (250 supporters) within a much shorter period (14 days) aimed to encourage a greater sense of urgency to promote the campaign and gather additional supporters. However, there was a decline in the number of campaigns being created and many campaigns were unable to achieve the required threshold. Reflecting upon the most popular app (Drone Zones) that has in excess of 28,000 users, the campaign was very well received and accrued 215 supporters. Given the app's success with a supporter threshold much lower than the 250 supporter target (C2) it is apparent that this target is set at too high a level to be achievable by future campaigns. Therefore, these targets were modified and within the current configuration the supporter target is set to 150 supporters within a 14-day period.

There is a trade-off between setting the supporter threshold at a perceived achievable figure but also large enough to be representative of both the collective decision of the community as well as demonstrate the current level of investment by the community. The supporter target also needs to be perceived by new supporters as something that is worthwhile investing their own time and resources within but also not set at an unrealistic and unachievable threshold that they become disincentivised by these constraints.

6.6.8 Verifying Support

Within the App Movement process campaigns are required to accumulate a target number of supporters during the support phase. This initial barrier to entry provides campaign creators with a mechanism to demonstrate community needs and highlights the levels of supporters willing to engage in the commissioning process. However, ensuring that there are real individuals endorsing a campaign requires a level of authentication in the supporter process. During the deployment of the service, two approaches were taken to verify the support from users; verification through an associated App Movement app, and a simplified Google ReCaptcha in-line form. The initial approach to verifying new supporting users required users to download the App Movement verification mobile application, available on both the Google Play Store and Apple App Store, and enter a unique code within the mobile app to verify their support. This process (as seen below) demonstrates the initial design of the authentication workflow that proved overly complex and was subsequently removed;

1. Visit the campaign page
    a. Register as a new user of the App Movement platform or sign in to existing account
    b. Return to campaign page
    c. Click 'Verify Support' button
2. Present user with verify support modal
    a. App Movement platform generates a unique code
    b. User is presented with unique code and App Movement verification app download links
3. User Verifies support
    a. User downloads the App Movement mobile application
    b. User opens the App Movement application and enters unique code
    c. App Movement platform verifies code and the user's support is verified

The motivation behind the use of such a complex process was initially to authenticate real people with the service but it was also implemented to deter what Rotman *et al* define as slacktivism – "*low-risk, low-cost activity via social media whose purpose is to raise awareness, produce change, or grant satisfaction to the person engaged in the activity*" (Rotman et al. 2011). Although low cost actions, such as signing up as a supporter, are low-

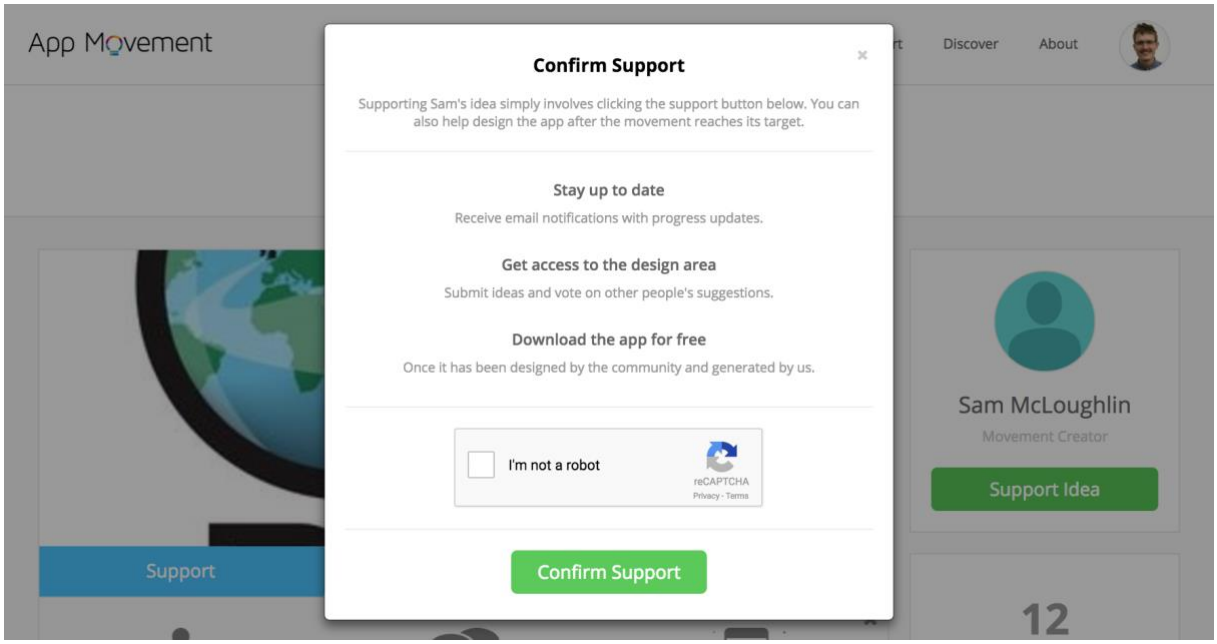

Figure 23. Human verification step in supporting a campaign

cost actions it is important to deter the disinterested or those simply in support of a technology that will ultimately require further time and effort in contributing and sustaining a shared information resource. An additional benefit of taking this approach was also that the verification app allowed us to ensure that users had the required hardware and software to make use of the apps generated by the platform. Similarly, the verification app provided information on the OS and types of devices that the community were using and therefore informed our technical decisions in the development of the app templates. It was also hoped that the verification app would create an opportunity to communicate campaign updates and deliver prompts using calls-to-action.

Perhaps understandably this authentication mechanism deterred engagement with the campaign process due to the complexity of the process. Supporters were often confused about what the verification app allowed them to do or if indeed they were downloading the commissioned information resource. In response to this the verification process simplified using existing anti-spam design patterns based upon CATPCHAS (Completely Automated Public Turing test to tell Computers and Humans Apart) (Ahn et al. 2008). This second

approach used a further simplified process (Google reCaptcha[48]) prior to validating an endorser's support. Using this approach required that users must simply click a checkbox and the Google reCaptcha service detects bot-like behaviour within the mouse movements to prevent spam. New visitors begin by clicking the 'support' button (call-to-action) upon which they are presented with a modal explaining the App Movement process, as well as to expect future campaign updates, and to expect an invitation to the design area. Visitors can then register or login using the in-line forms (if required) and are then prompted to check the Google reCaptcha box, and finally click support. Upon supporting the campaign the user receives an email notification within further information about the commissioning process.

6.6.9 Reducing supporter bounce rate

Within the initial design, supporters were required to be registered and signed into the platform before any supporter actions can be made. As such, new visitors to the service often landed on a campaign page, clicked the support button, and were then redirected to a registration form without any explanation of why they were redirected or what the process of supporting a campaign entailed. This led to a significant number of visitors simply abandoning the supporter process before they had even registered with the platform. In response to this, the supporter sign-up process was modified so that new visitors could complete an in-line registration form within the same modal that was used to describe the supporter process and supporter verification step (Figure 23). In making this design change, potential supporters are kept on the same campaign page, the process (and expectations) of supporters can be conveyed quickly, and we are able to reduce the complexity and uncertainty of the process.

6.6.10 Supporter anonymity

As part of the principles of transparency and openness within community commissioning it could be argued that the initial supporters behind a campaign should be made public on the campaign page itself. Indeed, the development team were asked by campaign creators on several occasions if a given individual had supported their movement however we were hesitant to provide this information due to privacy concerns. Services such as Change.org

[48] https://www.google.com/recaptcha

allows users to anonymously sign petitions however their details will always be shared (full name and city) with the person who initiated the petition[49]. Kickstarter has taken a more public stance and always presents a full name and location as part of the backers list with no ability for users to anonymize their identity[50]. Facebook have been criticised by privacy advocates[51], such as the Electronic Frontier Foundation[52], around displaying 'Friends who also like this page' interactions on third party websites through like buttons. Privacy advocates argue that users unknowingly displaying these interactions publicly, and therefore erode individual's privacy and safety online. Similarly, functionality that presents supporter details only to the movement creator was initially considered however it was apparent that this information could be used to pressure friends and family into supporting a campaign through peer pressure rather than through more genuine values of peer support. Developing this functionality would have also resulted in a disparity in the hierarchy between community members, with the creator possessing supporter knowledge that could be used against other members.

6.6.11 Campaign Creator Updates

In an effort to provide campaign creators with better communication channels the platform allows campaigners to make public announcements that will be received by the supporters via email. Similar functionality on services such as Kickstarter[53] and Change.org[54] provides campaign creators with the ability to make public announcements to both inform supporters as well as prompt users with calls to action to participate (Figure 24). Researchers (Xu et al. 2014) have identified the importance of campaign updates within platforms such as Kickstarter, and demonstrate that campaigns with announcements have a much higher rate of success (58.7% successfully reaching funding target) when compared to campaigns with no updates (32.6% only reaching funding targets). Indeed, campaigns on App Movement consistently made use of the campaign update feature to make community announcements,

[49] https://www.change.org/policies/privacy#4
[50] https://www.kickstarter.com/contact
[51] https://www.eff.org/deeplinks/2010/04/handy-facebook-english-translator
[52] https://www.eff.org/deeplinks/2013/01/facebooks-graph-search
[53] https://www.kickstarter.com
[54] https://change.org

prompts for further recruitment of supporters, and calls to action to participate in the design phase.

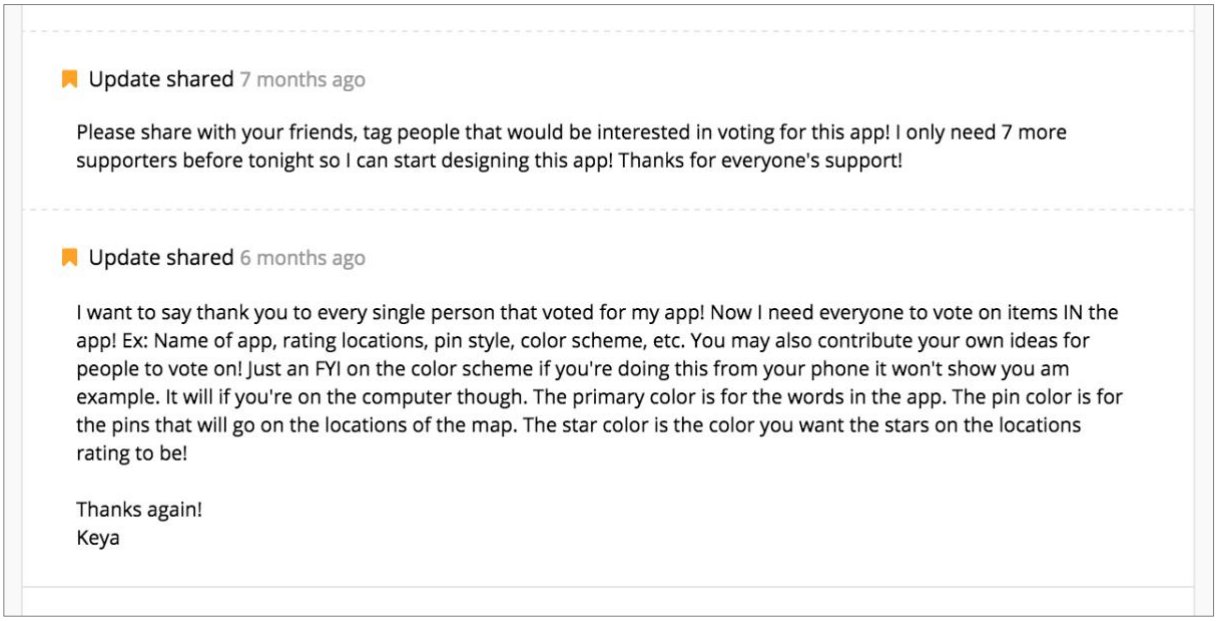

Figure 24. Campaign updates from the initiator of the Photography Map campaign

In order to prevent abuse, both unintentional and intentional, campaign creators may only post one campaign update every 24 hours. Although this value is set to a relatively low number, campaign creators can effectively mail all supporters every day for a minimum period of 14 days, in the case of a successful campaign. Campaign creators may also choose to use the 'movement update' notification outside of the allotted campaign period however this was rarely used. In almost all successful campaigns the creators posted at least one update using this functionality, with the majority of campaigns posting multiple updates throughout the process. Given that App Movement became adopted in different dialects (Greek, Arabic, and Russian) campaign creators chose to publish campaign updates in both their native language as well as English. Although this practice is not enforced in any community guidelines the act became the norm to publish both versions.

6.7 Design Phase and Design Area Overview

Once a campaign has acquired a target number of supporters within the support phase period, the movement progresses into a design area within which the community can contribute, discuss, and vote (both up and down) on community contributions within a specific set of design tasks. Within the design area supporters can contribute to the central discussion as well

as design task specific discussions as well. The design area consists of five design tasks (each with their own discussion area within each task).

6.7.1 Design Tasks

Design tasks comprise of a series of simplified and task-specific interfaces for soliciting contributions and votes from supporters (Figure 25). The tasks presented in three parts; a heading section containing the title and simple instructions to complete the tasks, a series of tiles containing existing contributions, and a submission and discussion area below. Tasks within the system were configurable so that different templates could share the design tasks. The design tasks could also be configured on a campaign by campaign basis and therefore provides the ability to A/B test given configuration of tasks should this be desired.

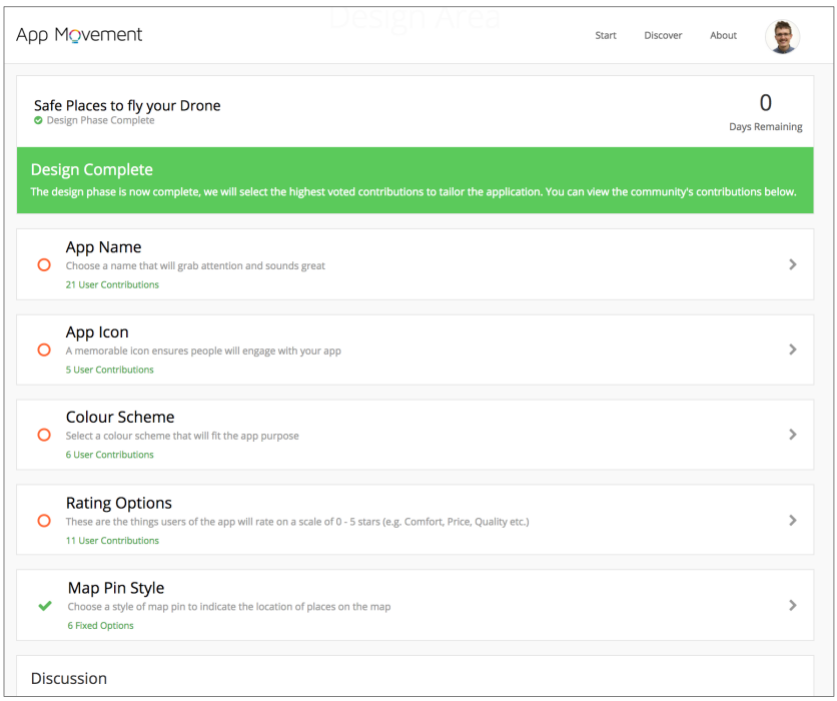

Figure 25. Overview of the design area and design tasks to be completed

App Name - Supporters can contribute ideas for the application name using a text-based entry interface.

App Icon – Supporters are presented with a file upload form and prompted to supply artwork for the app icon.

Colour Scheme – Using a custom colour picker interface supporters can select three colours (pin, review star, and primary colours) to be used in the app.

Rating Options – The rating options are the categories which are presented in the resulting location-based review app. The four rating options with the highest number of votes are selected and used in the final design.

Map Pin Style – Supporters can select from five pre-designed marker styles to represent the user submitted locations in the app.

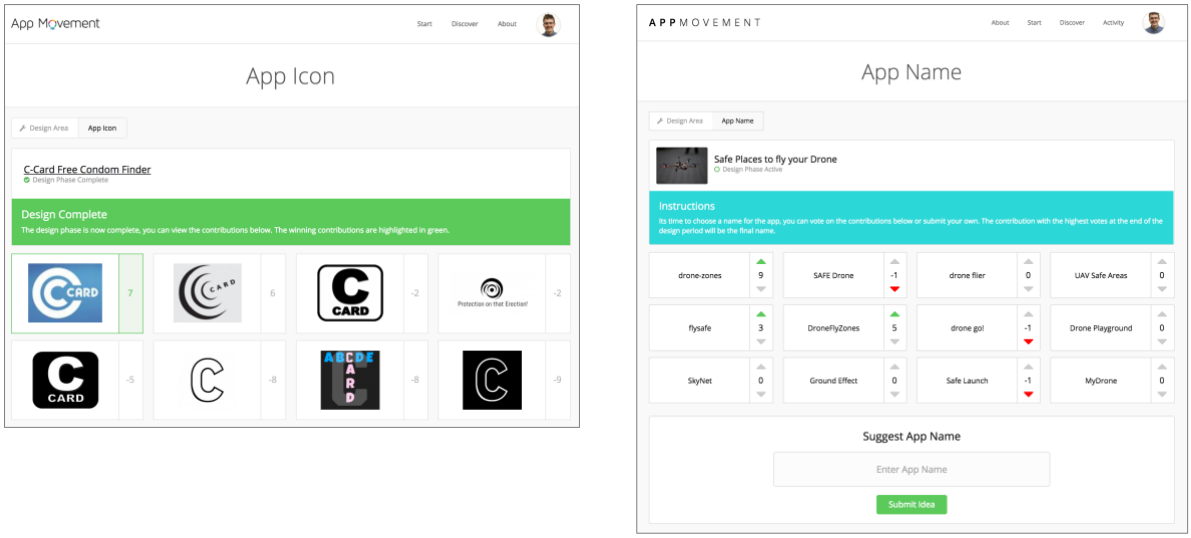

Figure 26. Design task to contribute and vote on application icons (left) and design task to contribute and vote on application name (right)

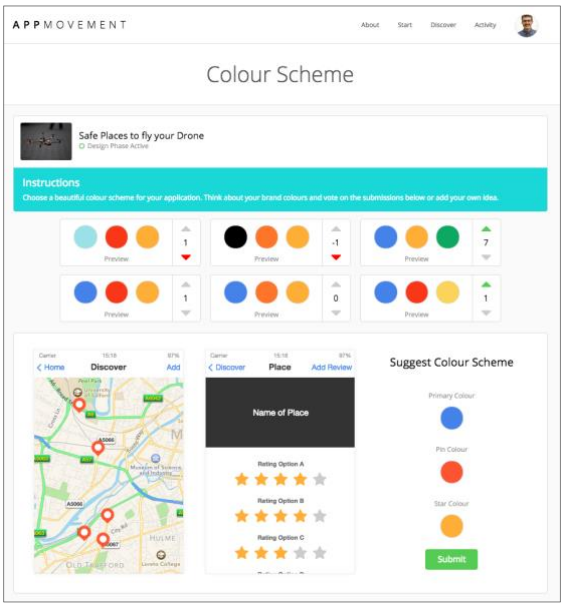

Figure 27. Design task to contribute and vote on colour schemes for the application

The design task interfaces varied in regards to the levels of interaction they received. Typically, text-based entry (App Name, Rating Options) received higher levels of engagement whereas more technical or design literate tasks, such as selecting colour schemes using the colour palette selectors (Colour Scheme task) and file upload forms (App Icons), received considerably lower rates of engagement.

6.7.2 Post-support phase access

In the initial implementation, the design phase was only accessible to campaign supporters who had supported the campaign in the initial support phase. In doing so we had unintentionally prohibited both possible future participation from late arrivals to the campaign and, perhaps more importantly, prevented access to retrospective visitors whom may wish to understand both the origins of the campaign and the underlying commissioning process. This resulted in willing participants being turned away simply because they had not been made aware of the campaign earlier on in the process. It became apparent that there were many individuals that had only become aware of the campaign after the campaign had successfully propagated through the community network and often once support phase had ended. In response to this, logic was added to allow supporters to pledge their support outside of the initial support phase, allowing those users who had only recently been made aware of the campaign to contribute and vote in the design phase as well as receive campaign updates and notifications. This provided campaign supporters and retrospective visitors with the ability to engage and observe in the process of commissioning.

6.7.3 Voting and Contributing limitations

Within each of the design tasks supporters can cast a single vote, either up or down, on each of the contributions made by the community. However, supporters were not able to cast votes on their own contributions. Contributions could therefore hold both a negative or a positive number of votes dependent upon community voting behaviour. The motivation behind this model was to prevent gaming of the voting system to promote an individual's own contribution. If a single contributor voted all other contributions negatively, their own contribution would be the only positively scored submission. However, if the entire community took the same approach, with each member voted down on all other contributions

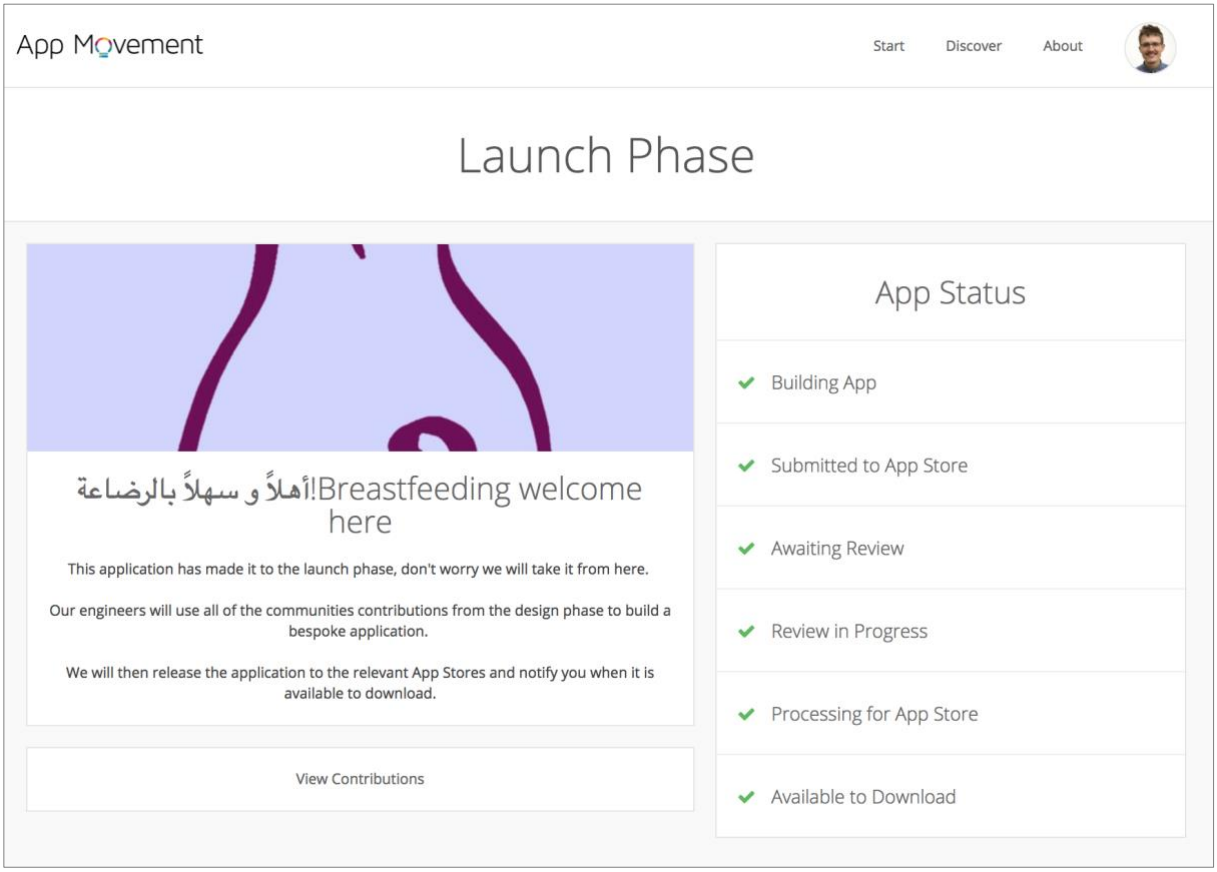

Figure 28. Launch phase of Breastfeed Proudly Lebanon campaign

when submitting their own, all contributions would result in a tie with each submission holding an equal number of votes.

6.8 Launch Phase

The launch phase is the third stage in the App Movement process, within which the community await the automated development of the final mobile application. Upon the applications being compiled, supporters are emailed a call to action that prompts them to download the new app and begin contributing content. The campaign and associated design tasks remain on the App Movement platform to encourage transparency and visibility of the process.

6.8.1 Automation of the app development process

The App Movement platform has been designed to be as autonomous as possible and incorporates elements such as automated campaign progression and system created email notifications in order to reduce workload and remove the reliance upon the research team in

order to enable citizens to engage with the platform unhindered by the administration of the process. The automated campaign progression will automatically progress new campaigns through the design phase and into the launch phase using flexible phase durations that can be adjusted on a campaign by campaign basis. The configuration also allows for adjustments such as support targets within the support phase. Adopting this approach allowed for the adjustment of timescales in circumstances where project partners required extended phases or adjust supporter targets, as was the case in a number of campaigns.

Initially the build process (Figure 29) was a manual process of copying over the template project, changing the assets, and manually exporting the signed application, uploading the resulting application to the associated app stores, publishing an app store listing, and launching the app through an admin interface. It quickly became apparent that this process was extremely labour intensive and therefore required automation in order to be scalable. Therefore, a more automated application build process was developed to incorporate a combination of server side configuration, local dynamic assets, a scripted build process, and finally automated screen shot capture of the resulting mobile application for use in the Google Play and Apple App Store listing. Within this process the platform creates a "published app" record that incorporates the winning design task contributions from the design phase, creates an application database, and exposes the data through a build specific API endpoint. Once this server side configuration has been completed a python build script then retrieves the build configuration from the platform, copies a template project, and injects dynamic content (such as application settings, design task features, and API credentials). The script then compiles and digitally signs the application with app store credentials and produces a final APK file (Android), and iOS project files. The final step in the script launches an emulator within which the application is installed. Generating screenshots is achieved using an automated UI testing suite, such as MoneyRunner[55], that provide API to access and control touch interactions with virtual devices. The screenshot generation process is a python script that executes a series of preconfigured touch and input events and allows for the capture of screenshots for use in the store listing.

[55] https://developer.android.com/studio/test/monkeyrunner/index.html

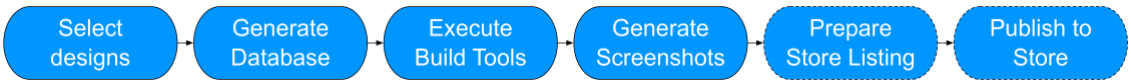

Figure 29. Automated mobile application build process

6.8.2 Preparing Store Listing

Currently, there are no fully automated methods of publishing applications through the Apple App Store and Google Play Store and as such there remains the manual process of preparing the store listing (title, short and full description, screenshots, age rating certificates, app category, privacy statements) and uploading the application for review. Both the Google Play Store and Apple App Store require that apps go through a vetting procedure before being listed in the respective app stores. As such, this delay ranges from a few hours (Google Play Store) to in excess of 7 days (Apple App Store). Currently, a generic store listing text is used when publishing new applications from the App Movement platform that states "[app name] *provides a simple and convenient way to discover places and leave reviews*" with a list of the rating options available in the app. In almost all instances of the deployment the campaign creator was contacted to provide the full store listing text which most could provide. However, in future iterations this task should ideally be completed by the community during the design phase to ensure that the message and tone of the listing is representative of the community.

6.8.3 Discussion Areas

Throughout the App Movement platform users are able to engage in active discussion in relation to the campaign. Users can post comments at the bottom of a campaign page as well as within the design area and associated design tasks (Figure 30). The comment functionality requires users to be authenticated with the platform in order to discourage spamming within the campaigns. Despite this relatively open approach to hosting discussions on the platform, no spam was observed within any of the campaigns. All comments within the system are publicly accessible and can be viewed immediately in the discussion areas on campaign pages and within the design area. The comments are displayed with newest at the top and oldest at the bottom, which can be sorted by the user. Users are also able to cast a single up or down vote on comments made by other users as well as reply directly to a comment. The comment area displays the users profile photo (or a default image if one had not been uploaded) as well as the username and date time of the comment. Users are also able to delete their own

comments if they wish. Within the design area users can post comments to the design area overview page as well as within each separate design task. Throughout the many of the campaigns users did in fact engage with the discussion areas on both the campaign and design area. Often the campaign discussions were messages of support and validation of the idea, as well as discussing the potential impacts of the technology and the potential for various functionality and features of the application. The impacts of the discussion area are presented within the three case studies that can be found within Chapter 7.

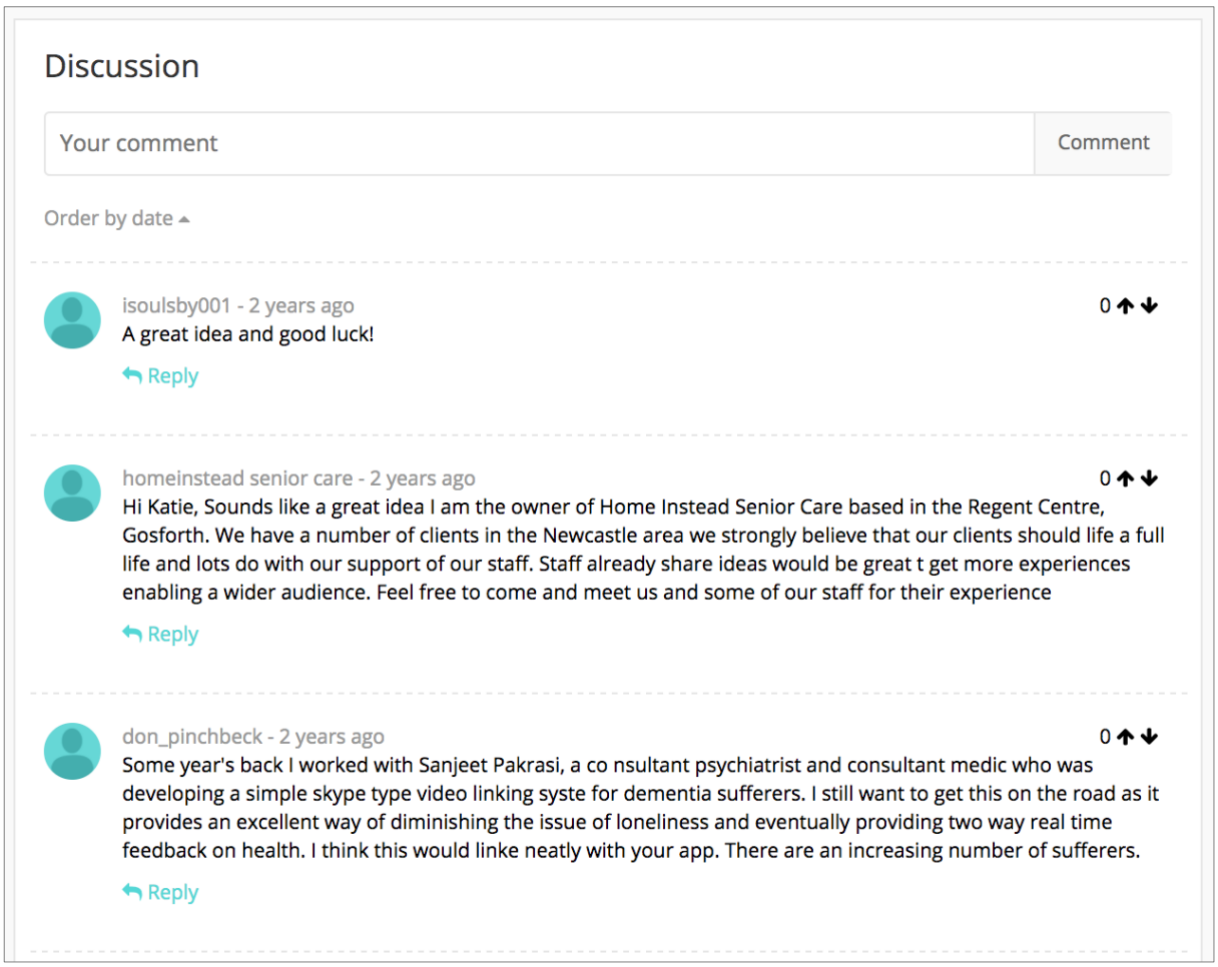

Figure 30. Discussion area on the Care and Connect campaign page showing messages of support

6.8.4 Promotion and Adoption: Analytics and Tracking

The commissioning process within App Movement actively encourages the promotion of campaigns, and as platform providers it is possible to capture this data and begin to understand how campaigns propagate through communities. The platform takes a similar approach to the quantitative analysis of case study 1 (chapter 4) in that all requests within the

App Movement ecosystem (both on the web platform and individual mobile apps) are captured and stored in the database. This data can then be used, either in aggregate or on an individual user action basis to understand; platform usage, adoption, and propagation within the wider web. The data is collected using a combination of server and API request logging (site usage logs), generation of unique tracking codes (share links), and inspection of referral headers from external websites visiting the App Movement platform (referral links). Campaign data (campaign page, discussions, contributions, and voting), explicit user contributions (venues, reviews, share links), and implicit user actions (site usage logs) are also available to understand these interactions in deeper context.

Although this data can be used by researchers for the purposes of analysis there is also an opportunity to use this data to inform campaigners and supporters about the effectiveness of their campaigns. For example, during campaigns data is collected that can represent strategic communication channels that leverage the highest levels of referrals. The data can provide an understanding of the communications channels that are actively used by the community and have the highest impact upon recruitment and engagement. Similarly, analytics data could be valuable to understanding key influencers in the commissioning process, calculated by observing their shared links and the conversion metrics of visitors becoming supporters of campaigns. This data could also be used to influence the number of available votes cast in the design phase or perhaps moderator privileges within the commissioning process or of the resulting content.

Tracking organic shares in the wider web

To track App Movement related content, such as; campaign pages, apps, and user submitted content, outside of the platform and within the wider web, the service generates unique short links that redirect to the associated content. This approach is similar to URL shorter services such as Bit.ly[56] and TinyURL.com[57] that provide shortened URLs but also provide click through analytics from site referral data contained within the originating site request. These services became popular with social media platforms, such as Twitter, that limit the number of characters in status updates but also provide analytics to understand when, who, and from

[56] https://bit.ly
[57] https://tinyurl.com

where these links have been posted. Initial research into this sharing behaviour from Lee *et al* (Lee et al. 2017) has sought to apply an epidemic model of share link generation to understand this behaviour.

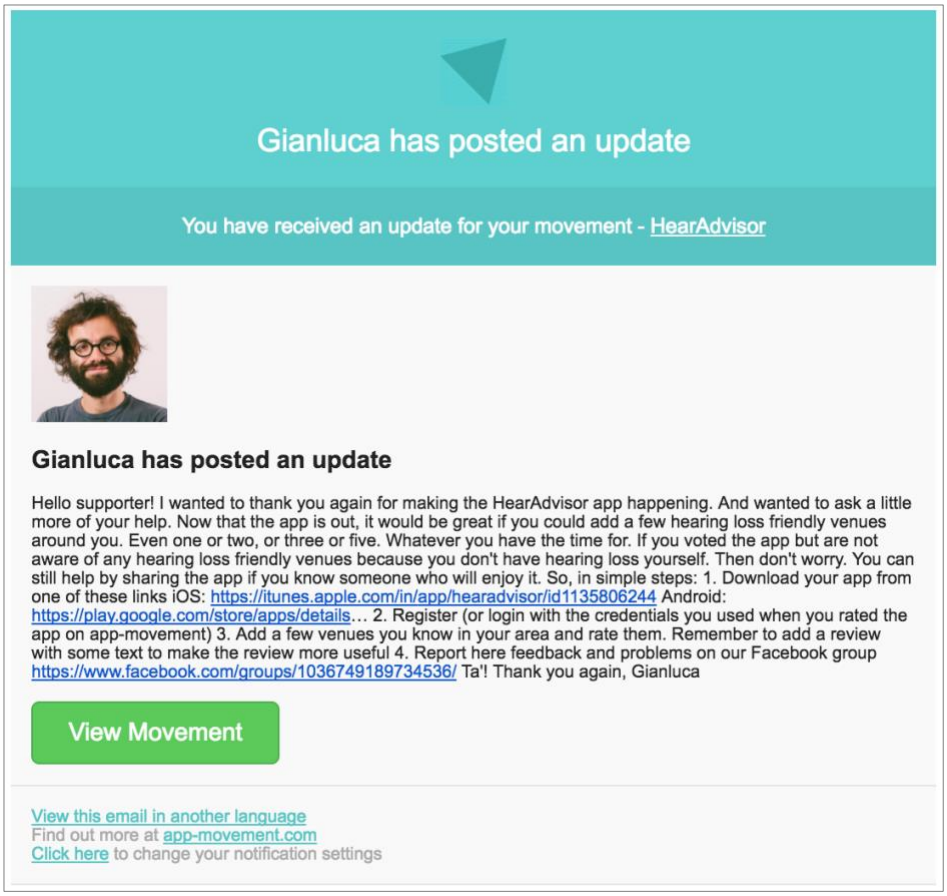

Figure 31. Campaign update posted by Gianluca for the Hear Advisor application

In order to capture and understand the data produced by these links, a custom URL shortening service was developed that hosts dynamic URLs on the http://apmv.co domain such as (http://apmv.co/rgykwe) and are referred to as Share Links. The short codes proceeding the domain name uniquely references a record of both the owner of the generated link and associated content that the link contains. Upon visiting a campaign page the platform generates a share link that is entirely unique to the specific visitor and for the specific content being viewed. Once the unique code has been injected into the browser URL, it is possible to capture the moment a user shares a campaign page directly from the browser window and onwards in social media. Similarly, share links are generated when sharing links to content within template apps. These share links take the same form (identifying the owner of a share link and subsequent referral data) and allow content to propagate outside of the mobile

application and onto the web. Through removing the requirement of having to access content through the application and placing this content on the open web, it is hoped that discussions outside of the platform take place. These discussions can then be captured using the unique referral link and provide us with a potential mechanism to identify discussion content.

Understanding anonymous interactions

Understanding adoption by active and registered members is possible through using the site usage logs. However, extending beyond existing users to understand why visitors chose not to engage with the process is also key to understanding how engaging the platform and campaigns are. To understand the actions of new visitors whilst using the web platform a web cookie is used to store a unique identifier for both authenticated and unauthenticated visitors. This unique identifier defines a "site user" that is logged along with each request to the platform. This provides a potential mechanism to understand those visitors who chose not to engage in the process as well as provides an indication of levels of engagement that campaigns receive. As part of this process, those users who proceed to authenticate with the service are attributed to the anonymous transactions stored prior to their visit.

6.8.5 Campaign updates and notifications

Throughout the campaign process the service sends email notifications to the movement creator and campaign supporters. These campaign updates attempt to clarify the community commissioning process by sending updates about the status of a campaign (created, phase completion, app launch). Similarly, summary notifications in the design phase provide overview of current levels of user activity.

Created Movement – campaign initiators receive a notification about the three-phase process regarding the campaign they have created.

Support phase complete – supporters are notified when the supporter target has been achieved within the restricted time and a call to action is presented in order to engage supporters in the next design phase.

Campaign updates – campaign initiators can publish campaign updates to supporters to call for further action or raise awareness of the campaign progress.

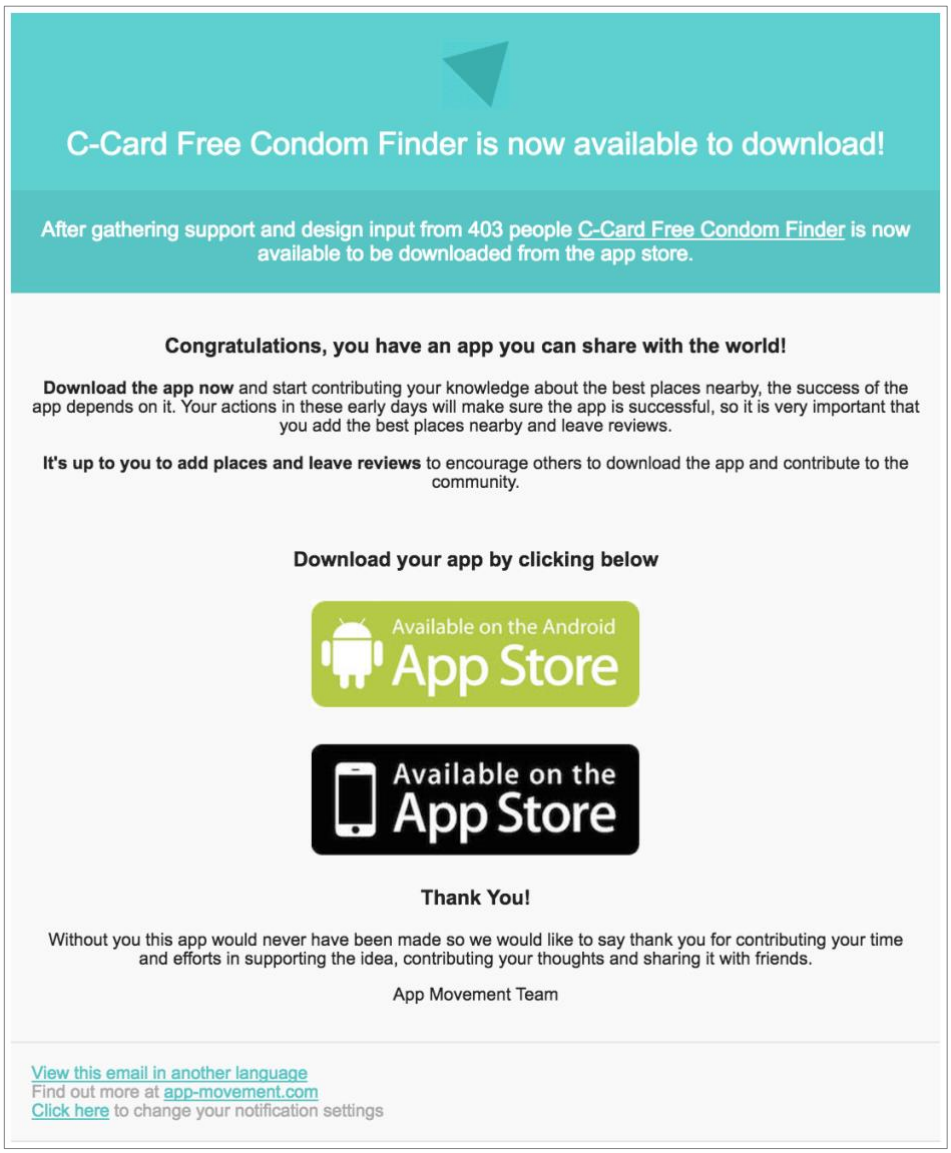

Figure 32. Email announcement notifying supporters of their application becoming available in the Google Play and Apple App Store

Movement updates – in the design phase, summary information regarding number of newly created content (comments and contributions) are sent to the supporters to encourage further engagement.

Design phase complete – once the period for the design phase has come to an end the supporters are provided with details about the automated build process that takes place before the app can be launched.

App Launch – after the app has been automatically generated and are available in the app stores, the supporters receive an email notification that prompts them to download the app and begin contributing content. The call to action links are deep linked into the associated app stores so supporters who are using a mobile device are directed to the Google Play or Apple App Store listing to download immediately.

Movement failed – if a campaign does not receive enough support within the allotted time period the current supporters are made aware that the campaign has failed.

6.8.6 Reporting content

Given the emphasis on community-led commissioning of these applications there are inevitably concerns around the moderation of the content within the App Movement platform and associated mobile applications. In order to encourage the community to identify problem content a number of reporting features were added that allowed members to flag and vote upon potentially unsuitable content. Within the discussion areas throughout the platform, it is possible to vote on comments (both up and down) to provide the community to more publicly identify unsuitable comments and vote accordingly. Similarly, within the design area supporters are also able to vote on the contributions made by others as well as flag the content to be identified by the research team. Within the associated apps, users are able to report individual comments and venues and leave an open comment to clarify their motivations.

6.8.7 Published App Microsites

Once campaigns have successfully progressed through to launch phase and apps are published in the respective app stores they are presented within a subsection on the main platform (https://app-movement.com/apps). Apps are effectively given micro-sites to provide a point of reference for supporters and campaign creators to link to. Within a published app micro-site basic descriptive statistics are displayed (registered users, number of venues, number of reviews) alongside a map displaying the community contributed locations (Figure 33). The micro-sites are intended to provide a means to access the data within the App Movement system, however this functionality is currently a work in progress.

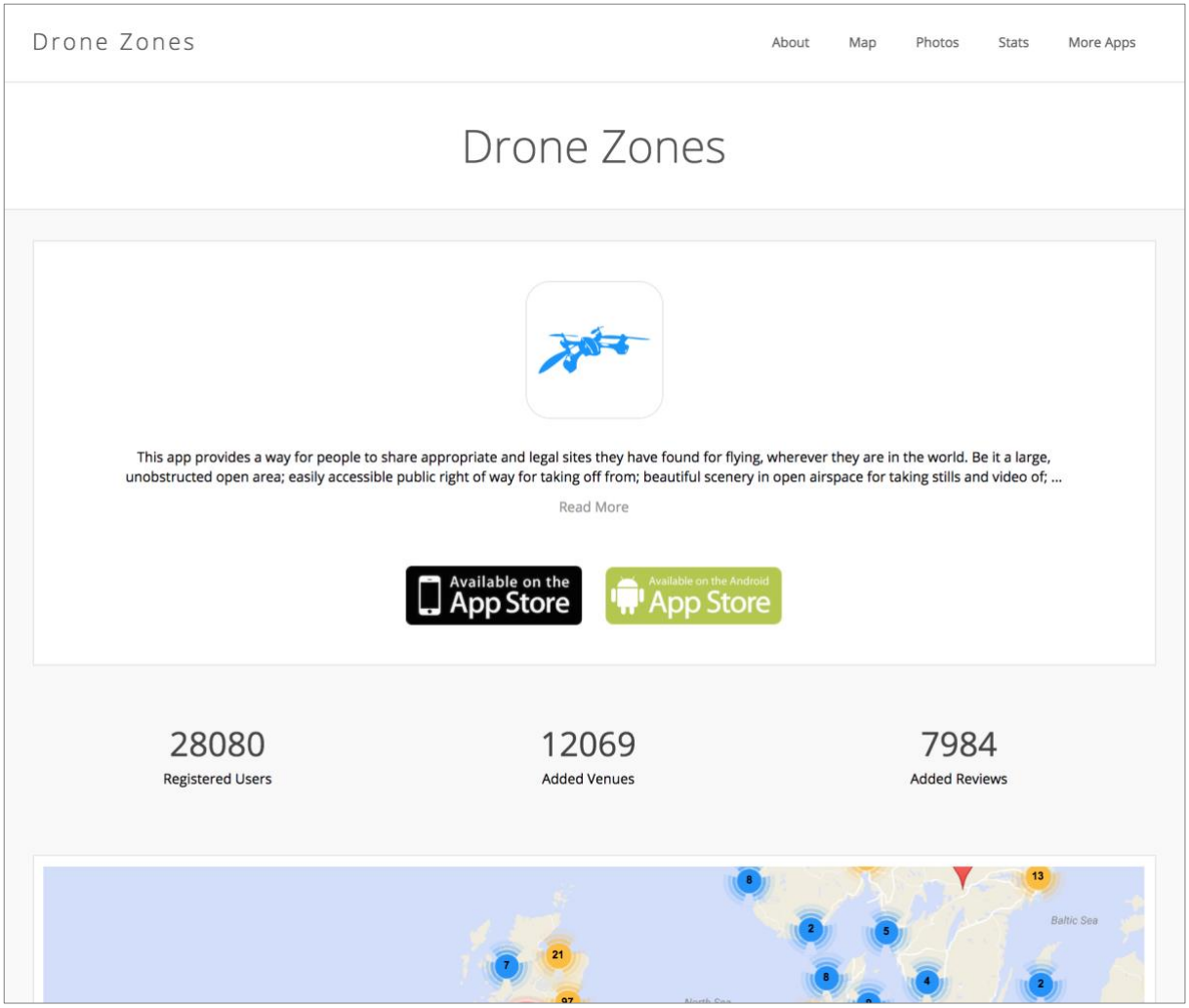

Figure 33. Drone Zones microsite providing an online presence and app analytics

6.8.8 Internationalization and Language Support

In order to maximise the potential users of the system the App Movement platform has been internationalized to support multiple languages (currently English, Arabic, Russian, and Greek versions of the platform are available) as well as localization to support non-latin character sets, right-to-left support for both text and interface design. This process required a substantial redevelopment of the platform (both dynamic database content and static web application files), email notifications, REST API, mobile applications, and associated promotional materials. The result of this process allowed the platform to be adopted by two separate international communities; a Volkswagen car enthusiast club in Russia, and as localized Arabic version of FeedFinder for use by breastfeeding women within Lebanon.

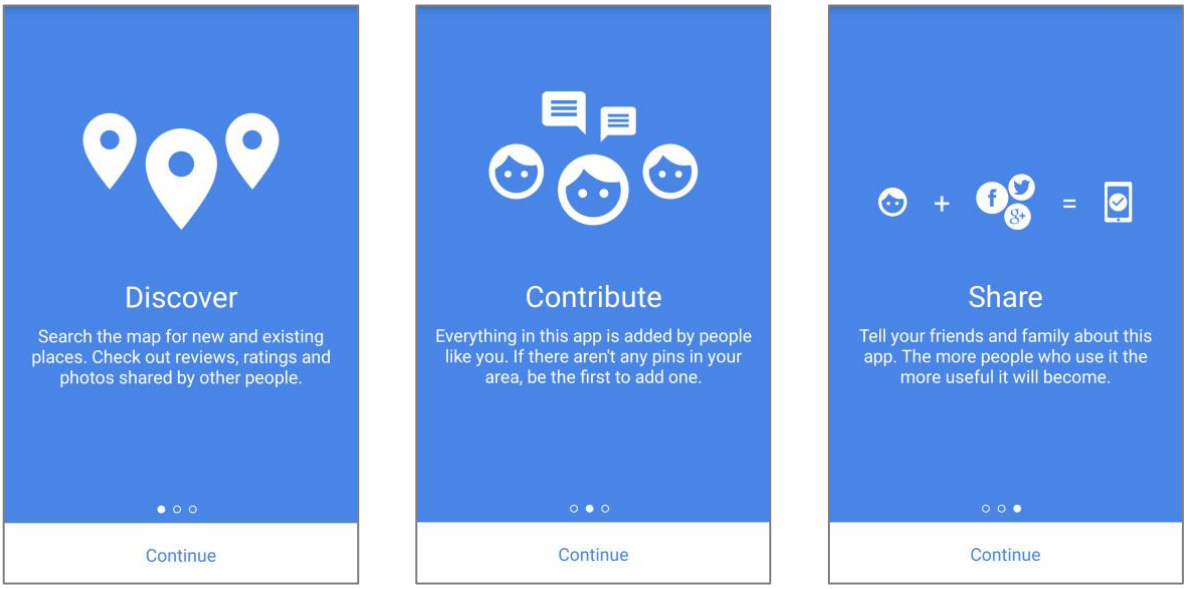

Figure 34. Onboarding process when first launching the application

6.9 Location based review application template walkthrough

This next section presents the overall functionality of the location based review application template and outlines the design choices made during the development process. Although the template functionality is similar to the FeedFinder application presented in chapter 3, the application template has been entirely redeveloped in order to accommodate the automated build process, interfacing with the App Movement platform, as well as in response to the design issues and functionality highlighted in the FeedFinder survey analysis.

6.9.1 On boarding process

When first launching the application the user is presented with three screens that attempt to convey the functionality of the application, the expectations of the data within the application, as well as the concept of a community driven information resource (Figure 34). This on boarding process is only shown once during the first launch of the application. The initial screen presents the user with an overview of the functionality of the application and highlights that the content is community driven. The next two screens attempt to incorporate calls to action stating that "*if there aren't any pins in your area, be the first to add one*" and "*Tell your friends and family about this app. The more people that use it the more useful it will become*". This was directly in response to the comments made within the FeedFinder survey around the data expectations within the application, and is used to emphasize both the

importance of community contributions and that the user themselves are directly responsible for the promotion of the application.

6.9.2 Surveying Users

The applications were developed to enable the research team to create and deploy surveys within a specific application. Previously within FeedFinder the in app survey functionality was hard-coded specifically for the four-week survey and as a result it was not possible to reframe, add, or remove questions, change timescales, or target specific users. Due to these limitations the survey functionality within the template was designed to be database driven and offers a remote and more flexible approach towards surveying users. This is achieved through a webview within the application which is presented after an initial setup API endpoint provides a survey URL to present. App Movement provides three survey conditions that can be used to present surveys, these are; *nth*-use (e.g. 5th opening of the application), duration offset (e.g. after 3-weeks), and within a fixed period (e.g. between 1st – 7th September). The platform has also been developed to incorporate additional conditions as and when they are required. Importantly, researchers are able to create web based surveys using existing familiar surveying tools, such as Google Forms, Survey Monkey, or Lime Survey, enabling greater flexibility around the creation and administration of the survey. In taking a database configuration approach to deploying surveys it is possible to not only modify the content within the survey but also take a more data driven approach when deploying a survey. This allows researchers to define specific conditions from which to target specific behaviours, using the log data collected during application use as characteristics from which to define selection criteria.

6.9.3 Interacting with the map

Upon opening the application, the user is presented with a map centred on their location (using the device's GPS) as well as any nearby locations added by other community members, identified by markers within the viewport (Figure 35). Users were able to tap on a marker to present an overview card of the venue name, average rating, and number of reviews. The user can then subsequently tap on the overview card to view more details about the venue within the Venue Information screen. Within the map view the user is also presented with a search box using the Google Geocoder API to search for places, businesses,

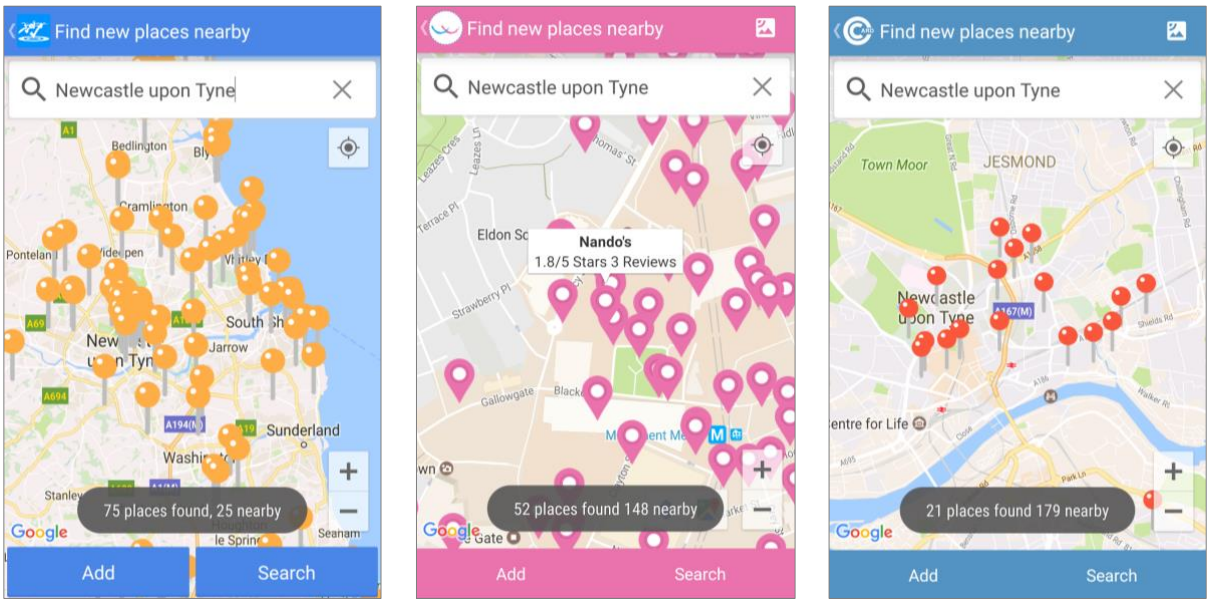

Figure 35. Drone Zones, FeedFinder, C-Card Condom Finder Map Screen

and locations which presents an autocomplete list of results that can be tapped on to centre the map at that

location. The map can be explored using familiar interactions such as pinch to zoom and dragging the map to freely pan around the current location however the user must manually tap the search button in order to retrieve additional locations. After tapping the search button, a small toast message is presented to the user notifying them of the current number of places located within the bounding box of the view, as well as the number of results outside of the screen. This was included to provide greater context to the search results and prevent confusion when displaying only a subset of the search response. Adding locations to the map can be achieved using four methods; tap and hold to "drop" a pin on the map, searching for a location using the search input that places a marker at the resulting location, and tapping the "add place" button and going through the "Add New Place" process using either a Foursquare lookup, or using the "Add New Place" process manually pinpoint a location (discussed in the Adding Venues section).

Searching for nearby locations using this map screen was available to access without the user requiring authentication with the service, however upon tapping a marker pin the user is presented with a "sign up to see more" dialog. Although it would have been possible to allow users to explore the entire application without authenticating, this mode of interaction was used so as to both demonstrate the value of the information resource and incentivize the user

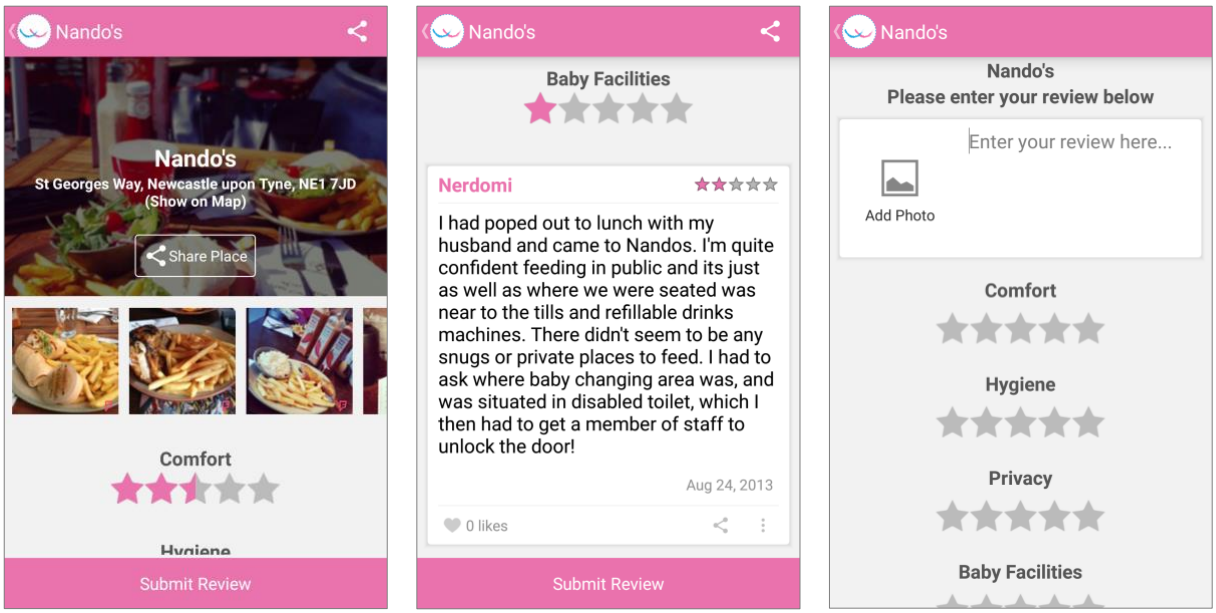

Figure 36. FeedFinder screenshots – Venue screen (left), Reviews of venue (center), Review screen (right)

to register with the service. Through registering with the service users are able to contribute and delete their own reviews, add new locations to the map, and create a profile within the application.

The default map view uses the standard map view which presents a simplified map that highlights the road network and surrounding area. Initially within the application template there was no method of changing this view however, during the deployment of Drone Zones a number of users emailed the research team with suggestions in regards to accessing the terrain view within the map screen due to their practice of drone flying commonly being undertaken within large green spaces, that are featureless within the standard map view, and thus the terrain view provides a clearer indication of the location. Although this functionality seems trivial to incorporate it demonstrates a unique problem within this model of commissioning using common application templates. There are two possible approaches to overcoming this problem; incorporate the feature into the application template, or branch off a separate instance for a potentially infinite number of applications commissioned through App Movement. Deciding to incorporate the feature meant that future releases location based review applications would benefit from the introduction of additional functionality, but we also needed to ensure that the feature was generalizable for use in other contexts. However, the alternative approach of fragmenting or branching the template to provide a more customized an application requires additional complexity in future iterations of the

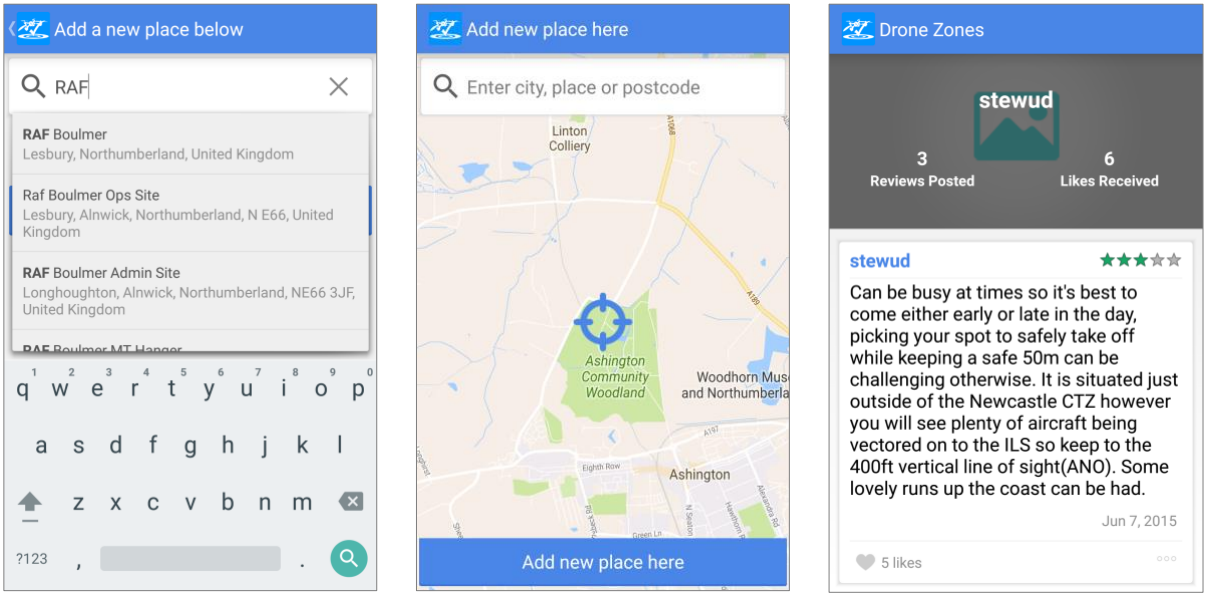

Figure 37. Drone Zones screenshots – Add venue using Foursquare API (left), Manually adding a venue (centre), and Profile of Drone Zones contributor

application template development cycle. In the case of Drone Zones, the satellite functionality was included in the next release of the application template and subsequently provided another community, users of the local photography spots application, with improved functionality.

In the previous FeedFinder deployment users highlighted the issue of searching the map outside of their local area. In response to this the map screen provides a search box that uses the Google Places API to reverse geocode search queries for place and business names. However, unlike the Foursquare search API, the Google Geocoder API does not use the user's current latitude and longitude the results vary considerably in regards to accuracy. During the development of the template this functionality was only achieved through creating a custom search box autocomplete, however later on in the project Google released a more suitable Places API that provides more business oriented search results.

6.9.4 Adding New Venues

Within the add venue screen users are presented with an autocomplete textbox that uses the Foursquare API search endpoint as a lookup service for nearby venues as well as a button to manually pinpoint a location through the location picker if not results are returned, or the search box or the location is not a local business or attraction (Figure 36). Using the

Foursquare service provides an extensive, free, and accurate service of local venues, spanning from local businesses for entertainment, leisure, food venues to municipal buildings, and public facilities. The Foursquare service also provides venue categorization, venue images, and reviews left by Foursquare users. A constraint of using the service is that a latitude, longitude, search radius, and search query must be provided in order to contextualize the search results. This was achieved by using either the latitude and longitude of the user's current location or the bounding box within which the user was exploring when panning in the map screen. The initial interaction was based upon an expectation that users would use the service on demand and in situ of their interest and thus nearby to business locations, however this assumption was challenged in the context of the FeedFinder deployment. Within the FeedFinder survey responses, a number of users identified that they were frustrated with the requirement of needing to be within the search radius when using the "Add New Venue" functionality. Indeed, the quantitative usage analysis also demonstrates that mothers were often at home and most likely outside of the Foursquare search radius to locate businesses, as highlighted by both the times of day (early morning or late evening), and the origin of search requests mainly residing within residential areas. This identified that users were simply not being presented with results from local businesses whilst adding venues using this Foursquare lookup method. It was important to therefore provide alternative methods of adding locations and as such within the map screen it is possible to drop pins and search for locations using the search box. The use of the Foursquare search was also only appropriate for certain use cases and for the purposes of FeedFinder that focused on rating and reviewing local businesses, using the Foursquare service seemed like a viable and appropriate solution. However, it quickly became apparent that this might pose an issue within other contexts (such as Drone Zones, Local Photography Spots, etc.). Therefore, it was important to include the ability to manually add locations in the world which are not business oriented. This was achieved through the "Location Picker" screen which presented the user with a crosshair overlay on a map in order to enable them to accurately place a location. Within the initial deployment this screen did not include a search box which was again was problematic in that the map centred on the user's location and thus made locating places further away from home a difficult task. Therefore, a location search box was also added to this screen in order to allow users to look up place names and businesses using the Google Geocoder API.

Within the workflow of adding a new venue users were required prompted with the review screen in order to provide a review. The process behind adding this information initially allowed the user to engage in the adding of a venue, and when presented with the review screen, exit out of the workflow causing the location to be added to the map without a corresponding review. It was felt that when adding a place to the application it was important to encourage users to also contribute an associated review with the location. This ensures that when a user browses any venue within an application they can always observe review content and derive value from interacting with the system through observing the experiential data in the form of community reviews. This was hoped to encourage further contributing behaviour through demonstrating that users were actively reviewing locations within the application. In creating this sense of value and usage by other community members it was hoped that users might be further spurred on to contribute to a resource that others were actively contributing towards. Therefore, in order to encourage this behaviour, the venue contribution workflow can only be recorded once the entire process has been undertaken (adding a location and leaving a review). Once this has been completed the location is presented to the user along with their associated review.

6.9.5 Viewing venue information

When viewing the venue information screen, the user is presented with venue details such as; name, address, average ratings for the four rating options and reviews left by the community, and the screen also allows them to contribute a review, report a venue to the administrators, and share a link to the location to social media. The venue information will also provide an image gallery of user submitted photos (contributed when leaving a review) as well as photos provided by the Foursquare venue API if the venue was added using the Foursquare search API (see Adding Venues section). The user is presented with a list of reviews in a material design style card layout and within each review the contributor's username, average rating across the four rating options, review, associated photos, and date published is presented. Users are also able to interact with the review in four interactions; tapping the username to view the posting user's profile, "like" a review, share a review, and report a review. When tapping the username on the review card the user is presented with a profile view that shows the reviewing user's contributions within the system (see profile view section). "Liking" a review is intended to provide users with the ability to endorse content within the app. The

sharing of a review provides a mechanism to link to content outside of the app and within the open web.

Within the venue screen users can report both venues and individual reviews (providing a reason why they think the content should be removed) which then emails the development team with the flagged content. In future iterations (C-Card Condom Finder) campaign creators could also access this content for the purposes of moderation however this was a bespoke interface for the sexual health north east organisation to ensure safeguarding of their service users.

At the bottom of the screen the user is presented with a "submit review" button that is fixed to the bottom of the screen at all times during the view in order to encourage the user to contribute their own review. Initially this button was located at the bottom of the view and required the user to scroll through the entire screen before it was presented as the last element in the view. However, this was altered when it became apparent that venues with a large number of reviews required the user to excessively scroll through the entire list of reviews before being able to contribute their own review. Therefore, the design decision of fixing the review button to the bottom of the screen maximizes the potential of the call to action.

6.9.6 Accessing user profiles

Users are provided with the ability to explore user profiles through interacting with individual reviews within the venue screen. Within the profile view users are presented with the user's name, number of reviews contributed and "likes" received by others, as well as the reviewing history of the user that is presented as a list of review cards. Users are also able to report both individual reviews as well as report the profile being viewed.

6.9.7 Contributing reviews

When reviewing a venue, users can write a brief review (~1000 characters) as well as upload a single photo (either via the camera application or photo gallery), and interact with four rating sliders to denote ratings between zero and five stars. Users were required to leave a comment of at least 10 characters before submitting their rating. Although this process seems straight forward there were a number of design issues that became apparent during deployment. Users often struggled to locate venues once they had moved away from the

physical location due to the workflow of leaving a review. To access the review screen users must first locate the venue on the map screen, view the venue and then tap the "leave review" button. Survey responses within the FeedFinder deployment highlighted that users felt they needed to be at a given venue in order to leave a review (alluded to within the 'Add New Venue' section previously). This is because the map initially centres on the user's location, and as the analysis shows, users are often at home prior to visiting or post visit and therefore not within the same geographic context of the venue. Therefore, users must first overcome the issue of locating the venue to leave a review, a task that is particularly difficult if the location is some distance away, and increased in difficulty if there are a large number of venues (i.e. in the city centre of Newcastle) as there is no method of filtering venues. Future iterations should include the ability to bookmark locations to quickly locate venues and encouraging more reviews, post-visit.

Within the initial release of the location based review template ratings of zero were recorded without user confirmation. This was problematic in that as observers of the review data, it wasn't possible to ascertain if the user had simply refused or failed to rate the venue or if the rating was intentionally submitted with a zero value. In response to this issue, additional functionality was added that prompts the user to confirm a zero rating before submitting a review or cancel in order to leave a higher rating. Similarly, within the initial release of the application template, users were not provided with the opportunity to confirm a submission and as such a small proportion of reviews have been clearly submitted in error given the incomplete nature of the review text. Due to this issue, the decision was made to include a confirmation dialog that allows users to confirm they have completed their review before finally submitting the contribution.

6.9.8 Sharing review information

Upon submitting a review, the user is presented with a confirmation screen and a call to action, prompting them to share their review with others. Once shared, the system shares a preformatted message (i.e. "4.5/5 Newcastle Railway Station http://apmv.co/rde5pe #FarmShopFinder #AppMovement") which shows; the user's average review, venue name, share link short URL, and custom hashtags for the application. Enabling users to share their own content with friends is an action that attempts to leverage the strength of social ties and encourage adoption by peers using a word of mouth recommendation. Rather than a generic

message being sent to friends, the application attempts to use elements of the user's own review as part of the preformatted message to both personalize the message and also minimize the barrier to composing the call to action. Perhaps more importantly, taking this approach also provides us with an opportunity to incorporate a unique tracking link within the message that directs visitors to a web accessible version of the content. The share links not only enable the research team to track sharing behaviour between users, but also act as a publishing mechanism to uniquely identify and promote discussion on the web, external to the application domain, through social media channels. In doing so a greater number of people can be involved in the discussion around a particular review or venue without having being required to install the app or register an account with the application. In doing so, the content can be appropriated and propagated as the community requires. This approach bares similarity to tweets within Twitter, that can be referenced externally, such as within news articles, as independent pieces of content that are provided with the ability to referenced on the web and promote visibility through the ability to share and reference an individual piece of content. The hashtags appended to the preformatted message can be dynamically defined by the API and are loaded during application launch. This allows the research team to alter hashtags within a given period, should they wish to track a set of shared content during a specific event.

6.10 Summary

This chapter documents a real-world community-led commissioning service for mobile applications and discusses the design challenges that were observed during a live deployment of well adopted commissioning platform. Both the web platform and mobile application functionality and design motivations have been documented and discussed. In the next chapter three case studies are presented that provide further domain specific insight into the usage and adoption of the resulting community driven information resources. The case study presented in this chapter is then revisited in chapter 8 to define a more formalized framework to discuss the concept of community commissioning and its application in other domains.

Chapter 7. App Movement in Action

7.1 Introduction

This chapter aims to provide a more contextualized understanding of how communities have adopted and engaged with the App Movement platform and resulting community-owned information systems. Given the large-scale method of deployment and social computing aspects of App Movement, a controlled observation would not have been possible to demonstrate the uptake and adoption of the platform. Therefore, this chapter presents three case studies, each of which proposed location-based review apps for quite different domains (i.e. relating to hobbies, social care, and health), that demonstrate the different contexts and approaches communities took when engaging members in the process of community commissioning. App Movement service continues to be deployed for communities to adopt and as such, the chapter begins with a brief overview of the current levels of adoption of the platform. Towards the end of this chapter the three case studies are discussed and reflected upon to understand why and how communities may or may not have adopt the resulting community-owned information resources.

7.2 Overview

The App Movement platform was launched in Feb 2015 and has continued to provide communities with the ability to engage in the process of commissioning mobile apps. As of March 2017, the service has been adopted by over 52,000 members supporting 111 campaigns, 20 of which have been successful in reaching their target number of supporters and 19 campaigns have generated mobile applications that are currently available in the Google Play Store and Apple App store. Table 8 provides an overview of these successful campaigns, and Table 9 provides an overview of the currently available apps and the associated levels of adoption.

During the ongoing deployment of App Movement several changes were made to respond to the ways in which the platform was being used. As such, both the target number of supporters and the duration of the support phase were altered to maximize engagement with the platform, with supporter targets ranging from 50 to 250 people, and support phase duration ranging from a 14 to 30-day period. Similarly, the design of the service (both platform and associated

mobile applications) were also iterated upon in response to ongoing adoption of the service as well as from suggestions made by community members in discussion sections and app store reviews.

Campaign Title	Supporters / Target	Support Phase (days)	Contributors in Design Phase	Total Comments	Share Button Clicks	Theme
Safe places to fly your drone	186/50	30	20	50	94	Leisure, Hobby
Nut allergy friendly places	50/50	30	5	2	71	Health, Food
BAMER women & girls guide to cultural venues	52/50	30	3	3	29	Informational
Dementia friendly places	94/50	30	6	25	30	Social Care
The best photography spots in the North East	65/50	30	7	12	2	Leisure, Hobby
Skate park finder	60/50	30	5	2	5	Leisure, Hobby
Best local farm shops	53/50	30	5	1	2	Food
Disability accessible facilities	102/100	14	9	52	34	Social Care
Gender neutral toilet finder	108/100	14	6	2	37	Civil Rights
Bariatric-surgery friendly restaurants in the North East	127/100	14	10	16	24	Health, Food
C-Card Free Condom Finder	368/150	14	39	17	41	Health
“On Hold” Network	202/150	14	2	10	33	Charity
Deek- Directory of Recovery	196/150	14	1	14	20	Social Care
Brutalist Mapper	193/150	14	15	13	44	Architecture
HearAdvisor	175/150	14	10	1	23	Health
Community action and events in Wingrove	167/150	14	4	5	19	Community events
Photography Map	158/150	14	4	0	21	Leisure, Hobby
Das Tartastan	276/250	14	13	6	6	Hobby
Breastfeeding welcome here	331/250	14	39	72	52	Health
SOLE Connect	301/250	14	9	8	47	Health, Civil Rights

Table 8. Successful movements that have reached a target number of supporters.

Given that the App Movement platform is a novel concept that began with no initial community to support the platform the launch of the service required a focused attempt to promote and engage members of the public with the service. A range of approaches were used to recruit initial campaign creators that ranged from contacting potentially influential community leaders, to a local social media “push”, using Twitter and Facebook, to promote the App Movement concept. The combination of community-led campaigns and the inclusion of supporter targets yielded large numbers of new service users with the creation of each campaign. Inevitably as communities shared their campaign in an effort to meet their

supporter target using social media their own personal networks, the service became more widely adopted. Similarly, as campaigns were developed into working mobile applications and launched in the Google Play and iOS App Stores the App Movement service saw further traction.

App Name	Downloads (Android)	Downloads (iOS)	Downloads Total	Venues	Reviews	Reports	Photos	Likes	Active Users*
BAMER Sista's Cultural Guide	27	1,267	1,294	13	18	0	7	0	6
Breastfeed Proudly	394	647	1,041	125	109	2	8	34	133
Brutalist Mapper	95	159	254	71	61	2	25	5	144
C-Card Condom Finder	87	378	465	456	81	20	2	20	253
Care and Connect	**110**	**519**	**629**	**155**	**78**	**0**	**7**	**10**	**62**
Das Tatarstan	53	67	120	48	46	17	4	15	33
Designed4All	24	51	75	21	15	0	6	2	5
Drone Zones	**24,927**	**20,848**	**45,775**	**11,680**	**7,726**	**70**	**2,379**	**1,497**	**12,049**
Feed Finder	4,870	5,214	10,084	3,570	3,542	1	34	104	2,393
Gender Neutral Toilet Finder	467	875	1,342	322	187	0	10	9	294
Hear Advisor	39	67	106	40	29	1	1	4	42
Local Photography Spots	709	827	1,536	384	265	0	84	20	369
Neighbourly	37	52	89	22	15	0	1	3	49
NutFree	**190**	**316**	**506**	**153**	**122**	**0**	**20**	**69**	**42**
PhotoGo	22	103	125	19	15	0	9	4	51
Poetry Pick-n-Mix	54	313	367	201	266	27	154	255	19
Skate Map	861	0	861	918	467	0	86	22	444
Slim Pickings	129	169	298	47	16	0	1	1	33
SOLE Connect	19	73	92	19	17	4	6	6	15
Total	**33,114**	**31,945**	**65,059**	**18,264**	**13,075**	**144**	**2,844**	**2,080**	**16,436**

Table 9. Currently available apps in Google Play Store and Apple App Store as of 10th March 2017

7.3 App Movement: Case Studies

The three case studies presented in this chapter draw from three distinctly different domains (hobby, social care, and health) and demonstrate the potential for these forms of community commissioning platform to be utilized in various contexts. Although each of these campaigns were successful in reaching the supporter target, the engagement and adoption of the resulting community-owned information resources varies considerably. Drone Zones (case study 1) allows drone pilots to map and review suitable flying locations case study 2, Care and Connect, helps carers of individuals living with dementia to find dementia friendly locations; and case study 3, Nut Free, is intended for people with severe allergic reactions, for which users' rate and review restaurants for their awareness of, and practices in relation to, nut allergies. The case studies presented here capture various levels of adoption by their corresponding communities, with some campaigns being more widely adopted than others. The documentation of these case studies draws upon qualitative data, based on online comments, campaign descriptions and quantitative data pertaining to system interactions on the platform.

7.3.1 Case Study 1: Drone Zones

Unmanned Aerial Vehicles (UAVs), known as drones, have become readily available to hobbyists and are also being used in activities ranging from aerial photography and surveying to search and rescue. The increasingly widespread adoption of drones is giving rise to debate about the legality of some of the applications of drone use, as well as safety and the suitability of flying locations. Within the UK legislation relating to drone use is in preparation, and at the time of the creation of the Drone Zone movement, the UK Parliament and the Civil Aviation Authority were in discussions to form recommendations of best practice[58]. The contentious issue of where UAVs can be safely flown is a topic that is widely discussed, not just in relation to the safety of the pilot and the public, but in terms of the reputation of the community[59].

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[58] http://www.independent.co.uk/news/uk/home-news/drones-are-filling-the-skies-look-up-now-to-see-what-is-looking-back-down-at-you-9746459.html

[59] http://www.bbc.co.uk/news/uk-england-34269585

The creator of the Drone Zones campaign, Simon, is an influential member of the drone community who hosts a YouTube channel[60] with over 19,000 subscribers interested in the topic of drones and over 3.7million channel views. On his channel, Simon presents product reviews, discusses current drone news affairs, and presents how-to tutorials on drone flying and construction. Due to Simon's position within the drone flying community we contacted him through YouTube to make him aware of the App Movement service. Fortunately, after an initial email discussion with the research team Simon responded by creating his campaign page[61] entitled "Safe place to fly your drone". In this discussion, we described the process of App Movement, responded to questions regarding the process and cost free nature of the service, and reassured him that the application development would be generated by the platform. We also offered to assist with finding royalty free images for the campaign page as the initial image chosen was subject to copyright.

As part of this exchange Simon was clear that he wanted to coincide the launch of the campaign with a YouTube video[62] about the motivations of the campaign, process of the App Movement service, and a call to action for the community to support and discuss the idea. In the video, Simon emphasizes the importance of identifying safe drone flying locations to support responsible flying. He also manages expectation around data through stating the importance of the collective participation by the community in mapping locations. Within 11 hours of creating the campaign and publishing the video the target number of supporters was met and exceeded.

The initial target for this movement was set at 50 supporters, however, this was quickly surpassed and the movement achieved 186 supporters overall. The supporters actively made use of the discussion functionality throughout the support and design phase and discussed the implications of the application itself as well as engaging in discussion around specific design elements. Discussion points and contributions throughout the design process originated from a number of different supporters. Looking more closely at the comments made on the campaign page users expected the Drone Zones app to have much more of a direct impact on

[60] https://www.youtube.com/user/Nomisnotwen
[61] https://app-movement.com/vv7r53
[62] https://www.youtube.com/watch?v=fv6_itSlkr8

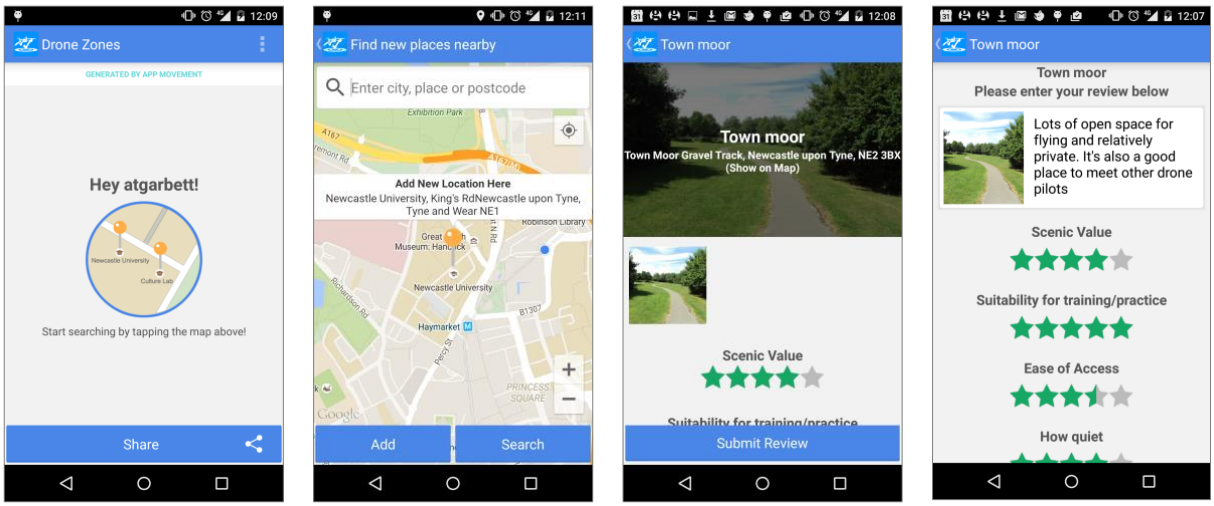

Figure 38. Drone Zones application to map safe drone flying locations

government legislation (e.g. "*Great idea. It shows the powers that be that at least pilots at trying to get our own house in order*."; "*Brilliant! If it succeeds, it could go a long way to helping the various government departments tasked with dealing with the small quad copters*."). Before launching the app, it is clear that members felt as if they might be able to unify the community, through the use of the app, and demonstrate to the authorities that the community as a whole can be responsible pilots. Supporters also intended on using the app to encourage responsible practices within the community itself (e.g. "*Great idea, especially when travelling abroad - a quite nice way to respect each countries flying rules...*"; "*This app would not only benefit enthusiasts wanting to fly somewhere but could also encourage responsible & knowledgeable fliers too*.").

In the design phase, approximately 10% of supporters engaged with the design tasks with 20 supporters making a total number of 58 contributions (30 app names, 8 app icons, 6 colour schemes, 14 rating options). Supporters (n=20) also cast 132 votes on community contributions during this process. The winning contributions in the design process led to the name "Drone Zones" with a community contributed app icon and associated colour scheme. The winning four rating options that were used to review drone flying locations were; (i) Scenic Value, (ii) Suitability for training / practice, (iii) Ease of Access, (iv) How Quiet (Figure 38).

Figure 39. World map showing venues added by the Drone Zones community

The discussion that took place around the design tasks focused on functionality and intentionality of the application's use. For example, discussions formed around naming the application to imply safety and suitability in flying locations – "*I like SafeFlyZone. We all have to check No Fly Zones etc. What we need are safe fly zones.*". The community were also conscious of limiting their potential user base by selecting a drone specific name for the app – "*this app could be useful to other RC pilots and exclusively referring to drones may limit the user base?*" – whereas some members felt the app should be directed specifically for drone flying locations – "*I like the variations on "Drone Safe Zones" as its specific to the app. The others could suggest, by the apps name only, you can fly any aircraft there"*. These discussions around the design tasks appear to be beyond simply completing the task, but also offer an opportunity for the community to begin forming their intentions for application use once the application has been deployed.

After the release of the Drone Zones app, Simon released a review video[63] through his YouTube channel that reflects on the App Movement process and emphasizes the community-led approach to creating the application. In the video, he also encourages his community to

[63] https://www.youtube.com/watch?v=flD4HuDh7JY ["Drone Zones", an app that YOU helped to design, is now available...]

contribute their own reviews and locations, and stresses the importance for collective efforts around data collection. Subsequently several articles on drone news sites about the app were posted, and two other video reviews[64][65] of the Drone Zones app were posted to YouTube.

The Drone Zones app was launched in June 2015 and currently has 45,755 downloads (24,927 Android, 20848 iOS) resulting in ~26,000 users who have added ~11,000 venues, ~7,500 additional reviews and ~2,300 photos. The community have extensively mapped Western Europe and North America and has smaller pockets of use throughout Australia, Asia, The Middle East and South America (Figure 39).

7.3.2 Case Study 2: Care and Connect

Dementia is considered a complex condition that includes a range of symptoms that range from cognitive to the interpersonal. Sabat *et* Lee (Sabat & Lee 2012) identify several themes with those living with dementia; a sense of a changing self, a loss of status as a competent social partner, a loss of social and familial, and difficult feeling in social situations. Due to both the complexity of the illness people commonly find themselves 'ageing in place' – preferring to stay at home or living in care for as long as possible. In response to the challenge of helping people living with dementia live longer and more meaningful lives within their immediate locale has been the launch of the 'dementia-friendly community' initiative (Mitchell 2012). Initially launched by the Alzheimer's Society in the UK, the initiative aims to support people living with dementia to continue to live meaningful lives within a dementia aware community who are sensitive to their needs. However, despite initiatives such as these the underlying concept of 'dementia-friendliness' is relatively undefined.

The creator of the Care and Connect campaign, Katie, is a social science academic who works in the field of social gerontology and has strong personal and professional interest in dementia care in the community. Through her research at Newcastle University, she has close relationships with both local and national dementia organizations. Katie approached the research team after hearing about App Movement through her colleagues and hoped to create

[64] https://www.youtube.com/watch?v=zy4AIewnRU4 [Drone Zones App - Quick Review]
[65] https://www.youtube.com/watch?v=ckgU2pYvTlQ [App Drone Zones, descubre zonas de vuelo cercanas a tu ciudad para volar tu drone]

the application to explore the concept of 'dementia-friendliness' within her own research as well as support residents in building a sense of community across disparate areas of the city.

The Care and Connect app enables carers to find dementia-friendly locations, as the campaign creator, Katie describes; "*places people with dementia and their carers enjoy to go, whether this is outside or inside*"[66]. The campaign message made clear that Katie has a research background in dementia that stems from both a professional and personal experience with this area. Katie also uses the campaign page as a prompt to "*ask the question how can we design or shape outside places, such as our cities or our neighbourhoods, to support people with dementia to continue to use and enjoy them?*". The campaign message is distinctly different from Drone Zones and NutFree in that the call to action is focused on responding to the question of "what is a dementia-friendly space?" rather than how the community might engage with the process of mapping locations and understanding associated values.

When promoting the campaign Katie shared it with personal contacts on social media, and in her professional role as an academic. She also presented the idea to several dementia-care specific local advocacy groups. This can be seen in five of the twenty comments on the campaign page that were from local support groups and healthcare professionals working with people living with dementia;

- "*Sounds like a great idea I am the owner of Home Instead Senior Care based in the Regent Centre, Gosforth. We have a number of clients in the Newcastle area we strongly believe that our clients should life a full life*"
- "*Katie - I am Sandra, Director of www.silverlinememories.com, a Community Interest Company that provides activities for people living with Dementia. We facilitate weekly Dementia Cafes, a Choir for people with Dementia, Reminiscence Workshops*"
- "*Katie - I think there could be a lot of interest in this. I will pass it on through my networks and ask people to get back in touch with you.*"
- "*I am in full support of this and would love to help in any way possible. I will talk about it at work with my colleagues as well*"

[66] https://app-movement.com/wybdg5

Comments on the campaign page also provide personal accounts around why they want to get involved with the campaign; "*[..] I speak on behalf of all of my family when I say we would willingly support this. We have recently discovered a brilliant cafe in Dunston […] we take my dad there as often as we can, it is accessible, friendly and very understanding of my dad's condition.*". Comments were also made more generally about how the community might improve the local area; "*It would be ideal if there were clear signage on dementia friendly shops, cafes etc and also clearly marked bus stops and drivers whom can identify if there is a person needing assistance*".

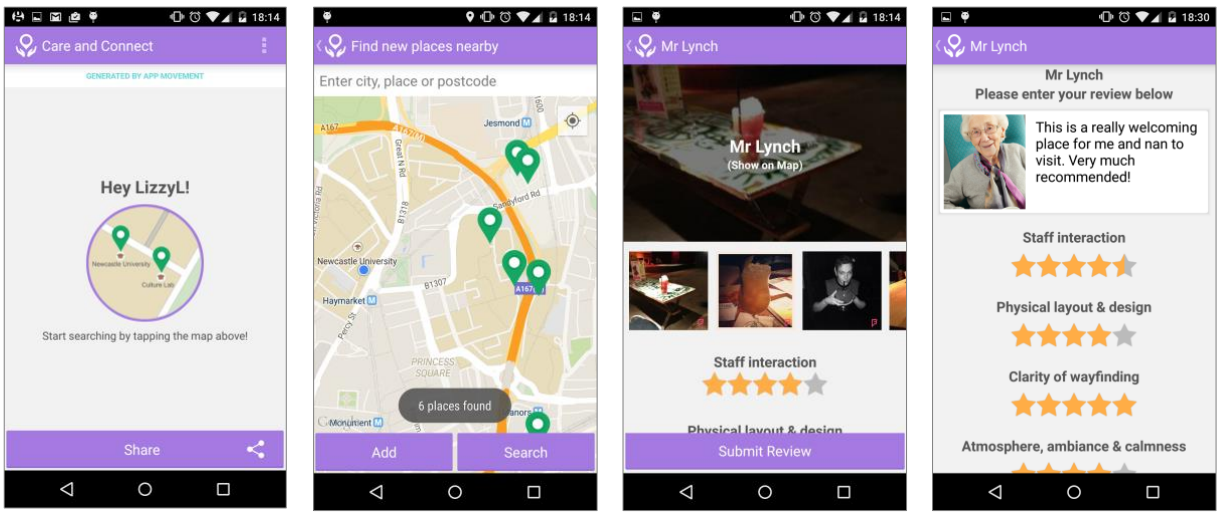

Figure 40. Care and Connect application to map dementia friendly places

The campaign began with a target of 50 supporters however the campaign achieved almost double the required number of supports (94) after the initial support phase was completed. The concept of the dementia friendly places also received a considerable amount of support in the form of comments on the campaign page. Unlike Drone Zones, the supporters of this movement were mostly localized to the Newcastle region in which Katie works.

Within the design phase 6 supporters made a total number of 11 contributions (4 app names, 0 app icons, 3 colour schemes, 4 rating options). Supporters (n=6) also cast 13 votes on community contributions during this process. The winning contributions in the design process

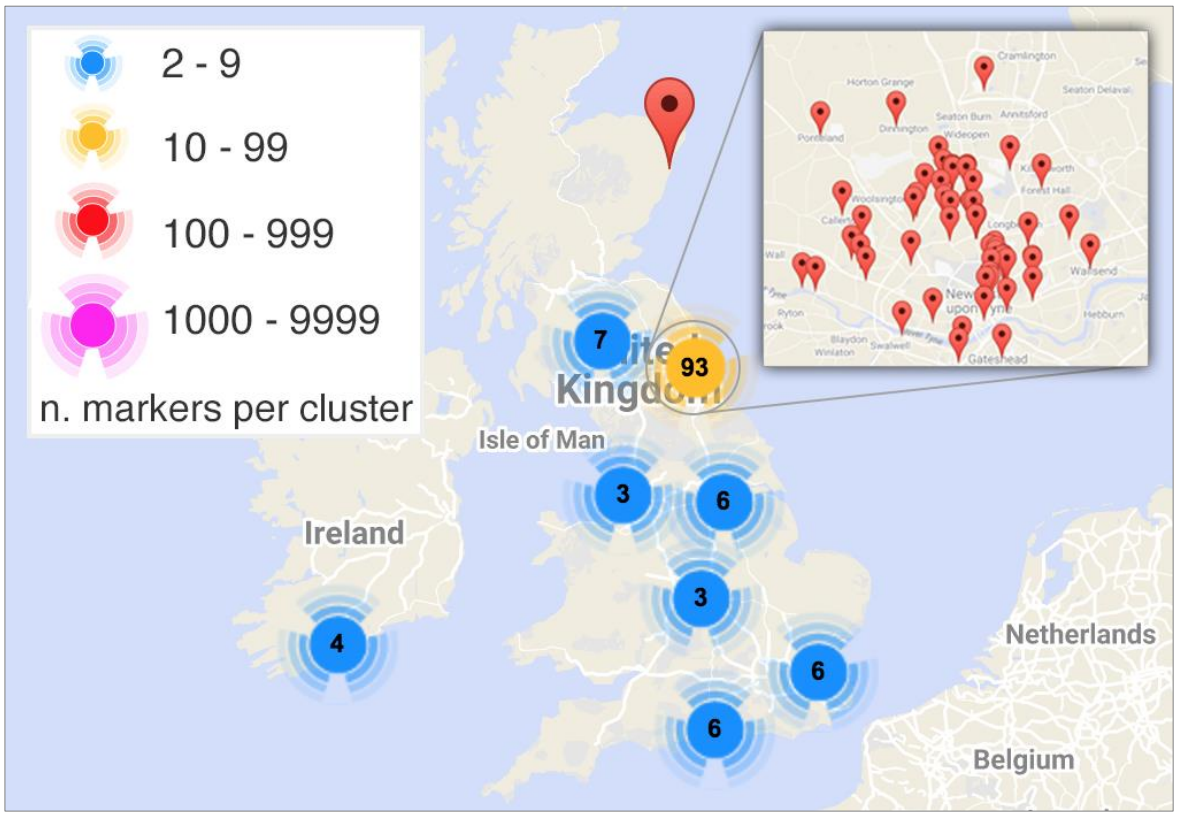

Figure 41. World map showing venues added by the Care and Connect community

led to the name “Care and Connect” however the community did not contribute in the creation of an app icon. The winning four rating options that were used to review dementia-friendly locations were; (i) Staff Interaction, (ii) Physical layout & design, (iii) Clarity of Wayfinding, (iv) Atmosphere, ambience & calmness (Figure 41).

The comments, discussed previously, clearly demonstrate the motivations for engaging in the campaign process, however despite this the application saw limited engagement in the design phase. The engagement around the configuration of the app was limited to a small number of community members, some of whom had previously commented on the campaign page. Overall the design phase consisted of only a few contributions, with the app icon task receiving no contributions at all. Although the design tasks were incomplete, the architecture of the process did not account for incomplete tasks. As such, the research team had to create assets on behalf of the community and coordinated efforts with Katie to accept the final icon design. This issue of an incomplete design area became somewhat of a reoccurring theme in other instances within the App Movement campaign.

In an effort to publicise the Care and Connect app after it had been launched the research team, including the author, attended four local dementia awareness events to promote the application. We also met with two local social care charities who offer support to those living with dementia to demonstrate the Care and Connect application and answer any possible questions or concerns about the app (Figure 42).

The Care and Connect app has been available since May 201 and has 629 downloads (110 Android, 519 iOS) resulting in 273 users who have added 155 venues, 78 reviews and 7 photos. The areas which have subsequently been mapped using Care and Connect been mapped are centralized around this area. This is most likely due to the geographic proximity of networks that were approached and promoted to by the Katie.

Figure 42. Promotion of Care and Connect at the dementia-friendly Silverline memories café

7.3.3 Case Study 3: NutFree

The NutFree app enables people to map the level of nut allergy-awareness and good practice (in relation to allergies) of restaurants. Those living with nut allergies often face uncertainty when dining outside of the home as they have less control over the food and drink they consume. For example, relaying specific allergies to a member of the serving staff can be uncomfortable and misunderstood, resulting in a potentially life threatening situation. In the

words of the creator, Neil, the app "*will let you (or your family) share experience of good places for people with nut allergies to eat, and also how good the food is*" [67].

Neil is a paediatrician specializing children with severe allergic reactions who is also a researcher at Newcastle University studying the role of technology in supporting patients and clinicians in the management of chronic health conditions. Neil became aware of the App Movement service through internal discussions whilst at Newcastle University. As part of the ongoing research with a local young adult support network for those with chronic nut allergies, Neil created the campaign as part of an effort to engage this specific community.

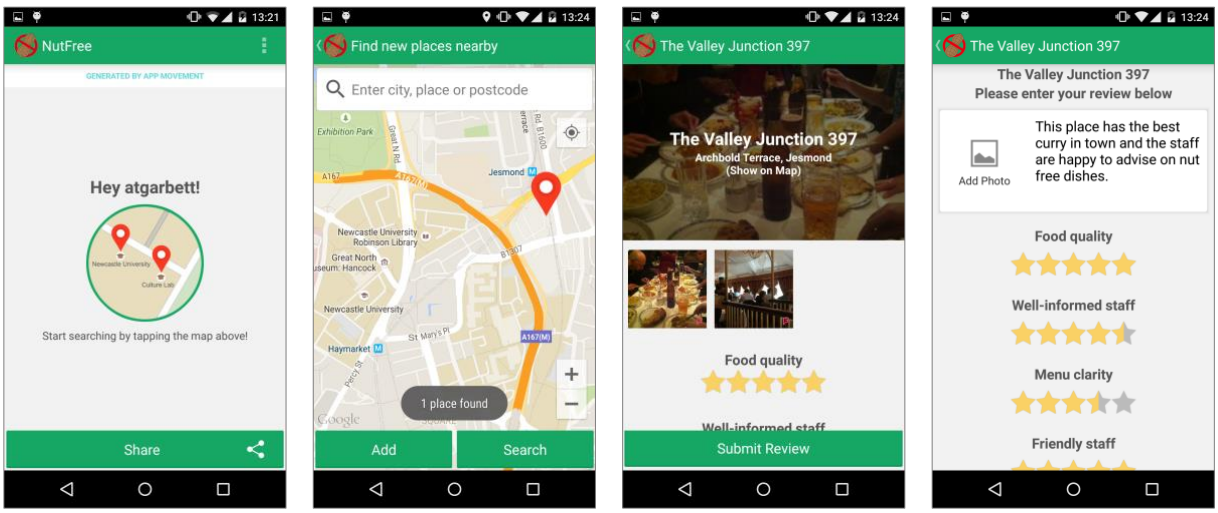

Figure 43. NutFree application to map anaphylaxis aware restaurants

In an effort to increase the potential impact of the campaign Neil partnered with the research team in order to engage in discussions with Anaphylaxis UK[68] – a leading UK wide charity that supports people with severe and potentially fatal allergic reactions. Before the campaign began, he contacted the charity to persuade the charity to create the campaign under their own brand in order to leverage their existing national membership network. However, after several discussions with representative of the charity they withdrew their support due to specific concerns regarding: potential liability, the lack of readily accessible interface for moderation (by the charity), resource implications for the charity (to perform moderation), and ownership of the content submitted by users within the app.

[67] https://app-movement.com/wybd5b
[68] http://www.anaphylaxis.org.uk/

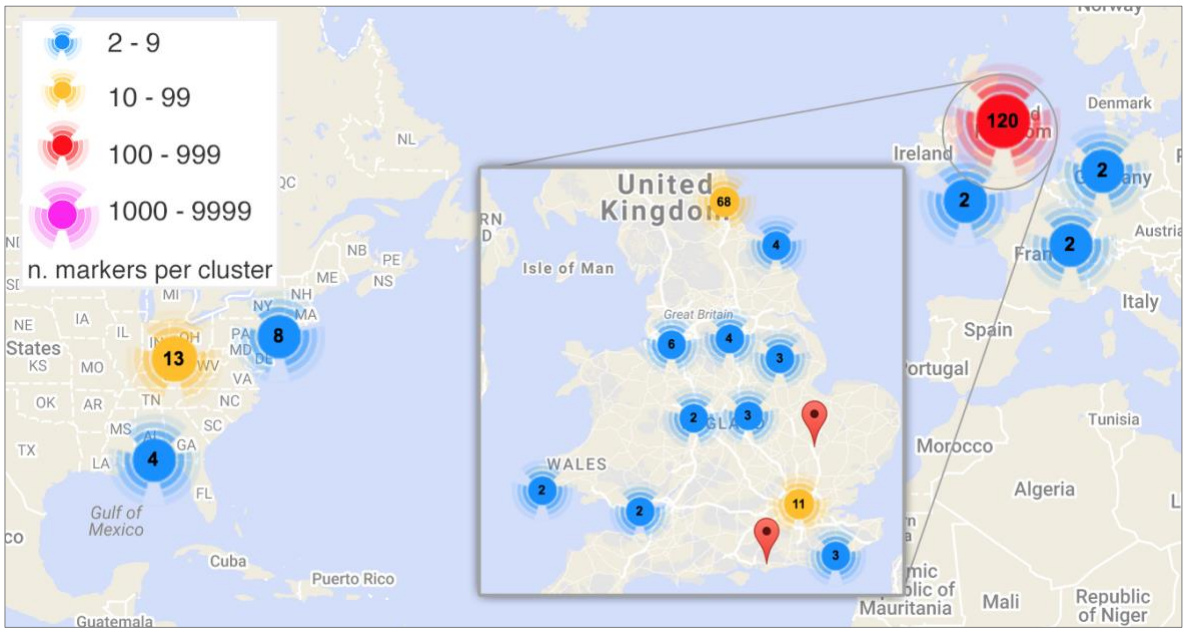

Figure 44. World map showing venues added by the NutFree community

Neil promoted the app through personal networks as well as local patient networks with which he was engaged with. Although the target of 50 supporters was achieved in within just a few hours of the campaign announcement, other than contributions made by the campaign creator (who used the comment system to make announcements in the design phase) no comments were added to either discussion sections on either the campaign page or in the design area.

Within the design area 5 supporters made a total number of 20 contributions (10 App names, 1 app icons, 2 colour schemes, 7 rating options) made by 5 contributors who cast 21 votes during the design phase. The winning contributions in the design process led to the name "NutFree" with a community contributed app icon and associated colour scheme. The winning four rating options that were used to review nut allergy friendly locations were; (i) Food Quality, (ii) Well-informed Staff, (iii) Menu Clarity, (iv) Friendly Staff (Figure 43).

The NutFree apps have been available since July 2015 and has 506 downloads (190 Android, 316 iOS) resulting in 296 users who have added 153 venues, 122 reviews and 22 photos. The geographic spread of venues contributed by the users is nationwide, with the majority of contributed content relating to the geographic region in the North East where Neil works, and with reviews generally focusing on restaurants in city centres (Figure 44).

7.4 Discussion

Through our case studies and other movements proposed through the platform, we can gain insight into the nature of both successful and unsuccessful campaigns; reflect upon assumptions we made in our design and operation of App Movement in relation to what success of a movement means; and consider issues that have arisen relating to governance of both the apps themselves and the data they solicit.

7.4.1 What makes a successful campaign?

The creators of movements and their motivations for creation has varied considerably between the 111 proposed to date (20 successful). In general terms, we can distinguish three categories of creators: embedded community members; lone citizens; and professionals. Through reflecting upon these three campaign initiators we can begin to understand the motivations and actions of the various types of individuals who might engage in this commissioning process.

7.4.2 Embedded community members

Successful movements such as Drone Zones or Local Photography Spots were created by members of the community of interest that each movement's creators sought to mobilize. In these cases, the creators (Simon: Drone Zones; and Ahmed: Local Photography Spots) used the discussion section of the campaign page, as well as established social media sites of the target community (e.g. Ahmed's use of the Facebook page of his local photography group) to mobilize support. A desire to act as a community was very apparent in many of the statements of support, including explicit references to both their own needs but also the collective good of the community. This is evident in the case of Drone Zones, wherein the campaign page allowed for the discussion around attempts to establish best practices for drone piloting.

7.4.3 Lone Citizens

The findings indicate that most of the unsuccessful movements, or successful movements that resulted in app with low-levels of utilization, were created by lone citizens. Although acting on issues that were personally important to them, and that were of prima facie interest to a wide constituency of other citizens (e.g. electric car charging stations, gluten free restaurants, rating local landlords), they were unable to leverage sufficient support (e.g. through social

media) from a like-minded community. It became readily apparent that beyond the creator's initial friends and family, support for these campaigns waned after the first tranche of promotion, ultimately resulted in failed movements.

7.4.4 Professionals

Care and Connect or NutFree were campaigns initiated by professionals, and academic researchers (Katie: Care and Connect) and a clinician (Neil: NutFree). On one level their initiation of successful campaigns points to the potential of App Movement as a grassroots commissioning platform; neither Neil nor Katie sought to leverage official endorsement by their employers (a University and a Hospital Trust), but instead adopted the to call to direct action that App Movement espouses. As professionals, and experts working in areas of social and health care, they were well-placed to leverage both their professional networks. In Katie's case this included colleagues within her discipline, as well as local activists and advocates of people with dementia whom she engaged with through her own research on dementia care. In Neil's case this involved local patient networks in particular. It is therefore apparent that professionals such as Katie and Neil, while not actual members of communities of interest in the manner that Simon (Drone Zones) or Ahmed (Local Photography Spots) are, were highly aware of communities and networks of need (including formal organizations such as local charities) and their professional standing as experts means they are well placed to solicit support from their members.

7.4.5 Social Media Literacy and the Need-Understanding Gap

In some cases, there appeared to be an existing and active community with a genuine need for a technical solution such an App Movement location-based review app. These movements had an active campaign stage, but the resulted in an app that was a relative failure in that it was not adopted by the anticipated number of users (nor were many reviews produced). Care and Connect was one such case, in that is was both well supported (94 supporters in response to a target of 50) and advocated (25 comments, 30 share clicks and 97 organic shares) but saw much reduced participation in the design phase (6 contributors) and low levels of engagement with the final app (61 venues, 36 reviews) even after considerable post-launch promotion by the creator at dementia-related events. In such cases (see also the Disability Accessible Facilities movement) is a gap between the needs of a community, as well as their willingness to advocate for their cause, and their understanding of (or capability to engage in) the forms

of participation that App Movement requires. That is, to understand that value of the resulting app depends on the production of reviews by supporters and other users, and that the appropriateness of the review criteria in the app are dependent on participation by supporters in the design phase. In the case of Care and Connect this is more likely to have occurred the average age of carers of people with dementia in the UK is between 60-65 years old, and age-group for which levels of social media usage is known to be lower.

On reflection it is clear that App Movement failed to anticipate this need-understanding gap in the design of its on-boarding and supporter confirmation process. One approach to addressing this would be to integrate an element of participation before an individual can support a campaign, similar to Cheng et al (Cheng & Bernstein 2014) who highlight the potential of higher-friction signups requiring payment or increasing a sense of urgency through role-based thresholding. For example, initial participation might require potential supporters to contribute towards an aspect of the app's design or perhaps even contribute initial data point that would also be used to populate the app before it is launched. The development of such participatory on-boarding processes would thus serve the dual purpose of educating users as to the expectations of movement supporters, but also mitigate some of the cold-start barriers (i.e. no initial data in a community data sharing application) that App Movement was originally conceived to address.

7.5 Data expectations around mapping density

Within each of these case studies the operating context varies significantly and as a result, as does the expectations around mapping and data density. There is a trade-off between the levels of data coverage and the motivations for using the app in that some apps only require specific localized contexts, whereas others require national and international levels of participation to be of use to the community. This can be seen in the case of NutFree, where the community are attempting to map, rate, and review all possible restaurants worldwide - a significant number of venues. However, there is an immediacy required of the data in finding nearby restaurants, on demand, that are suitable to eat at, and serve good food that you would like to eat at that point in time, requires the app to present a densely populated commercial area that has enough ratings and reviews to make an informed choice. In this sense, the number of available locations to map, level of immediacy required of the request, and

spectrum of choice all dictate the expectations around the mapping density required before the information becomes useful.

Care and Connect, although somewhat similar, might require less mapping density given that the community perhaps need less well-travelled places to ensure the environment is both calming and reassuring to the care giver and care receiver. However, given the expected limitations of highly localised care providers and limitations around ensuring those living with dementia visit relatively familiar areas as well as the attempt at creating and maintaining a sense of community (for both the family member and care provider). There is perhaps less of a requirement for mapping all possible locations and more emphasis on providing a much narrower but deeper selection of venues that accurately reflect the suitability of a venue for those living with dementia. In this sense, there is more at stake when planning the logistics of providing both care and a positive experience that demands more consideration by a care provider and as such there is an argument around quality over quantity regarding data density.

In the context of Drone Zones, the community's practice can only be carried out in specific areas, notably wide open spaces. Given that green spaces tend to be fewer in number and more towards the leafy city suburbs due to inner city areas being highly populated, pilots must already travel to a nearby areas before they can begin enjoying their hobby. This geographic constraint on the piloting of drones in green spaces reduces the number of possible flying locations and thus reduces the expectations around the Drone Zones mapping density when engaging with the application.

7.5.1 Organizations and Governance

A small number of organizations (charities, government bodies and commercial enterprises) that engaged, to some degree, with the App Movement process, from proposing fully fledged campaigns to inquiring about features of the apps the platform generated. In these discussion the concerns of organizations nearly always turned to issues of ownership and moderation. Positions on moderation differed between government, for-profit, and not-for-profit organizations, with government bodies expressing clear desires to maintain control over the user generated content for the purpose of political expediency (e.g. local government directorate considering App Movement for community engagement in local decision making).

By contrast non-profit organizations were more concerned with their legal responsibilities (e.g. national charity in relational to a proposed maternal health services review app) or the maintenance of the duty of care they owed to their network (e.g. national charity in relation to creation of the movement that led to NutFree). Non-profit movement creators also generally had very specific intentions in mind when creating the campaign page, and in each such movement the campaign page was used as a platform to promote their own organization using links to their own websites and including branding on the campaign header image. The principal concern of for-profit organizations was the maintenance of brand consistency (e.g. online retailer) and the potential threat that un-moderated content might pose to this. Furthermore, for-profit organization expressed a desire for more control over both the design process (being resistant to the benefits of a limited feature template) but also wanted to maintain control over the final output.

In reality, moderation was a feature of App Movement apps that we had considered but not addressed adequately. Although in the successful campaigns, malicious user behaviour was rare, the concerns of organizations who considered themselves to have more at stake means that future versions of App Movement will necessarily need to incorporate a sustainable model of moderation. With the assumption that such a model will require the involvement of the organizations, communities of interest, professionals or lone citizens themselves, the question of governance naturally arises.

7.5.2 Summary

This chapter has presented three case studies of App Movement in action in order to provide further insights into how the service has been adopted. It explores how individuals can establish and engage a willing community in the design and adoption of an automatically developed community driven information resource. These generated tools should be seen as the first step of data collection that could offer future prospects of wider civic participation resulting in change. Designers should consider how individuals might begin to explore, share, and export this community contributed data through analytics interfaces. In doing so, individuals could create evidence to enact legislative change and encourage into civic debate. However, the ownership of contributors' data and rights of users to access and even withdraw their data will need to be addressed. Similarly, we need to consider whether these platforms are deployed as a managed service, or develop a facility to "transfer" resulting apps to the

community, as Scholz (Scholz 2014) suggests. Further to this, we might also consider how to enable communities to re-evaluate and redesign these services once they have become established.

The next chapter reflects on the literature presented in this thesis as well as the deployment of the two case studies (chapter 3 and chapter 7) in order to define the process of community commissioning and provide a provisioning framework from which to draw upon in the delivery of these forms of services.

Chapter 8. A Framework for Designing Community Commissioning Services

8.1 Introduction

This chapter reflects upon existing practices of commissioning and introduces a novel framework for the community commissioning of technologies to support individuals in the production of shared community resources. The chapter draws upon the case study in chapter 6 and the literature in chapter 5 to more formally define the various components and processes of a community commissioning platform to inform a formal framework for designing in this area. The framework defined in this chapter includes a definition of community commissioning and an abstracted ontology and lexicon to discuss the provisioning of community commissioning services in relation to; *roles*, *infrastructure*, *resources*, and *constraints*. The community commissioning framework not only defines the concept but also identifies the values embedded within the practice of designing for this domain.

8.2 Community commissioning and service provisioning

Chapter 5 presents existing approaches towards facilitating citizens in the transition from citizen as consumer, to citizen as producer of goods and services. With the increasing adoption of technologies that support new models of participation, the potential for citizens to become producers of their own technologies is beginning to unfold. The growth and adoption of these new models of commissioning have yet to be defined within a formal framework in the context of HCI literature regarding community-led commissioning despite sharing several similarities between domains. Extending this research domain requires a shared definition and understanding of the underlying components and expectations around community commissioning technologies. This chapter therefore provides a framework consisting of two parts; a definition and formal model of community commissioning, and a lexicon that aids designers to discuss the provisioning and design of community commissioning services. The terminology defined in the community commissioning framework is derived from the case study presented in chapter 6, as well as the literature discussed in Chapter (5) and draws briefly upon existing public service commissioning literature to provide a transferrable and shared understanding of commissioning more generally across applied contexts. To ensure

that this framework is cross compatible within similar domains, the framework is applied to existing practices and processes within; Open Government Data, Sharing Economy, Commons-based Peer Production, and Citizen Science. Within each of these approaches four key elements can be identified; *Roles*, *Infrastructure*, *Resources*, and *Constraints* (Table 10).

8.3 Defining Community Commissioning

The concept of community commissioning has yet to be explored within HCI literature and as such a formal definition has yet to be established. In order to explore the concept of commissioning this chapter begins by drawing from the wider UK public service literature from which similar models of commissioning exist and then reflects upon the App Movement commissioning service. Within public services commissioning literature Bovaird *et al* describe initial understanding of commissioning as the act of responding to citizen needs and "bringing into active service" new facilities or services through centralized, top-down administration acting in the role of service producer (Bovaird et al. 2014). More recently, this producer role played by central government has transitioned towards that of service procurer within a market place of providers (Bovaird et al. 2012). In this instance those with the authority to spend centrally held resources ultimately decide upon the services that are produced or procured. Commissioning models have been formally established that are discussed in these terms within areas of communities and local government (DCLC - Department of Communities and Local Government 2008) and health and social care (Department for Education 2009) that define the role of government bodies in the commissioning of services and mechanisms for delivery. These models are somewhat citizen focused and attempt to solicit community needs through public engagements which inform government in the design or procurement of infrastructure and services to deliver the desired outcomes. Bovaird *et al* (Bovaird et al. 2012) argue that the top-down decision-making processes associated with this model are "increasingly distant from the expectation of citizens" and that more should be done to include citizens in this process.

8.3.1 Existing models of commissioning

An example of existing top-down practice can be seen in the Commissioning Support Programme (CSP), that published guidelines (Department for Education 2009) to support local authorities in the commissioning of children's services. The cycle of commissioning is discussed from the perspective of service providers and is discussed in terms of; recognising

local needs (*Understand*), assessing resources to support proposed needs (*Plan*), investing in appropriate services (*Do*), and monitoring service in regards to expected outcomes (*Review*) (Figure 45) presents the Commissioning Support Programme (CSP) cycle of commissioning which identifies four key phases;

Understand – recognise local needs, resources and priorities and agree what the desired end-product should be.

Plan – map out and consider different ways of addressing the needs identified through needs assessment including; finance, workforce, facilities and communities.

Do – make investment decisions based on the appropriate action identified in the plan stage to secure delivery of the desired service or services.

Review – monitor service delivery against expected outcomes and report how well it is doing against the plan.

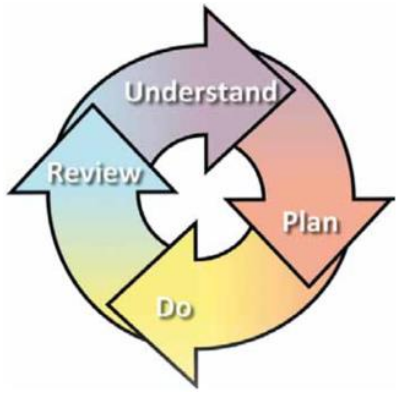

Figure 45. Commissioning Support Programme (CSP) cycle of commissioning

In this model the needs of the community are identified through public consultations (understand), resources are held by centralized government (plan), who are then responsible for procuring the most suitable and cost effective solution (do), and continue to monitor the quality of service and report on outcome measures (review). It is possible to consider commissioning comprising of three key aspects; identification of needs, the allocation of resources, and the production of services to respond to these needs. Within this model citizen engagement is limited to the initial "Understand" phase within which those with authority to spend resources make attempts to engage specific communities and solicit requirements.

These requirements are then abstracted and result in the tendering and procurement of resources and infrastructure to support the production and delivery of public services. Those with the ownership of resources, held centrally in this instance, also hold the authority to allocate and spend resources within a procurement process. This top-down approach to service production is therefore removed from those who will consume and engage with the services resulting from this process. The assessment of the suitability of service delivery is bound to the initial expected outcomes prior to procurement and measured in regards to these targets by those who initially allocated resources. The decision to maintain and sustain services therefore rests in the hands of those with resources and not within those whose needs are being addressed.

However, this mode of top-down commissioning is being challenged by the Cabinet Office who discuss commissioning as a more bottom-up approach where "citizens and their communities should define the priorities and expectations of the public services they receive and play an active role in ensuring that those services deliver or are reformed to ensure effectiveness and efficiency" (Cabinet Office 2010). Although the Cabinet Office calls to "increase choice by giving people direct control over the services they use" (Cabinet Office 2011) it stops short in describing how citizens themselves can both identify and express their own needs as well as act as producers of their own services. Similarly, the literature does not address the configuration of public service commissioning when groups of individuals, *communities*, can provide their own resources and are supported in the production of services in a collaborative, bottom-up approach. In this instance, the act of commissioning moves away from existing understandings of what commissioning entails and begins to move towards the notion of community-led commissioning.

8.3.2 Community Commissioning model

This next section draws upon the experience of designing and provisioning the App Movement service (chapter 6) and defines a more citizen-led commissioning approach wherein the resources and production of services are fulfilled by communities themselves rather than provisioned by central government. The stages in this process reflect a more bottom-up and participatory approach to expressing community needs, identifying demand, and engaging in the design and production of community commissioned resources. The model

also continues beyond the production stage and highlights that the community should be provided with the necessary tools to promote, adopt, and sustain a shared resource.

The App Movement service provides three distinct phases within which campaigns progress through, these are the; *Support Phase*, *Design Phase*, and the *Launch Phase* (Figure 46). Within the initial support phase, community members are provided with a mechanism to express needs and gather support behind a concept before proceeding with the creation of a community resource. This is achieved through the creation of a campaign page that provides campaign creators (*initiators*) with a publicly accessible and more widely visible page on the App Movement service that can be used as a vehicle for promotion and awareness. In this initial step, the campaign creator is well placed to express the needs of the community. Similarly, as observed in the successful campaigns (chapter 7), communities made extensive use of the comment section to express support for a campaign and, perhaps more importantly, this demonstrated the potential utility of the resulting resource within their own context. This provided a mechanism to express their own needs for the application and shape the future design and utilization of the community owned resource. Threshold targets provide a means for campaign creators to demonstrate the levels of support behind a campaign as well as encourage potential supporters to invest their own resource within the commissioning process. Within the *design phase* supporters provide their own resources - such as social capital (promotion) and personal assets (time and concepts) to design and resource the community-owned location-based review service. Once applications have been automatically generated by the App Movement platform the adoption and sustaining of the resulting community-owned resources is the last integral part of the commissioning process. In this step, the App Movement platform uses the initial supporter-base to bootstrap the concept with willing participants as well as provides visibility in both app stores and within the micro-sites on the App Movement service.

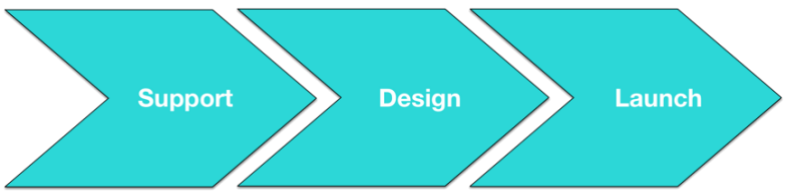

Figure 46. The App Movement commissioning model

Looking more closely at the phases included with the App Movement process it is apparent that these three phases are broad in their description and encapsulate a more nuanced process of community-led commissioning. To more accurately convey this process of community commissioning two additional phases have been added (establish demand and adopt and sustain) that highlight the importance of engaging a community around the community commissioned resource in both the expressing of needs as well as adoption and sustaining of the community owned resource. The act of community commissioning can therefore be considered as having five stages; *express needs*, *establish demand*, *design and resource*, *produce*, *adoption and sustain* (Figure 47).

Figure 47. Proposed Community Commissioning Model

Express Needs – enable embedded community members to publicly express the needs of the community through the creation of a proposal that prompts a potential course of action.

Establish Demand – determine the levels of demand within the community for the proposed course of action and enable community members to express their support of the proposal.

Design and Resource – provide community members with the ability to collaboratively participate in the ideation and design of resources for use in the proposals production.

Produce – utilise the resources resulting from community participation to facilitate the production of the proposed community-designed resource.

Adopt and Sustain – Engage supporters in the adoption of the produced community resource and establish a community to support and sustain the resource.

8.3.3 Express Needs

Within this initial step embedded community members are well placed to express the needs of the community. Considering this first step as an expression of needs, rather than an identification of needs, is intended to emphasize the bottom-up approach to self-identifying the needs of the community. In this mode, the role of the service provider is removed from the action of identifying needs and allocation of resources and the role is adopted by the community members themselves. In expressing needs, community members can publicly define a proposal for the appropriate course of action or desired outcome resulting from the commissioning process. The next step in expression of needs and proposal is to ensure that there is sufficient demand behind the concept.

8.3.4 Establish Demand

In this second step, community members must be able to demonstrate their support of a community-led proposal. The establishing of demand effectively identifies matters of concern that are shared by a representative proportion of the community. In this citizen-resourced configuration of commissioning it is important that enough individuals are involved who can pledge their support and resources that can be drawn upon to collectively produce a community owned resource. Unlike existing commissioning models that rely upon centrally owned resources, it is important that a critical mass of support behind a proposal is achieved to ensure enough individuals are involved to achieve the proposed outcome. To ensure that a critical mass is achieved either the service provider or proposal initiator can determine a supporter threshold that must be achieved before a proposal can go ahead. In evidencing the high levels of support for a proposal prompts further engagement from other potential supporters who might participate in the commissioning process. The act of collectively supporting a proposal also demonstrates to others that the concept is of value to more than simply a select few individuals. Employing a thresholding mechanism also ensures that collective outcomes are resourced and adopted by a proportion of the community. This is especially important if the shared outcome derives value from having large-scale collective input from the community once produced. Once support behind a proposal has been identified the community members are then provided with the ability to participate in the deliberation and design of a potential community-led resource.

8.3.5 Design and Resource

In step three, the initial foundation of supporters should have access to tools and processes that allow for the collective participation of the community in the design and resourcing of a community-led resource. Engaging in this process can either be limited to the initial founding members or provide the ability for newcomers to participate in this step. Importantly, the configuration of participation should allow for participation by all individual within this process to ensure that the eventual consumers of the produced outcome can engage in the service design. This participation step can also be an opportunity to bring together individual resources (skills, knowledge, time, and personal assets) that could be drawn upon to sustain the community resource. The participation step should be focused on encouraging deliberation around what resources are available and what the desired outcome should look like. However, this deliberative process should provide more explicit requirements that can be drawn upon in the production of the shared resource. Once these have been established production of the shared resource can begin.

8.3.6 Produce

Within the community commissioning model the planning or procurement process, as seen in existing models of commissioning, is facilitated by citizens themselves rather than a central authority who holds resources to carry out the production of the service. The resources used to produce a community resource are identified and contributed by the community themselves. This configuration can be discussed in terms of *needs-led* production - what is it the community needs and how can we find the resources to produce the community resource? - as opposed to existing models of *resource-led* production – what resources do we have and how can we identify community needs and produce or procure a service with the remaining resources? The production of community owned resources does not directly require all members to be involved in the production process. Similarly, production can be carried out by existing tools or services and facilitated by a structured process.

8.3.7 Adopt and sustain

Once a community-led resource has been produced it is important that members continue to resource the community-owned asset to ensure that the output continues to provide value to the community. This is especially important when considering community-driven information resources, such as App Movement, that require continued input by members to ensure the

Roles	Infrastructure	Resources	Constraints
Producer	Service	Knowledge	Agenda
Consumer	System	Personal asset	Resources
Initiator	Template	Skills	Actions
Technical expert	Components	Time	Complexity
Observer			
Service provider			
Endorser			

Table 10. Four elements of Commissioning; Roles, Infrastructure, Resources, and Constraints

information provided is relevant and timely to the community. As part of the adopt and sustain phase efforts should also be made to both demonstrate the decisions that have led up to the creation of the community-owned resource and provide a means by which community members can access and utilize the asset that has been commissioned.

8.4 Provisioning Community Commissioning Services

With a formal model of community commissioning established it is now possible to discuss how this can take effect in the design of services to support community commissioning. Therefore, this next section defines a series of components that are involved in the provisioning of a community commissioning service and provides service designers with a lexicon to discuss these forms of systems in action. The core components presented in the provisioning of community commissioning services are discussed in terms of; *roles* that can be adopted within the process, the approach to *infrastructure* in supporting the process, *resources* required to implement such a system, and the *constraints* to be aware of when deploying a community commissioning service.

8.4.1 Roles

When engaging with community commissioning services there are a number of different roles that an individual may assume. Although these roles are defined explicitly, individuals are able to adopt and transition between various roles depending upon the current state of the deployment. An example of this can be considered in the role of producer, who can also transition between roles and access a service as a consumer.

Producer – an individual who contributes resources towards the deployment of a community commissioned resource.

Consumer – an individual who derives value from a community commissioned resource.

Initiator – a community member who expresses a community need and proposes a campaign or concept to support or respond to a community issue.

Technical expert – an individual with the *skills* and *knowledge* to develop technology *infrastructure* to support a commissioning service.

Observer – an individual who accesses and analyses the resulting data from commissioned service.

Service Provider – the person(s) who deploys the commissioning technology and necessary *resources* to sustain the service.

Endorser – community members who pledge their support and engage with an *initiators* concept.

8.4.2 Infrastructure

The deployment of a community commissioning technology can be achieved through three approaches; Systems, Templates, and Components. Within each of these approaches there are constraints on aspects such as; configuration and flexibility of deployment, ownership of technology, and resources required to maintain infrastructure. Ultimately, these three approaches can be used to deliver a *service* that is accessed and utilized by the community within which they have been deployed.

System – can be considered as an instantiated template for a specific purpose that abstracts low level configuration of the service and is deployed by a service owner. The deployment of a system requires the creation of centralized infrastructure and resources to support initiators

in the commissioning process. This can be considered as a complete system (i.e. Blogger[69] – a fully managed blogging service) that reduces the technical overheads and lowers complexity to both producing content and consuming content but with constraints placed upon flexibility and configuration in the process of commissioning content.

Template – a collection of software components that have been developed to operate within a cohesive and configurable context. The expertise required to deploy a toolkit can vary from one-click installations, to a highly configurable and self-managed software package. Within this configuration the operational context is not defined by the template's developer but rather the individual who deploys the toolkit using their own infrastructure and configures template accordingly. Templates can be adopted by anyone with the resources (knowledge, skills, time) to provide the infrastructure required to maintain the service (i.e. Wordpress.org[70] – an open source and self-hosted blogging toolkit).

Components – are the foundational building blocks of a template or system (such as an SDK or software library) and offer a specific set of functionality, requiring technical expertise to incorporate several components to form a technology. The constraint in this instance is due to the complexity of coupling components to form a complete system and it is almost unconstrained in regards to flexibility of using this approach. However, this undoubtedly increases constraints upon resources (knowledge, skills, time) to design and implement infrastructure to support community commissioning.

8.4.3 Resources

The resources around a community commissioning service are the intangible skills, knowledge, and time of the community as well as the physical and monetary assets required to deploy a community commissioning service.

Knowledge – includes the tacit knowledge of a community member and the explicit knowledge of internal processes, information, and expectations within a community.

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[69] https://www.blogger.com
[70] https://wordpress.org/

Personal asset – both a physical and non-physical item owned by an individual such as a hand tool, webserver, or money.

Skills – an ability to perform a task with expertise and mastery over time by an individual.

Time – personal free time available to engage with the process of commissioning or the resulting community commissioned technology.

8.4.4 Constraints

The roles, infrastructure, and resources are all bounded by constraints regarding how a shared community resource is used, resourced, supported, and implemented. This can be discussed in terms of how; commissioning is applied within a given context (*agenda*) and the *resources* required to create, facilitate, and maintain the commissioning process. Encompassing this is also the constraints placed upon the *actions* any given role may take and the extent of *complexity* around the infrastructure and process to support community commissioning.

Agenda – can be defined as the operationalized context within which the commissioning technology resides. The agenda is often set by a *service provider* and therefore prohibits the flexibility and adoption of a commissioning service within other contexts, outside of the platform's initial conception. Services such as WhatDoTheyKnow[71], are bounded by a *service provider agenda* (MySociety - encouraging citizen participation with government through third party data platforms) and therefore restricting the platform to the submission of only public authority related FOIs. A transparent and open service, without this *agenda*, could encourage a more flexible and open platform to submit public requests for data more generally (i.e. Subject Access, FOI, etc.) to any organisation and therefore be adopted for use in contexts that are needed by service users. The commons-based peer production model of services such as Wikipedia encourages communities of interest to contribute their knowledge to both Wikipedia and community specific wikis. Within this model, peer production is supported through free and open source technologies and as such, the decoupling of the *service provider agenda* from the operationalized context within which the technology exists.

[71] https://www.whatdotheyknow.com

Resources – are considered as the knowledge, assets, skills, and time required to create, sustain, and maintain both a commissioning service and associated commissioned outputs. The constraints in this instance are the limitations faced by service providers and technical experts when establishing a commissioning service. Depending upon the resource constraints of service providers, varying approaches to infrastructure can be taken. Service providers with limited technical knowledge may utilize commercial off-the-shelf software (*templates*) to enable commissioning of community resources (i.e. Blogger). Alternatively, access to technical knowledge and skills, allows service providers to develop a more tailored solution but with an additional constrain placed upon *personal assets* (cost).

Actions – that any individual may take may be constrained in regards to access, creation, modification, deletion of infrastructure and resources within the commissioning process. These constraints may be placed upon actions regarding service providers managing infrastructure, an initiator moderating community content, or perhaps as an endorser requiring an invitation to access the commissioning process or shared resource.

Complexity – is a trade-off between the *infrastructure* (system, template, and components) approach, access to *resources* (knowledge, skills, assets, time), and desired outcome that govern the *process* of commissioning a shared community resource.

8.4.5 Checkpoint: Commissioning Scenarios

In order to demonstrate the community commissioning framework in action, the following section provides three scenarios to explore how different configurations of *roles*, *infrastructure*, *resources*, and *constraints* impact upon the provisioning of a community commissioning service. These three scenarios describe three characters; Alice, Bob, and Charlie who each have differing *constraints* regarding the *resources* that impact upon the *complexity* of provisioning a fictional event commissioning service for local communities to identify community needs, as well as plan, organize, and resource local events. Within each of these scenarios each character has varying levels of technical capability and resources with which to begin provisioning a community commissioning service for event commissionin.

Scenario 1: Limited Resources

Charlie has limited technical knowledge and skills as well as limited funds and time to draw upon in creating an event commissioning service. He begins by looking for low cost solutions for connecting individuals together and sharing community knowledge. He finds Facebook Groups and creates a closed Facebook group and invites local community members (*initiators*) to the page so they can begin to commission all local events (*agenda*) through posting ideas to the group. Fellow community members (*endorsers*) respond to the posts through "likes" and express their thoughts by leaving comments. Once ideas have enough *endorsers* supporting the idea, *initiators* create their own private Facebook groups to engage deliberation around planning and organizing of the community event. Events go ahead, however finding out how the decisions were made is difficult due to the number of concurrent discussions in the private group and searching through content is difficult due to the volume of discussions going on. Members of the group are unsure of the final decisions that are made and everyone receives too many updates about events they have little or no interest in. As an *Observer,* it is also difficult to find current and previous events that have successfully gone ahead. Charlie finds it hard to manage and maintain authority over the events that are being made given that individuals are creating their own pages. However, people see that a lot of their friends have joined the group and events are going ahead.

Charlie made use of an existing system that required no technical expertise to create an event commissioning service. The infrastructure costs are provided by the Facebook platform which meant that Charlie required minimal resources to create the system. However, Charlie faced a trade-off between flexibility and functionality and had limited *actions* which he could take in authorizing, promoting, and moderating the content within the group. The complexity of the process was initially simple to engage with however as demand increased, became difficult to understand and manage.

Scenario 2: Partial Resources

Bob has a basic understanding of using tools like Wordpress.org, and php Bulletin Board (phpBB) that allow him to create his own website and discussion forums. He purchases some server space, installs WordPress and phpBB, and invites community members (*initiators*) to create editorial accounts and begin posting ideas for local events (*agenda*). Bob installs plugins that allow people to sign up to newsletters via RSS feeds to show they pledge their

support for an event. *Endorsers* visit the blog posts, register for updates, and leave comments to show they'd like to be involved. Once a project goes ahead everyone is emailed and invited to create accounts on the phpBB forum so they can deliberate and discuss ideas related to the event. Bob continually invites new editors on Wordpress and has to associate their accounts as moderators on phpBB. Sometimes editors delete content accidently and the website is inaccessible from time-to-time when new posts are viewed by lots of people. *Observers* can easily search for content using the search functionality however it is difficult to extract the comments and discussions from campaign pages and forum posts. The links to the discussions on the phpBB forum are placed on the Wordpress blog post so people can also engage in the discussion.

Bob used technical literacy, personal assets (money), and existing open source software to create and host the event commissioning service. The infrastructure approach (*template*) required Bob to continue resourcing the project through *personal assets* (money) for server space and investing his *time* in ensuring WordPress and phpBB is up-to-date, backed-up safely, and that the service was running securely to protect people's personal data.

Scenario 3: Full Resources

Alice is an experienced software developer with extensive knowledge of creating mobile and web applications. She begins by designing a technical solution and develops an initial prototype system to deploy using her experience of suitable *components*, such as Facebook connect for authentication[72], Google Firebase[73] for elastic server and database hosting, and Mozilla Open Badges[74] for incentivising and rewarding engagement. After several weeks, she finally has an initial version of a working system that can be used by the community. She shares the stable version with other community members (*initiators*) who begin to post ideas on the system and share campaigns between friends (*endorsers*). The campaign *endorsers* register for updates from the *initiator* and engage in a bespoke design and discussion area. The design area provides both *endorsers* and *initiators* with the ability to create polls, pin important information, make announcements, and raise money for the event through

[72] https://developers.facebook.com/docs/facebook-login
[73] https://firebase.google.com
[74] https://openbadges.org/

integrating with external platforms like SpaceHive[75] - a community crowdfunding service. *Initiators* and *endorsers* initially struggle with the complexity of such a novel system, and Alice modifies existing workflows and site content to convey the commissioning concept more clearly. New visitors to the system (*observers*) access campaign pages and identify the discussions, key decisions, and expenditure of community funds during the commissioning process and after the community event goes ahead. Due to this transparency, Alice can evidence and report on the success of community commissioned events and applies for local council funding to help her in sustaining the system, given that she is currently having to fund (*resources*) the service herself.

Alice relied upon her extensive technical knowledge to develop a novel system to support an event commissioning service. The infrastructure approach Alice took in developing her own bespoke system allowed her to respond to changing community needs with the development of new features and functionality. However, creating a system using this approach required several design iterations which resulted in a delay of a few weeks before an initial prototype was produced. Although Alice had to invest time in the development of the system using existing *components*, the *service* could easily be modified by Alice to simplify the commissioning process. It was also possible to design for transparency and provide *observers* with the data behind the decisions that led to the creation of an event. A strength in having access to this data is that Alice can evidence levels of engagement to external funders who can support the service given that Alice is currently responsible for the *resources* to support the *service*.

8.5 Summary

The framework presented in this section discusses community commissioning in regards to both the process of community commissioning, as well as the act of provisioning community commissioning services. Existing practices of top-down commissioning processes within government involve identifying community needs through consultation rather than providing communities with the tools and mechanisms to express their own issues in a bottom up approach. Aspects of needs identification, procurement of design and development, and post-

[75] https://www.spacehive.com/

deployment reflection of based upon performance metrics are models of centralized resources and therefore remove the ability for communities to become active actors in this existing top-down process.

Extending beyond the initial concept of the three stages of App Movement, the process of community commissioning can be considered as having five stages; *express needs*, *establish demand, design and resource, produce*, *adopt and sustain*. These five stages are discussed in terms of participatory resourcing and production that require the community to identify resources and expertise within their own resources. Beyond engaging with this process of commissioning the framework has also provided an insight into how service providers might also engage in the provisioning of such a system. The three scenarios highlight the different approaches that can be taken to support service providers with varying levels of technical ability and resources in the process of community commissioning.

In this next section the community commissioning framework is used in context of commissioning; *data, services, and research*, and attempts to draw upon the process and terminology used in within the framework in order to demonstrate how we might consider these processes through the lens of community commissioning.

8.6 Commissioning in Practice

The *roles*, *infrastructure*, *resources*, and *constraints* within the community commissioning framework have been identified and can now be applied to more directly to existing practices of commissioning. The commissioning models identified in chapter 6 are now revisited and the community commissioning framework is applied directly to the models of commissioning seen within; *Open Government, Sharing Economy,* and *Citizen Science*.

8.6.1 Open Government: Commissioning of Data

In the context of Open Government Data, Government act as *producers* of data via services such as Data.Gov.UK and respond to FOI requests from citizens. In this transactional model the Government acts as the *service provider* and citizens are both *initiators* of requests and *consumers* of the commissioned data through a one-to-one relationship between Government and citizen. The *infrastructure* to support citizen data commissioning is achieved through online services such as Data.Gov.UK as well as the law system using Freedom of Information

Requests. The Data.Gov.UK provides citizens with the ability to request datasets[76] from Government however it is not possible to act as an *endorser* of these requests to demonstrate a shared community need for a given dataset. As a *consumer* accessing, comprehending, and acting upon the data produced by Data.Gov.UK requires extensive knowledge of the processes and data structures used by Government to collect and produce data. As such, the commissioning and consumption of Open Government Data is limited to only those with the knowledge, skills, and time to adopt and make use of Open Government Data in this manner. The *infrastructure* is provided as a *service* and within a specific domain (*agenda*) as determined by Government. The Data.Gov.UK service places fixed constraints on the *roles* that can be adopted as well as the *actions* and *agenda* of the platform. The operational *agenda* is constrained to the production of Open Government Data by Government (as both *producer* and *service provider*) for citizens to consume rather than providing a service for citizens and organisations to publish and commission their own datasets alongside Open Government Data. However, the *resources* used to facilitate this interaction draw from both citizens and government spending in regards to *knowledge*, *skills*, and *time* that are attributed to the production of the data and infrastructure.

Included within the context of Open Government Data, are third party services such as FixMyStreet[77] and WhatDoTheyKnow[78] that act as mediation tools that enable citizens to interact with Government Services in a neutral and non-state-owned space. *Services* such as these are specifically preconfigured by the *service providers* (MySociety) for the purpose of collectively commissioning data and facilitating interaction between citizen and the state. *Initiators* commission data through FOIs and *endorsers* (members of the public) can follow requests to demonstrate a collective sense of value of the request as well as create a sense of urgency through publicly demonstrating a response is being waited upon by multiple *endorsers* rather than simply the initial *initiator*. However, the service offers limited interaction between the citizens to promote deliberation around what collective needs are for the data being commissioned and to ensure that requests represent collective interests. *Constraints* are placed upon the operational context (i.e. the production of FOIs), the setting

[76] https://data.gov.uk/data-request
[77] https://www.fixmystreet.com
[78] https://www.whatdotheyknow.com

of the agenda within which producers of FOIs can operate within (i.e. contacting only Government services), and the actions that can be taken to commission data (i.e. the mechanism of only using FOIs in these requests).

Within these forms of services transparency of the data and commissioning process is key to providing *observers* with transparency in regards to the decisions made and promote accountability of the actions taken throughout the process. Embedded within this approach is the ability to also provide visibility and representation to these decisions and actions within the commissioning process. Platforms such as WhatDoTheyKnow not only provide transparency of the data resulting from an FOI but also bring visibility to the requests made by others. This is achieved through making visible each citizen's request and in turn, provides others with the ability to learn and understand what the act of commissioning government data entails. Therefore, WhatDoTheyKnow is also a mechanism to produce best practices of FOI requests in regards to making visible successful and unsuccessful FOI requests and providing learning resources to inform future FOI initiators.

8.6.2 Sharing Economy and Collaborative Consumption: Commissioning of Services

The Sharing Economy and Collaborative Consumption models of production emphasize the ability for individuals capitalize upon skills, knowledge, and assets in order to transform existing models of consumption and production of the delivery and provision of goods and services. These models of participation encompass many forms of services from corporate owned, fully managed *systems* (AirBnB [79], TaskRabbit [80]) to self-hosted *templates* (MediaWiki[81], Wordpress[82]) for the provision of services by citizens as both *producers* and *consumers*. Across these services the *agenda* is set within a tightly constrained context or as a much more fundamentally open and flexible commissioning process.

Crowdfunding platforms such as Kickstarter[83] enable highly motivated *initiators* to solicit capital and establish a brand through engaging *endorsers* (or backers) to fund and promote

[79] https://www.airbnb.co.uk
[80] https://www.taskrabbit.co.uk
[81] https://www.mediawiki.org
[82] https://wordpress.org
[83] https://kickstarter.com

campaigns. The *agenda* of crowdfunding platforms is focused on demonstrating product demand and financial viability through the front-loading of funds by forward-paying *consumers*. The operationalized context is purposefully left open and flexible for *initiators* to appropriate as they require. However, these services do not provide a mechanism to engage *consumers* or *endorsers* in commissioning of collectively desired products. In this sense, Kickstarter provides individuals with a *service* to commission a crowd around an idea rather than as a *service* for communities to collectively commission community owned resources. The platform therefore provides a means to bootstrap a potential user-base before the product has been produced to ensure there is an adequate market of consumers to purchase the outputs. In this setting the *initiators* are effectively responding and establishing the needs of the community and the backers (*endorsers*) pledge cash to realise the final output. However, as backers they are unable to officially provide input into the design and context within which the campaign will operate within. Within Collaborative Consumption models of production, in the case of MediaWiki or Wikipedia, the initial expression of needs is founded by an enthusiastic contributor who creates a page on the Wikipedia *system* or downloads an open source version of MediaWiki to self-host a specific special interest wiki (community-owned resource) that other members can contribute towards.

8.6.3 Citizen Science: Commissioning of Research

Within Citizen Science research commissioning services are beginning to emerge that enable citizens to develop their own data collection projects (Sheppard 2012; Hartung et al. 2010; Kim et al. 2013; Zaman & De Meuter 2015) to inform scientific research. In this context citizens act as *initiators* of citizen science projects and fellow citizens engage as *producers* of scientific data collection. The infrastructure around these projects has been developed by researchers using a bespoke *component* based approach, however the delivery of these services has taken two approaches – self-hosted *template* based services and fully-managed *systems*. *Services* such as wq.io (Sheppard 2012) and Open Data Kit (Hartung et al. 2010) provide a *template* based approach that provides citizens with the necessary tools to provision their own *service* and act as *service providers*. Whereas services such as CitSci.org (Newman et al. 2011), Sensr.org (Kim et al. 2013), and DisCoPar (Zaman & De Meuter 2015) take a *system* based approach that require researchers to act as the *service provider*. There is a *complexity* trade-off between selecting each of these approaches, with fully managed systems requiring citizens to have minimal resources to engage with the process and self-hosted

solutions requiring additional *resources*. *Resources* can be discussed in terms of resources supplied by *service providers* and *resources* supplied by citizens who engage with these *services*. Within each of these research projects citizens can also act as *observers* of the data derived from citizen contributions. The *agenda* of citizen science services leans towards data collection however the operationalized context is decided by citizen scientists.

8.6.4 Towards a definition of Community Commissioning

This chapter has discussed community commissioning in terms of roles, infrastructure, resources, and constraints and has been applied in context to the three themes (commissioning of data, services, and research). These themes highlight that existing services to support commissioning do not currently support citizens in setting the agenda of service use and are not currently configured as bottom up approaches to service commissioning. The use of the community commissioning framework in exploring these themes has demonstrated the applicability of the concepts and language within the framework to describe these processes. Apparent in these three themes are aspects of technical and social systems that are configured and provisioned to support commissioning in practice. Drawing upon these themes and the discussion of provisioning these technologies we can define the process of community commissioning as; *A collection of technical and socio-technical systems that enable citizens to express needs, establish a demand, self-organize, and participate with others in the creation of community-owned resources, reliably, at scale and as a service.*

8.7 Summary

This chapter presents a framework for community commissioning and reflects upon the design of the App Movement commissioning process as well as public services commissioning literature in order to identify and define the five stages of community commissioning. Extending beyond the conceptual model of community commissioning, this chapter also discusses the components of provisioning community commissioning services in an attempt to provide a lexicon to discuss and explore this novel model of participation. The community commissioning framework presented in this chapter was also applied to three practices; commissioning data, commissioning services, commissioning research to explore the use and applicability of the framework. The next chapter concludes the findings from the research presented in this thesis and reflects upon the potential issues of provisioning technologies using the approach identified in the community commissioning framework.

Chapter 9. Conclusion

9.1 Introduction

The primary aim of this dissertation has been to explore a new model of citizen-led participation that facilitates communities in commissioning shared information resources. The approach undertaken to explore this area has been conducted through the design, development, documentation, and analysis of two large-scale social computing systems (*FeedFinder* and *App Movement*) that continue to be deployed and utilized by communities. Through reflecting on this research process, it has been possible to produce a novel framework to discuss both the practice of community commissioning and the provisioning of services to support this new model of participation. This conclusion chapter begins by summarising the chapters and revisiting the initial research questions presented in chapter 1 to explore how the research presented in this thesis has responded to these questions and how this work can inform future research within HCI and further afield.

9.2 Overview

The collective efforts of citizens, crowds, and communities has seen the formation of processes and infrastructure to support collaborations for the development of Open Source Software, Open Knowledge, and Open Data. These efforts have also been utilized as a resource to crowdfund ideas, engage in citizen-led research, and leverage the computational power of crowd intelligence. These forms of research, identified in chapter 2 and chapter 5, are often conducted by highly skilled and knowledgeable citizens (i.e. Open Source, Citizen Science) or performed as a low paid (or non-paid) micro-task by a crowd worker (i.e. Crowdsourcing, Wikipedia). The creation and provisioning of these services requires extensive resources (skills, knowledge, time, capital) and as such, harnessing these collective efforts is beyond the capabilities of many citizens. This dissertation responds to this opportunity and presents an alternative model of community-led commissioning through the development of technologies to support communities in the provisioning of citizen-led services. This research extends beyond facilitating citizens to simply express needs to those who have these resources and attempts to facilitate communities in collectively resourcing and designing information systems that respond to their own needs.

Chapter 3 presents FeedFinder, an initial foray into designing a community driven information resource to support mothers to share their experiences of breastfeeding in public. The case study context was identified by researchers and responds to the community through a researcher-led user-centred design process that was identified by attending and engaging with four breastfeeding support groups in various areas of the North East. As part of this user-centred design process we also conducted 21 interviews with new mothers with whom we conducted two design tasks that explored women's experience of breastfeeding locally. An initial mapping exercise with the mothers provided us with discussion points around the physical locations, such as where in the city women breastfeed and the qualities that are considered important to women. This also provided us with opportunities to discuss the personal experiences of breastfeeding publicly such as instances where women might either face stigmatism around breastfeeding publicly or positive and supportive experiences of breastfeeding. The data resulting from these design workshops led to the development of FeedFinder, a community-driven mobile application that facilitates the members to share, rate, and review breastfeeding friendly locations nearby. The FeedFinder application currently serves over ~11,500 mothers worldwide who have contributed ~3,600 experiential ratings and reviews for over ~3,500 breastfeeding locations worldwide. The application was initially launched with breastfeeding support groups in the North East of England and promoted via word of mouth.

In chapter 4, the implicit user interaction data resulting from low-level FeedFinder usage logs provided an opportunity to explore trends in user behaviour and adoption of the service over a 19-month period. The analysis of the transaction logs using the session based approach allows for the definition of three behaviours (Seeker, Explorer, Contributor) using a k-means cluster analysis. These three types of behaviour, although somewhat expected, clearly delineate typical usage patterns of the FeedFinder application that could be applied to similar location-based rating and review services (such as those generated by the App Movement platform). Given the geospatial nature of the session data it was also possible to understand the context of use, that is, when and how are mothers using the FeedFinder service.

Using services such as Open Street Map it was possible to identify the categories of locations (commercial, residential, industrial etc.) combined with a simple ruleset that allowed for the identification of where the application was being accessed from when sessions began. Using

this session based approach identified that mothers (~63% of sessions) were more likely to take a pre-emptive rather than an "on-demand" search behaviour when interacting with the application. Lastly, it was possible to enrich the geographic information contained within the data by cross-referencing mapping behaviours with the Index of Multiple Deprivation to provide insights into the sociodemographic factors of application use. Findings from this analysis demonstrate that a higher number of venues have been added in more deprived areas where existing research shows that breastfeeding rates are typically lower than the national average (Pain et al. 2001). These findings for the search behaviour and IMD data analysis correlate with the qualitative data presented in chapter 3 and contradicts existing research of contributing behaviour within crowd sourced mapping communities (Quattrone et al. n.d.; Thebault-spieker et al. 2015; Mashhadi et al. 2013). The findings from chapter 4 demonstrate that community driven information resources such as FeedFinder have the potential to uncover deeper understandings of *how* communities engage with these technologies through low-level log analysis as well as provide communities of practice with the infrastructure to support their practice. However, this approach to identifying the application domain was very much top-down and researcher-led that was facilitated through design consultations with women from the breastfeeding groups in the North East. Extending beyond this method of design and more towards a community-led approach required a fundamentally different process of developing infrastructure to support.

Chapter 5 begins by exploring existing models of civic participation around the production and use of Open Data, peer-to-peer production within the Sharing Economy, and the inclusion of citizens in research through Citizen Science. These three distinct areas that attempt to support a more citizen-led and bottom up approach to the production of data and services. The production and use of Open Data is an attempt by the UK Government to be more transparent in their actions and improve accountability despite being both the producer and publisher of the data that is used to hold them to account. Despite this matter, there also remains an issue around visibility of the data produced through the Data.Gov.UK portal in that citizens require extensive knowledge of business processes to understand the context of the data as well as hold the relevant skills to access and interpret the data in the formats provided. Interfaces to better present this data to citizen are provided by third party charities, such as FixMyStreet, WhatDoTheyKnow, or TheyWorkForYou, in an effort to convey this data in a more meaningful and visible manner. The Government has also attempted to encourage citizens to

participate in parliamentary debates through forming and sharing online petitions, evidencing and making visible public opinion. However, in these instances the collection, processing, and analysis of the data and associated production methods continues to be provided *to* citizens rather than *by* citizens themselves.

The concept of shared data, service, and resource production within the Sharing Economy focuses much more on either the capitalization upon assets through access to global markets (Sundararajan 2016) or the altruistic model of Commons-based Peer Production (Botsman & Rogers 2011) to harness to collective potential of disparate networks for a common goal through the sharing of under-utilized resources. Infrastructure in these examples reduces the barriers involved in engaging in collaborations (or commercial transactions) by enabling citizens to become independent vendors of their own assets and resources. Utilizing sharing economy platforms, such as Uber or Airbnb, increases visibility of individuals and provides a potentially global marketplace to operate within. Alongside this is the reduction in risk and complexity by utilizing these platforms to transact with customers rather than requiring the individual to coordinate the transactions themselves. However, the operationalized context within which citizens can engage in this practice is ultimately bounded by the agenda of the service provider. In this mode, service providers control how the platform is used, and what it is used for, rather than as a platform for citizens to express needs and exchange resources freely. The data resulting from interacting with these services is also expressly owned by companies to optimize and monetize their own services rather than providing service users with data to evidence and support their own practices.

However, alternatives to a centralized model of single market platforms are have been proposed. Scholz attempts to address this issue through the notion of platform cooperativism, wherein '*worker-owned cooperatives could design their own apps-based platforms, fostering truly peer-to-peer ways of providing services and things*' (Scholz 2014). This mode the creation, ownership, and governance of the sharing economy infrastructure is collectively owned by the workers themselves. Scholz's vision of the Cooperative Sharing Economy focus on fairer delivery and access to both the services and underlying data within these services. However, we as researchers should also consider this in our own approach to developing centralized infrastructure, dependant on the researchers themselves, rather than the potential to be appropriated as standalone platforms without our own intervention. These values are

discussed later in this chapter in regards to community governance, moderation, and ownership. Reflecting upon these existing practices, it is possible to understand the current boundaries and limitations of these approaches to inform a framework for community commissioning (chapter 8) as well as inform and motivate the design of a novel commissioning platform (presented in chapter 6).

Chapter 6 documents the development and deployment of a novel community commissioning platform that enables communities to propose, design, and automatically generate mobile applications in response to community needs. The chapter comprised of three parts; the App Movement commissioning process, campaigning infrastructure, and the resulting community mobile applications. The experience gained from taking a researcher-led approach within the FeedFinder case study (chapter 3) informed the design activities of the campaigning process within App Movement that are required to facilitate community-led commissioning. The technical challenges surrounding App Movement included developing a responsive infrastructure to support the automation of multi-platform and multi-instance of mobile applications as well as the autonomous campaign procession and flexible of design tasks. The chapter discusses some of the issues that arose around aspects such as security vs usability, the importance of campaign updates within the campaign process, and the configuration of the platform to capture low-level logs to provide insights into service use. The goal of this chapter was to both document the App Movement service but also to demonstrate the continued reflection through designing and deploying the system in response to use over time.

Chapter 7 presents an initial overview of the App Movement service which continues to provide communities with the ability to engage in the process of commissioning mobile apps. The service has been adopted by over 50,000 members supporting 111 campaigns, 20 of which have been successful in reaching their target number of supporters and 19 campaigns have generated mobile applications that are currently available in the Google Play Store and Apple App store. The chapter also presents three case studies of App Movement in action to understand typical service use; Drone Zones, Care and Connect, and NutFree.

Chapter 8 consolidates literature discussed in chapter 5 and draws upon existing public service commissioning models to define a novel framework for community commissioning as well as discusses the configuration and provisioning of community commissioning services

more generally. The development of the framework was a reflective process that is a culmination of literature and the experience of deploying App Movement as a service. The framework presents a definition of community commissioning and an abstracted ontology to discuss the provisioning of community commissioning services in relation to; *roles*, *infrastructure*, *resources*, and *constraints*. The commissioning process of App Movement consisted of three phases (Support, Design, Launch) however this was found to be too broad in the description of these tasks to accurately reflect the stages of commissioning for use more generally. Therefore, the process was revisited to incorporate five stages; expression of needs, establishing a demand, design and resource, produce, adopt and sustain. Greater emphasis has been placed on the expression of needs and the establishing of available community resources to highlight the community-led approach to commissioning more generally.

The next section returns to the research questions proposed in chapter 1 and discusses these in relation to the two case studies presented in chapter 3 and chapter 6. The research questions presented in chapter 1 are as follows;

1. *In what ways do citizens use and generate value from community-driven information resources?*
2. *How do we configure tools, platforms, and services to maximize reach and depth of citizen participation in the generation of community-driven information resources?*

9.3 Use and value of community-driven information resources

Q1. In what ways do citizens produce data for, and use data from, community-driven information resources?

Throughout this research there has been an emphasis on exploring this domain through the development of large-scale commissioning platforms that have been designed to be deployed "in the wild" to understand how communities engage in this process. This platforms approach has highlighted a number of challenges whilst deploying these services and has provided insights into the configurations of the roles, resources, infrastructure, and constraints involved in provisioning these services. This citizen-led method of production resulting from community commissioning platforms has highlighted that we must consider more than facilitating the act of production, but also the configuration and motivation of citizens to adopt the roles that support these types of systems. Therefore, this next section responds to

this research question through reflecting upon the citizen-led production and use of data resulting from these community driven information resources and is discussed in terms of the roles and advocacy to highlight the importance of motivating and facilitating this production process.

9.3.1 Exploring use and value through FeedFinder and App Movement

The design and development of both FeedFinder and App Movement provides a unique opportunity observe and understand the ways in which citizens produce and use data from community-driven information resources. Chapters 3 and 4 present a combination of qualitative survey data and quantitative analysis of low-level usage logs, to understand how communities who are currently underserved by information systems can collectively express their own needs, engaging in the resourcing and design of a concept, and lastly adopt and sustain a collectively owned information resource. Taking this approach rather than reflecting upon existing practices, such as Wikipedia or TripAdvisor, provided us with an opportunity to capture all aspects of the motivations and community interactions around collective technology design, the process of deployment, as well as gain access to explicit user interactions for analysis. It has been possible to observe how existing communities support their practice and transition from an expression of needs through to the design, resourcing, and adoption of a community-owned information resource.

Existing models of commons-based peer production (Benkler & Nissenbaum 2006), discussed in chapter 5, such as the production of knowledge (Wikipedia) and Open Source software (Linux) have proven to work effectively with disparate, less-rigid, hierarchical structures within large problem domains. Case study 1, FeedFinder, demonstrates that this approach to the production of data for niche communities of practice can also result in a self-sustaining community information around shared experiential data. Similarly, in case study 2 – App Movement, the successful campaigns and resulting applications also demonstrate that communities are willing to engage in the process of community commissioning. Within HCI, researchers are exploring what it means to deploy technologies ‘in-the-wild’ (Rogers 2011; Taylor et al. 2013) that are trialled and evaluated over extended periods of use outside of the lab, in-situ, and embedded within everyday life. Taking this approach requires consideration of aspects such as; technical failure, self-sustaining adoption, and resourcing beyond researchers promoting and resourcing the project. These issues are revisited later and are

discussed in terms of governance, moderation, and ownership of community commissioned information resources.

The initial case study, FeedFinder, was conceived through a user-centred design process that require the research team to take a leading role in identifying the community's needs, designing a possible solution, and deploying it with the specific community. Undertaking research in this manner requires that researchers are the driving force behind the inception of these technologies and as such, they are ultimately limited by the scope of the research team in understanding a community's needs. Taking this approach is a resource intensive task that requires researchers to co-design possible technological solutions, develop and deploy the technology, and finally analyse the resulting output. Moving beyond the existing approach of researcher-led production of community information resources required further exploration of tools and platforms to support a more citizen-led commissioning process. Subsequent technology designs, as seen in chapter 6, focused more on providing tools, infrastructure, and processes to facilitate this larger-scale commissioning approach. In doing so, we began to observe community networks adopting the App Movement platform for their own use and we can begin to examine this process of community data production through three themes; *data*, *roles*, and *advocacy*.

9.3.2 Data

Responding to the question (Q1) on the ways in which citizens produce and use data from community-driven information resources requires that we revisit the findings from the two case studies, FeedFinder and App Movement. Both the survey and quantitative analysis of low-level log data from FeedFinder allows us to answer some of the questions around the why citizens engage in shared data production of existing applications, whereas case study 2 (App Movement) provides us with the motivations of engaging with the process of community commissioning.

When designing FeedFinder we were initially hesitant as to whether placing this role of production entirely upon the community would yield sufficient data to be of use to the wider community. Indeed, the survey responses showed that there were conflicting expectations regarding who should be involved in the creation of new locations. Some mothers believed that the research team should pre-populate the application or that business owners should add

their own locations to the map, rather than relying upon the community to produce the data. As evident in the quantitative analysis (chapter 4) participants who were presented with varying levels of existing locations resulted in some participants feeling obligated to populate sparsely populated local areas and others disincentivised in contributing at all. A small proportion of mothers (~7%) did engage in mapping and reviewing local businesses despite this potential issue. These roles that emerged with application use in both FeedFinder and App Movement are discussed in the next section.

In similar projects, such as OpenStreetMap, the mapping community organize local workshops (mapping parties) that aim to create and annotate content for localized geographical areas. This approach focuses on strengthening a sense of community amongst members and "*play an essential part in creating and fostering local OSM user groups and creating a vibrant social community around the project*" (Haklay & Weber n.d.). This approach focuses on recruiting individuals into the OpenStreetMap community of practice through face-to-face interactions. In doing so, the community can discuss the shared values and expectations around their practice and maintain consistency amongst the community. In the case of FeedFinder, the face-to-face design sessions at breastfeeding support groups provided us with an opportunity to present the concept but also to respond to questions or concerns they might have. However, the survey analysis of the FeedFinder application (chapter 3) highlights that mothers did not always share similar values in how data production and usage should be framed by the community. Participant survey responses highlighted that there was a strong sense that the data from FeedFinder should be used to positively identify and encourage breastfeeding at any suitable location rather than report on "appropriate" places to breastfeed. In this sense, some mothers felt they could use the application to positively advocate for change in public breastfeeding behaviours within their local area and encourage breastfeeding as a more public behaviour. This is adoption of roles and advocacy for change is discussed later in the chapter. Breastfeeding mothers are not a explicitly pre-existing community of interest but rather a continuously changing community of practise as new mothers begin breastfeeding and more experienced move away from breastfeeding. As such, there was limited opportunity to define expectations of application usage early on. Therefore, it is understandable that different use cases and expectations of data use exist given the transient nature of the underlying community. Conversely, in App Movement attempts to provide existing communities with an opportunity to begin defining the values and expected

usage earlier on in the campaign process. This is achieved through the creation of a campaign and hosting discussions to formulate the purpose of the application before it's launch.

In an effort to maximise the potential number of contributors to a community driven information resource, case study 2 (App Movement) made use of *activation thresholds* similar to that of Cheng *et al* (Cheng & Bernstein 2014). Utilizing this configuration attempted to overcome potential issues of the cold start problem whereby an information resource fails to recruit content producers early on due to the initial sparsity of content, thus resulting in limited utility to subsequent adopters. This paradox requires that a user generated content is present before users begin investing their own resources in generating further content. App Movement attempts to overcome this potential issue by utilizing activation thresholds that attempt to establish a willing community around the resource prior to the launch. This ensures that a sufficient population of willing contributors are motivated to generate content earlier on at the initial launch of the application, resulting in more immediate value to future adopters. Setting an artificial barrier to entry using activation thresholds, coupled within a restricted time span, attempts to promote a sense of urgency in recruiting potential supporters to engage with the process of community commissioning. Similarly, the process of supporting a campaign was somewhat an involved that required users to register an account to continue supporting the campaign. This more involved process was directly to deter what Christensen (Christensen 2011) would define as slacktivism which "*refers to political activities that have no impact on real-life political outcomes, but only serve to increase the feel-good factor of the participants*". In this mode campaigns would be widely supported but have limited engagement with subsequent tasks of production (either in the promotion, design, or engagement with the resulting information resource). Indeed, several campaigns faced this issue (Care and Connect, Slim Pickings, Designed4All) and saw an initial high volume of support that resulted in limited interactions during the design phase and engagement in the community owned resource.

Throughout the process of deploying App Movement, the target number of supporters (50, 250, 150 respectively) as well as the support phase duration (30 – 14 days) was modified to encourage sustained engagement with supporters. It became apparent that the majority of successful campaigns often achieved their target within the first 24 hours and rarely exceeded the supporter target once it had been achieved. In a few instances the supporter target was

surpassed in a few hours (Drone Zones) and continued to far exceed the required level of supporters to progress. Although somewhat arbitrary in the supporter target, this initial barrier serves as a mechanism to ensure there is a sufficient quantity of early, content-producing, adopters when the application is launched that will continue to sustain and support the application as it becomes more widely adopted. Using a staged campaigning process also provides an opportunity for the community to discuss the purpose and values of the application (as discussed previously) prior to its release.

The quantifying of supporters backing a campaign also attempts to provide potential supporters with evidence to demonstrate the community's willingness to engage in the process, and as a result, encourage supporters to invest their own resources in this process. Beyond expending their own resources, individuals engaging with this commissioning process are also expecting others to invest their resources as well. This is particularly important given that there is a high cost involved in community members effectively leveraging their own human and social capital (Coleman 1988; Bourdieu & Wacquant 1992) within the community of practice. Unlike crowdfunding platforms, such as Kickstarter, that exist in a one-to-one relationship between backer and campaign creator for the purposes of accumulating (monetary) capital, commissioning platforms such as App Movement require collective action across the community to produce a shared information resource. More broadly across the App Movement service, metrics regarding the number of successful and well supported campaigns are indicators of trustworthiness and reliability of the service that can be used by initiators of campaigns as to whether they should invest their resources in creating a campaign.

Although there were large collective efforts to establish campaigns around community-driven information resources, not all campaigns yielded successful results. This was due, in part, to the gap between the needs of the community, their willingness to engage in the process of commissioning, and their understanding or capability to engage in the production of data to support shared information systems. In response to this issue, future work should incorporate an element of data production prior to engaging in the process of commissioning to ensure the community fully understand the process as well as a mechanism to mitigate cold-start issues in future data use.

The initial expected interactions around the use of data within the context of a community-driven location-based review mobile application was that search strategies would be a spur of the moment, on-demand form of activity, when visiting an urban area during the day. Designing around this expectation, especially in the case of FeedFinder, meant that early iterations of FeedFinder immediately presented nearby venue results but did not provide the ability to text-search for locations further afield. This assumption of on-demand interaction with the technology was in fact dismissed after conducting further analysis of FeedFinder (chapter 4) which provided us with a strategy to analyse search patterns through observing both the temporal and spatial aspects of the low-level log data. The initial search origins (opening the app) often resided in residential areas, where mothers were likely to be at home, with subsequent search requests in more densely populated and commercial areas. Although the evidence of this search strategy is draw from FeedFinder, future designs location based review systems should incorporate features to support planning types of behaviour as a prominent mode of use.

The quantitative analysis of FeedFinder in chapter 3 demonstrates that citizens engage with shared information resources are not only capable of producing explicit experiential data through publishing content, but they also inadvertently generating data through implicit interactions during service use. These interactions provide researchers with genuine insights into the usage and adoption of these information systems. Context specific access to data i.e. accessing implicit user data for a specific mobile application could provide citizens with evidence to be used to demonstrate aspects such as the percentage of the community engaging with the application or perhaps the levels of demand in an area through logging where users are searching. The latter providing insights into currently unperceivable levels of demand that might otherwise be missed by exploring explicit interactions, such as mapping or reviewing.

Data regarding the implicit interactions with the App Movement service could also be leveraged by campaign creators to provide analytics on the effectiveness of their communication channels when promoting their campaign to maximise potential recruitment in support of a campaign. However, this raises questions of how implicit user interaction data be used by citizens themselves given that these actions may contain sensitive data. As such there requires an element of anonymization of the dataset prior to viewing by citizens themselves.

9.3.3 Roles

The process of designing and deploying FeedFinder and App Movement highlighted an array of roles that community members adopted during the creation and launch of the community driven information resources. These roles have been identified through usage of FeedFinder, the case studies from the campaigning process of App Movement, and abstracted to inform a more general framework to discuss the provisioning of community commissioning technologies. Within case study 1 the roles emerged from the quantitative analysis of the low-level log data as well as from the qualitative survey responses after the applications use after 12weeks. Case study 2 focuses more on the types of campaign creators identified in the case studies (chapter 7) to identify three types of initiators; lone citizens, professionals, and embedded community members. Reflecting upon these two case studies it was then possible to discuss these roles in the context of community commissioning and identify more generalized roles of; producer, consumer, initiator, endorser, technical expert, service provider, and observer. Understanding the roles identified within this dissertation provides us with an opportunity to discuss the ways in which each role derives value and motivates them to engage in the process of commissioning.

Looking at the quantitative analysis of the FeedFinder, three distinct patterns of use (*Seeking, Exploring, and Contributing*) emerged that demonstrated the different ways in which members engaged with the application. Seeking behaviour accounted for ~83% of sessions observed over the 19month deployment period. This behaviour is akin to *Lurkers* (Nonnecke & Preece 2000) who are described as the silent majority who interact very little or not at all within online communities. This behaviour also correlated strongly with the lack of available venues when initially searching in the application. Participants did actively engage in attempting to seek for venues, far greater than explorers, outside of their initial search area for an extended period. Exploring behaviour can be explained by participant responses and quantitative search behaviour that can be described as using the application to explore venues in preparation for their activities further away from home rather than using the application on demand. Despite high levels of seeking behaviour mothers also actively contributed content to the application in significantly greater proportions than those identified in similar studies of online digital health networks (van Mierlo 2014) that found user-participation was limited to ~1% of super-users. Conversely contributing users within FeedFinder accounted for a much

larger percentage (7.36%) of the total user base that the results presented by van Mierlo (van Mierlo 2014).

The case studies in Chapter 7 highlight the importance of initiators for these forms of technology and identified three distinct types of campaign initiators; lone citizens, professionals, and embedded community members. The creation of campaigns by our first group, lone citizens, often led to unsuccessful campaigns or successful campaigns that remain underutilized and under supported. Lone citizens often acted on issues that were of personal importance or were of prima facie interest to a disparate group of other citizens rather than focused within a specific community. It was clear that after the initial promotion to close friends and family, the support for these campaigns failed to engage a critical mass of willing endorsers or content producers. More problematic were professionals who were acting on issues that were personally and or professionally important to them, and were highly aware of community issues that could be supported through the App Movement process. However, despite understanding the issues these communities faced, healthcare professionals (particularly in the case of Katie in Care and Connect, and Neil with NutFree) leveraged their existing social and professional networks that were supportive of the concept but who did not engage in the design of the application or production of data.

Perhaps understandably, embedded community members were more often capable of both understanding existing community needs as well as mobilizing the community in the process of commissioning and data production due to their position within the community. This was especially true in the case of Drone Zones, where the campaign initiator (Simon), was well placed to express the needs of the drone flying community regarding the recent political and legal challenges, and in the effective communication and recruitment of supporting community members through his YouTube channel who were willing to engage with the process of commissioning and data production.

As defined in the commissioning framework in chapter 9, there are seven roles within the process of provisioning community commissioning services; producer, consumer, initiator, endorser, technical expert, service provider, observer. Although these roles have been defined it is important to note that actors may transition between these roles throughout the commissioning process. The producer and consumer role is one such case where citizens may

both produce and consume the content or resources that is being contributed by the community without being mutually exclusive. However, the observer, service provider, and technical expert roles are more difficult to adopted due to the constraints on required resources (skills, knowledge, time, capital). This is discussed later in this chapter regarding governance, moderation, and ownership.

The observer role, in the case of App Movement, was limited to members of the research team who required access to the low-level log data for further analysis. However, access to this data was facilitated, in this case, through the technical expert (the author) who acted as a mediator between data and researcher. In this role, customized queries were developed that could provide answers to researcher's questions however this process in its current format is unsustainable given the reliance on the technical expert.

To some extend citizens could adopt an observer role and engage with basic descriptive data, (mapping information, community size, and overall contributions) for any application [84] however this interface to the data is somewhat limited and unrefined due to time constraints. However, future iterations should provide deeper insights about application use through behavioural analytics, similar to chapter 3, as well as provide citizens with evidence of community practices. Similar interfaces can be seen in the cases of WhatDoTheyKnow or TheyWorkForYou which attempt to convey complex data in more readable and accessible formats so that citizens themselves can begin asking questions of the underlying data.

9.3.4 Advocacy

It is apparent that advocates play an important role in the promotion and adoption of community driven information resources. Within both case studies the production and use of data resulting from community commissioned resources requires that we design for the role of data advocates who are promoting these resources to the wider community in an effort to recruit others in this data production. More importantly, we should also design to support willing advocates to use this data as a tool promote and enact wider change.

[84] https://app-movement.com/apps

The FeedFinder survey responses highlighted that some mothers were personally compelled to continue using the application after breastfeeding to support mothers in their area in feeling confident to breastfeed publicly. It was also apparent that healthcare professionals were using the application to promote public breastfeeding within their own support groups. Survey responses discussed using the application to demonstrate to breastfeeding friends and family that others have had positive experiences locally. This promotion of the application through word of mouth between local support groups was evidence and has clearly led to a strong growth in the number of venues mapped within the North East. New mothers engaging with the application not only adopted the role of data producer but also began to fulfil the role of data advocate.

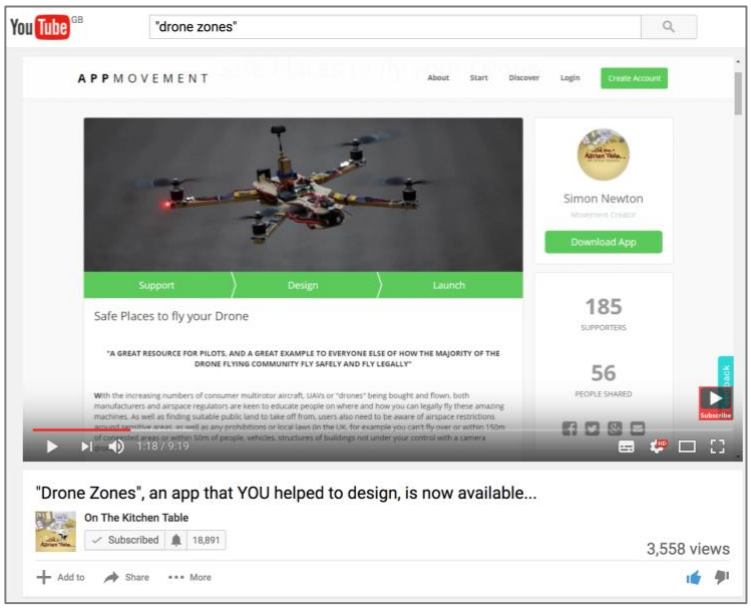

Figure 48. Simon promoting Drone Zones on his YouTube channel

The FeedFinder community extended beyond the research team's initial expected use by using the service as a mechanism for promotion and advocacy of local breastfeeding support groups. In this mode, members adopted the role of breastfeeding advocate and leveraged FeedFinder as a resource to promote pro-breastfeeding events in their locale. As FeedFinder became more widely adopted it began being used to announce and promote local events that were organised by breastfeeding advocacy groups. We observed similar behaviours by healthcare professionals who used the application as a resource when raising awareness of breastfeeding friendly locations during their face-to-face training sessions.

The production of experiential data, specifically in the case of FeedFinder, is an ongoing process that requires constant reflection through new content. However, given that some practices such as breastfeeding are only for a short period of a few months, typically three to six, there is a potential for data production to become outdated if not reinvigorated by fresh content. In response to this issue, some mothers reported continued use of the FeedFinder application despite no longer breastfeeding and reported that they felt an obligation to reciprocate in the production of reviews. This issue of operating within a transient and evolving population is discussed later in regards to governance, moderation, and ownership and requires that we rethink how we might support emerging and existing advocates within the community to promote and recruit contributing members.

In the case of Drone Zones the creator of the campaign created a promotional video[85] (Figure 48) shortly after the application was released and in the video, Simon not only promotes the application but also uses the video as an opportunity to shape the expected behaviour of the community when adding "responsible" flying locations as well as to emphasize the community driven nature of the application. Similarly, the Drone Zones app became a community resource that was used as a promotional tool in of itself, through the use of YouTube videos[86][87]. Through providing an online presence with which to reference the community-owned resource advocates can then use this place on the web to promote and integrate with third party services to raise awareness of the community asset.

9.4 Processes and platforms for community commissioning

Q2. How do we configure tools, platforms, and services to maximize reach and depth of citizen participation in the generation of community-driven information resources?

The recent transition from citizen as consumer to citizen as producer, as presented in Chapter 5, is facilitated through the creation and adoption of tools and platforms that allow for large-

[85] https://www.youtube.com/watch?v=flD4HuDh7JY ["Drone Zones", an app that YOU helped to design, is now available...]
[86] https://www.youtube.com/watch?v=zy4AIewnRU4 [Drone Zones App - Quick Review]
[87] https://www.youtube.com/watch?v=ckgU2pYvTlQ [App Drone Zones, descubre zonas de vuelo cercanas a tu ciudad para volar tu drone]

scale participation in the shared production of goods and services, through a collective expression and resourcing of needs. The configuration of the underlying process and the technologies used to enable this transition directly impacts upon the values and delivery of these services. More specifically, taking an 'in-the-wild' approach in delivering research-based civic technologies requires that we consider our approach to delivering these services regarding adoption and use by the community as well as providing utility and longevity of the services. Alongside this we need to consider who we are engaging and at which point they might engage in this process. Within the commissioning framework there are opportunities for community members to engage within each of the five stages of commissioning as well as engage in the production, consumption, and analysis of data resulting from the community owned resource. The framework also discusses the act of provisioning commissioning infrastructure to facilitate community members in assuming a service provider role and enable others to commission resources.

Maximizing reach and depth of these services can be considered as the act of lowering the technical and organisational barriers to engaging in this participatory process but also ensuring that the process and resulting output has sufficient utility in providing configurable functionality to be of value and use to the community. The configuration of tools and platforms to operate as services to facilitate community commissioning is addressed, in part, in chapter 5 when reflecting upon citizen science projects and the deployment of toolkits and platforms for engaging citizens in research. In these examples citizens engaged with these forms of technologies within a spectrum that ranged from toolkits (highly configurable self-hosted solutions requiring technical knowledge and resources) to platforms (configured for a specific purpose at the expense of ownership and configurability). This spectrum of limited to extensive configurability, and centralized to decentralized ownership, dictates the method of delivery and impacts upon the reach and depth of citizen participation. The community commissioning framework discusses the affordances of three different types of infrastructure; Systems, Templates, and Components that are used to deliver services to support this practice. Within each of these types of infrastructure various trade-offs are made regards to aspects such as configurability, technical knowledge, and resources required to provision these systems.

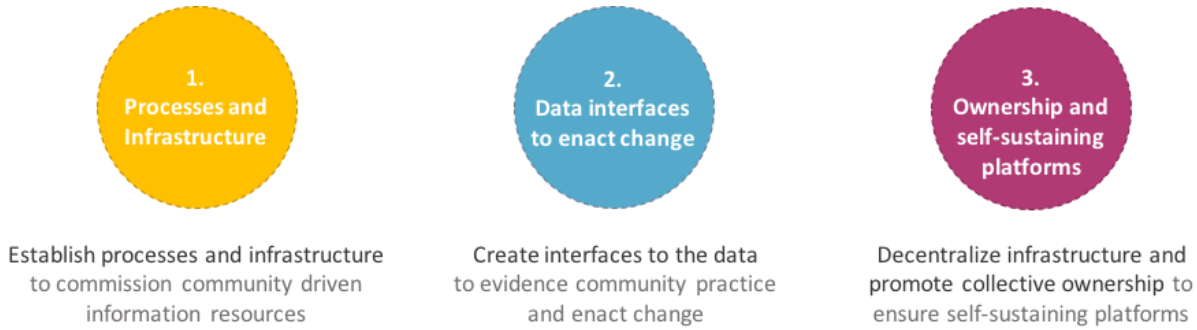

Figure 49. Three challenges of provisioning community commissioning services

This dissertation has explored the concept of community commissioning through the design and development of commissioning infrastructure and the definition of the process within a commissioning framework. However, further challenges exist (Figure 49) specifically around how citizens can to evidence practice and enact change through leveraging data from community resources as well as exploring how communities can own and self-sustain these forms of services. To explore these issues further, and in response to Q2, this next section discusses four themes; *towards lowering the barriers to grassroots commissioning*, *designing for future participation*; *visibility, transparency and ownership of community data and process; and community-led governance, moderation, and ownership*. These themes have reoccurred throughout the design, development, and ongoing deployment of the two case studies as well as become apparent through reflecting upon the literature discussed in this dissertation.

9.4.1 Towards lowering the barriers to grassroots commissioning

The recent shift in consumer as producer, as discussed in Chapter 5, has been observed in the relationship between citizen and government, citizen and industry, and citizen and research. These attempts to facilitate citizens in this producer role reside within a predetermined context, as defined by the organisations establishing the commissioning process. Government services such as Data.Gov.UK define the data that is to be disseminated *to* citizens rather than engaging citizens in the ideation and commissioning of datasets. Third party services such as FixMyStreet is operated for use *by* councils to leverage community efforts in identifying local issues. The existing transactional model between citizen and government continues to be orientated through the technologies and services controlled and delivered by authorities. Similarly, sharing economy and collaborative consumption platforms are delivered as part of an agenda, predetermined by service providers, around a given context. Within these existing

models, those in control of resources (infrastructure, capital, technical expertise) decide upon the delivery and context of use within which citizens are able to engage with these services.

Benkler and Nissenbaum's notion of Commons-based peer production (Benkler & Nissenbaum 2006) focuses on coordinating large groups of individuals around the collaborative production of shared resources. Within this model, Benkler and Nissenbaum (Benkler & Nissenbaum 2006) emphasize that in order to maximize potential collaborative efforts, production must focus on reducing production to asynchronous modular work that consists of high granular tasks that can be easily integrated into the final produced resource. This work is then carried out by a hierarchically flat network of decentralized peers who are rewarded by engaging in the social act of collaborative production. However, in this model the infrastructure and operationalized context (agenda) are already clearly defined by the service providers (e.g. Wikipedia, Linux, OpenStreetMap) and provide minimal opportunity for communities to establish their own needs and appropriate these technologies to respond accordingly. In each example, extensive resources (infrastructure, technical expertise, social capital) are required to provision technologies to support communities making use of these technologies within their own domains despite the model of commons-based peer production proposed by Benkler (Benkler & Nissenbaum 2006).

The community commissioning framework attempts to extend beyond facilitating peer-to-peer production through redefining the provisioning of infrastructure to support communities in expressing and resourcing their own needs. Communities must first be able to identify what it is that they require in order to begin coordinating resources and members to engage in the process of peer-to-peer production. The focus upon communities demonstrates that participation is not simply a series of separate interactions carried out by a disparate and distributed network of crowd workers. Rather, this is a deliberative process within which individuals are able to mobilize and engage existing or newly formed communities around a shared agenda for the purposes of creating tangible outputs. The design of these outputs should be configurable by the members themselves to accurately respond to the needs of the community. This is achieved through the decoupling of the service provider from the community's agenda through the design of workflows that focus on enabling them to collaboratively produce the services they require without intervention by service providers.

Lowering barriers to commissioning requires that we reconsider our approach to provisioning technologies that support peer-to-peer production to incorporate this aspect of agenda setting by community members themselves. Within App Movement this is achieved through an automated campaign process that enables individuals to express community needs, engage in collaborative configuration of a technological solution, and establish shared values around the process of peer-production and use of the resulting artefact. This process of campaigning reduces the complexity of establishing needs and provides communities with visibility in when leveraging their network to engage in peer-production. Commissioning self-sustaining community-driven information resources also requires that a body of willing volunteers produce content that provides value to the community and incentivises further engagement by potential contributors. Establishing this body of willing peers is an immediate barrier to commissioning these forms of technology. The use of activation thresholds within App Movement demonstrates that we as designers can configure the process of commissioning to support the establishing of willing content producers and overcome these barriers to engagement and resourcing. The configuration of process must also consider how we can facilitate community members in identifying resources that could collectively support and sustain these community owned resources. The App Movement design phase attempts to leverage Benkler and Nissenbaum's notion of small asynchronous modular tasks (Benkler & Nissenbaum 2006) to facilitate the process of commissioning and designing the final community resource. As mentioned previously, the design tasks within App Movement can be extended to complete any form of contributing and voting tasks and as such, further collective resourcing tasks could be designed in the future. Lastly, the location-based review template has been designed to simplify the production of reviews and the contributing of venues by allowing anyone to publish content without the need for hierarchical oversight.

However, the technical expert(s) ultimately decide upon their approach to provisioning the technical solution through the development of components, toolkits, or platform. As such, the designers of such systems must consider the level of integration and ownership provided to communities when developing the technology. Specifically, how we design for adoption outside of the initial founders of the component, toolkit, or platform. The creation of commissioning infrastructure should therefore aim to reduce the technical barriers of supporting community-led commissioning as well as be considerate of the issues discussed later on in this chapter around ownership, moderation, visibility, and transparency.

9.4.2 Designing for future participation

Although research projects often focus on closely coupled researcher-led deployments, the model of community-led commissioning proposes the potential for technologies to become adopted by the community themselves. Embedded within the concept of community commissioning is the removal of the researcher from the overall process of commissioning, deployment, and continued adoption of the resulting technology. This decoupling of research team requires careful consideration, especially in the continuation of maintenance and support surrounding the community owned resource and supporting infrastructure. Given the large-scale and participatory nature of community commissioning platforms there is a unique opportunity for this form of research to extend into real-world settings and engage communities outside of the lab. Indeed, these services may even be used by participants who are unaware of the wider research agenda and rely upon the service as a technology in of itself. Delivering services in this manner raises several issues around service reliability, visibility, and dependability, that must be taken into consideration when designing similar services.

Deploying services outside of the lab settings inherently limits the opportunity for researchers to respond directly to potential technical issues or concerns that an individual might have whilst engaging with the technology. Although we are not advocating that lab based studies are built to be unreliable, operating these technologies in the 'real world' inevitably requires that researchers consider aspects such as security and resilience more closely given the potential for these services to contain large quantities of sensitive data. Similarly, we must also be conscious of designing systems we want communities to perceive as reliable and trustworthy enough to invest their own resources (human and social capital, time, efforts) and the resources of others in the commissioning process. In the case of App Movement, the service is delivered as an ongoing deployment that supports over 52,000 users to engage with the resulting mobile applications. Therefore, the delivery of the App Movement platform was visually designed to appear as a reliable and active service rather than being explicitly branded as a Newcastle University research project. This distinction was made to eliminate concerns around reliability and lifespan of the service that might have dissuaded communities in engaging with the service. Taking a platforms approach to deploying these forms of technologies inevitably centralizes efforts within a self-contained ecosystem. In doing so,

citizens are afforded with an overview of existing successful projects within which they can become involved and provides compelling evidence of the community's level of trust to potential campaigners.

Within the framework of community commissioning the underlying infrastructure, existing data, and community around the project should be transferrable to representatives within the community to ensure longevity of these resources beyond research. This concept is discussed further in the governance, moderation, and ownership section later in this chapter. Beyond transferring the commissioning infrastructure and community owned resources to the communities themselves, this dissertation also advocates transparency and access to the data resulting from this process. This next section discusses the potential issues around sharing and analysing these forms of implicit and explicit data in the future.

9.4.3 Visibility and transparency of community data and process

Sharing economy platforms such as Uber and Airbnb have the ability to provide deeper insights into our collective behaviours of the lived environment however this data is collected, owned, and only accessible by private enterprise for the purposes of profit rather than for a common good. Accessing existing civic datasets (Open Government data, petition.parliament.uk, FixMyStreet, WhatDoTheyKnow) currently requires technical knowledge and skills (available through developer APIs or custom data formats), as well as understanding of business processes to access and interpret the information contained within these systems. Despite this, the UK Government has described the potential for Open Government data to *"empower citizens, foster innovation and reform public services"* and is discussed in terms of openness and transparency of the underlying government data (Government 2012). However, there has been critical reception of the existing practices and perspectives around Open Government Data (Janssen et al. 2012) around issues such as data provenance, visibility, and access. Indeed, citizens must first be aware of the available data and able to comprehend the contents before they can begin to ask questions of the data. This can be achieved through incorporating varying levels of access and presentation to the data in a manner that encourages citizens to search, discover, and access relevant information. Interfaces such as TheyWorkForYou and WhatDoTheyKnow take parliamentary and Freedom of Information request data that is already transparent (and available through as Open Government Data), and lower the barrier to engaging with this data by increasing the

visibility and usability of the data through meaningful interfaces. Importantly, this also requires that the context and provenance is presented alongside the data in order to promote better understanding of the available data. Data visibility should therefore be considered as a spectrum, from raw data to rich abstract data visualization and intermediary interfaces in between. In these examples citizens can evidence existing practices within parliament or local government and use this data to enact change, facilitated through visualizing this data in more transparent and visible ways.

Within the existing services highlighted in chapter 5, there are several limitations currently on the extent to which this information is shared. Data in the context of community commissioning platforms, such as App Movement, may take the form of explicit and implicit user interactions that are either actively contributed or passively collected during system use. Explicit data in this case refers to consciously contributed content and interactions (supporting campaigns, comments, votes, photos etc.) whereas implicit user interactions refers to the inferred interactions (log data; time of day, location of search, distance travelled). This dissertation has emphasized the need for citizens to be able to access, observe, and interpret collectively contributed data through an easily accessible, meaningful, and transparent process. As researchers and designers of community commissioning systems we should incorporate concepts of collaborative consumption (Hamari et al. 2016) and open source within the collection and usage of this data. The generation of the data is, after all, produced by the communities that adopt the technologies we design and develop as researchers. In the same vein as Open Data, we should provide data as an asset from which communities can begin asking questions of the community's interactions and knowledge in an effort to derive evidence of collective practice and enact change. This could be in the form of mothers using this data to call for improvements in breastfeeding friendliness standards in local businesses, or perhaps used to inform public policy (Simpson et al. 2016a). As demonstrated in the quantitative analysis of FeedFinder, there is real potential for this data to inform both the general public's and academic research's understanding of the everyday behaviours of communities. We as researchers can better understand the network effects of adoption and promotion around these campaign through capturing interaction data to understand how communities engage in this process.

Beyond these forms of data, we can also discuss how these platforms provide communities with visibility of their needs and practices. In making visible the act of engaging with the process, communities are inevitably making explicit their matters of concern for others to engage in deliberation and understanding of how an issue affects them. Campaigning and promotional tools provide the ability for citizens to establish an online presence that can be referenced, shared, and engaged with the intended community. This creation of a shared online space provides an opportunity to enter deliberative, visible, and transparent discussions and actively stimulate public debate regarding their matter of concern through making visible their campaigns and resulting community resources.

Visibility can also be discussed in regards to making visible the process of community commissioning for both the aspect of campaigning around a community need or reflecting upon the what decisions were made and by who once the resource has been developed. Given that the collection actions of the community contribute to the overall resulting technology the provenance of community decisions is also an important factor that must be considered when designing community commissioning systems. This includes transparency and visibility of community deliberation and decision making process to contextualize the origin of the commissioned resource. In doing so citizens who were not involved with the initial process are provided with the ability to transparently reflect upon the decisions leading to the community technology.

However, providing individuals with the ability to ask questions of shared community data resulting from platforms such as App Movement is problematic. First off, the explicit data contributed by an individual can be clearly subject to copyright and ownership by the author however this issue blurs somewhat when asking the same of implicit user interaction data collected during service use. Further still, consent to access an individual's implicit and explicit data may be granted for the purposes of research on the understanding that the data will be handled with care and anonymized for publication. However, can the same be expected or enforced by the data creators when made available to all? Providing unadulterated access to such potentially sensitive data (as seen in chapter 4) can potentially de-anonymize individuals within the data and as such we as designers of these interfaces to the data should be mindful of the implications of providing access to this data. Similarly, access and control to data we generate about through our interactions is a particularly difficult task when

attempting to opt-in or opt-out of specific requests for the data. We must first be aware that we are creating this data and then understand and agree to the use cases of providing universal access to implicit interaction data. Again, this issue of de-anonymization continues when providing access to multiple sources of data about the same individual. This might well be the case when providing interfaces to query data from App Movement whereby an individual using multiple applications could be used to corroborate facts about an individual's personal preferences and activities.

The leveraging of existing communities not only provides a more bottom up approach to identifying shared issues but also affords benefits such as collective engagement and visibility of process, promotion within the engaged community, as well as pre-seeding and adoption of the resulting output. This next section discusses the implications of making this process visible in regards to access, moderate, and ownership of community owned resources.

9.4.4 Community-led governance, moderation, and ownership

Providing citizens with this ability to commission and co-produce technologies inevitably leads to questions around governance, moderation, and ownership of the resulting artefact and underlying process. This dissertation advocates that the design of community commissioning platforms should enable communities to actively engage in the collective ownership, moderation, and governance of the resulting technologies. Both FeedFinder and App Movement attempt to embed a more bottom-up approach to the process of commissioning and production of community-owned information resources however these challenges of are not yet fully explored in these case studies.

The final release of community commissioned applications through App Movement fall short of defining a moderation strategy to resolve community flagged content. Currently, moderation is carried out by the research team as and when content is flagged by the community. Given the potential increase in applications that could be developed through the service, this approach is simply not scalable. As time progresses, there will inadvertently be an increase in the moderation demands placed on the research team. More fundamental to this issue of researcher-led moderation is that this approach does not accurately reflect the values and standards set by the community and provides no means for them to establish these values. Therefore, this dissertation reflects upon both the FeedFinder and App Movement services

that have been developed, existing literature, and the proposed community commissioning framework to explore these issues of ownership, moderation, and governance further. Let us begin by drawing upon similar sharing economy and platform cooperative concepts that facilitate, to some extent, access to collaborative networks of workers.

Most true to this ideal of collective ownership is Scholz's proposal of *Platform Cooperativism* (Scholz 2014). In this model Scholz seeks to decentralize infrastructure through platform cooperatives in a bid to remove third party service providers profiting from "*running off your car, your apartment, your labour, your emotions, and importantly, your time*" (Scholz 2016). This ideal by Scholz falls short of proposing a solution, and can be considered more as call to action in rethinking how sharing economy cooperatives might function. In this call to action, Scholz (Scholz 2016) identifies several concepts regarding; collective ownership, transparency and data portability, protection against arbitrary behaviour, and portable worker reputation which provide discussion points to explore governance, moderation, and ownership. Scholz attempts to address issues of platform ownership without regarding the day-to-day activities of running such a platform. Similarly, the use of Open Source software inevitably causes friction between the platform producers (technical experts) and the communities who instantiate the platform (service providers) in that technical experts can inevitably control the focus of the platform through the production of code. This calls into question how service providers can request additional features or even chose to reject features implemented by the technical experts. The response to this issue would be the Open Source forking of projects and the adoption of an open tender process to fulfil potential features that could be paid for by the cooperative of service providers.

Ownership and governance are not inherently the same concept however it is arguable that ownership, at least in existing commissioning practices, can lead to the enforcement of governance. Governance in the concept of community commissioning can be used to describe the collective decision making process of how these platforms operate. In existing systems, those with direct ownership of a technology can position themselves to have complete control over the way those systems are used despite not being direct producers of the content they are controlling. For example, when Google changed the YouTube their 'real name' policy to

prevent spam and trolls in the comments of videos, these changes received community wide opposition through online petitions [88] and widespread media coverage [89 90 91]. Similarly, Reddit's CEO was found to be modifying posts made by users and faced community-wide criticism for his abuse of power[92]. In both cases the content was produced and governed by the community themselves but they were also subject to service providers enforcing their own agendas through ownership of the technology.

In the case of the sharing economy, Sundararjan (Sundararajan 2016) discusses governance in terms of regulation of platforms for consumer protection. However, these concepts can be abstracted to determine three distinct models of governance; peer regulation, self-regulatory organisation, and data-driven delegation. Within peer regulation, the network of members regulate themselves through performing regulatory action i.e. moderating and removing content, however the allocation of these regulatory roles requires either a democratic process or service providers to award these roles. Self-regulatory organisations, such as the British Medical Association, facilitate communities in establishing and maintaining shared standards. In this approach, the shared standards are defined (and can be redefined) by a collection of representatives within the organisation who enforce standards and identify individuals who do not conform to regulation. An individual's threat of being removed from the regulatory organisation is an integral part in maintaining control of its members and enforcing standards of practice. Given that these technologies can provide insights into the behavioural interactions of the community, another approach could be to use this data to automate the process of awarding roles for moderation and governance. Sundararjan (Sundararajan 2016) describes this as *data-driven delegation* whereby reputation systems are used to identify key influencers and community leaders that interact with a community owned resource and award them specific administration privileges.

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[88] https://www.change.org/p/google-change-the-youtube-comment-section-back-to-its-original-form
[89] https://www.theguardian.com/technology/2013/nov/26/youtube-spam-comments-google-plus
[90] http://www.huffingtonpost.com/2012/07/24/youtube-real-names-users-comments_n_1699749.html
[91] https://www.wired.com/2012/07/youtube-google-plus/
[92] https://www.independent.co.uk/life-style/gadgets-and-tech/news/reddit-donald-trump-steve-huffman-spez-pizzagate-trolls-hillary-clinton-a7436406.html

Stackoverflow[93] provides a clear example of how moderation roles and tasks can be awarded based upon the user's interactions with the community who then vote positively or negatively on these interactions and directly impact upon a user's ability to perform administrative tasks. However, when applying this logic to community commissioning we must consider who should decide upon the mechanics of the reputation system in regards to number of points awarded and the thresholds required to meet these targets. As technical experts, we could create platforms that have pre-configured reputation models however we have no domain knowledge of the potential communities this reputation system might operate within. Therefore, we should provide communities with the ability to set these thresholds and conditions themselves rather than being researcher-led. Once these thresholds and roles have been set by the community we also must consider how these may change over time to reflect change of existing behaviours and the formation of new behaviour and how we might integrate these into an ongoing process of shared reflection by the community.

The commissioning framework discusses the ability for communities to provision their own community commissioning platforms similar to that of Schoz's Platform Cooperatives (Scholz 2016). However, as these individual instances begin to form, we face a fragmentation of how these platforms are provisioned and the values that are embedded in these platforms could begin to change. Within Open Source software, licenses are used as a mechanism to regulate the use, re-use, modification, and ownership of the resulting software project. This allows project creators to define their expected intentions for reuse upfront before software is appropriated in an effort to maintain a level of control over the resulting outputs. However, what remains underexplored are the possibilities for project owners to define community guidelines that dictate the values embedded within future instantiations of commissioning platforms.

Beyond the initial campaigning process there is also an issue of transient communities and the passage of time. As communities evolve and change we must also consider the prospect that the values of that community change with them. In the case of FeedFinder, the community is

[93] https://stackoverflow.com/

somewhat momentary given the short-term nature of breastfeeding. As time progresses the initial values and method of use by the community may change with the shift of existing members no longer use the resource and new mothers adopting it. This highlights the fact that community commissioned systems must continue to provide the community with the ability to reflect and alter the resource even after it has been deployed.

The community commissioning framework discusses how designers facilitate the provisioning of individual commissioning platform instances. However, in the future we might begin to think of how commissioning platform providers can form networks of likeminded communities. This can best be described as a *federated network* that attempts to facilitate the establishing of shared values that inform moderation standards. In this approach, community standards are set by each service provider and shared across a federated network who can then maintain shared values but also enforce further standards that are suitable for the community. StackExchange[94] (provider of StackOverflow style communities) is one such attempt at this federated approach to provisioning commissioning services. Within StackOverflow, members engage in elections [95] to propose and vote on their preferred community moderators. Similar approaches could be incorporated within instances of commissioning platforms that provides users of the service with the ability to modify content within the service.

However, this discussion returns to Scholz's (Scholz 2016) suggestion of portable worker reputation whereby community members should be able to move between services whilst maintaining evidence of their existing community standing or reputation. However, in the model of community commissioning issues arise from the community-led nature of establishing shared reputational status. Transferring reputation gained from one service to the next requires, at the very least, some form of shared understanding of the criteria for gaining that reputation. Similarly, reputational persistence is a double-edged sword that can provide a somewhat truer account of an individual's reputation over time but at the mercy of the community's ability to modify or alter reputational standing requirements or reputational metrics weightings at any moment. Along with community voting (as seen in StackOverflow)

[94] https://stackexchange.com/
[95] https://stackoverflow.com/election

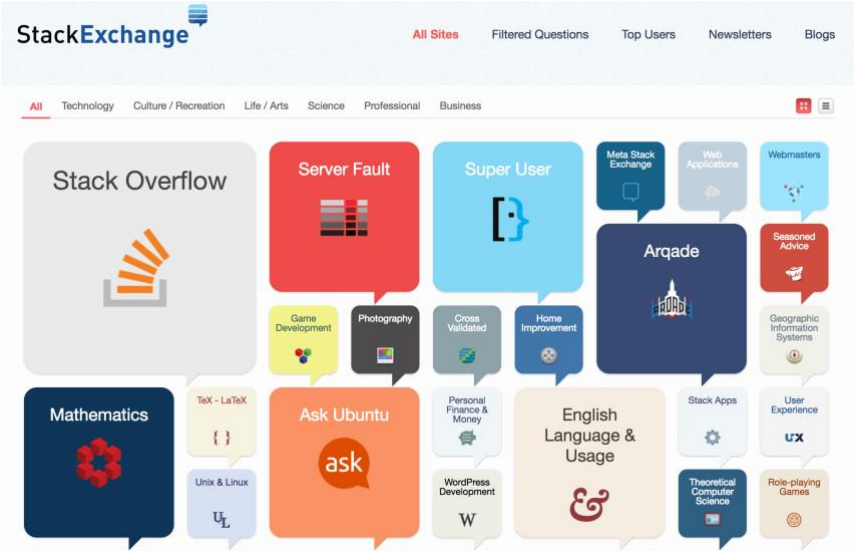

Figure 50. StackExchange network of specialized Question and Answer communities

towards an individual's performance can also be irreparably damaged by an early conflict (justified or unjustified) that subsequently affects future attempts to adopt more senior roles. Therefore, providing transparent historic overviews of an individual's reputation when the criteria are produced through federated platform instances requires careful consideration.

In the case of StackExchange (Figure 50), reputation from other Stack-communities (federated network) is not explicitly transferrable, but remains visible through maintaining a centrally held profile within the network. Similar approaches could be adopted by a federated network of commissioning services however there must also be infrastructure in place to make this reputation visible across providers. Within App Movement, the automatically generated community applications use a single sign-on account and as such, any App Movement user can access any application. However, this is only possible given that the user credentials are held by the App Movement service and subsequent third party platforms would need to integrate into the service to authenticate users across domains. This could be achieved through the integration of the OAuth 2.0[97] protocol, that allows third parties to request data from a provider using tokens that can be revoked by data owners. Similar

[97] https://tools.ietf.org/html/rfc6749

mechanisms might also provide control over the data that would be shared with the previously mentioned data analytics interfaces.

Looking more closely at the process of community commissioning, we must also consider how communities can moderate or contest campaigns to ensure that they accurately express shared needs. The commissioning process within App Movement is configured more towards a single individual expressing the needs of the community through a single campaign message. The success of the campaign is a clear indicator that the community agree on the message however there is limited discussion that challenges this initial campaign proposal. Reflecting on the process of campaign creation, it is evident that future iterations should provide the ability for communities to enter an initial consultation period that allows them to collectively express their own perspective on how best to respond to the community's needs.

However, consider for a moment incorporating an entirely democratic process of establishing a campaign message whereby every modification to a campaign page required majority confirmation. This would severely hinder the progression of a campaign if agreement must be reached by the many to proceed. Therefore, alternative mechanisms of reaching consensus must be considered for this to be a viable approach. Ultimately, if a campaign message does not express the community's needs they can create a separate challenging campaign. A potential resolution to this issue can be seen in the open source community within which projects are "forked" when critical decisions are made by core team members that reflect differing principles. At current contestation of these values and practices embedded within community owned resources is limited, and should include the ability to hand-over, merge, or modify the underlying confirmation options within the applications themselves.

This dissertation has explored the configuration of tools and platforms to support communities in the process of commissioning their own information resources. Through the design, development, deployment, and analysis of both FeedFinder and App Movement it has been possible to reflect on how these technologies can facilitate a new process of community commissioning. As evident from these discussions, the introduction of a community within the commissioning process introduces new opportunities for research around collective ownership, governance and moderation of resulting community owned resources.

9.5 Future Research

The research presented in this dissertation provides immediate research challenges around further design and development of App Movement as well as methodological challenges of future analysis of the increasing number of communities engaging with the service. The configuration of the App Movement service provides an increasing opportunity to observe, analyse, and understand under-served communities in the adoption of community driven information systems. As discussed in this chapter, this requires that future research considers how we design systems that provide this data to the community as well as the configuration of systems to incorporate aspects such as governance, moderation, and ownership of community owned resources. Beyond the App Movement service there are also research opportunities to directly explore and apply the community commissioning framework to other application domains to explore the boundaries of this new model of participation. This chapter has also raised several future research opportunities regarding aspects such as access to data transparency, visibility, and access, and the potential for new models of governance, moderation, and ownership in the provision of community commissioning services. These opportunities of future research have been addressed in three parts; *immediate challenges*, *methods challenges*, and *extending application domains*.

9.5.1 Immediate challenges

The ongoing deployment of the App Movement service has highlighted several immediate improvements that could be made in order to more accurately reflect the proposed community commissioning framework identified in chapter 8. These immediate challenges attempt to respond to issues of visibility and transparency of resulting data, as well as encourage further participation around the resourcing, sustaining, and ownership of the community-owned information resource. It should be noted that as FeedFinder has become integrated within the App Movement ecosystem and as such these challenges reflect both case studies. The immediate challenges proposed in this section draws upon the discussion points within this chapter and form more tangible future work for the App Movement service.

Immediately evident is that the design of App Movement should more accurately reflect aspects of the proposed community commissioning framework. Altering the initial campaign proposal phase could be reconfigured to provide the entire community with the ability to collaboratively express their needs rather than the existing practice of a single embedded

community member framing the campaign proposal without input from the community. In doing so the initial campaign proposal would more accurately reflect the needs of the community but also provide an opportunity for the community to establish the roles and resources that might be required to facilitate such an endeavour. Fortunately, the architecture of App Movement is developed in such a way that provides us with the ability to alter aspects of the three-phase process (*Support*, *Design*, *Launch*) to address the issues highlighted in this dissertation and observe the impacts on adoption and usage.

An important distinction to be made is that both case studies were specifically configured to produce location-based rating and reviews mobile applications. This design decision provided a reduction in the complexity of automating application development but also defined the boundaries within which communities could engage with the process of commissioning. The limitations placed upon designing and configuring an application template allow for the automation in the development process. Extending beyond this functionality is currently only possible if the research team intervene to modify the application template. Therefore, future design challenges for the service might incorporate the ability for the community to engage in a tendering process to incorporate external developers (or capable community member) in the development of additional features. In this configuration, there are opportunities around the designing of micro-crowdfunding design tasks in order to tender and pay for further development of the application template or identify willing and able community members to complete these tasks. However, developing additional interfaces and applications requires that the research team resolves the issue of data coupling within the App Movement service. This would require providing third parties with the ability to access the data for the purposes of creating their own interfaces or applications that used the App Movement service as a data source.

Within the design phase the configuration of the application templates is limited to preconfigured tasks. Further development of these tasks to facilitate the community in pre-seeding an application prior to its release would also reduce the production workload when deploying the application live for the first time. This would then provide new users with an immediately valuable resource rather than the initial under developed resource that is current deployed. Similar to the OpenStreetMap ‘mapping parties’, design tasks could also be used to facilitate real-world interactions for supporting the mapping or pre-seeding of application

content. These physical meetups could be used both as a promotional tool to encourage others to interact with the application as well as provide a means to richly populate the community owned resource within a specific local area of interest.

Future work might also look to extend beyond the initial concept of a collaborative design process and explore the trade-offs between a single motivated individual or skilled expert within the community and the collective design decisions of the crowd. In this mode, a single, well informed, and skilled individual could theoretically produce a more consistently designed final artefact rather than the current model that focuses on the division of labour over smaller micro tasks as proposed in the Commons-based Peer Production model defined by Benkler (Benkler & Nissenbaum 2006). In the case of App Movement supporters are asked to engage with micro-tasks irrespective of other design tasks that have been completed by a contributor. To this effect, an individual's entire vision for the design elements may only be desirable if selected in their entirety rather than in part. Exploring this concept further, individual might perhaps put forward complete proposals rather than design on individual aspects of the applications final design in an attempt to contribute a more complete design concept. These concepts could then be put forward to be voted on in their entirety by the community of supporters.

Currently the design process does not support any notion of critical mass, as seen in the support phase, and therefore campaigns are often left unfinished in the service. In one respect this prevents additional workloads for the platform and research team and prevents potentially already unsuccessful or disinterested communities from being provided with technologies. This Darwinian based approach to the design phase might also be expanded to the support phase whereby the process of campaigning and development is provided without consequence or barriers to campaign approval becoming a fully-fledged mobile application. In this mode, all app concepts would be developed and available for use by communities beyond the initial community who proposed this solution. In doing so there may be more potential for other communities to become involved and make use of the application. The obvious drawback of this approach is the increased workload of the research team to submit designs to the various app stores and the potential for violation of app store guidelines on developing spam applications. However, this could be potentially achieved through a similar approach as

CitSci.org or Sensr.org that use a single parent application that projects are published within, in order to resolve this issue of repeated app store publishing.

Once the mobile applications are deployed, opportunities exist around more intelligently identifying community leaders or highly active contributors in order to incorporate aspects of governance, moderation, and ownership that have been discussed previously in this chapter. This includes adopting these roles for both the underlying commissioning process as well as once the community-owned resource is established. Using the low-level log data from the existing mobile applications it would be possible to identify typical patterns of use across the 19 applications to inform the design decisions for a reputation system to determine moderation and administrative roles. Similarly, this could also be incorporated into the process of commissioning the application through providing the community with the ability to propose or elect existing community leaders to perform these tasks before launch.

As the community owned resources resulting from App Movement continue to be used in the real world and active communities become established there needs to be an opportunity for revisiting the design decisions made during the commissioning process. The configuration of App Movement does not currently support the community to reflect upon the suitability of the resulting community-driven information resource. As such, future iterations of the service should incorporate a more iterative process in the launch phase that allows communities to revisit the campaign in order to reflect and address issues that arise once a technology has been deployed for a period. Similarly, as applications become less active we might also want to consider how new communities could appropriate existing applications that may be suitable to their community.

An important factor identified in the FeedFinder deployment was the ability to leverage the data resulting from these forms of technology to advocate for change through evidencing existing community practices. Although there are notions of transparency embedded within the App Movement service there remains barriers in accessing the data resulting from successful campaigns. However, as mentioned previously, providing these interfaces to data require that we rethink the way this data is made transparent and available before providing access to the public. Lastly, a more suitable model of collective ownership needs to be established in order to ensure that App Movement continues to exist beyond the resources

provided by the research team. At current, App Movement is open source and freely available on GitHub[98] for anyone to use and create their own community commissioning service. However, further design work is required to provide communities with the ability to collectively own an instance of the commissioning service or provide a mechanism for a community to adopt and modify their own mobile application resulting from this process.

9.5.2 Methods challenges

Current analysis and research around App Movement has focused on reflecting upon existing campaigns through the case studies presented in chapter 7. However, as the service continues to grow, in both quantity of campaigns and wider adoption by disparate communities, more scalable and automated methods of analysis will need to be identified that allow us to explore each of these applications independently and collectively. The session-based analysis of implicit transactional user behaviour data of FeedFinder (chapter 4) presents an opportunity to apply this method within the contexts of the successful campaigns from the App Movement platform to understand how these resources have become adopted and subsequently used over time. Alongside identifying novel approaches to examine implicit user interactions is also the challenge of understanding how community commissioning tools, such as App Movement, are adopted the community. Initial efforts to model this form of behaviour (Lee et al. 2017) draw upon epidemic modelling in an effort to understand the spread of campaigns through community networks. In this research Lee *et al* (Lee et al. 2017) highlight the opportunities of observing such granular data of almost entire communities that is not currently possible in existing epidemic modelling techniques.

With the increasing number of community driven information resources begin commissioned by communities through the App Movement, there is an ongoing challenge in not only providing citizens with transparent interfaces to the data but also in the publishing of datasets within the academic research. McMillan *et al* (McMillan et al. 2013a) propose ethical guidelines for large-scale mobile HCI research that describes potential ethical issues of these forms of data. The guidelines discuss data collection in terms of user expectations of data collection and levels of user identifiability directly impacting upon the ethics of collecting

[98] https://github.com/digitalinteraction/appmovement

such data. As evidenced in chapter 4, the data provides us with the ability to identify home locations as well as distinctive patterns of use that could be used to identify individuals through low-level log data. McMillan *et al* (McMillan et al. 2013b) would describe this data as *Identifiable Data*, *Expected Collection* (IE) in that there are risks involved in collecting such data however collection is not unexpected by the user given the nature of the application. Potentially collecting and providing this data to external third parties would require that we make explicit our intentions prior to engaging with the service or resulting applications through more than agreeing to terms and conditions. The guidelines also suggest that users should be given an opportunity to review the data collected and expunge any data they determine to be too sensitive. Similarly, McMillan *et al* (McMillan et al. 2013b) also call for a data sanitisation strategy to ensure individuals are appropriately anonymized and sufficiently obscured.

9.5.3 Extending application domains: beyond information resources

The initial concept of community commissioning has been demonstrated through the design, development, and deployment of the App Movement service however the underlying conceptual framework, presented in chapter 8, of community-led commissioning has the potential to extend beyond the domain of automated mobile application development. Indeed, research conducted at OpenLab is beginning to adopt this framework of community commissioning for use in several application areas, such as; the commissioning of learning resources to support community driven curriculums (Kharrufa et al. 2016), the commissioning of citizen-led radio [99] programmes for use in refugee camps in Lebanon, and the commissioning and resourcing of real-world events[100]. In each example the emphasis is upon connecting individuals within communities to collaboratively express needs, identify resources, and collectively engage in a process of development or production of shared resources.

[99] https://citizenrad.io
[100] https://eventmovement.com

9.6 Final Remarks

This thesis has proposed a new model of community commissioning that can be applied and used by communities worldwide. Indeed, the continued adoption and usage of the App Movement service is testament to the potential for real impact through genuine adoption of these forms of technology, and provides extensive opportunities for future research around the resources, infrastructure, and data that are commissioned through this approach.

Emerging platforms and services offer the potential to harness the collective efforts of production by the many, but that continue to be provided by a select few. We as HCI researchers and designers must ensure that we reconfigure these technologies to serve, and be shaped by, the needs of the communities themselves and ensure that these tools continue remain in the hands of those that will ultimately engage in the production of the value afforded by these systems. The production of implicit and explicit data resulting from these resources also provides us all with the opportunity to explore and evidence community practices to enact change and inform our understanding of the world. However, we have only just begun to explore the effects of facilitating communities in commissioning their own goods and services and future research must focus upon designing new models of collective governance, moderation, and ownership of these community commissioned resources in order to truly empower citizens.

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Appendix A

Code	Example Survey Response
Breastfeeding Healthcare Worker	I'm a breastfeeding Peer support worker based in wallsend, I've recommended this app to a number of my mums. Thank you for your work.
Pre-emptive Usage	No longer breastfeeding but will use it when next baby is born.
Confident Breastfeeder	I’m already confident to feed but think would help new mums maybe
Limited use	This app is a great idea but needs much more content before it becomes really useful
Potential for Technology	As a new application it has great potential and I'm keen to help add places to it.
In support for others	I used the app more when my baby was new born, now my baby is 4-5 month I am more confident and feed where ever I want! I think it's great for more nervous mothers so will still review places for them
Map interaction issues	Can't work out how to add a place if you're not near that place
Facilities	As an employee of the university I find it disappointing that there is no designated breast feeding room on campus.
Regular use	Really great idea! Thank you. I have looked at the app a lot. I may be more likely to add comments/ ratings if I could submit them from home rather than when I am actually in the venue, as I am normally socialising with friends.
Advocacy	If someone was nervous about feeding in public and found confidence in others feeding at a location without issue then that's where this would be handy. For this reason only I've added some locations. But I hate the idea of acceptable places to feed, if your baby wants feeding then it's fine to feed them, wherever, whenever. Focus on baby and be proud of what you're doing
Contributing places interaction issue	Great idea. User interface to add new places is a bit clunky. Think it needs more promotion too to get more users & more places added. Thanks for creating app.
Promotion	please advertise so it will be easier to use! more users means more people adding locations all over! as it stands in kansas city mo I simply have to add my own and absolutely nothing shows for my area!
Useful	Easy to use app and has helped me to locate breadtfeeding friendly locations. Would benefit from further reviews and more locations however I understand this requires user feedback.
Planning behaviour	Really great idea! Thank you. I have looked at the app a lot. I may be more likely to add comments/ ratings if I could submit them from home rather than when I am actually in the venue, as I am normally socialising with

	friends.
Reviewing interaction issues	The first question 'Is this a designated...?' is off-putting. I don't know what it means!
Motivated contributor	I live in Essex and because the app is new not many locations have been added so far. However it is a great start and I will start adding locations
Planning behaviour	Really great idea! Thank you. I have looked at the app a lot. I may be more likely to add comments/ ratings if I could submit them from home rather than when I am actually in the venue, as I am normally socialising with friends.
Inaccurate locations	this is inaccurate and lacking in information. I find it unhelpful to be told where a Costa Coffee shop is.
Technical Issues	it never seems to be able to detect where I am. was very excited about using this app but doesn't seem to work properly
Usability	it's difficult to use and theres no clear instructions as to how to add places.
Technical Issues	The app is slow to respond when adding a feeding place or completely crashes which means having to start again. It would also be helpful to have it possible for us to access our accounts to adjust any feedback given or any details that may need updating
Expectations of contribution	this is inaccurate and lacking in information. I find it unhelpful to be told where a Costa Coffee shop is.
Expectations of pre-population	I really like the concept of this app but there's a number of breastfeeding friendly cafes in town that aren't include, popular chains like cafe Nero, Costa, Starbucks. Also, one of the 2 original shown (mothercare) had closed down several weeks ago. Please keep going and update as obtains this could be really useful in the future.
Facilities	Not enough users. Designated BF areas are rare and not the norm so it is a pointless classification. Everyone has different places they prefer to feed so it is a very personal preference.
Contributing places interaction issue	Recently had difficulty adding a new place that had more than one word for it's name. Ie oracle riverside
Advocacy	If someone was nervous about feeding in public and found confidence in others feeding at a location without issue then that's where this would be handy. For this reason only I've added some locations. But I hate the idea of acceptable places to feed, if your baby wants feeding then it's fine to feed them, wherever, whenever. Focus on baby and be proud of what you're doing
Reviewing interaction issues	The first question 'Is this a designated...?' is off-putting. I don't know what it means!
Feature Request	It would be very helpful if the app displayed distance or directions to nearest feed friendly place from your current location
Technical Issues	Wishes that you could add places once you are home, I've been to a few places and when I've went to leave feedback haven't had a phone/Internet signal but was unable to rate once I had left the place, which is a shame!

Motivations for use	I added a review for a place but it doesn't show on the search! There's one place in the whole of Leicestershire!! I don't see the point in using it anymore and will uninstall it. I can't believe nobody uses it so it clearly just doesn't work.
Usability	it's difficult to use and theres no clear instructions as to how to add places.
Promotion	My baby isn't here yet so haven't fully utilised the app but have told loads of people about it and expect it to be a lifesaver. Thanks!
Motivations for use	this is inaccurate and lacking in information. I find it unhelpful to be told where a Costa Coffee shop is.
Expectations of pre-population	I really like the concept of this app but there's a number of breastfeeding friendly cafes in town that aren't include, popular chains like cafe Nero, Costa, Starbucks. Also, one of the 2 original shown (mothercare) had closed down several weeks ago. Please keep going and update as obtains this could be really useful in the future.
Male users	app is on my partner's phone and was only used during his paternity leave, seems like a good idea. Accessible toilets might also be useful.
Promotion	My baby isn't here yet so haven't fully utilised the app but have told loads of people about it and expect it to be a lifesaver. Thanks!
Facilities	Not enough users. Designated BF areas are rare and not the norm so it is a pointless classification. Everyone has different places they prefer to feed so it is a very personal preference.