Designing social media analytics tools to support non-market institutions: four case studies using Twitter data

A thesis submitted in partial fulfilment of the requirements
of the Royal College of Art for the degree of Doctor of Philosophy.

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Abstract

This research investigates the design of social media tools for non-market institutions, such as local government or community groups. At the core of this practice-based research is a software tool called LocalNets. LocalNets was developed to collect, analyse and visualise data from Twitter, thereby revealing information about community structure and community assets. It is anticipated that this information could help non-market institutions and the communities with which they work.

Twitter users send messages to one another using the '@mention' function. This activity is made visible publicly and has the potential to indicate a Twitter user's participation in a 'community structure'; that is, it can reveal an interpersonal network of social connections.[1] Twitter activity also provides data about community assets (such as parks, shops and cinemas) when tweets mention these assets' names.

The context for this research is the Creative Exchange Hub (CX), one of four Knowledge Exchange Hubs for the Creative Economy funded by the UK Arts and Humanities Research Council (AHRC). Under the theme of 'Digital Public Space', the CX Hub facilitated creative research collaborations between PhD researchers, academics and non-academic institutions. Building on the CX model, this PhD research forged partnerships between local councils, non-public sector institutions that work with communities, software developers and academics with relevant subject expertise.

Development of the LocalNets tool was undertaken as an integral part of the research. As the software was developed, it was deployed in relevant contexts through partnerships with a range of non-market institutions, predominantly located in the UK, to explore its use in those contexts. Four projects are presented as design case studies: 1) a prototyping phase, 2) a project with the Royal Society of Arts in the London Borough of Hounslow, 3)

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[1] Java et al., 2007

a multi-partner project in Peterborough, and 4) a project with Newspeak House, a technology and politics co-working space located in London.

The case studies were undertaken using an Action Design Research method, as articulated by Sein et al.[2] Findings from these case studies are grouped into two categories. The first are ‘Implementation findings’ which relate specifically to the use of data from Twitter. Second there are six ‘situated design principles’ which were developed across the case studies, and which are proposed as having potential application beyond Twitter data.

The ‘Implementation findings’ include that Twitter can be effective for locating participants for focus groups on community topics, and that the opinions expressed directly in tweets are rarely sufficient for the local government of community groups to respond to. These findings could benefit designers working with Twitter data.

The six situated design principles were developed through the case studies: two apply Burt’s brokerage social capital theory, describing how network structure relates to social capital; two apply Donath’s signalling theory – which suggests how social media behaviours can indicate perceptions of community assets; and two situated design principles apply Borgatti and Halgin’s network flow model – a theory which draws together brokerage social capital and signalling theory. The principles are applicable to social media analytics tools and are relevant to the goals of non-market institutions. They are situated in the context of the case studies; however, they are potentially applicable to social media platforms other than Twitter.

Linders identifies a paucity of research into social media tools for non-market institutions.[3] The findings of this research, developed by deploying and testing the LocalNets social media analytics tool with non-market institutions, aim to address that research gap and to inform practitioner designers working in this area.

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[2] Sein, et al., 2011

[3] Linders, 2012

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Abbreviations

ACV	Asset of Community Value
ADR	Action Design Research
AHRC	Arts and Humanities Research Council
ANT	Actor Network Theory
API	Application Programming Interface
CCG	Clinical Commissioning Group
CPR	Common-pool Resource
CSCW	Computer-supported Cooperative Work
CX	The Creative Exchange
DCLG	Department for Communities and Local Government
DR	Design Research
FMsRDM	Future Makespaces in Redistributed Manufacturing
HCI	Human-Computer Interaction
IS	Information Systems (the research discipline)
IT	Information Technology
NHS	National Health Service
ONS	Office for National Statistics
RCA	The Royal College of Art
RSA	The Royal Society for the Encouragement of Arts, Manufactures & Commerce
SDP	Situated Design Principle
WTA	Willingness to Accept
WTP	Willingness to Pay

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Declarations

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1. Introduction

This chapter opens with a description of the structure of the thesis, states the research questions and indicates the contribution to new knowledge. It goes on to discuss the motivation for the research and the and the discipline of design research to which this work contributes. Three subsequent sections are included, which describe the research context: the Creative Exchange Hub (CX) in which this research was undertaken, the software development practice (building LocalNets) and social network analysis (a set of methods that model social interactions as a network of nodes and edges).

1.1 Overview and research questions

Crime, planning disputes and other emotive neighbourhood issues are staple topics featuring on social media; car parking, refuse collection and other ordinary everyday issues are also prevalent. In the same way that commercial brands monitor social media to understand their customers' views, could local government adopt a similar approach?

The idea of building software to make social media activity more visible or legible to local government in the UK initiated this research. During the research a web application called LocalNets was created to collect and visualise Twitter discussions about local issues, with the goal of helping local government to better serve citizens – to better target the services they currently provide to a community or to provide new types of services. LocalNets also aimed to uncover community structure, to help identify citizens concerned about particular issues and to indicate which organisations and events are most widely discussed. LocalNets was built as a web application.

This thesis aims to contribute to the design research literature regarding how non-market institutions can effectively use software tools to analyse digital social media activity, an area in which the sparsity of existing research has been noted.[4] The 'Research framing' section in Chapter 1 provides details of the specific areas that are poorly served by current literature and situates my research in a historical context. This framing provides support for two main research questions, which are:

1. How can Twitter social media analytics tools support non-market institutions?

2. What design principles might support designing social media analytics tools for non-market institutions?

LocalNets was developed iteratively over four cycles, described in four case study chapters. Each case study was conducted with one or more partner institutions. This style of research, with collaborative, interdisciplinary projects and concurrent theoretical and practical development, was supported by the Creative Exchange Hub (CX) – a UK AHRC (Arts and Humanities Research Council) funded programme focusing on ‘digital public spaces’. The influence of the Creative Exchange on my research is discussed in the ‘Creative Exchange’ section of this introductory chapter.

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[4] Linders, 2012; Criado, et al., 2013

Figure 1 gives an overview of the research structure. The research questions and theoretical aspects developed in tandem with the practical work, as described in the ‘Creative Exchange’ section of this chapter. Figure 2 give an overview of the case studies.

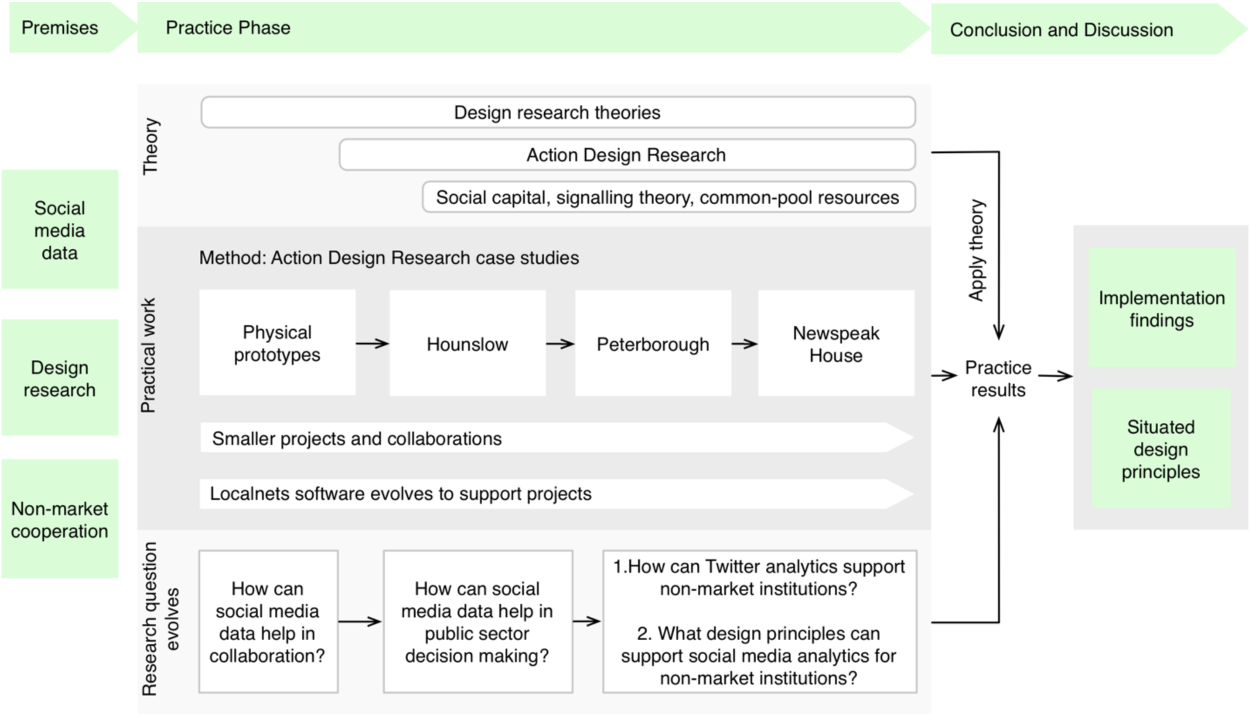
Premises
Practice Phase
Conclusion and Discussion
Social media data
Design research
Non-market cooperation
Theory
Design research theories
Action Design Research
Social capital, signalling theory, common-pool resources
Practical work
Method: Action Design Research case studies
Physical prototypes
Hounslow
Peterborough
Newspeak House
Smaller projects and collaborations
Localnets software evolves to support projects
Research question evolves
How can social media data help in collaboration?
How can social media data help in public sector decision making?
1.How can Twitter analytics support non-market institutions?
2. What design principles can support social media analytics for non-market institutions?
Apply theory
Practice results
Implementation findings
Situated design principles

Figure 1. Overview of the research structure

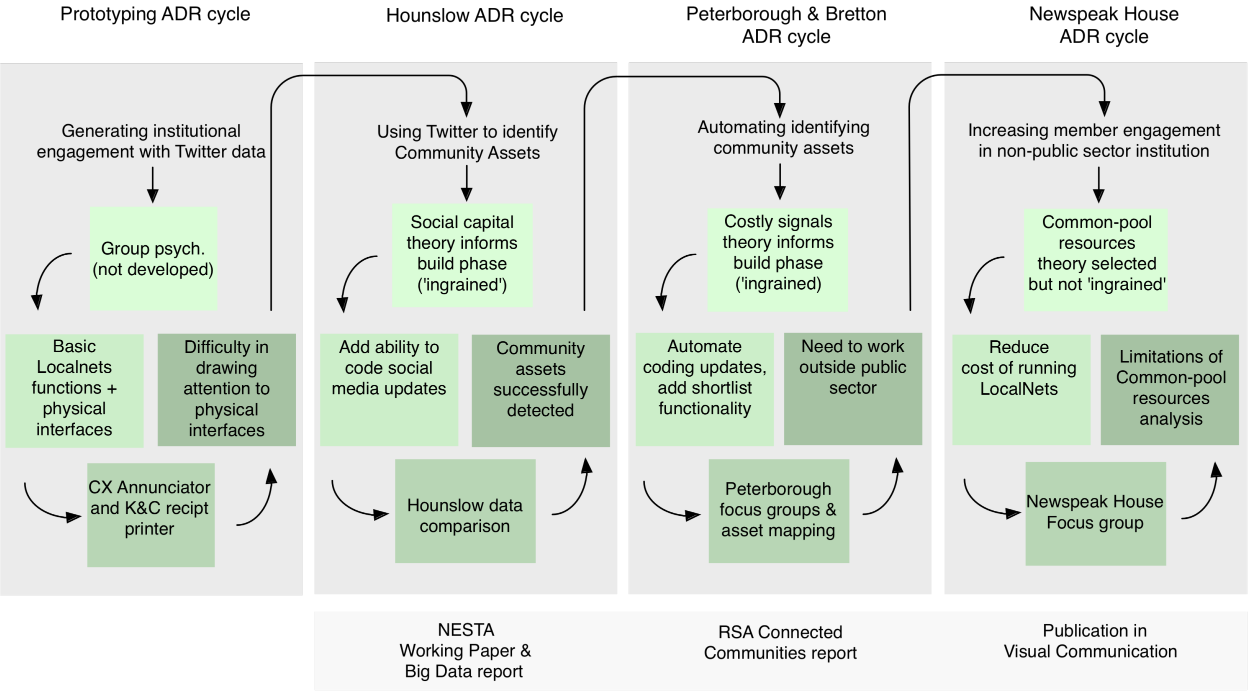
Prototyping ADR cycle
Hounslow ADR cycle
Peterborough & Bretton ADR cycle
Newspeak House ADR cycle
Generating institutional engagement with Twitter data
Group psych. (not developed)
Basic Localnets functions + physical interfaces
Difficulty in drawing attention to physical interfaces
CX Annunciator and K&C recipt printer
Using Twitter to identify Community Assets
Social capital theory informs build phase ('ingrained')
Add ability to code social media updates
Community assets successfully detected
Hounslow data comparison
Automating identifying community assets
Costly signals theory informs build phase ('ingrained)
Automate coding updates, add shortlist functionality
Need to work outside public sector
Peterborough focus groups & asset mapping
Increasing member engagement in non-public sector institution
Common-pool resources theory selected but not 'ingrained'
Reduce cost of running LocalNets
Limitations of Common-pool resources analysis
Newspeak House Focus group
NESTA Working Paper & Big Data report
RSA Connected Communities report
Publication in Visual Communication

Figure 2. Overview of the case studies

The next section of this chapter discusses the historical context of this research, the research gap that this research intends to address, and finally summarises the contribution to knowledge.

1.2 Research framing

Historical context

Research into digital social technologies predates the widespread use of social media. One of the canonical examples is the Blacksburg Electronic Village project. Established in 1993, the project provided the residents of Blacksburg, Virginia, USA, with a fast internet connection and public computers, and undertook other interventions to increase digital participation. Custom-built software allowed residents to share and access local information. The study sought to understand the social impact of these newly deployed technologies.[5]

Since the Blacksburg Electronic Village project, networking infrastructure has improved, broadband connections have become widespread, and in Western countries a large proportion of the population use social networking websites. The impact of these technologies has been widely studied: for example, a survey paper from 2016 identifies 140 papers reporting statistical connections between interpersonal connections and social network behaviours.[6] Other work has considered the psychological impact of social networking and the potential political implications of increasing social network adoption.[7,8]

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[5] Carroll, & Rosson, 1996
[6] Liu, et al., 2016
[7] Turkle, 2011
[8] Sunstein, 2009

Social media in the non-market context: research gaps

This research is situated in relation to research in the fields of information systems and eGovernment research. Crucially, it also draws on and contributes to design research by providing findings that could inform practitioners designing social media analytics tools for non-market institutions. In the information systems and eGovernment fields, the use of social media in the public sector is a well-developed area of research. Linders states that ‘social media has become a central component of e-government in a very short period of time’.[9] This area is also well explored within design research – for example, Bødker and Zander’s research on ‘Web 2.0’ technologies ‘at the intersection between public sector and citizen communities’.[10]

Chapter 2 describes areas where social media has been employed by governments: common examples include disaster response and predicting and analysing election outcomes. This thesis, however, focuses away from these areas, and instead specifically towards the ‘everyday business’ of local government. This distinction is deployed in Bødker and Zander’s work on social media in ‘municipal work’:

> A significant body of literature deals with the use of social technologies/Web 2.0 in this setting. However, most addresses how politicians and citizens debate in relation to elections, which is a different arena than the “everyday business” of municipal work.[11]

Linders suggests that despite the ambition to harness social media analytics in everyday governmental contexts, there is limited research on how it should be done.[12] Porwol and Oji describe ‘a paucity of research on the effectiveness of Social Media technologies as e-Participation platforms’, in their paper ‘Barriers and Desired Affordances of Social Media

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[9] Linders, 2012

[10] Bødker, & Zander, 2015

[11] Bødker, & Zander, 2015

[12] Linders, 2012

Based e-Participation'.[13] This stands in contrast to the private sector. According to Criado et al, '… much more knowledge has been developed concerning the exploitation of social media in the private sector than in the public sector'.[14] The research presented in this thesis aims to contribute in this area by exploring the use of Twitter social media analytics in the 'everyday business' of non-market institutions. The term 'non-market institutions' is intended to refer to the public sector, in addition to other institutions that do not clearly belong to either the public or private sector, as described in the 'Public, Private and Non-market institutions' section of Chapter 2. This exploration is undertaken through a series of case studies, structured using Action Design Research (ADR). A software artefact (the LocalNets web app) was developed and deployed with institutional partners, with research findings derived from the process of developing, deploying and using this artefact.

The two research questions respond to the gap in the existing research, discussed above.

Attributes of the non-market sector

This section will give a description of the specific attributes of non-market institutions that are salient to the design of social media analytics tools for non-market institutions. It continues by discussing existing research into social media analytics for non-market institutions.

The scope of the term 'non-market institutions' is discussed in detail in the section 'Public, Private and Non-market institutions' in Chapter 2. In outline, the non-market sector is defined to include public sector institutions (in this research, local government) as well as institutions that have goals other than profit-based motivations typical of the private or market sector.

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[13] Porwol, & Ojo, 2017

[14] Criado, et al., 2013

Criado et al. suggest that ‘social media tools face problems of adaptation to the existing organizational culture and institutional structure of public sector organizations’.[15] This view is supported by Kankanhalli and Kohli, who suggest that in eGovernment ‘The plain replication of concepts and practices from private sector to public sector organizations is problematic and has not always produced beneficial outcomes’.[16]

With regard to the ‘everyday business’ of government discussed above, government institutions may seek to use social media for the ‘co-production of services and public policies, crowdsourcing of solutions to social and political problems, and political and democratic engagement in a growing dialogue about political issues’.[17] These goals contrast with goals such as branding, sales and customer support that may exist in the context of commercial social media analytics tools.[18] Such divergent goals are likely to lead to different design requirements in public sector social media analytics tools.

Broadening the design context beyond the public sector to non-market institutions is appropriate because of the natural tendency of eGovernment approaches to break down the barriers between civic organisations and the public sector. Linders develops a typology of eGovernment, defining three possible modes of action: citizens-to-government, government-to-citizens, and citizen-to-citizen.[19] The citizen-to-citizen modality might be enabled by government but is not directly undertaken by a public sector institution. Such arrangements are captured in my research by using the term ‘non-market institutions’, which is intended to encompass all three of Linders’ modalities. Bødker and Zander emphasise a similar point, stating that 'Web 2.0 has been celebrated for distributing power from central institutions to the masses through involvement’.[20] Linders connects these phenomena to the ‘Big Society’ and Ostrom’s work on public and private sectors, echoing the idea that citizens might help themselves and each other without the direct intervention of the public sector.[21]

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[15] Criado, et al., 2013
[16] Kankanhalli, & Kohli, 2009
[17] Criado, et al., 2013
[18] Culnan, et al., 2010
[19] Linders, 2012
[20] Bødker, & Zander, 2015

This research responds to the difficulty of transferring social media tools from the private to public sector discussed by Criado et al.[22] Such a failure to transfer social media tools between sectors may in part be due to the different uses of social media in those sectors and their divergent goals. The iterative structure of the ADR method used in the research presented here enabled feedback from a variety of non-market institutions to gather insights into the types of features and design principles that are appropriate and relevant in the non-market context.

Contribution to knowledge

This research contributes to new knowledge through two sets of findings.

The implementation findings concern the use of data derived from Twitter, methods of data visualisation appropriate to data derived from Twitter and approaches to participation using Twitter. These findings respond to research question 1 and are addressed in Chapter 8, ‘Implementation Findings’. These findings are relevant to design practitioners working on social media analytics tools for the non-market sector using Twitter data. The implementation findings are also summarised in the ‘Summary of findings’ section of the ‘Conclusions’ chapter.

This research also contributes to new knowledge by proposing six ‘situated design principles’ (SDPs) through the application of theory in the case studies. These findings respond to research question 2 and are addressed in Chapter 9, ‘Situated design principles’. The term situated design principles indicates that principles remain situated in the case studies, but have the potential for application in other social media analytics tools for non-market institutions.

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[21] Linders, 2012

[22] Criado, et al., 2013

Burt’s Brokerage social capital and Donath’s signalling theory were found to be applicable theories for designing social media analytics tools for non-market institutions. Four SDPs are proposed, articulating how design practitioners can apply these theories.

Two further synthetic situated design principles drawing Borgatti & Halgin’s network flow model and connect the concepts of brokerage social capital and signalling theory. The situated design principles are summarised in the ‘Summary of findings’ section of the ‘Conclusions’ chapter (Table 16).

The next section of this chapter describes how this work connects with the discipline of design research.

1.3 Design research

Christopher Frayling describes three categories of design research: research *through design*, research *into design*, and research *for design*.[23] His categories are a good fit for the findings presented here. For Frayling, research through design constitutes (among other things) ‘customising a piece of technology … and communicating the results’ and ‘action research’.[24] Chapters 8 and 9 present findings derived through observation and evaluation of a customised technological artefact, the LocalNets Twitter analytics software – reflecting Frayling’s concept of research through design.

Research into design is characterised as ‘Research into a variety of perspectives on art and design – social, economic, political, ethical’.[25] Chapter 9 responds to the practical work but also constitutes research into design, addressing the political and ethical considerations that are raised by designing digital technologies for non-market institutions. Aside from congruence with Frayling’s design research categories, design research’s political heritage is in keeping with the theory presented here. The work of prominent design researchers is drawn on to position this work. Carl DiSalvo’s Adversarial Design is discussed as a possible design framing, as is Ezio Manzini’s work concerning participatory design and social media.[26,27]

The next section of this chapter describes the Creative Exchange program that supported this research.

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[23] Frayling, 1994
[24] Frayling, 1994
[25] Frayling, 1994
[26] DiSalvo, 2012
[27] Manzini, 2015

1.4 The Creative Exchange

This research was undertaken as part of the AHRC's Creative Exchange Hub (CX) led by Lancaster University, with Newcastle University and the Royal College of Art. The CX is one of four Knowledge Exchange Hubs for the Creative Economy, funded by the Arts and Humanities Research Council (AHRC). The hubs encouraged collaboration between academic and non-academic partners in a range of ways. The Creative Exchange was the only hub that engaged doctoral students as part of its model. Each of the 21 doctoral students supported by CX undertook collaborative projects with academic and industry partners during the course of their studies, and these projects contributed to the development of their doctoral research. Although the structures of the collaborative projects varied, both between students and within individual programmes of research, the default setting was a collaboration between a student, a non-academic institution (an 'industry partner', though not always a commercial one) and an academic. Students undertook formal project proposal processes, leading to agreements between partners which included establishing intellectual property ownership and defined contributions from each party, often supported by funding from the CX programme.

The CX began with a concept of 'digital public space', a means of 'thinking about the way that the BBC archives could be made publicly accessible'.[28] As more institutions expressed an interest, digital public space evolved to refer to a broader concept of an online space where culture and knowledge are publicly shared and created.[29] Each project and researcher treated digital public space differently, and the contested meaning of digital public space was a recurrent theme for debate among the CX PhD students and the wider group engaged with the CX. The research presented here relates to digital public space in the sense that Twitter is a public digital medium, sometimes characterised as a 'digital town square'.[30]

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[28] Brody, & Fass, 2016

[29] Hemment, et al., 2013

[30] Yardi, & boyd, 2010

The CX also encouraged and investigated ‘knowledge exchange’, the process of collaboration between academia and industry with a view to sharing knowledge in a reciprocal manner.[31] Amongst other mechanisms, the CX programme included ‘sandpit’ events where the doctoral researchers could meet potential collaborators. In this thesis, this collaboration provided an opportunity to test and develop LocalNets, and also provide opportunities for partner institutions to gain insights into the way they might use social media analytics tools.

Positioning of this research within the Creative Exchange

The two practices of ADR and software development that feature in this research connected with the Creative Exchange programme. The ADR framing fits with CX’s goal of conducting research projects with partner institutions, while the software development practice enabled the creation of a software artefact to investigate digital public space.

As a result of the ADR method, the context review and the practical work in this research were not distinct phases; instead, they overlapped considerably. This enabled a wide range of collaborations and the rapid testing of nascent research directions. However, it also meant that the first phases of practical work took place before a detailed theoretical framework was in place. The ‘Methods’ chapter describes an ADR method as an appropriate and effective methodological response to the research realities of the CX programme: an important feature of ADR is that it focuses on undertaking evaluations of software artefacts in institutional contexts. This connects with the Creative Exchange’s knowledge exchange objectives and the Creative Exchange’s framework for initiating projects with partners external to academia. The CX funding programme also provided funding for the web development agency TABLEFLIP to assist in creating LocalNets – again, congruent with the themes of collaboration and digital innovation.

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[31] Cruickshank, et al., 2012

1.5 Practice and context

Present non-market conditions

The ‘Research framing’ section discusses the historical setting for this research and examines the contrasting design contexts of the non-market sector and private sector institutions. This section will briefly examine the conditions of the contemporary non-market sector as described in eGovernment literature and design research, particularly subsequent to the 2008 financial crash and the resulting reduction in public spending. Two contexts are highlighted for their role in shaping the contemporary public sector: New Public Management and the austerity that followed the 2008 financial crisis in the UK.

Bonsón et al. say of the New Public Management approach: ‘During the 1980s, Anglo-Saxon countries introduced a new public managerial approach that emphasizes efficiency, effectiveness, and value for money.’ This search for efficiency, according to Bonsón, drives the adoption of social media tools government.[32] Kankanhalli and Kohli,[33] Criado et al.[34] and Reddick et al.[35] frame their research into social media in relation to the idea of what they term ‘New Public Management’.

More recently, austerity after the 2008 financial crisis has become an important context for non-market social media research. For example, Kleinhans et al. describe a situation in which ‘financial austerity and government retrenchment’ predisposes governments to seek ‘citizen involvement through social media and mobile technologies’.[36]

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[32] Bonsón, et al., 2012
[33] Kankanhalli, & Kohli, 2009
[34] Criado, et al., 2013
[35] Reddick, et al., 2016
[36] Kleinhans, et al., 2015

These conditions are the backdrop to the case studies presented in this thesis. The Hounslow and Peterborough case studies were conducted in conjunction with the Royal Society of Arts (RSA), and contributed to their *Connected Communities* report.[37] The report notes in its introduction that a ‘defining trend affecting local communities and their relationship to government over these last five years has been that of austerity. Local authorities have experienced cuts in funding of 40 per cent since 2010.’[38] Linders links austerity to the Obama administration's Open Government Initiative and the former UK prime minister David Cameron’s Big Society initiative – both schemes resulted in a goal of ‘doing more with less’.[39] Linders goes on to explore how such rhetoric opens opportunities for social media to play a role in non-market institutions.

The partner non-market institution in the case studies did not articulate their motivations in terms of New Public Management rhetoric. While this framing is prevalent in eGovernment research, and may tacitly inform non-market institutions’ decisions, it was not directly evidenced in the case studies.

The following section will summarise how the use of the ADR method unfolds in this research.

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[37] Parsfield, et al., 2015

[38] Parsfield, et al., 2015, p.4

[39] Linders, 2012

Action Design Research

The Action Design Research (ADR) method is used to structure the case studies (details are presented in the ‘Methods’ chapter). ADR occurs in cycles.[40] As used in this research, a series of four ADR cycles were undertaken, with each cycle having the following structure:

1. Formulating the problem
2. Developing a theoretical perspective
3. Building or modifying a software artefact (LocalNets), in light of the theory under investigation in the cycle
4. Undertaking an intervention using the software artefact
5. Evaluating the performance of the software artefact
6. Reflecting on the problem formulation, theory, intervention and evaluation.

Each of the four case studies within this thesis introduces a set of theoretical considerations: 1) group psychology, 2) social capital, 3) costly signalling and, 4) common-pool resources. While the research process is cyclical, findings cannot always be localised to a single ADR cycle, and can accrue across cycles. For example, features built into the software to apply social capital theory in the Hounslow case study remained in LocalNets subsequently, and evidence about social capital continued to accrue in the subsequent Peterborough case study.

Chapters 8 and 9 present the findings drawn from the case studies. Chapter 8 covers ‘implementation’ findings arising from the individual case studies. In Chapter 9 six ‘situated design principles’ (SDPs) are described. The SDPs were developed across the case studies and aim to have potential applicability beyond Twitter. The application of brokerage social capital and signalling theory are used to derive four SDPs that designers working on social media analytics tools for the non-market sector could apply. Further, a synthetic concept the network flow model, which brings signalling theory and brokerage social capital together, is also articulated in this chapter. Two further SDPs are derived from applying Borgatti and Halgin's 'network flow model' of social networks.[41]

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[40] Hevner, et al., 2010

Relationship between the ADR practice and software development practice

The ADR practice was used to inform and structure the software development practice. Four cycles of ADR took place; in each one a new iteration of software development was undertaken. This approach allowed the partner institutions to feed into the software development process, as well as informing the theoretical positions that were developed throughout the research process. Examples of similar ADR projects undertaken by other researchers are given in Appendix E.

This iterative approach to software development is common even beyond the context of research, particularly through the agile method of software project management. A discussion of the application of agile approaches to software development in the context of design research for social media tools is provided by Bødker and Zander.[42] The relation between ADR and agile software development is explored by Conboy et al., who find the two practices to be highly compatible.[43] Except for the work with TABLEFLIP during the Peterborough case study, the software development was not framed as an 'agile' process. (A different approach was adopted to working with TABLEFLIP, as developing the codebase with an external team required a more formal approach to project management.) However, my previous experience of software development using the agile project management technique provided a level of familiarity with the cyclical approach of ADR.

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[41] Borgatti, & Halgin, 2011

[42] Bødker, & Zander, 2015

[43] Conboy, et al., 2015

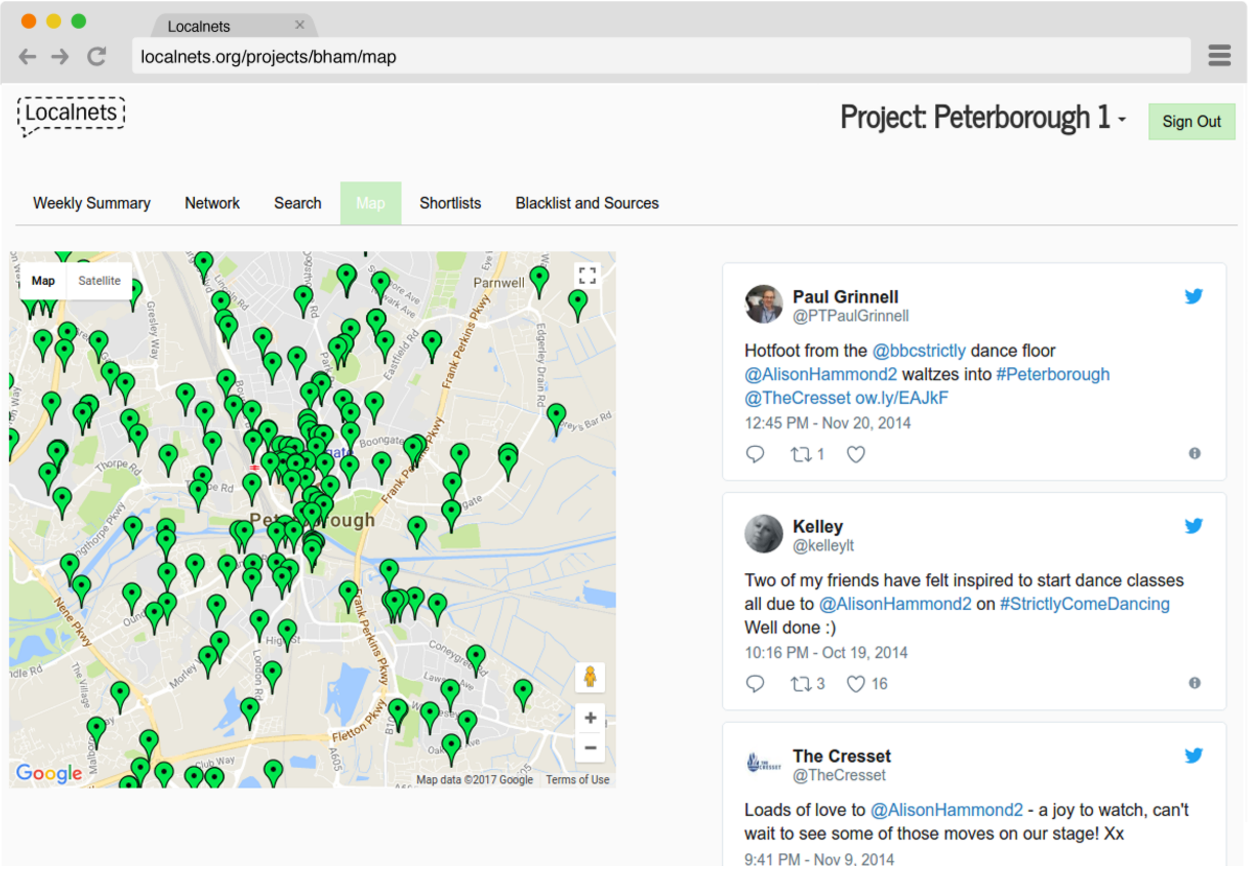
Summary of the practical work

Cycle	Project	Theoretical perspective initiated	Context	Dates
1	Prototyping	Group psychology (not developed)	Workplace	January – August 2014
2	Hounslow	Social capital (Responding to RSA's community capital theory)	Public sector	March 2014 – March 2015
3	Peterborough and Bretton	Costly signals (Responding to RSA & DCLG's need to automate LocalNets)	Public sector	January 2015 – January 2016
4	Newspeak House	Common-pool resources (Found to be not applicable)	Non-market sector	July 2016 – February 2017

Table 1. Case studies and theoretical perspectives

Prior to undertaking the doctoral research, two projects had already been carried out in the context of social media and communities. A project in 2014 with Mark Simpkins, at the time a researcher at Central Saint Martins, University of the Arts London, led to a pilot software tool for gathering text from web forums focused on communities in south London. Another commissioned project, also in 2014, was undertaken with NESTA, a London-based innovation foundation, looking at thinktank activity on Twitter.

At the start of the doctoral research a deliberately wide-ranging exploratory phase was carried out. This led directly to the development of the first case study, consisting of two physical prototypes (the CX Annunciator and the Kensington and Chelsea micro-newspaper) that were aimed at workplace communities.


Localnets
localnets.org/projects/bham/map
Localnets
Project: Peterborough 1
Sign Out
Weekly Summary
Network
Search
Map
Shortlists
Blacklist and Sources
Map
Satellite
Peterborough
Google
Map data ©2017 Google
Terms of Use

Paul Grinnell
@PTPaulGrinnell

Hotfoot from the @bbcstrictly dance floor @AlisonHammond2 waltzes into #Peterborough @TheCresset ow.ly/EAJkF

12:45 PM - Nov 20, 2014

1

Kelley
@kelleylt

Two of my friends have felt inspired to start dance classes all due to @AlisonHammond2 on #StrictlyComeDancing Well done :)

10:16 PM - Oct 19, 2014

3 16

The Cresset
@TheCresset

Loads of love to @AlisonHammond2 - a joy to watch, can't wait to see some of those moves on our stage! Xx

9:41 PM - Nov 9, 2014

Figure 3. LocalNets map view, Peterborough and Bretton case study. This screenshot provides a sense of how it appeared towards the end of the research.

The Royal Society for the Encouragement of Arts, Manufactures and Commerce (RSA), is a fellowship organisation committed to ‘helping to create fulfilling lives and a flourishing society’.[44] In discussions with the RSA, the possibility of partnering with them to deploy LocalNets arose. Partnering with the RSA was a compelling opportunity because of the scale of their ‘Connected Communities’ research programme. The programme had the potential to provide a wide range of opportunities to evaluated Localnets.[45] With the RSA, a joint application for funding was made in response to a NESTA call for proposals investigating ‘below the radar’ social media activity. This funding was used to conduct the Hounslow case study. The Hounslow case study led on to the Peterborough and Bretton case study, continuing the collaboration with the RSA. Finally, the Newspeak House case study marked a move away from working with public sector institutions to working with an institution that is community focused but is not governmental. This was a deliberate choice intended to explore deploying LocalNets with non-market institutions that were not part of the public sector.

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[44] www.thersa.org/about-us

[45] Parsfield, et al., 2015

Supporting projects

These four case studies are part of a broader set of 28 research projects undertaken during the practical work, giving insights into the use of LocalNets in a wider range of institutional contexts and taking advantage of the relatively low time commitment required for small projects once LocalNets was functional. Nine of the most significant projects are briefly described below. Five projects were undertaken as commissioned work: Birmingham South Central Clinical Commissioning Group, CommonPlace in Greenwich, Democratic Society in Coventry, a project with Edgeryders looking at open-source healthcare, and a project investigating Hackspaces with the RCA's Redistributed Manufacturing group. (Appendix A provides a comprehensive list of all the projects that contributed to the research context.) Figure 4 presents the sequencing of projects and their duration to help give an overview of the chronology of the research presented here.

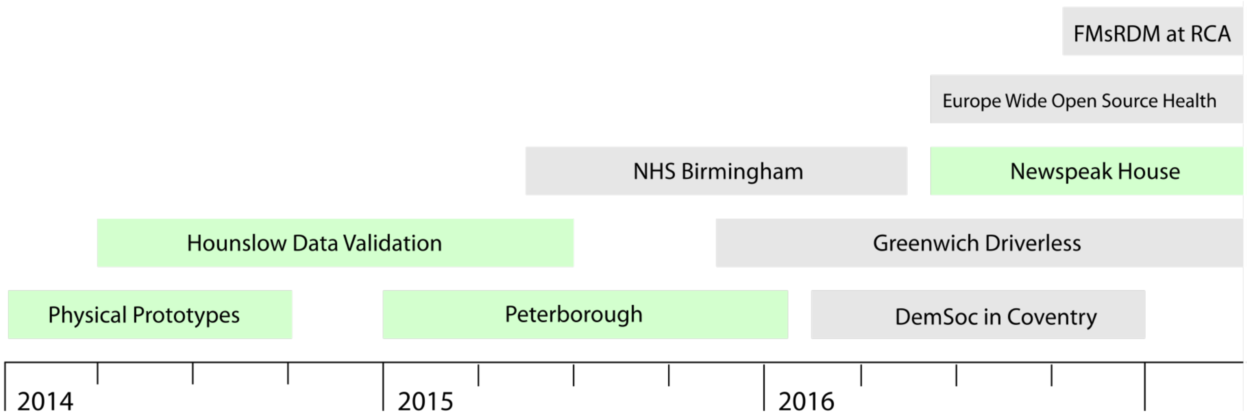

Figure 4. Timeline of commissioned projects and case studies (case studies in green)

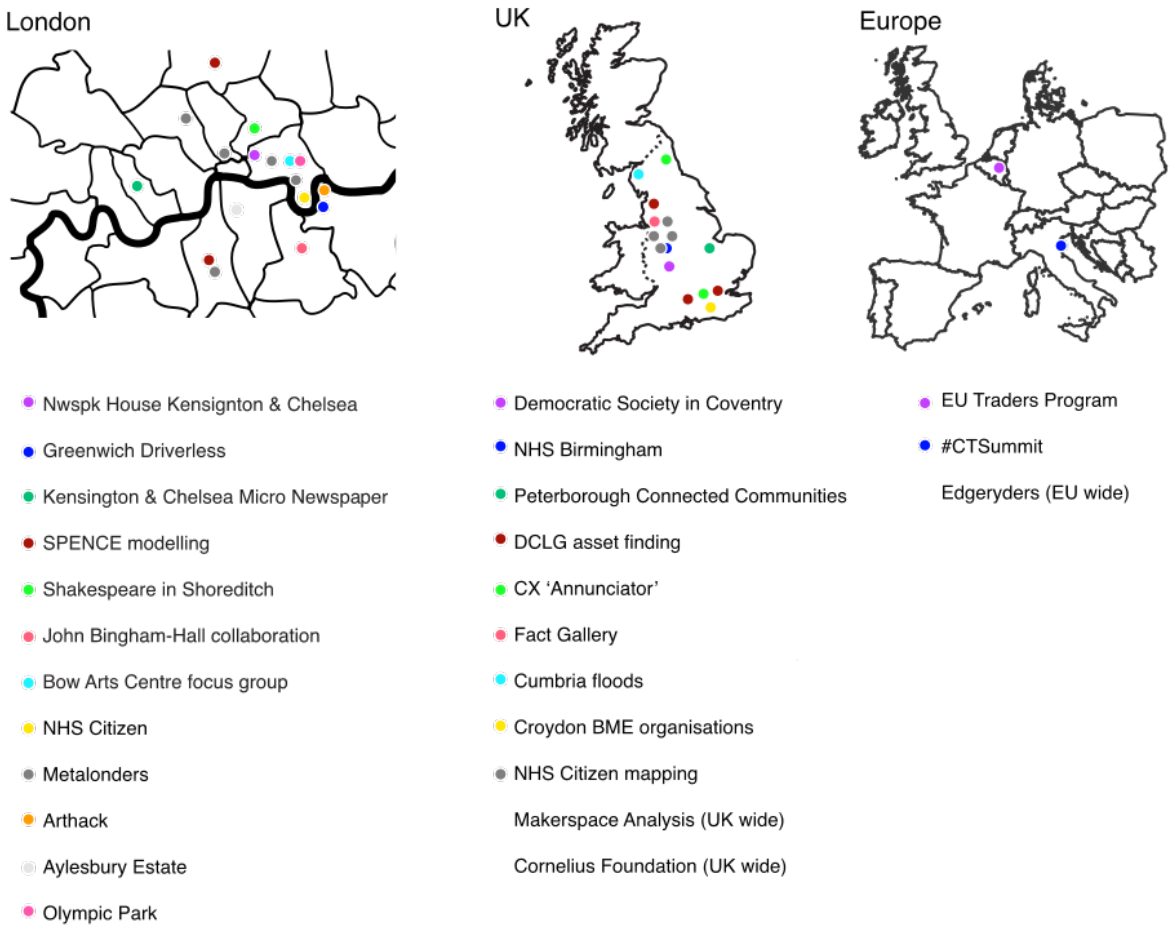
London
UK
Europe
Nwspk House Kensignton & Chelsea
Greenwich Driverless
Kensington & Chelsea Micro Newspaper
SPENCE modelling
Shakespeare in Shoreditch
John Bingham-Hall collaboration
Bow Arts Centre focus group
NHS Citizen
Metalonders
Arthack
Aylesbury Estate
Olympic Park
Democratic Society in Coventry
NHS Birmingham
Peterborough Connected Communities
DCLG asset finding
CX 'Annunciator'
Fact Gallery
Cumbria floods
Croydon BME organisations
NHS Citizen mapping
Makerspace Analysis (UK wide)
Cornelius Foundation (UK wide)
EU Traders Program
#CTSummit
Edgeryders (EU wide)

Figure 5. Map of projects

Social network analysis and visualisation were key aspects of this research. The next section introduces these topics.

1.6 Social network analysis and visualisation

Social network analysis and visualisation of social networks were key components of the practice. Methods from social network analysis were used to discover relevant Twitter accounts, to filter data from Twitter, and to evaluate the social connections between focus group participants. The methodological details of the social network analysis are discussed in the 'Social network analysis' section of Chapter 3. Visualisations of social networks were used in the LocalNets software and to present findings to partners and focus groups, although the research focus was on mechanisms for processing data with LocalNets. Appendix F provides details on social network visualisation. Both the social network analysis and visualisation were developed as part of the ADR practice, with the research conducted in institutional contexts that could shape and inform the development of LocalNets. The collaborative nature of the CX programme, working with a range of partners across ADR cycles, supported this feedback process.

Social network analysis

Social network analysis was an important part of the research. Social network analysis was first deployed in the Peterborough and Bretton case study. In this case study, the number of times a 'community asset' (a person, event, organisation or location) was mentioned in tweets was used as a proxy for its importance in the local community. Using a sociometric survey approach (described in Chapter 3), the relationship between the perceived importance of local 'community assets' and the importance of community assets as derived from LocalNets data was investigated. Social network analysis was of particular value because it was highly congruent with the RSA's research agenda in its *Connected Communities* programme. It was also resonant with Ed Saparia's approach to managing and developing the community around Newspeak House, as demonstrated in the Newspeak House case study. Dr Elisa Bellotti and Dr Susan O'Shea from the Mitchell Centre for Social Network Analysis, who were engaged as part of the Peterborough and Bretton case study, provided guidance on the use of social network analysis.

Social network visualisation

Throughout the research, a range of approaches to manifesting the data were trialled. The physical prototypes used in the first case study investigated using screen-based displays and a receipt printer. In the Hounslow case study, undertaken with the RSA, LocalNets was modified to export data to the Gephi visualisation package to integrate with the RSA's existing workflow. Subsequently, in the Peterborough and Bretton case study, network visualisations were demonstrated to be effective at generating interest from potential partners and explaining the value of LocalNets to partner institutions. Approaches to visualisation responded to the needs of the partners in each case study.

2. Context review

The context review proceeds in four phases. The first section, ‘Related products and research’, describes published research into using social media data in non-market settings, and surveys commercially available approaches to social media analytics. The next section discusses the meaning of ‘non-market institutions’, as used in the research questions. The final two sections discuss design framings and ethical framings.

The design framings section explores five theoretical approaches adopted by design researchers working with social media or in non-market settings: ‘Participatory design’, ‘Publics and Actor-network theory’, ‘Adversarial Design’, ‘Action Research and Action Design Research (ADR)’ and ‘Herbert Simon's “design science”’. A comparison section considers the merits of these approaches and identifies ADR, with its focus on testing design artefacts in institutional settings, as the most appropriate framing.

The ethical framings section discusses two ethical approaches that might provide ethical foundations for the design process: cost-benefit analysis and the capability approach. Cost-benefit analysis became salient because of its use in the public sector to guide policy formation; the capability approach was explored as a means to respond to the shortcomings of cost-benefit analysis.

This section is termed a ‘Context review’ to reflect its scope, which includes a review of the relevant literature, but further provides a survey of currently available commercial social media analytics tools and other non-academic projects.

2.1 Related products and research

This section will give an overview of products and research relevant to social media analytics.

2.1.1 Social media and the private sector

Social media data is put to diverse uses in private sector contexts, many of which are likely to be proprietary or intended to deliver competitive advantage and are therefore undisclosed. Facebook provides a tool called Signal, aimed at helping journalists and publishers get an overview of activity on the platform, as well as offering detailed analytics for those purchasing advertising through the site.[46] Signal uses technology developed by CrowdTangle, an analytics platform Facebook has purchased, but which continues to provide a standalone service.[47] Usher says of CrowdTangle:

> Top news organizations have access to CrowdTangle, a social media analytics platform that is the best (and nearly the only) tool on the market that allows journalists to essentially 'Google' Facebook for content.[48]

Laine and Frühwirth provide a survey of social media analytics tools.[49] Beyond using web data to discover opinions and sentiment, social media has been used for credit scoring,[50] and for measuring a person's 'social media influence'.[51] Twitter data has been correlated to stock market outcomes,[52] and some companies have used digital news feeds to automatically conduct trading activity.[53]

Another use of social media is to inform business decisions through competitive analysis. *Edited* is a service that collects price data from UK fashion retailers by automatically reading their websites. That data is then sold back to retailers who can see, for example, levels of discounting and overviews of the price points of their competitors.[54]

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[46] Mullin, 2015
[47] Mullin, 2016
[48] Usher, 2016
[49] Laine, & Frühwirth, 2010
[50] Vasagar, 2016
[51] Edwards, et al., 2013
[52] Bollen, et al., 2011
[53] Nuij, et al., 2014; Mitra, et al., 2015

Commercial applications of social media analytics are beyond the scope of this work. The field is so diverse, dissipated, and often secretive that it is challenging to provide a comprehensive picture. This difficulty is intrinsic to a developing and potentially commercially sensitive technology such as social media analytics tools. However, an awareness of the landscape of private sector social media analytics tools helps to situate the research in this thesis: while commercial social media analytics tools might not be directly transferable to non-market institutions, the way social media has been used in the private sector can give indications of what could be done in the context of non-market institutions.[55]

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[54] Payne, 2016

[55] Criado, et al., 2013

2.1.2 Web data and government

In this subsection, some examples of social media use by public sector institutions are introduced. As with the private sector, public sector uses of social media represent such a large scope of activity that it is difficult to examine exhaustively; nonetheless, an overview helps to position the case studies and resulting findings.

One notorious use of social media data and web data is for covert law enforcement and counterterrorism operations, a role that rose to prominence after Edward Snowden revealed the extent of secret US government programmes.[56] This area is so distinct and substantial that it will not be dealt with in this review. A survey of the literature that elucidates the use of social media data for policy formation is provided by Prpić.[57] Some notable examples of public sector use of social media are provided below.

Health

Google Flu Trends, which uses Google's large dataset of search terms, is a well-known project in the public sector health domain. It used increases in searches for terms relating to flu symptoms to estimate changes in flu prevalence over time. In 2009, Google Flu Trends was shown to be detecting outbreaks faster than the US Government's Center for Disease Control, which relied on doctors reporting the frequency of flu-like symptoms in their patients.[58] However, in 2013 the model started to break down and by 2015 Google Flu Trends stopped reporting official data, due to its unreliability.[59] Despite this setback, other approaches have been developed for disease tracking from web data, and it has since become a well-established research area.[60] For example, in 2015 the UK Food

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[56] Harding, 2014
[57] Prpić, et al., 2015
[58] Ginsberg, et al., 2009
[59] O'Connor, 2015
[60] Gilbert, et al., 2016

Standards Authority launched a programme to monitor the spread of norovirus using Twitter data.[61]

Planning

Digital activity can provide useful data for urban planning. Mobile phone network data, comprising logs of the times at which mobile phones are connected to particular transmission masts and the locations of those masts, preceded the use of data collected from the web. In 2011 Becker et al. were able to generate behavioural data from a dataset of mobile phone activity in New York.[62] They used the data to establish the 'laboursheds' – the shape of the commuter belt around New York. They also found what they memorably termed the 'partyshed', the area from which people came to enjoy the nightlife, and discovered times of peak activity in various locations. This information, they speculate, could be useful to urban planners, especially for transport provision. Focusing on Twitter, researchers have used Twitter data to algorithmically categorise neighbourhoods as primarily concerned with business, leisure, nightlife or housing.[63] In similar work, Wang et al. consider another 'zoning' issue by attempting to algorithmically detect commercial districts within a city by parsing tweets originating from across the urban area.[64] Panizio processes Twitter data to consider mobility around tourist sites, with the specific goal of helping planners to cope with the increasing number of tourists in Amsterdam.[65] His data is able to suggest which sites are in danger of becoming congested with visitors.

Resch et al. look at another aspect of Twitter data, extracting affective parameters to understand citizens' emotional responses to different locations.[66] Nik-Bakht and El-Diraby take a more qualitative approach, using a social game to encourage users to classify tweets for their meaning in terms of sustainability, with the goal of creating taxonomies for understanding public attitudes to environmental issues.[67] Le Dantec describes the use of a custom-built mobile phone app created to allow cyclists to report the routes they have taken. The data gathered through this means is then used to inform an urban planning event at which improvements for cyclists are discussed.[68]

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[61] Haynes, 2016
[62] Becker, et al., 2011
[63] Frias-Martinez, et al., 2013
[64] Wang, et al., 2016
[65] Panizio, 2015
[66] Resch, et al., 2016

Macroeconomic

The Billion Prices Project provides a measure of economic inflation by sampling prices in online stores.[69] Adobe subsequently started a similar project to monitor inflation.[70] The Billion Prices project began in 2007, when a suspicion arose that the Argentine government was manipulating inflation statistics to hide the state of the economy for political reasons. Using price data from online shops, it was possible to provide an alternative inflation measure that was free from government manipulation. Reporting macroeconomic statistics is usually undertaken by governments – before the age of online shopping, it would have been difficult for any other institution to gather such data. Here, a non-state, non-market service provides a more reliable picture than the equivalent public sector approach.[71] This illustrates a destabilisation of the concepts of the public and private sectors.

Disasters and Emergencies

Research has been carried out on social media activity after major incidents have taken place, often seeking to support relief efforts.[72] Two projects investigated the aftermath of emergencies as part of the same NESTA grant that funded the Hounslow case study. Researchers from Cardiff University investigated the mobilisation of political opinion on Twitter after Islamic extremists murdered Lee Rigby in Woolwich in 2013, finding that the vast majority of messages in the wake of the event were positive messages of support for Rigby's family.[73] In another study, Carl Miller from the think tank Demos looked at the way Twitter became a means of cooperation for those affected by flooding in the UK in January 2014.[74] Their research recommended an 'information exchange or brokerage hub' to help deal with the large number of offers of assistance made on Twitter during the emergency.

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[67] Nik-Bakht, & El-Diraby, 2016
[68] Le Dantec, et al., 2015
[69] Cavallo, & Rigobon, 2016
[70] Maykot, 2016
[71] Aparicio, & Bertolotto, 2017
[72] Wukich, 2016

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[73] Roberts, et al., 2015

[74] Miller, 2015

2.2 Public, private and non-market institutions

This section of the chapter will discuss how the term ‘institution’ is used in this research, and goes on to discuss the meaning of the term ‘non-market institutions’.

2.2.1 Institutions, organisations, communities, collective action

The research questions in this thesis are phrased in terms of non-market institutions. Douglass North provides a definition of institutions:

> Institutions consist of formal rules, informal constraints (norms of behavior, conventions, and self-imposed codes of conduct), and the enforcement characteristics of both.[75]

He goes on to describe organisations as follows:

> If institutions are the rules of the game, organizations are the players. Organizations consist of groups of individuals engaged in purposive activity.[76]

These two definitions correspond with the intended meanings of the terms in this thesis. The title and research questions refer to non-market institutions: this term is intended to include organisations that are ‘playing’ by non-market rules.

The term ‘community’ is not explicitly defined in this research. As Ostrom’s research indicates, the boundaries of a community are not an exogenous variable that can be externally defined, but are instead a design decision that a community ought to make itself if it is to run effectively.[77]

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[75] North, 1987

[76] North, 1987

[77] Ostrom, 1990, p. 90

Several notable publications have offered an understanding of the impact of digital technology on society by viewing it through this kind of institutional lens: examples include Shirky's *Here Comes Everybody,*[78] Tapscott and Williams' *Wikinomics*[79] and Benkler's *The Wealth of Networks.*[80] These connections suggest the applicability of such an institutional lens. These relationships are explored in more detail in Appendix B. Although these connections suggest the applicability of an institutional lens, such a link is not central to this research. Appendix C outlines how collective action connects with non-market institutions, and it briefly describes work connecting social media and collective action. Again, these connections indicate that an institutional lens can be applied to social media and collective action, but such relationships are not at the core of this thesis.

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[78] Shirky, 2008

[79] Williams, & Tapscott, 2011

[80] Benkler, 2006

2.2.2 Categories of economic institutions

This section develops a model of the public and private sectors and uses that model in order to define the non-market sector. The model draws on Ostrom's work in political economy.[81] In the model, the ways in which individuals can coordinate to 'efficiently' deliver goods and services depends on the properties of the underlying goods to be provided, specifically their *rivalry* and *excludability*.[82] This model suggests that the private sector ought to deliver rivalrous and excludable goods, and the public sector non-rivalrous and non-excludable goods.

These two properties are particularly relevant in the context of digital technology regardless of whether this is in private or public sector: when a new digital technology is used to assist in delivering a good or service, it frequently changes the rivalry and excludability of that good or service.[83] This type of shift is exemplified by projects such as Opendesk, which allows anyone with access to a laser cutter to make furniture from freely distributed 3D files, thus changing the rivalry and excludability of furniture.[84] Perhaps most famously *Wikipedia* has undermined the commercial publication of encyclopedias and other knowledge products.[85] These changes are relevant to the designer, who can make decisions that will determine the rivalry and excludability of a good or a service.

Knowing whether a good has been 'efficiently' provided requires a value judgement. Pareto efficiency is used as a means of discriminating between outcomes that are desirable and those which are not while minimising that judgement.[86]

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[81] Ostrom, 2005,
[82] Ostrom, 2005, p. 24
[83] Hess, & Ostrom, 2011, p10
[84] Opendesk, 2017
[85] Mason, 2015, p. 7
[86] Samuelson, 1954

A situation is said to be Pareto *efficient* if no one can be made better off without making anyone worse off. In a Pareto *inefficient* situation, someone can be made better off without making anyone worse off.[87] Many situations that are not desirable are Pareto efficient, but no situation which is desirable is Pareto inefficient. Pareto efficiency is, in this model, a necessary but not sufficient condition for any desirable outcome. Goods are thought to be provided Pareto efficiently by the market if they are *rivalrous* and *excludable*. This is often expressed in the following matrix.

	Excludable	**Non-excludable**
Rivalrous	Private Goods: food, clothing	Common-pool resources: fish stocks, timber, common pasture
Non-rivalrous	Club goods / toll goods: Swimming pools, cinema	Public goods: National defense, street lighting, weather forecast

Table 2. Categories of goods defined by rivalry and excludability, adapted from Ostrom [88]

Some goods – for example, food or clothing – are thought to be efficiently provided by the market because the properties of those goods tend to cause the necessary incentives to arise for suppliers. It is possible to grow food crops and sell them in return for money. By contrast, street lighting (a typical public good) gives rise to more complex incentives. One household might wish to install street lighting. Short of sitting up all night to monitor those taking advantage of the illuminated pavements, the household that paid for the installation will not be able to recoup any of their costs. Assuming they do not wish to keep watch every night, they alone will have to foot the bill for a service all passers-by enjoy. This is referred to as *non-excludability*. As a result, if left exclusively to the market, the model predicts that street lighting will not be sufficiently provided. Why should one person cover the cost of something others will enjoy? This situation is likely to be Pareto inefficient: everyone on the street would gladly make a small contribution for the benefit of lighting, but without some non-market means of coordinating – a club, or, in the UK, typically the local council – they will typically fail to do so. Everyone could have been made better off by the provision of street lighting, so the failure to provide it is Pareto inefficient.

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[87] Samuelson, 1954

[88] Ostrom, 2005, p. 24

Rivalry is well exemplified by informational goods. Informational goods often are non-rivalrous: for example, a weather forecast.[89] If a person hears a weather forecast, they do not 'use up' that forecast: any number of people can consume the forecast without diminishing it.

The two-by-two matrix presented by Ostrom is not the only model of incentives for the provision of goods and services; other discourses use related but distinctive categorisations. Ludwig von Mises, a fierce proponent of the benefits of markets, only recognises two of the four quadrants: 'There are two methods for the conduct of affairs within the frame of human society. One is bureaucratic management, the other is profit management'.[90] Ostrom argues against this view in her Nobel Prize address.[91] Ostrom points out that there must surely be more than the public and private categories recognised by Mises:

> What one can observe in the world, however, is that neither the state nor the market is uniformly successful in enabling individuals to sustain long-term, productive use of natural resource systems. Further, communities of individuals have relied on institutions resembling neither the state nor the market to govern some resource systems with reasonable degrees of success over long periods of time.[92]

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[89] Anaman, et al., 1995

[90] Von Mises, 1944, p. xv

[91] Ostrom, 2010

[92] Ostrom, 2010

Ostrom’s analysis often considers farming practices in which scarce irrigation water must be allocated amongst farmers, or fisheries, where the fish stocks must be sustainably managed. Her work focuses on communities that address these problems without recourse to a centralised state or market mechanisms.

Drawing on Ostrom’s words, Lee Anne Fennell posits ‘Ostrom’s Law: a resource arrangement that works in practice can work in theory’.[93] The term ‘non-market sector’ is intended to capture the public sector, in addition to other institutions that do not fit into the private sector category: for example, Opendesk and *Wikipedia*.

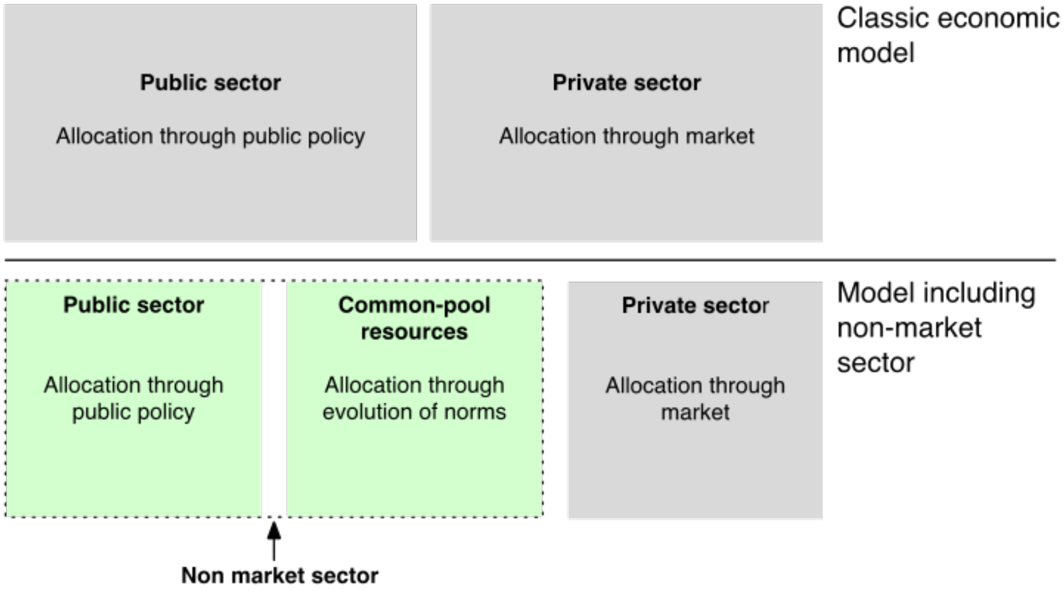
Public sector
Allocation through public policy
Private sector
Allocation through market
Classic economic model
Public sector
Allocation through public policy
Common-pool resources
Allocation through evolution of norms
Private sector
Allocation through market
Model including non-market sector
Non market sector

Figure 6. Defining the non-market sector

In many cases, excludability and rivalry are design choices: for example, the design decision to add Digital Rights Management (DRM) to digital media such as DVDs to prevent their owners making copies. That design decision transforms DVDs from weakly rivalrous to strongly rivalrous goods.

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[93] Fennell, 2011

This research focuses on designing social media analytics to support non-market institutions: that is, institutions that manage resources that are not, by virtue of their excludability or rivalry, purely market goods.

2.3 Design framings

This research positions itself in relation to design research literature. The term ‘design framings’ is used to refer to different approaches to design research within the design research literature. This section explores five design framings, all of which have been used in the context of researching software in community settings: Participatory Design (PD), Actor-network theory (ANT), Adversarial Design, Action Design Research (ADR), and Herbert Simon’s Design Science.

For each framing, two subheadings discuss its relation to social media and to the non-market sector. At the end of the ‘Design framings’ section a comparison weighs the merits of each framing and advocates ADR as appropriate for the case studies due to its particular applicability to institutional settings. The implications of this choice are reflected upon in the ‘Conclusions’ chapter.

2.3.1 Participatory design

Historically, Participatory Design (PD) developed in the context of the ‘social, political and civil rights movements of the 1960s and 70s’, in which, according to Simonsen and Robertson, ‘people in many Western societies demanded an increased say in decision-making about different aspects of their lives and were prepared to participate in collective action around shared interests'.[94] They go on to suggest that a key aspect of PD is a ‘commitment to ensuring that those who will use information technologies play a critical role in their design’. Further, in PD, the designer’s role is 'supporting mutual learning between multiple participants in collective “reflection-in-action”.’[95] This leads to a blurring of the lines between participants and designers, so that within PD these terms are ‘contested and generally used with some unease’.

The non-market sector in participatory design

PD has been explored in non-market settings. Anthopoulos et al. describe the application of PD in eGovernment, suggesting that the PD approach is ‘a means to support the discovery and essential improvement of digital public services’.[96] Shapiro suggests that the public sector has been the site of many expensive, and failed, large-scale IT projects. He positions PD as a potential solution to such expense and failure in the public sector.[97]

Carroll and Rosson discuss another aspect of the non-market sector in their paper ‘Participatory design in community informatics’, in which they describe a category of activity that includes ‘Nonprofit community groups, non-governmental social service providers, and the lowest, most local level of government’. This category is highly coincident with the category of the non-market sector, although it excludes central government.[98] They go on to highlight the particular suitability of PD to community informatics, stating that PD ‘is a particularly appropriate domain for participatory design from both the moral and pragmatic perspective’ on the basis that people have a right to 'to participate in the design of technological artefacts and systems that affect their activities and experiences’. Within this understanding, PD is applicable to a non-market setting because of the intimate way it might affect citizens’ lives.

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[94] Simonsen, & Robertson, 2013
[95] Simonsen, & Robertson, 2013
[96] Anthopoulos, et al., 2007
[97] Shapiro, 2005
[98] Carroll, & Rosson, 2007

Social media and PD

Bødker and Zander describe a move from a trade-union-oriented context for PD (for example) towards applications in software that focus on communities – ‘We see, with many others, a potential for PD to utilize Web 2.0 or post-Web 2.0 design ideas to address user participation (sometimes qua citizen involvement)’.[99] Carroll and Rosson provide a survey of the history of participatory and community informatics.[100]

Social media has been framed as both an artefact that can be subject to a PD process and a platform that can facilitate PD; Reyes and Finkin suggest that ‘From a designer’s perspective these digital spaces have strengthened the voice of the public in similar ways as PD from the outset helped workers have a say in design processes’.[101] Ezio Manzini states that ‘the diffusion of social media has created the technological platform on which the idea of open design has been conceived and experimented with’, again positioning social media as a platform that enables PD.[102]

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[99] Bødker, & Zander, 2015

[100] Carroll, & Rosson, 2007

[101] Reyes, & Finken, 2012

[102] Manzini, 2015, p. 42

2.3.2 Publics and Actor-network theory

Designers have sometimes turned to Actor-network theory, or ANT, to describe and understand communities – an approach that could be deployed in the analysis of LocalNets. Callon's paper 'The Role of Hybrid Communities and Socio-Technical Arrangements in the Participatory Design' emphasises the importance of 'hybrid collectives', in which the hybridity is between humans and non-humans.[103] Callon states that 'communities cannot be reduced to the individuals who constitute them; and they cannot be considered as pure associations of human beings who communicate one to each other'.[104]

ANT holds that the appropriate units of analysis are not people, but instead networks of people and the physical objects with which they interact, where both people and physical objects have agency: a network of actors. Such a networked understanding implies that 'it is important for the design work to include all those who are going to be concerned by the innovation'.[105]

Social media and ANT

In 'Scraping the social?' Marres articulates the benefits of an ANT methodology when using data derived from the web.[106] She asks, 'Where does social research derive its analytic categories from?'. When sociologists analyse a phenomenon, they are likely to invoke categories of social behaviour in their analysis, but which systems of categorisation are legitimate? Marres gives an ANT-oriented answer by suggesting that 'Digital social research displaces this debate about the provenance of the analytic categories of social research onto the plane of devices'.[107] That is, data collected from the web often already has a system of categorisation implicit within it. If sociologists adopt that system of categorisation in their analysis of it, they are using categories that reflect both the inclinations of the people who created the data and the technological limitations of the computer systems that they used to create it. Humans and devices both have agency.

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[103] Callon, 2004
[104] Callon, 2004
[105] Callon, 2004
[106] Marres, & Weltevrede, 2013
[107] Marres, & Weltevrede, 2013

Beyond discussing methodological issues around web data, Marres also uses ANT to discuss participation and democracy as hybrid human-object concerns, captured in the idea of ‘publics’. With extensive reference to the writings and ideas espoused by the early twentieth-century thinkers John Dewey and Walter Lippmann, Marres’ paper ‘Issues Spark a Public into Being’ works to ‘provide key arguments as to how the objects of politics can be attended to as part of democratic politics’;[108] that is, how democratic theory can move beyond considering people exclusively to incorporate ANT’s focus on networks of people and objects. Objects are construed as the focus of ‘issues’, where ‘[i]ssues call a public into being, and public involvement in politics stands in the service of these issues’.[109]

Le Dantec’s *Designing Publics* describes a project in which digital technology is used to share information in a shelter for vulnerable women and their children. He suggests that ‘Issue formation through design is a tactic in a larger strategy of social design that helps counter the marginalization of implicated actors.’[110] In contrast to the work of Marres and Le Dantec, the research presented here did not start by focusing on a single issue, or with a group of people who are necessarily interacting with a specific set of material objects, and therefore has not adopted an ‘issue publics’ perspective.

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[108] Marres, 2005
[109] Marres, 2005
[110] Le Dantec, 2016, p. 58

The non-market sector in issue publics and ANT

ANT has been deployed in eGovernment research as a model to understand public sector IT projects. For example, in ‘Understanding e-Government project trajectories from an actor-network perspective’, Heeks and Stanforth deploy ANT as a means to understand what might be driving the success or otherwise of a range of government IT projects. Their case study uses ANT as a ‘research tool for analysis of e-Government project trajectories, the local/global networks approach also offers insights into e-Government leadership as a process of network formation and maintenance’.[111]

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[111] Heeks, & Stanforth, 2007

2.3.3 Adversarial Design

Adversarial Design has developed alongside the idea of publics and ANT. If ANT provides a sociological perspective on participatory design, Adversarial Design has, by developing the views of Chantal Mouffe, developed an approach rooted in political economy. It draws on Mouffe's idea of 'agonism': that contestation, not consensus, is the basis for democracy; that democracy is founded upon radical pluralism and the ability to dispute.[112] This is a position she feels is lacking in contemporary politics because of the 'unchallenged hegemony of the neo-liberal discourse'.[113]

Björgvinsson, Ehn and Hillgren have developed this position further. In their paper 'Participatory design and "democratizing innovation"' they contend that

> The current hegemonic view, clearly exemplified in the work of von Hippel,[114] judges innovation by to what degree the innovator and the product or service is ahead of the market, rather than whether it enhances democratic practices or living conditions.[115]

The large-scale Malmo Living Labs project realises an alternative vision of innovation:

> …to empower a multiplicity of voices in the struggle of hegemony and at the same time find "constitutions" that help transform antagonism into agonism, from conflict between enemies to constructive controversies among "adversaries" who have opposing matters of concern but also accept other views as "legitimate".[116]

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[112] Simonsen, et al., 2013
[113] Mouffe, 2000
[114] Hippel, 2005
[115] Björgvinsson, et al., 2010a
[116] Björgvinsson, et al., 2010a

DiSalvo’s related idea of Adversarial Design also draws on Mouffe’s work, often applying it to design objects that are designed to make a political point.

The non-market sector in Adversarial Design

Adversarial Design both engages with the non-market sector and complicates the distinction between public, private and non-market categorisations. DiSalvo states that ‘from an agonistic perspective, politics and the political are separate notions that should not be conflated. The distinction emphasizes the difference between ongoing acts of contestation and the administrative operations of government’.[117] Those who are concerned with designing for politics use ‘techniques of merging form and content in aesthetically compelling and functionally appropriate ways to support the means of governance – the mechanisms by which a state, organization, or group is held together’. By contrast, political design ‘reveals, questions, and challenges conditions and structures in the urban environment; it opens a space for contestation’.[118] Adversarial Design, therefore, suggests that there are two modes by which design can engage with civic life – although, at least in DiSalvo’s formulation, it does not make an explicit connection to the ideas of the market sector, public sector or non-market sector.

Social media in Adversarial Design

The specific application of Adversarial Design to social media analytics tools remains a nascent area of design research. Paulo Gerbaudo’s *Tweets and the Streets* uses Mouffe’s work to underpin his understanding of social media and to develop an ‘alternative understanding of the process of mobilisation, based on the notion of “assembling” or “gathering” rather than “networking”’.[119] Many social media platforms use algorithmic approaches to presenting updates and suggesting content to users. Adversarial Design has been applied to algorithms in general, where agonistic pluralism has been suggested 'as both a design ideal for engineers and a provocation to understand algorithms in a broader social context: rather than focusing on the calculations in isolation, we need to account for the spaces of contestation where they operate'.[120]

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[117] DiSalvo, 2012, p. 8
[118] DiSalvo, 2012, p. 8
[119] Gerbaudo, 2012, p. 22

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[120] Crawford, 2016

2.3.4 Action Research and Action Design Research

This section will describe Action Design Research (ADR), which has its origins in the discipline of information systems research, as a design framing. ADR has evolved out of the broader category of Action Research. In this section, Action Research is described first, to give context to Action Design Research.

Action Research

Kurt Lewin's 1946 paper 'Action Research and Minority Problems' has been cited as the origin of Action Research.[121,122] In a survey paper, Waterman et al. identify the following two broad features as typical of the 285 Action Research papers considered in their review:

- The cyclic process of Action Research, which involves some kind of action intervention.

- The research partnership, in which the degree of involvement or participation of the researched may range from cooperation, when the research participants work with outsiders to determine priorities but responsibility remains with the outsiders to direct the process, to collective action.[123]

The *SAGE Handbook of Action Research* defines Action Research as 'a family of practices of living inquiry that aims, in a great variety of ways, to link practice and ideas in the service of human flourishing'.[124] Baskerville provides a history of Action Research from

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[121] Lewin, 1946
[122] Reason, & Bradbury, 2013
[123] Waterman, 2001
[124] Reason, & Bradbury, 2013

the perspective of the discipline of information systems, in which he describes the importance of Sussman and Everard's five-phase, cyclical approach to Action Research, often called 'Canonical Action Research', within the information systems discipline.

Action Research and design research have often been placed in relation to each other. The design researcher Cal Swann suggests that 'action research and the action of designing are so close that it would require only a few words to be substituted for the theoretical frameworks of action research to make it applicable to design'.[125] Zimmerman et al. suggest that the 'action research sequence' is profoundly connected with Frayling's 'research through design' – the mode of design research discussed in the 'Design research' section of the introduction to this thesis.[126] PD, with its emphasis on collaboration, has often been compared to, and contrasted with, Action Research. Foth and Axup investigate this relationship, finding them to be distinct but complementary practices.[127] Action Research also frequently occurs in eGovernment settings. For example, in 'Developing an E-Government Research Roadmap', Wimmer et al. cite Action Research as a key method.[128]

Action Research has been applied to a range of social media contexts, including disaster management after the 2010 Haiti earthquake.[129] *Action Research and New Media,* which considers the methodological issues of applying Action Research to new media, describes projects combining Action Research and social media: for example, an internet radio project and the LEARNERS project, designed to improve digital literacy in a rural community.[130,131]

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[125] Swann, 2002
[126] Zimmerman, et al., 2010
[127] Foth, & Axup, 2006
[128] Wimmer, et al., 2007
[129] Yates, & Paquette, 2010
[130] Hearn, et al., 2009
[131] Hearn, et al., 2009

Action Design Research

Action Design Research (ADR) has its origins in the information systems discipline. The term was first coined by Juhani Iivari.[132] The method is advocated in a later paper by Sein et al.,[133] in which they state: ‘We propose a solution in the form of a new research method for DR [design research] that draws on action research (AR) and call it Action Design Research (ADR)’.

ADR is a method which specifies a cyclical research process, frequently used in the context of research into software use in institutional settings. More detail on the structure of ADR is presented in the ‘ADR, practice and the research’ section of Chapter 3. ADR’s focus is institutional: ‘IT artifacts are ensembles shaped by the organizational context during development and use’.[134]

Hovorka and Germonprez worry that in information systems research ‘the role of the humans who will use the system has been marginalized to that of a source in a requirements elicitation process’.[135] ADR endeavours to address exactly such a concern. Sein states that ADR contrasts with ‘a technological view of the IT artifact’ that pays ‘scant attention to its shaping by the organizational context.’ The ADR method ‘conceptualizes the research process as containing the inseparable and inherently interwoven activities of building the IT artifact, intervening in the organization, and evaluating it concurrently’.[136] In this way, Sein’s work addresses Hovorka and Germonprez’s criticism that the human context of technology software artefacts is insufficiently considered in information systems research. Appendix D gives more extensive details of the history of ADR.

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[132] Iivari, 2007

[133] Sein, et al., 2011

[134] Sein, et al., 2011

[135] Hovorka, & Germonprez, 2011

[136] Sein, et al., 2011

Social media in ADR

Hussain and Vatrapul present a project that has parallels to the development of LocalNets - the Social Data Analytics Tool (SODATO).[137] Their projects focus on two case studies, one concerning social media discourse around the clothing store H&M that focuses on business analytics, and a second that focuses on analysing data from social media behaviour around the 2011 Danish general election. Mullarkey et al. use ADR to investigate the design principles applicable to designing a tool for analysing inter-organisation social media interactions.[138] Private equity companies serve as the institutional context for Mullarkey's research. Appendix E provides a list of similar projects deploying ADR in social media or related contexts.

These projects demonstrate the ADR process as applied to social media analytics tools, particularly emphasising the importance of embedding these tools in institutional settings to evaluate them. This supports the approach taken in the case studies.

The non-market sector in ADR

ADR as a method is deeply embedded in the eGovernment literature. One example of the application of ADR in the non-market sector is Keijzer-Broers' work on designing a health and wellbeing platform designed to integrate with public health systems, and tested in a living lab context. They describe their research as 'using ADR in design science to bridge the gap between theoretical propositions and successful adaptation of smart living platforms in daily practice'.[139]

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[137] Hussain, & Vatrapu, 2014
[138] Mullarkey, et al., 2013
[139] Keijzer-Broers, et al., 2015

2.3.5 Herbert Simon's ‘Design Science’

In the early stages of the research, Herbert Simon’s work on ‘Design Science’ was considered as a framing for the case studies. Simon’s work is often cited as formative in the tradition of design research.[140] His book *Sciences of the Artificial*, published in 1968, gives a detailed description of his conception of Design Science. Design research has developed significantly since Simon’s work; despite this, his approach was considered of interest because of its links with cost-benefit analysis, an approach that is strongly connected to public sector decision-making.[141] The case studies did not strongly connect with cost-benefit analysis, and as a result a Design Science framing became less salient.

The ‘Ethical framings’ section of the ‘ADR and design principles’ chapter reflects on the case studies and their relation to the ethical positions explored in the context review.

Simon defines natural science as that which concerns declarative logic: rational descriptions of what *is*. Artificial science, by comparison, concerns research into what *ought* to be.[142] Simon provides considerable detail, but ultimately his claim is that a logic of what ought to be can be derived from what *is,* using utilitarian philosophy.[143]

This reasoning led Simon to characterise design problems as questions of optimally allocating resources for the greatest benefit, where the greatest benefit is determined by a utilitarian approach. Simon starts from a definition of economics, as follows:

> Because scarcity is a central fact of life – land, money, fuel, time, attention, and many other things are scarce – it is a task of rationality to allocate scarce things. Performing that task is the focal concern of economics.[144]

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[140] Bayazit, 2004

[141] Simon, 1968, p. 45

[142] Simon, 1968, p. 114

[143] Simon, 1968, p. 151

[144] Simon, 1968, p. 25

Simon endorses utility optimisation as the guiding principle for allocating scarce resources. While he acknowledges there are problems with utility, he proceeds with a broadly utilitarian framework. Having established this position, he suggests that utility optimisation is also a suitable principle for design, describing ‘two central topics for the curriculum in the science of design’:

> 1. Utility theory and statistical decision theory as a logical framework for rational choice among given alternatives.
>
> 2. The body of techniques for actually deducing which of the available alternatives is the optimum.[145]

In this way Simon connects design to a utilitarian framing and uses that connection to guide a systematic exploration of what designers ought to do.

Nigel Cross criticises Simon’s programme, drawing on Rittel and Webber’s work on ‘wicked problems’[146] to support the view that design is ‘fundamentally un-amenable to the techniques of science and engineering, which dealt with “tame” problems.’[147] Donald Schön develops a similar critique, suggesting that Simon’s approach faces a considerable challenge in converting messy real-world problems into the well-formed utility-based models Simon’s approach requires.[148]

Schön goes on to make a deeper criticism, arguing that Simon’s approach is not only difficult in practice but also inadequate in principle:

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[145] Simon, 1968, p. 118

[146] Rittel, & Webber, 1973

[147] Cross, 2001

[148] Schön, 1984, p. 47

> … professional practice is a process of problem solving. Problems of choice or decision are solved through the selection, from available means, of the one best suited to established ends. But with this emphasis on problem solving, we ignore problem setting, the process by which we define the decision to be made, the ends to be achieved, the means which may be chosen.[149]

As cost-benefit analysis did not become salient in the case studies, and because of the limitations in his approach discussed above, Simon’s Design Science was not developed further.

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[149] Schön, 1984, p. 39

2.3.6 Comparison of design framings

ADR provides a well-defined framing for testing IT artefacts in institutional settings, a context made salient in the research questions. ADR is currently one of the most prominent methodologies within information systems design research.[150] ADR embodies a participatory approach and close alignment with the action research process – features that are strongly apparent in the practical work. ADR is suited to retrospective application to action research projects – Sein's original paper applies the method in exactly this way.[151] Finally, ADR's commitment to working with partner institutions connects with the research context of the Creative Exchange, as described in Chapter 1. For these reasons, ADR offers a suitable framing for the case studies. A non-exhaustive list of similar relevant projects that apply ADR is presented in Appendix E.

The other design frameworks described in this section could also have been applied to the case studies. Focusing on PD might have emphasised the role of the focus groups, the discussion that occurred there and the design decisions flowing from them. A framing that emphasised the notion of publics and ANT could have recast the case studies in terms of their relation to the public sphere and social media's role in the public sphere. Adversarial Design might have focused attention on the political dimensions inherent to the concept of non-market institutions, or toward agonistic aspects of the discourse in the focus groups. The 'Further work and limitations' section of Chapter 10 will revisit the other potential framings.

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[150] Cronholm, et al., 2016

[151] Sein, et al., 2011

Action Design Research and the research questions

Sein et al. indicate that the ADR method emphasises the importance of ‘building the IT artefact, intervening in the organization, and evaluating it concurrently’.[152] This connects with the goals of the research questions, testing an IT artefact – LocalNets – in the context of non-market organisations. Through such a process, the LocalNets artefact became ‘theory-ingrained’, that is to say, the theories of social capital and signalling theory shaped LocalNets through the case studies.

These research questions are intended to address the research gap identified in the ‘Research framing’ section of the Introduction chapter. Research into social media analytics for non-market institutions has predominantly concerned topics such as election results and disaster management, rather than the ‘everyday business’ of government, according to Bødker and Zander.[153] This gap, also identified by Criado and Porwol and Ojo, is the focus of the research questions.[154,155]

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[152] Sein, et al., 2011
[153] Bødker, & Zander, 2015
[154] Criado, et al., 2013
[155] Porwol, & Ojo, 2017

2.4 Ethical framings and non-market institutions

This section discusses two ethical approaches that formed part of the context review: cost-benefit analysis, supported by utilitarian ethics, and Amartya Sen’s capability approach. The ethical framings concern the situating of LocalNets in relation to the ethical commitments of non-market institutions. The research ethics of working with Twitter data is discussed separately in the ‘Methods’ chapter.

Non-market institutions, the focus of this research, are often in the public sector or funded by the public sector. In the UK, the Treasury asks that all spending be justified with reference to cost-benefit analysis (CBA) as a means of decision making. CBA itself draws on utilitarian ethics.[156] The extent to which the public sector truly adopts a utilitarian approach, or whether it should do, can be contested. However, the UK Government’s explicit commitment to an ethical framework served as a point of departure for further investigation. The capability approach was considered as a means of addressing some of the shortcomings of CBA: for example, the difficulty in assigning monetary values to all costs and benefits in the scope of the analysis.[157] CA also has a track record in design research, though typically not in application to social media analytics.[158]

Ultimately, the theories were not as salient as anticipated. Ethical discourse did not form as prominent a part in the focus groups as anticipated, and discussions with the partner institutions did not lead to discussions of CBA or any other ethical framework. However, the ethical frameworks discussed in this chapter did shape the research. The concepts of revealed and stated preferences discussed in the cost-benefit analysis section led on to the theory of ‘signalling’ – signalling is held to be a means of revealing preferences.[159]

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[156] HM Treasury, 2003, p. 57

[157] Robeyns, 2006

[158] Oosterlaken, & van den Hoven, 2012

[159] Donath, & boyd, 2004

The ethical framings section of the Conclusion reflects on how CBA and Sen's capability approach could have been further applied and possibilities for further research.

2.4.1 Cost-benefit analysis

According to Cass Sunstein, ‘cost-benefit analysis has become part of the informal constitution of the US regulatory state.’[160] In the UK, the Government’s *Green Book*, published by HM Treasury, is intended to provide an all-encompassing process for policy evaluation:

> All new policies, programmes and projects, whether revenue, capital or regulatory, should be subject to comprehensive but proportionate assessment.[161]

The *Green Book* advocates CBA as the core component of policy decisions, recommending the following three steps when evaluating any policy:

- Identifying other possible approaches which may achieve similar results;
- Wherever feasible, attributing monetary values to all impacts of any proposed policy, project or programme;
- Performing an assessment of the costs and benefits for relevant options.[162]

Herbert Simon also references CBA in *Sciences of the Artificial*, stating that ‘a strong case can be made today for training design engineers in that body of technique and theory that economists know as "cost-benefit analysis."’[163]

CBA asks that a course of action be evaluated by comparing its predicted monetary cost with the predicted benefits, also denominated in monetary terms. Monetary evaluation can be achieved through various means. The *Green Book* asks policymakers to find analogous goods or services that are traded on the market which can be used to extrapolate a value, a ‘revealed preference’ approach. If this is not possible, it suggests surveying individuals and asking how much they would hypothetically pay (Willingness To Pay: WTP), or how much they would want to be paid to accept a certain state of affairs (Willingness To Accept: WTA). Both of these are considered to be ‘stated preference’ approaches.

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[160] Sunstein, 2012
[161] HM Treasury, 2003, p. 1
[162] HM Treasury, 2003, p. 1
[163] Simon, 1968, p. 125

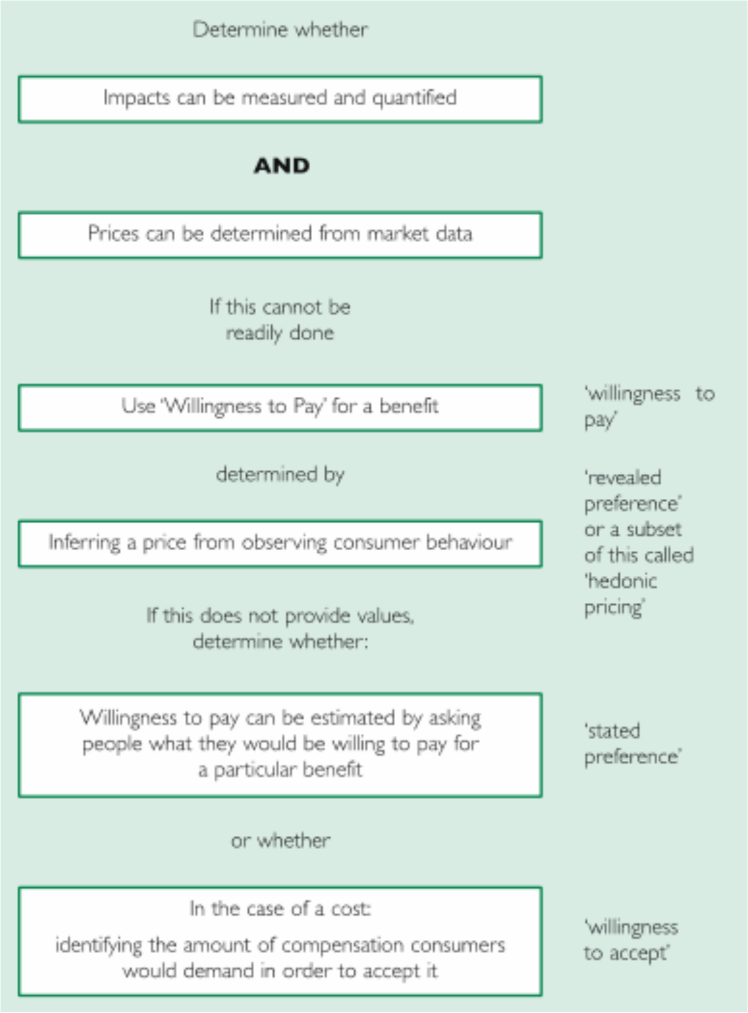
Determine whether
Impacts can be measured and quantified
AND
Prices can be determined from market data
If this cannot be readily done
Use ‘Willingness to Pay’ for a benefit
‘willingness to pay’
determined by
Inferring a price from observing consumer behaviour
‘revealed preference’ or a subset of this called ‘hedonic pricing’
If this does not provide values, determine whether:
Willingness to pay can be estimated by asking people what they would be willing to pay for a particular benefit
‘stated preference’
or whether
In the case of a cost: identifying the amount of compensation consumers would demand in order to accept it
‘willingness to accept’

Figure 7. Extract from the Green Book summarising CBA [164]

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[164] HM Treasury, 2003, p. 23

Once costs and benefits have been determined, the optimisation process can occur: according to CBA, the correct policy is the one that maximises the residual benefit after the cost has been borne.

CBA is usually supported through a utilitarian ethical account – the theory of ‘revealed preference’ holds that market prices reveal individuals’ utility expectations: people pay for things in proportion to the extent that they anticipate enjoying them, so prices operate as a proxy for (revealed) utility.[165] This is a simplistic model that is vulnerable to criticism on the basis that it is circular – if utility can only be revealed by spending behaviour, then the two things might considered synonymous. CBA also assumes that individuals behave ‘rationally’, where rationality is taken to mean self-interest.[166]

Fujiwara and Campbell’s work considers another limitation to CBA – possible biases when calculating values through the WTP and WTA methods. Of particular interest is ‘strategic bias’, where a person exaggerates their willingness to pay to encourage the public sector to focus resources in a way that is disproportionately beneficial to them.[167] Strategic bias is one reason why revealed preferences are held to be superior to stated preferences.

Design and CBA

Contemporary design theorists have described various, but often contentious, relationships between CBA and design theory. ‘Transition design’, advocated by Cameron Tonkinwise among others, responds to the changing pace of design and the increasing transience of artefacts, due to, among other phenomena, digital technology. He says:

> Transition Designers can navigate social complexity, aware that humans are structured by values that always exceed economic cost-benefit analyses.[168]

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[165] HM Treasury, 2003, p. 57

[166] Sen, 2009, p. 194

[167] Fujiwara, & Campbell, 2011

[168] Tonkinwise, 2014

Bødker gives a real-world example of a participatory design project failing to garner support from local government due to the absence of a cost-benefit analysis:

> The design concept was strong in its usability/citizen service improvement, whereas the business case was less clear – we had no cost-benefit analysis or equivalent model. Accordingly, the local municipal office declared that they wanted the solution, but could not afford it.[169]

Expanding beyond design research, in the discipline of information systems, Coleman reports similar problems in relation to eGovernment:

> There has been a utilitarian tendency to assess e-governance projects either in term of cost benefits … more important evaluative questions, that are rarely asked, concern the normative purpose of e-governance. Are the digitally governed freer, happier, more empowered?[170]

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[169] Bødker, & Zander, 2015

[170] Coleman, 2007, p. 10

2.4.2 Sen and the Capability Approach

Sen's Capability Approach was investigated because of its ability to extend and nuance CBA, which, as outlined in the previous section, is prevalent in decision-making in the public sector.[171]

What is Sen's capability approach?

Sen positions CA in relation to utilitarian accounts, which typically require the optimisation of individuals' utility: that all individuals have equal utility, or the highest average utility, or some other optimising rule.[172] The Capability Approach, by contrast, concerns 'functionings', that is, the things one does or is. Examples of functionings include experiencing good health, dressing in a way that does not cause social exclusion, or having time to enjoy a hobby.[173] These functionings are held to be valuable in themselves, not because they will be the source of utility. Ensuring that all individuals experience equality with regard to functionings would be extremely authoritarian: equality of functionings would require, for example, everyone to dress in a socially acceptable way, even if some people would prefer not to. To address the danger of authoritarianism, CA requires equality of capability, where capabilities are the ability to engage in functioning, regardless of whether one chooses to exercise that functioning or not. Therefore, CA focuses on equality of opportunity for what one might do or be:

> The core characteristic of the capability approach is its focus on what people are effectively able to do and to be; that is, on their capabilities.[174]

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[171] Robeyns, 2006

[172] Sen, 1980

[173] Robeyns, 2006

[174] Robeyns, 2005

In his 1985 lecture ‘Equality of what?’, Amartya Sen explains the motivation for his development of CA.[175] He suggests that utility measurements are subject to fundamental limitations such that utility can never be a sufficient ethical account. One limitation is that utility does nothing to capture the ‘irreducible value of personal liberty’.[176] Sen contrasts a person who is hungry because they are engaging in religious fasting with a person who is hungry because they cannot afford food. He contends that these people are obviously in different ethical situations. Utility does not, at least without modification, take freedom or liberty into account.

CA is also effective at accounting for situations in which an individual’s decisions cease to be utility-maximising. This is hard for utilitarians to account for because, as just described, utility is typically assumed to be revealed through behaviour: utility, a psychological state, cannot itself be easily measured. If a person is given a choice of purchasing options, their choices are assumed to be a true indication of what would maximise their utility. If individuals are not utility-maximising, utilitarians need another way to observe utility.[177]

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[175] Sen, 1980
[176] Sen, 1980
[177] Sen, 1999, p. 175

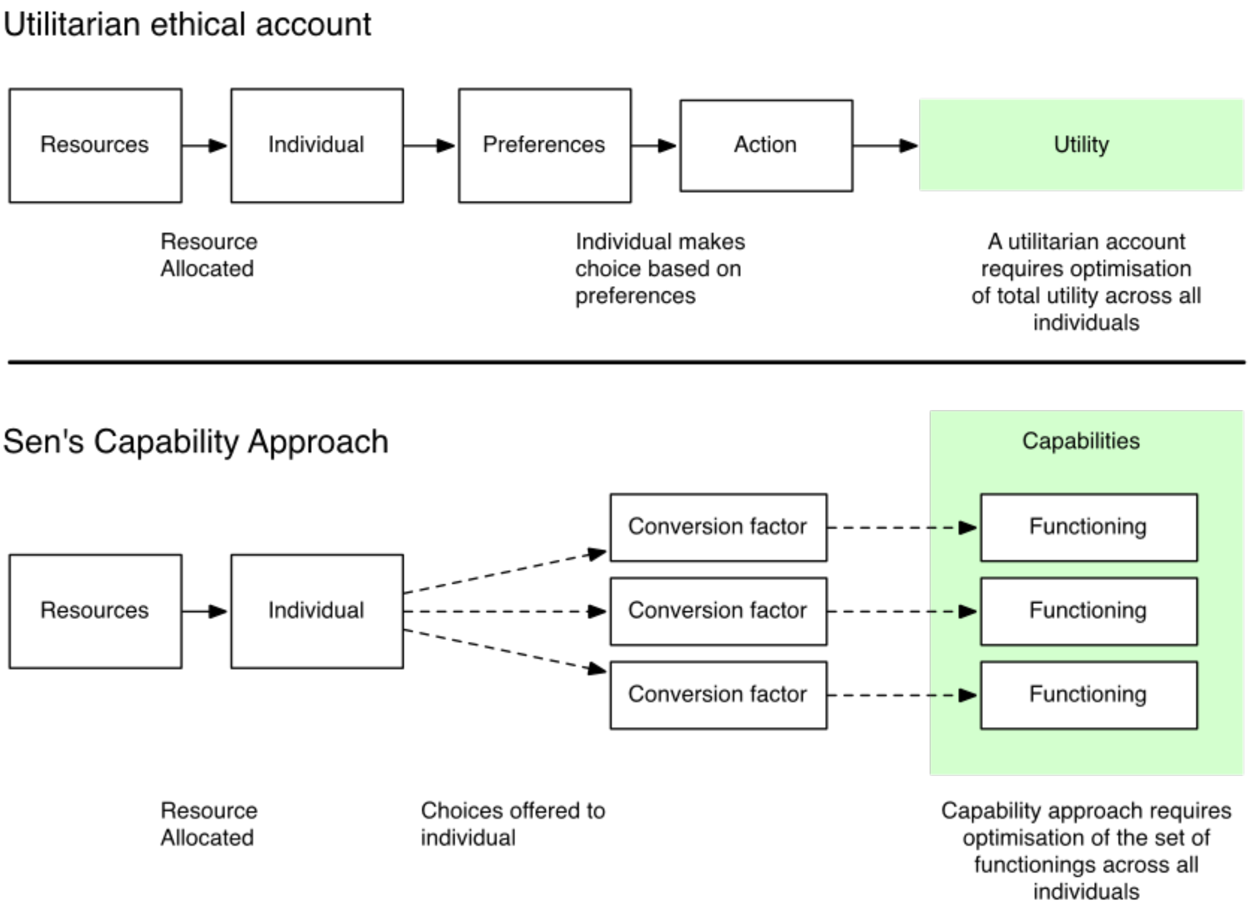
Utilitarian ethical account
Resources
Individual
Preferences
Action
Utility
Resource Allocated
Individual makes choice based on preferences
A utilitarian account requires optimisation of total utility across all individuals
Sen's Capability Approach
Capabilities
Resources
Individual
Conversion factor
Conversion factor
Conversion factor
Functioning
Functioning
Functioning
Resource Allocated
Choices offered to individual
Capability approach requires optimisation of the set of functionings across all individuals

Figure 8. Contrasting utilitarian ethics with the Capability Approach

Selecting the set capabilities that ought to be valued presents a problem for CA, as Sen acknowledges in his original paper. He offers five categories of capabilities (referring to them as freedoms),[178] but declines to offer a 'canonical list'.[179] Nussbaum, on the other hand, offers a list of ten specific functionings.[180] In both cases, they believe that public reasoning is required, such that those affected by the application of CA are able to modify the list of functionings under consideration.[181] Notably, however, the capability approach gives a starting point, so that an ethical framework can be applied even in the absence of a participatory process. An example refining the list of functionings is given by Wolff and De-Shalit, who start their study of inequality by using surveys to validate Nussbaum's list of capabilities.[182]

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[178] Sen, 1999, p. 10
[179] Sen, 2005
[180] Nussbaum, 2001b, p. 148

Design and the capability approach

Ilse Oosterlalken has developed capability-sensitive design, which she suggests offers 'a clear philosophical foundation of the ultimate ends of design'.[183] Oosteralken goes on to say that design should 'aim at expanding people's capabilities and not force people into certain functionings': that is, to expand people's meaningful choices, rather than drive people to particular behaviours.

In their chapter in Oosterlaken's book *The Capability Approach, Technology and Design,* Murphy and Gardoni discuss the CA in relation to cost-benefit analysis, stating that 'a capability-based design has a central principled advantage, namely, it puts the well-being of individuals as a central focus of the design process.'[184]

The Capability Approach, Technology and Design sets out applications of CA in design projects in developing countries. Of particular relevance to LocalNets, the book discusses several digital applications. One is the global One Laptop Per Child project, where Kullman and Lee combine Sen's approach with Latour's concept of translation, concluding that 'both authors share an interest in the interactions between persons and designed materials as well as in how such interactions "convert" and "translate" both people and materials to better adapt to specific settings.'[185] Sen himself has written about the use of mobile phone technologies in expanding capabilities.[186] Smith et al. build on Sen’s observation and suggest that there is ‘evidence that mobiles have been the platform for a uniquely massive and multidimensional enhancement of capabilities in developing countries’.[187]

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[181] Nussbaum, 2001b; Sen, 2004
[182] Wolff, & De-Shalit, 2007, p. 36
[183] Oosterlaken, 2009
[184] Murphy, & Gardoni, 2012
[185] Kullman, & Lee, 2012

Outside of work in developing countries, the RCA’s Helen Hamlyn Centre for Design has used CA in designing for people with Autism Spectrum Disorder, developing three capabilities to guide their design work so as to ‘create positive experiences for people living with autism’.[188]

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[186] Sen, 2010

[187] Smith, et al., 2011

[188] Gaudion, et al., 2015

3. Methods

This chapter describes the ADR methodology and the research methods used in the case studies. It also provides a brief overview of the Twitter platform and its limitations, and outlines how data from Twitter was accessed.

3.1 Aims, objectives and methods

The research questions call for the evaluation of social media analytics software in the context of non-market institutions (RQ1. How can Twitter analytics support non-market institutions? RQ2. What design principles might support designing social media analytics tools for non-market institutions?). It was determined that building software would be the most effective way to address the research questions. Other approaches were considered: using or modifying off-the-shelf products, or making mock-ups that tested selected aspects of the system. An informed decision not to use a commercially available product was deemed appropriate as a result of the following limitations to commercial options:

- Often prohibitively expensive
- Provided with inflexible licences
- Cannot be modified and the algorithms used are unknown

Mock-ups were considered, but not chosen: a key aspect of the research was to establish the quality of the data that can be derived from analysis of Twitter data. Social media analytics results could be presented to relevant institutions in a mocked-up social media analytics tool. This would elicit responses that could address the research questions; however, it would be impossible to know if the mock-ups were showing results that could be derived from Twitter data.

For these reasons a full prototype software application was built to address the two research questions.

Evaluating LocalNets

One approach to evaluating the LocalNets software is to compare data generated by LocalNets with another set of data that is considered reliable. One such example is Google Flu Trends, where data on the prevalence of flu was generated using search behaviour (people searching for flu symptoms) was compared with flu prevalence data from the US Government's Center for Disease Control (CDC).[189] (Google Flu Trends data was, initially, found to be accurate and available more quickly than the CDC's data, though the quality of the Flu Trends data declined over time) Under such an approach, Localnets would be considered successful if it generates data that correlates with another comparable and trusted data source. This approach was used in the Hounslow project, and as a component of the Peterborough and Newspeak House project.

However, only checking the accuracy of the data assumes that the output will be useful to institutions that support communities. The practical work goes on to test this assumption. Using LocalNets 'in the wild',[190] with a variety of partners, allowed further evaluation of the following aspects of the first research question (How can Twitter social media analytics tools support non-market institutions?), specifically regarding:

- What kinds of information is it most useful for LocalNets to generate from Twitter data?

- In which contexts can LocalNets generate information beneficial to non-market institutions from Twitter data?

The practical work was undertaken as a series of action research projects: each of the case studies was conceptualised as cycles of problem formulation, intervention and evaluation. In writing up it was determined that a more specific approach – Action Design Research – would provide a clearer structure for both describing the projects and structuring the findings. The relation between generic action research and ADR is addressed in the 'Action Research' section of this chapter.

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[189] Ginsberg, et al., 2009

[190] Brown, et al., 2011

3.2 Social network analysis

Social network analysis, according to Marin and Wellman, 'takes as its starting point the premise that social life is created primarily and most importantly by relations and the patterns formed by those relations.'[191] They go on to define a social network as a 'set of nodes (or network members) that are tied by one or more types of relations'. This section examines social network methods used across the case studies. The case study chapters provide detail on how social network analysis was used in LocalNets.

In the Peterborough and Bretton case study, there was a requirement for automating detected mentions of 'community assets' (people, events, places, organisations) in tweets. Social network analysis was subsequently applied to selecting focus group participants and understanding the social networks of the participants who attended focus groups. LocalNets generated a ranking of community assets according to their prominence within the community being investigated. This functionality was added to meet the requirements of the Hounslow case study and is described in more detail in that case study chapter. The functionality was used throughout the subsequent case studies. It is described in detail in the Peterborough and Bretton case study chapter. The concept of 'community assets' stemmed from the 'Asset based community development' framework applied by the RSA in the Hounslow case study. It generated the ranking by modelling the data from Twitter as a network, where a node in the network is a Twitter user or a community asset. Edges in the network were formed when Twitter users mentioned each other or a community asset. Social network analysis was then used to infer a ranking of the prominence of the community assets.

This ranking was then compared with another measure of the perceived prominence of people and organisations within the community. In the case of the Hounslow project, the comparative data was 'door-to-door' ethnographic research conducted in Hounslow by the RSA, discussed below as the ‘name generator’ approach. The RSA’s research also generated a set list of ‘community assets’ and how often those assets were mentioned by respondents.

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[191] Marin, & Wellman, 2011, p. 12

In the case of Peterborough and Bretton, and Newspeak House, the top-ranking Twitter accounts, as detected by LocalNets, were presented to participants, who were asked to indicate their familiarity with those accounts. This method is described as a ‘sociometric’ survey: further details are given below. Reported familiarity from the sociometric survey was compared with the LocalNets-generated ranking to gain insight into the perceived accuracy of the LocalNets approach to ranking community assets.

In the case studies, these comparisons were intended to probe the relationship between the LocalNets data and community participants’ perceptions.

RSA’s name generator approach

In the Cranford area of Hounslow the RSA carried out a type of social network survey known as a ‘name generator’, using a team of trained ethnographers. The aim of the research was to understand participants’ perceptions of community assets. Having gained appropriate consent, the ethnographers asked the respondents to name people they connected with in different ways: ‘who do you enjoy spending time with?’, or ‘who would you ask to borrow money from if you lost your purse?’. As the process unfolded the researcher also noted down the community assets mentioned – organisations, events, places and people. The researcher then asked a series of ‘cognitive social structure’ questions, in which respondents were asked to say how the people they had named knew each other.[192]

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[192] Krackhardt, 1987

Sociometric survey

In contrast to Hounslow, in the Peterborough and Bretton and Newspeak House case studies no ethnographic survey was available, and conducting one would have been prohibitively resource-intensive. Instead, a sociometric survey was administered. This survey was administered in an identical manner in both projects.

The sociometric method draws on the work of Moreno, who also pioneered the 'sociogram', forerunner of the now widely known social network graph.[193] In contrast to the name generator approach, respondents are given a fixed list of individuals and asked if they have a connection with them. In this case, participants were asked, using a paper-based survey, to specify which of six types of relationship they had with a list of individuals:

1. I don't know this person
2. I know this person from Twitter
3. I know person from online, but not Twitter
4. I know this person offline
5. I've collaborated with this person
6. I would like to work with this person in the future

The participants were asked these questions in relation to two groups of people. First, participants were asked these questions in relation to how they knew one another. This survey was intended to probe the social connections between participants. Some of the focus participants were selected using LocalNets, and it was anticipated this might influence the social connections within the group.

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[193] Moreno, 1953

Secondly, participants were asked to indicate their relationship with community assets selected by LocalNets as most prominent. This aspect of the survey was intended to investigate the relationship between participants' perceptions of their community and the results from LocalNets. Not every Twitter account represented a person; some also represented institutions. In these instances, institutions act in some ways as an individual on Twitter, @mention other users and mentioning community assets in their tweets in the same way as personal accounts do. In the absence of any further information about the individuals operating institutional Twitter accounts, they were treated as individuals in the social network analysis.

Comparison of the two approaches

These two approaches are applicable in different settings. Considering both approaches provides a rationale as to why the name generator approach was not chosen for the Peterborough and Newspeak case studies.

- *Restrictive vs open.* The name generator approach allows respondents to give responses without limitation, while the sociometric approach asks for a selection from a predefined list. By allowing the respondents to go beyond a predefined list, the name generator can, in principle, allow respondents to describe a more accurate representation of their social interactions. All else being equal, this would offer a reason to prefer the name generator approach.

- *'Cognitive' limitations.* The name generator approach requires respondents to recall a long list of people with whom they have interacted. Hlebec Ferligoj describe the cognitive demands this places on respondents, and the likelihood that respondents will fail to produce a comprehensive list.[194] The sociometric approach eases this burden by providing a list of names. One way to improve responses is to ask many different and overlapping questions to elicit a larger ego net.[195]

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[194] Hlebec, & Ferligoj, 2002

[195] Marin, 2004

However, this could lead to respondents naming individuals they otherwise would not have done, in the belief that continued questioning means that more answers are required.[196] This factor counts in favour of the sociometric approach.

- *Complexity of administration.* Asking respondents to engage in the name generator approach may require questions to be repeated, or prompts to be given.[197] As such, it is more appropriate in the circumstances in Hounslow, where nine trained staff could provide face-to-face questioning, as opposed to the situation in Peterborough and Bretton and Newspeak House, where groups undertook a paper-based survey simultaneously.

Data reliability

Limitations to respondents' cognitive ability to recall their interactions have the potential to affect both survey types. It is also possible that participants will seek to deliberately misrepresent themselves. Bernard et al. compared recall of social interactions with diary-based data and found that recall is highly imperfect.[198] However, the data presented here does not ask for exact recall of conversations, as the Bernard paper does. Instead it asks for overall, long-term aspects of familiarity or cooperation. In survey of research testing individuals' accuracy of recall of social interactions, including contexts such as offices and academic departments, Freeman et al indicates that even though respondents do not recall specific interactions, they do recall long-term patterns with greater accuracy, as one might expect.[199]

Another source of unreliability is the subjective nature of the question asked of them. For example, when asked whether you know someone 'offline' or not, does being aware of them count as knowing them? Or does 'know' imply being on a conversational basis with them?

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[196] Marsden, 2011, p. 374
[197] Marin, & Wellman, 2011, p. 22
[198] Bernard, et al., 1980
[199] Freeman, et al., 1987

It might be assumed that having worked with someone ought to be reciprocal – that is, that if person A reports having worked with B, then B ought to report having worked with A. Again, ambiguity comes into play, and individuals will not always respond in such a consistent manner – either because of imperfect recall or because of the interpretation of the question. Cases where, for example, one person reports they have worked with another, but that second person does not reciprocate, are noted when they occur in the case studies.

In the Peterborough and Bretton case study, in line with the RSA's theoretical commitment to community capital, a goal was formulated to use focus groups to test LocalNets to help select individuals who could establish productive new links within the social network. This concept was formalised as 'social capital' in the 'Theory' subsection of the Hounslow case study, and applied in the subsequent case studies. The 'Application of brokerage social capital' situated design principles draw on this aspect of the case studies.

The sociometric survey data was designed to discover opportunities for new social connections to form at the focus groups, and therefore opportunities to generate brokerage social capital. A weak measure of opportunity for brokerage capital formation could be provided by examining the number of participants who had not previously worked together but who were present at the focus group. This measure would indicate the potential for partnerships to form, although not the intention to form such connections on the part of the participants. A more restrictive measure would consider the number of participants who did not already know each other. This suggests the potential for partnerships or other social connections to form, but not the intention. Finally, an even stronger criterion would be that the participants had not worked together but would like to - suggesting both potential and intention on the part of the participants. These criteria are presented and discussed in the Peterborough and Bretton and Hounslow case studies.

3.3 About Twitter

Twitter is a social networking platform. It was launched in 2006 and has over 320 million active users.[200] It allows registered users to publish 280-character text-based updates called tweets, which can also contain videos, photos, links and '@mention' of other users which will send an altert to the mentioned user. Users can choose to follow one another. If a user follows an account, all the tweets from the account they are presented in chronological order on their 'timeline' – the home page presented to users when they log into Twitter.

Using data from the Oxford Internet Institute survey of online behaviour in the UK, Blank provides estimates of Twitter users' demographics using data collected in 2013.[201] He summarises the data as indicating that 'British Twitter users are younger, wealthier, and better educated than other Internet users, who in turn are younger, wealthier, and better educated than the off-line British population'. Gender is skewed towards men by about 2 per cent. About 16 per cent of British Twitter users are non-white, while 18 per cent of the UK population overall are non-white. Twitter users are not demographically representative of the UK as a whole, and this limitation will be addressed in the 'Data quality limitations' section of the Implementation findings chapter.

Twitter provides an Application Programming Interface (API, an interface for third-party software) which allows a limited amount of data to be gathered without charge. Exact limitations vary depending on the type of data requested. For example, to retrieve a list of tweets published by a specific user, 150 requests can be made every 15 minutes, each returning 100 tweets from that user's timeline. Repeated requests can be used to recover progressively older tweets, or to gather data from other users. This service provided sufficient volumes of for use in the development of LocalNets, which was not anticipated to exceed the data limits.

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[200] Frier, 2017

[201] Blank, 2016

The Twitter ‘Firehose’ is another service which allows unlimited access to people’s data. This was not available during the research, as access is very costly.[202] The sheer volume of traffic can also make implementing software that uses Firehose difficult.

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[202] Twitter, 2017. ‘Decahose stream’

3.4 Twitter research and ethics

This section concerns the research ethics of using Twitter data. The ‘ethical framings’ section of the ‘Context review’ anticipated how ethical framings of the research might connect with the ethical frameworks of non-market institutions.

Much existing research using Twitter data appears to give little consideration to ethical concerns such as the privacy and safety of users. A survey paper published in 2014 found 382 papers that used Twitter data, of which only six per cent provided specific ethical considerations.[203] One of the most prominent projects collecting Twitter data is the Library of Congress project to archive all Tweets, which has so far not been successful, apparently due to technical rather than ethical limitations.[204] A representative of the Library of Congress made this point clear, telling *The New York Times* newspaper that ‘It’s not as if we’re after anything that’s not out there already… People who sign up for Twitter agree to the terms of service’.[205] While it is important to make the appropriate considerations, much of the ethical literature on digital research treats Twitter as one of the least problematic sources of data.[206] McKee and Porter list four factors that are considered in relation to the requirement for consent from participants in digital research.

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[203] Zimmer, & Proferes, 2014

[204] Zimmer, & Proferes, 2014

[205] New York Times, 2018

[206] Moreno, et al., 2013

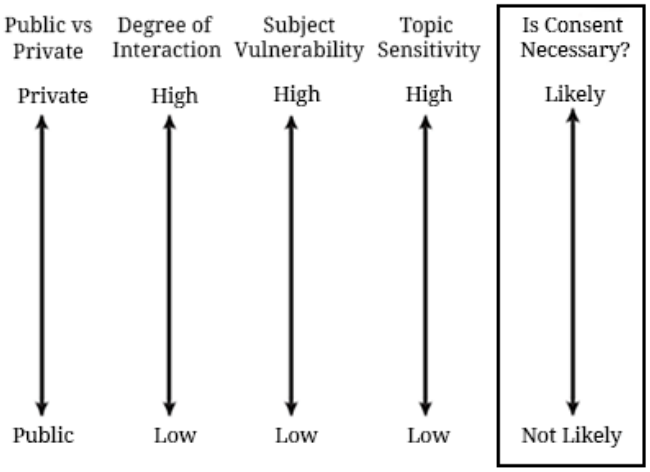
Public vs Private
Degree of Interaction
Subject Vulnerability
Topic Sensitivity
Is Consent Necessary?
Private
High
High
High
Likely
Public
Low
Low
Low
Not Likely

Figure 9. Factors relevant to the necessity of consent in digital research.[207]

In terms of privacy, Twitter is by default public – tweets from new Twitter accounts are public until the accounts' settings are modified to be private. In the case studies presented in this thesis, and in the other practical work, interaction with Twitter users was also limited. The highest degree of interaction was to invite individuals to focus groups or interviews. Focus group attendees filled out consent forms.

In the case studies, the topic was local politics or the specific interest of the community, so that subject vulnerability and topic sensitivity were also low – for example, issues such as preserving locally important buildings or parking regulations. In one project, more nuanced ethical considerations were necessary. The OpenCare project, looking at open-source approaches to healthcare across the EU, used LocalNets to map discussions of mental health on Twitter – a sensitive topic with potentially vulnerable users. In this case a decision was taken that only official institutions would be contacted through Twitter to participate in a Skype interview. Unlike the other projects, private individuals were not approached, with the goal of reducing interaction with the potentially vulnerable community.

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[207] McKee, & Porter, 2009

3.5 ADR, practice and the research questions

ADR sets out a series of steps and principles for evaluating IT artefacts in institutional contexts. While the methodology admits a variety of flows, during the course of this research each case study uses the following structure: problem formulation; building, intervention and evaluation; reflection and learning.

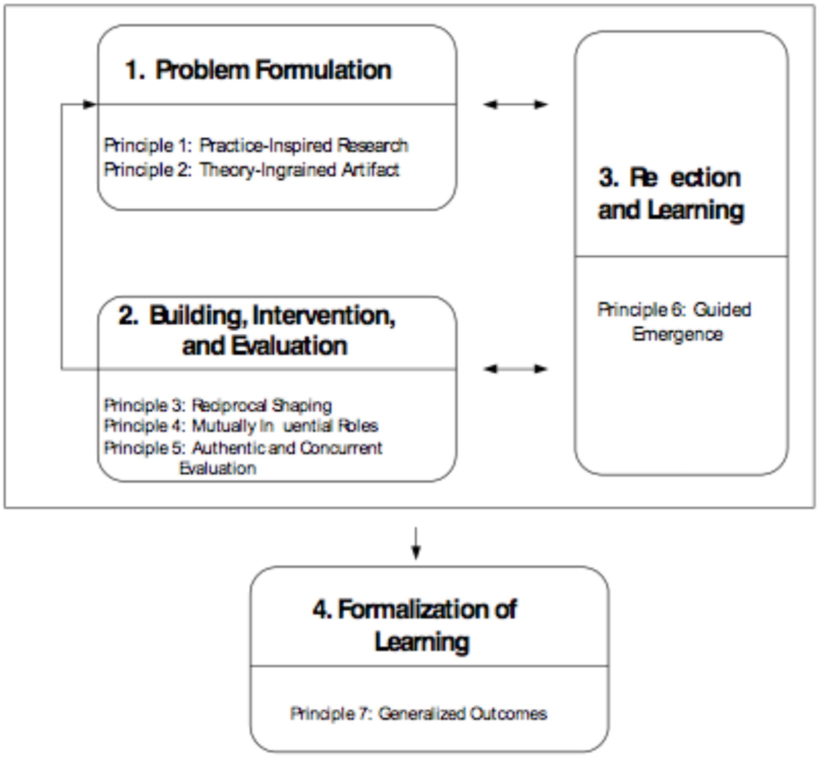
1. Problem Formulation
Principle 1: Practice-Inspired Research
Principle 2: Theory-Ingrained Artifact
2. Building, Intervention, and Evaluation
Principle 3: Reciprocal Shaping
Principle 4: Mutually In uential Roles
Principle 5: Authentic and Concurrent Evaluation
3. Re ection and Learning
Principle 6: Guided Emergence
4. Formalization of Learning
Principle 7: Generalized Outcomes

Figure 10. ADR research cycle (Diagram from Sein).[208]

The first principle, practice-inspired research, asks the researcher to view 'field problems (as opposed to theoretical puzzles) as knowledge-creation opportunities'.[209] In the research presented here, knowledge creation opportunities and the resulting findings are embedded in the case studies and other practical work listed in Appendix A.

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[208] Sein, et al., 2011

[209] Sein, et al., 2011

The ADR-driven case studies allow the software to respond to the issues encountered in the ‘field’ and give rise to the findings.

The theory-ingrained artefact principle asks that ‘the action design researcher actively inscribes theoretical elements in the ensemble artefact, thus manifesting the theory “in a socially recognizable form”’. Each case study chapter has a theory section which addresses the specific theoretical positions explored in that ADR cycle.[210]

Reciprocal shaping did not become an important part of the research process. The principle suggests that a software artefact will shape an organisation, just as the organisation shapes it. In this research, the small trials and focus groups were not observed to materially shape organisations, perhaps due to the large scale of the institutional partners and the comparatively small size of the case studies. However, the principle of mutually influential roles speaks to the key goal of the Creative Exchange as a research programme: collaboration between universities and industry. As a result, cooperation was deeply embedded in the case studies. Documentation of this is provided in the problem formulation phase of the case study chapters, where research partners and their roles are recorded.

Sein et al.’s phrase ‘Authentic and concurrent evaluation’ emphasises that ‘decisions about designing, shaping, and reshaping the ensemble artefact and intervening in organizational work practices should be interwoven with ongoing evaluation’, which resonates with a research process that had to be flexible in light of collaborative project constraints such as requirements, timelines, budgets, feedback and participant availability. [211]

Finally, the principle of guided emergence ‘emphasises that the ensemble artefact will reflect not only the preliminary design (see Principle 2) created by the researchers but also its ongoing shaping by organizational use, perspectives, and participants’.[212] This was the case throughout the research, perhaps most obviously in the shift away from local government towards other types of non-market institutions.

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[210] Sein, et al., 2011

[211] Sein, et al., 2011

[212] Sein, et al., 2011

ADR and structure of the case study chapters

The case study chapters instantiate the ADR method and are structured into six sections, as follows:

1. Problem formulation – describes how the previous case study led to the selection of new 'field problems', including the selection of new partners for the case study being described. This section also describes the research objectives agreed with the partner(s). This section draws on the principle of 'practice-inspired research'.
2. Design Decisions - describes how LocalNets was updated to support the research objectives, including specifically noting where and how theory drove design decisions, drawing on the principle of 'theory ingraining'.
3. Build – Building or modifying a software artefact in light of the design decisions
4. Intervention – Using the software artefact in the field
5. Evaluation – Evaluating the performance of the software artefact
6. Reflection – Reflecting on the problem formulation, theory, intervention and evaluation, and the future work suggested by the case study – drawing on the principle of 'guided emergence'. This section reflects specifically on the way the theory ingrained in the artefact impacted on the case study.

Figure 11 describes the generic approach to each case study; however, there are slight variations between the case studies to remain sensitive to the complexity of the partnerships associated with each case study.

In the Prototyping and Peterborough and Bretton case studies the ADR structure was modified to reflect the nature of the practical work. In the Prototyping case study two prototypes were constructed – the CX Annunciator and the Kensington and Chelsea project. The 'Intervention' and 'Evaluation' sections are presented separately for the prototypes, as each prototype was deployed individually. The Peterborough and Bretton case study had four research objectives, multiple partners and three interventions.

Interventions and evaluations are described across five sections of the case study chapter, an approach detailed in the introduction to that case study.

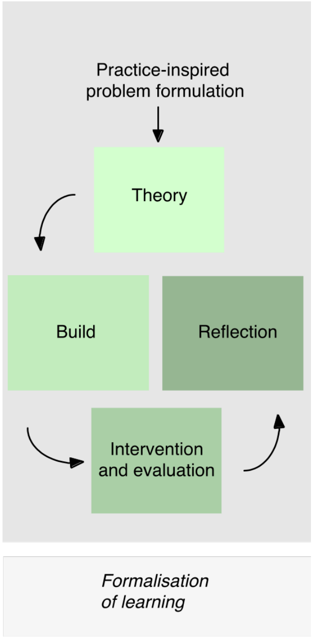
Practice-inspired problem formulation
Theory
Build
Reflection
Intervention and evaluation
Formalisation of learning

Figure 11. ADR cycle indicating the outline structure of the individual case studies

In total, four case studies are presented in this thesis, reflecting the first deployment of the LocalNets software and three subsequent cycles of development, following the cyclical structure described above.

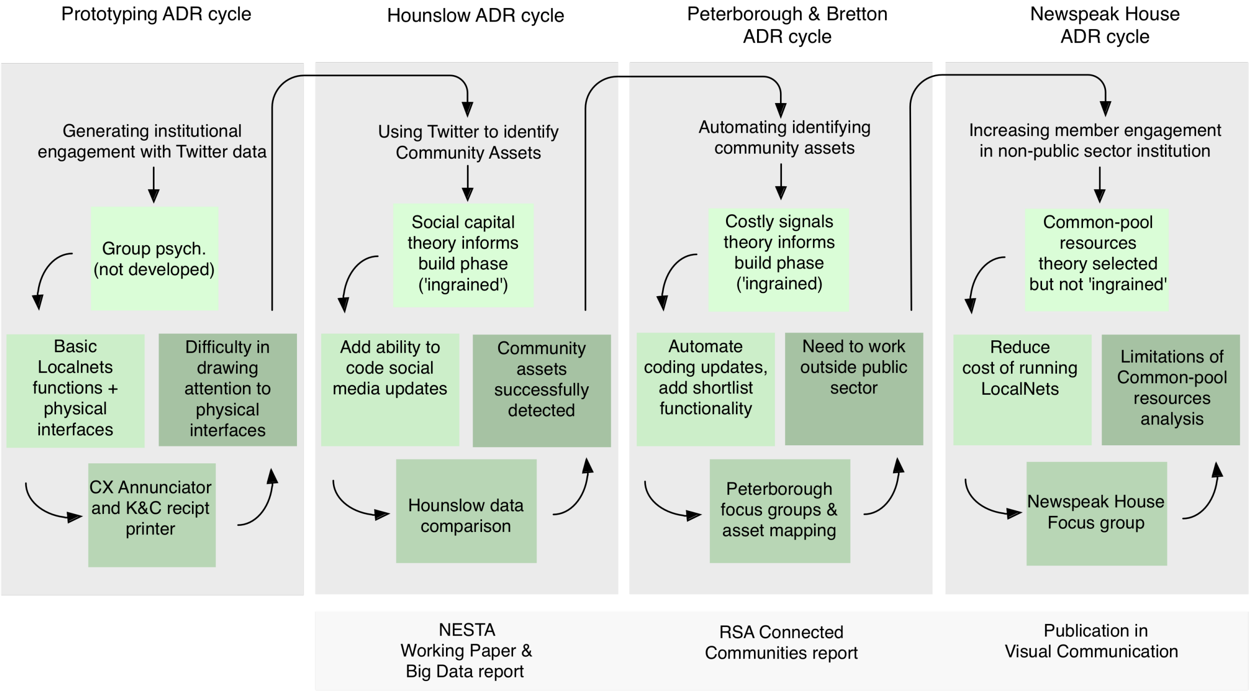
Prototyping ADR cycle
Hounslow ADR cycle
Peterborough & Bretton ADR cycle
Newspeak House ADR cycle
Generating institutional engagement with Twitter data
Group psych. (not developed)
Basic Localnets functions + physical interfaces
Difficulty in drawing attention to physical interfaces
CX Annunciator and K&C recipt printer
Using Twitter to identify Community Assets
Social capital theory informs build phase ('ingrained')
Add ability to code social media updates
Community assets successfully detected
Hounslow data comparison
Automating identifying community assets
Costly signals theory informs build phase ('ingrained)
Automate coding updates, add shortlist functionality
Need to work outside public sector
Peterborough focus groups & asset mapping
Increasing member engagement in non-public sector institution
Common-pool resources theory selected but not 'ingrained'
Reduce cost of running LocalNets
Limitations of Common-pool resources analysis
Newspeak House Focus group
NESTA Working Paper & Big Data report
RSA Connected Communities report
Publication in Visual Communication

Figure 12. Four iterations of ADR over the four case studies

Alongside the case studies, other project work was conducted using LocalNets. The full list of these projects is given in Appendix A. Projects that are not presented as case studies were not conducted with an action research approach due to the time required to conduct research using the method, and so are not presented as part of the cyclical ADR structure. Where projects that are not case studies are relevant, they are introduced separately.

Levels of ADR findings

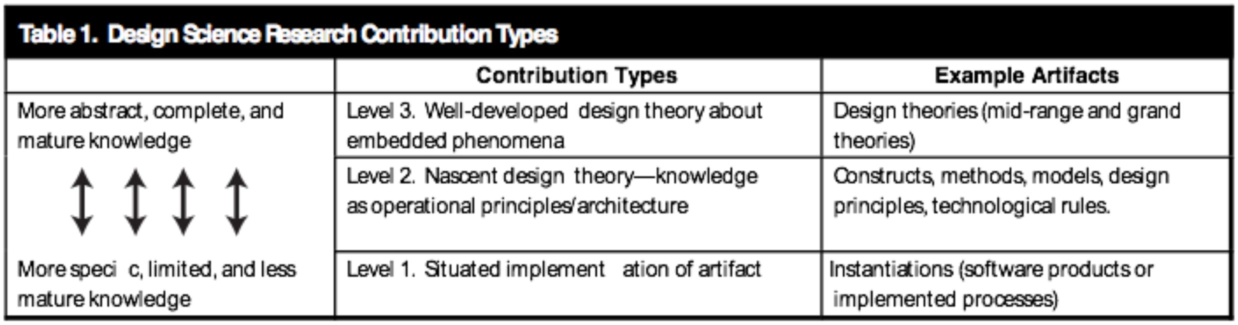

Table 1. Design Science Research Contribution Types

	Contribution Types	Example Artifacts
More abstract, complete, and mature knowledge	Level 3. Well-developed design theory about embedded phenomena	Design theories (mid-range and grand theories)
↕ ↕ ↕ ↕	Level 2. Nascent design theory—knowledge as operational principles/architecture	Constructs, methods, models, design principles, technological rules.
More specific, limited, and less mature knowledge	Level 1. Situated implementation of artifact	Instantiations (software products or implemented processes)

Figure 13. ADR types of findings (Diagram from Gregor and Hevner)[213]

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[213] Gregor, & Hevner, 2013

Gregor and Hevner suggest that ADR results in ‘levels’ of findings, moving from findings related to a ‘situated implementation’ (level 1) to findings which are ‘abstract, complete and mature’ (level 3).[214] Research question 1, regarding Twitter-based social media analytics for non-market institutions, corresponds to Level 1 contributions regarding the specific deployment of the LocalNets software, as presented in Chapter 8.

Research question 2, regarding design principles for social media analytics in non-market institutional contexts, is addressed through a set of six ‘Situated’ design principles (SDPs)– findings that are held to be SDPs are presented in Chapter 9. This new category is advanced because the term ‘design principle’, as used by Gergor and Hevner, might connote an unwarranted level of generality. None of the findings are held to rise to a scope of applicability of Gregor and Hevner’s level 2 or level 3 findings. SDPs are defined in more detail in Chapter 9.

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[214] Gregor, & Hevner, 2013

4. Prototyping case study

This chapter describes applying the ADR method initiate building LocalNets, the social media analytics tool to collect and process Twitter data. It also describes two physical prototypes intended to test the presentation of social media data using embodied or physical methods. One was a system which printed out tweets to be read by staff at the Royal Borough of Kensington and Chelsea council staff canteen. The other was a screen that displayed tweets written by PhD candidates on the CX programme in two CX offices, one situated at Newcastle University and one at the Royal College of Art in London.

4.1 Problem formulation

Selecting research partners in response to previous case studies

As the first case study of the research, no preceding ADR cycle was available to inform the problem formulation. A software tool called 'Heresay', an early experimental version of LocalNets developed as a side project before the initiation of the doctoral research, provided exploratory groundwork.

An initial observation from using the Heresay tool was that local government often expressed interest in data derived from it, but that the data failed to subsequently find a sustained audience within the institutions after their initial enthusiasm. Responding to this specific challenge, the research objective in the first ADR phase was to test the presentation of social media data using embodied or physical methods to improve institutional engagement.

Case study overview

The project represented the first build of the LocalNets web application. The application could collect tweets and blog posts and had functionality to output the text from these to the receipt printer or an 'ambient screen' – the two hardware prototypes. The prototyping projects were undertaken between January and August 2014. They are presented together because they took place at similar times, drew on the same theory (group psychology and ambient interfaces), and shared an objective to investigate the presentation of social media data using embodied or physical methods. Unlike the other case studies, where the full list of partners is listed at the outset of the chapter, details of the partners are provided separately in the intervention section for each project. This modification to the way the ADR cycle is presented is intended to allow the chapter to better articulate the exploratory first cycle of the ADR practice and reflects the fact that two projects are presented in the case study.

4.2 Theory and design decisions

Design overview

In the first ADR cycle, partners did not contribute actively to the design process. Instead, the cycle drew on related projects undertaken by other designers working on physical prototypes capable of representing social media data. These projects were selected to investigate potential audiences in institutions that had expressed an interest in social media analytics tools.

The Kensington and Chelsea prototype drew on the Postcode Paper, a data.gov.uk project, and BERG's Little Printer, a playfully designed receipt printer. The Postcode Paper used a printed newspaper format to show a range of local data for a single postcode – E5 0JA, in Homerton, London. The paper drew on hyperlocal digital sources of information – for example, transport updates using the Transport for London API; or crime updates using crime statistics from the Metropolitan Police. Significantly, the project generated interest from the Department for Communities and Local Government (who later became partners in two of the case studies in this research), and the Postcode Paper was circulated in the Cabinet Office. The Postcode Paper indicated the power of physical media to draw policymakers' attention to web-based sources of local community data.[215] The Kensington and Chelsea prototype also drew inspiration from, and used, BERG's Little Printer – described in *Design Transitions* in the context of BERG's transition from design consultancy to making connected hardware.[216] This decision was based on a wider 'physical computing' design approach, and an intention to move beyond traditional web pages as a means to communicate the output of the LocalNets tool by using the Little Printer as a charismatic object to attract attention.

The CX Annunciator prototype also drew design inspiration from the Annunciator in the UK Houses of Parliament. The Annunciator is a system of screens that display the business of both Houses of Parliament and shows when votes will be taken. The screens are positioned throughout the Palace of Westminster itself, and also in other nearby government buildings and even local pubs.

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[215] Arthur, 2009
[216] Yee, et al., 2013

Theory: group psychology and ambient screens

A nascent theoretical direction concerned the ways in which technology could be used to improve collaboration within groups, drawing on group psychology – for example, the work of Tuckman.[217] The idea of ambient interfaces was also explored, where, rather than focusing on one's private computer monitor, the goal is 'making use of the entire physical environment as an interface to digital information'.[218] This informed the use of the Little Printer and the public computer monitor in the CX offices.[219] The treatment of these theories is intentionally brief, as they were not taken forward, for reasons discussed in the reflections at the end of this case study.

Theory: Ingraining and design choices

As in every cycle of the ADR process, theoretically motivated design decisions have the potential to ingrain theory in the LocalNets artefact. Providing support for the screen interface and Little Printer could have ingrained theories relating to ambient interfaces, in the sense that 'artifacts created and evaluated via ADR are informed by theories'.[220] However, after this first exploratory case study it was found that 'ambient' interfaces did not engage audiences as intended, and were not further developed. As a result, ambient interfaces and group psychology are not held to have become ingrained in the artefact.

Further design choices

As the first instantiation of the software, LocalNets sought to support ingesting (reading from the web into the database) tweets and blog posts. It also supported selecting tweets appropriate for on the Little Printer. Finally, it needed to support the outputs specific to the case studies – a large screen display and the Little Printer.

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[217] Bonebright, 2010
[218] Wisneski, et al., 1998
[219] Weiser, & Brown, 1995; Vogel, & Balakrishnan, 2004
[220] Sein, et al., 2011

4.3 Build

An initial experimental version of LocalNets, Heresay, provided a very early instantiation of the core functionality. Heresay's code, written in PHP and MySQL, did not use a scalable web development framework; therefore at the beginning of the PhD a fresh code base was initiated, using the Meteor development platform.

Meteor was selected because it is prescriptive about code structure, which it was anticipated would make it easy for other developers to work on the project should the need arise. Meteor also emphasises rapid development over scaling up to very large numbers of users, as might be required when the software becomes more mature. These choices were made with a view to allowing the practice of software development to play a flexible role in support of the Action Design Research practice.

The first iteration of the LocalNets software had a user interface that enabled the user to select blogs or Twitter accounts from which blog posts or tweets would be ingested (blog-related functionality was removed in the Peterborough and Bretton case study – Twitter has a single consistent interface for collecting tweets, blog posts are much harder to collect because they do not follow consistent standards). Collection was regulated by a timer so that each blog or Twitter account would be checked once an hour to see if there were new updates. Tweets collected from those accounts could be 'tagged' manually with topics.

To support the Kensington and Chelsea work, an interface to the receipt printer was added to the software. As part of the interface, tracked URLs were added to each printed tweet, so that the number of people following the link could be counted. In order to support the Annunciator prototype a page was added to the LocalNets application (shown in Figure 17). It displayed a chronological list of the tweets collected, using large fonts designed to be legible at a distance. Audio notifications were added, in response to the observation that people working in the office never looked at the screen and did not notice it update. As noted in the evaluation of this prototype, even with audio notifications the interface struggled to capture and maintain users' attention.

Summary of features added during the ADR cycle

During this ADR cycle, the basics of the platform were implemented. These were:

- A system of user accounts, including functionality to sign up and log in to the app. The Meteor development platform has built-in support for user accounts.
- A feature to collect text from blog posts and tweets.
- An interface for logged in users to add the URLs of blogs from which posts are to be collected, and to add the Twitter usernames whose tweets should be collected.
- A feature to trigger the collection of blog posts and tweets on a timer, and record the success or failure of the collection process.
- A feature to select which tweets that the receipt printer would print out

In addition, two interfaces were added that were specific to the prototypes:

- A machine-readable API that supported the Little Printer for the Kensington and Chelsea prototype.
- A screen-based interface for the CX Annunciator prototype, described above.

Taken together, these features constituted the first iteration of the LocalNets software.

4.4 Kensington and Chelsea intervention

The Kensington and Chelsea prototyping was undertaken in collaboration with Kensington and Chelsea London Borough Council, following discussions with a representative of the council's communications team at an event focusing on technology and the public sector. The communications team wanted to explore ways the council could increase use of social media by staff. To address this issue a receipt printer was set up in Kensington and Chelsea Council staff canteen. Staff were invited to press a button that caused the printer to print a receipt with text from four tweets – a micro-newspaper of local events. The tweets were selected for their relevance to local politics and their recency. Tweets were manually selected each day, simulating what was anticipated to subsequently become an automated process. This allowed an evaluation of how people responded to the prototype before investing time in building the automation. Manually simulating functionality for evaluation can be referred to as a 'Wizard of Oz' protocol.[221]

Partners

Partner	Goal	Contribution to Research
Jimmy Tidey	Investigating presenting social media data using embodied or physical methods to improve institutional engagement	Building the printer prototype and LocalNets software
Mark Simpkins (Central St Martins)	Research on social media analysis in public sector	Building and installing printer prototype
Kensington And Chelsea London Borough	Promote awareness of social media to their staff	Providing space

Table 3. Kensington and Chelsea project partners

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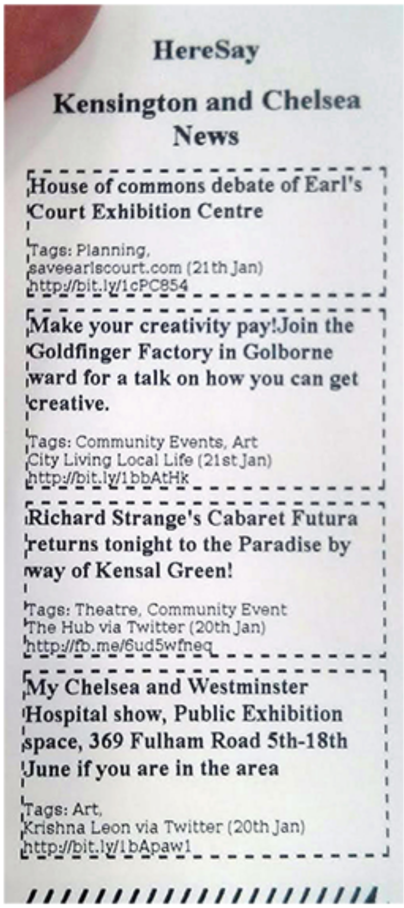
[221] Klemmer, et al., 2000

Research Objectives

Previous experience, for example in the Heresay project that preceded the PhD research, demonstrated that it was hard to bring social media analytics to the attention of local councils. Arranging to meet with the appropriate staff and articulate an innovative idea was time consuming. It was hoped that a charismatic prototype might articulate the idea and build interest in the research.

Structure and planning

During early discussions, it was decided that the staff canteen, which is also used for promotional events, would be a suitable place to locate the Little Printer. The printed receipts were conceived as a ‘micro newspaper’ that staff might read and discuss during their lunch. It was agreed that the printer would be placed in the canteen for one week, and that a member of staff would be allocated to check in with it and ensure that everything was working.



HereSay

Kensington and Chelsea News

House of commons debate of Earl's Court Exhibition Centre

Tags: Planning,
saveearlscourt.com (21th Jan)
http://bit.ly/1cPC854

Make your creativity pay!Join the Goldfinger Factory in Golborne ward for a talk on how you can get creative.

Tags: Community Events, Art
City Living Local Life (21st Jan)
http://bit.ly/1bbAtHk

Richard Strange's Cabaret Futura returns tonight to the Paradise by way of Kensal Green!

Tags: Theatre, Community Event
The Hub via Twitter (20th Jan)
http://fb.me/6ud5wfneq

My Chelsea and Westminster Hospital show, Public Exhibition space, 369 Fulham Road 5th-18th June if you are in the area

Tags: Art,
Krishna Leon via Twitter (20th Jan)
http://bit.ly/1bApaw1

Figure 15. Tweets printed on receipt paper

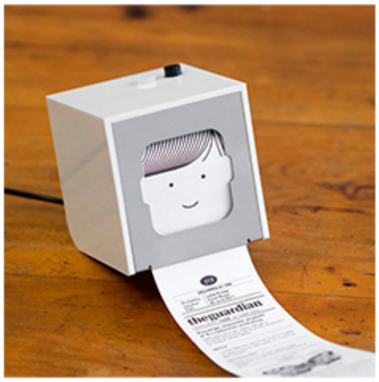


Figure 14. Little Printer, an 'Internet of Things' connected printer developed by BERG design studio

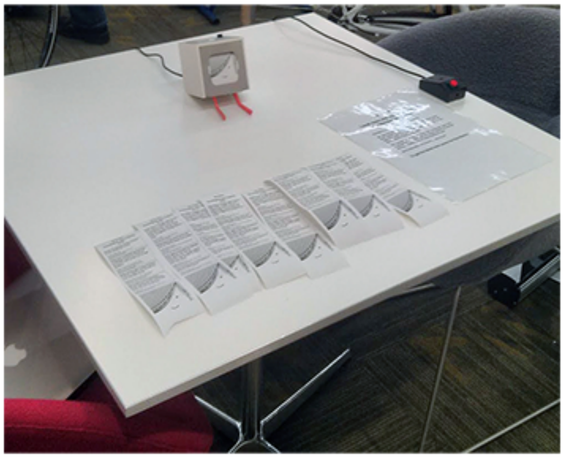


Figure 16. Little Printer in Kensington & Chelsea council canteen

LocalNets in use

Tweets were selected through a filtering process with several stages. The LocalNets software collected a corpus of tweets from Twitter accounts that had themselves been chosen because of their focus on local issues in Kensington and Chelsea. Sixteen tweets were selected each day to create a filtered pool of appropriate content. Tweets in this pool were chosen because they were non-offensive, might pertain to issues of interest Kensington and Chelsea council staff, and were tweeted on the day in question. When the button on the printer was pressed a random selection of four of the 16 tweets were printed out.

Intervention

During the event, several logistical problems presented themselves. The receipt printer took time to respond to a button press, and as a result, unless a researcher intervened to prompt the person to wait, many people walked off. The ‘call to action’ was unclear, and many of the staff could not understand the project.

Over the course of the week 50 receipts were printed out, many of them when researchers were present to explain the system and persuade council staff to engage. Each of the tweets was presented with a shortened link that was trackable; data obtained this way indicated that no one used the shortened links. Staff were observed to be confused about the project as a whole but also by the data as printed out on the receipt.

4.5 Kensington and Chelsea evaluation

Some of the problems described above, such as the need for a researcher to explain the project, could potentially have been addressed through better design, while leaving the fundamentals of the project unchanged. A faster-responding printer and a clearer call to action, a more robust physical interface and a more prominent location might have generated more interactions. Limitations were also observed in the receipt format itself: the limited number of characters available on each line made it hard to convey all the rich metadata around the tweet. For example, retweets, author follower count and previous tweets all provide important contextualising information.

The receipt printer could not print images, which presented a limitation because some of the richest and most engaging content on Twitter is image-based. That none of the staff followed the links printed next to each tweet is perhaps unsurprising, as it required them to carefully transcribe a 15-digit string of letters and numbers to their phone or computer. This is an unavoidable consequence of using paper, which cannot provide hyperlinks, unlike a screen. QR codes were considered, but were not pursued further because they took up a great deal of space on the receipt.

A more fundamental conclusion was that tweets, presented out of context, quickly become abstract and difficult to understand, especially if the audience is not already well acquainted with the Twitter platform. This issue informed developments in the subsequent case studies, which returned to the screen as a medium and developed non-textual interfaces, such as maps and network graphs. In later case studies, when whole tweets were reproduced they were presented almost exactly as they are on Twitter, using Twitter's native 'cards' system.[222] This familiar design includes many of the cues missing on the receipts, such as images, the number of replies, retweets and 'likes' and the author's profile image.

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[222] Twitter, 2017. 'CMS Best Practices'

4.6 CX 'Annunciator' intervention

The ‘Annunciator’ prototype allowed me to explore more fully the context of the Creative Exchange (CX) with PhD students who were part of the research programme. Throughout the CX programme, starting with the very earliest version of the LocalNets software, data was gathered from the Twitter activity of CX students with a prospective view to its potential use in research over the course of the CX research program. Inspiration was taken from design endeavours such as research into ambient displays and Weiser’s Calm Technology.[223]

Partners

A Newcastle University and RCA CX Student assisted on this project in an informal capacity, agreeing to have a screen in their office and helping to set it up.

Research Objectives

The objective of the research was to consider social media in the context of a workplace community, as opposed to a local community. These two heterogenous contexts constituted an initial exploratory phase that deliberately considered a wide range of settings, before limiting the scope of the research to non-market institutions.

Structure and planning

The project required little planning; installing the screen at Newcastle University was timed to coincide with a CX team meet-up already planned in Newcastle.

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[223] Weiser, & Brown, 1995; Vogel, & Balakrishnan, 2004

Description

Data was displayed as a ‘feed’ on a monitor in the office space shared by six RCA-based students. Each time any of the students’ Twitter accounts tweeted, speakers played a sound to direct attention to the monitor. The most recent tweet was displayed at the top of the list in a large font that could be read across the room, while less recent ones were visible in a smaller font bellow.

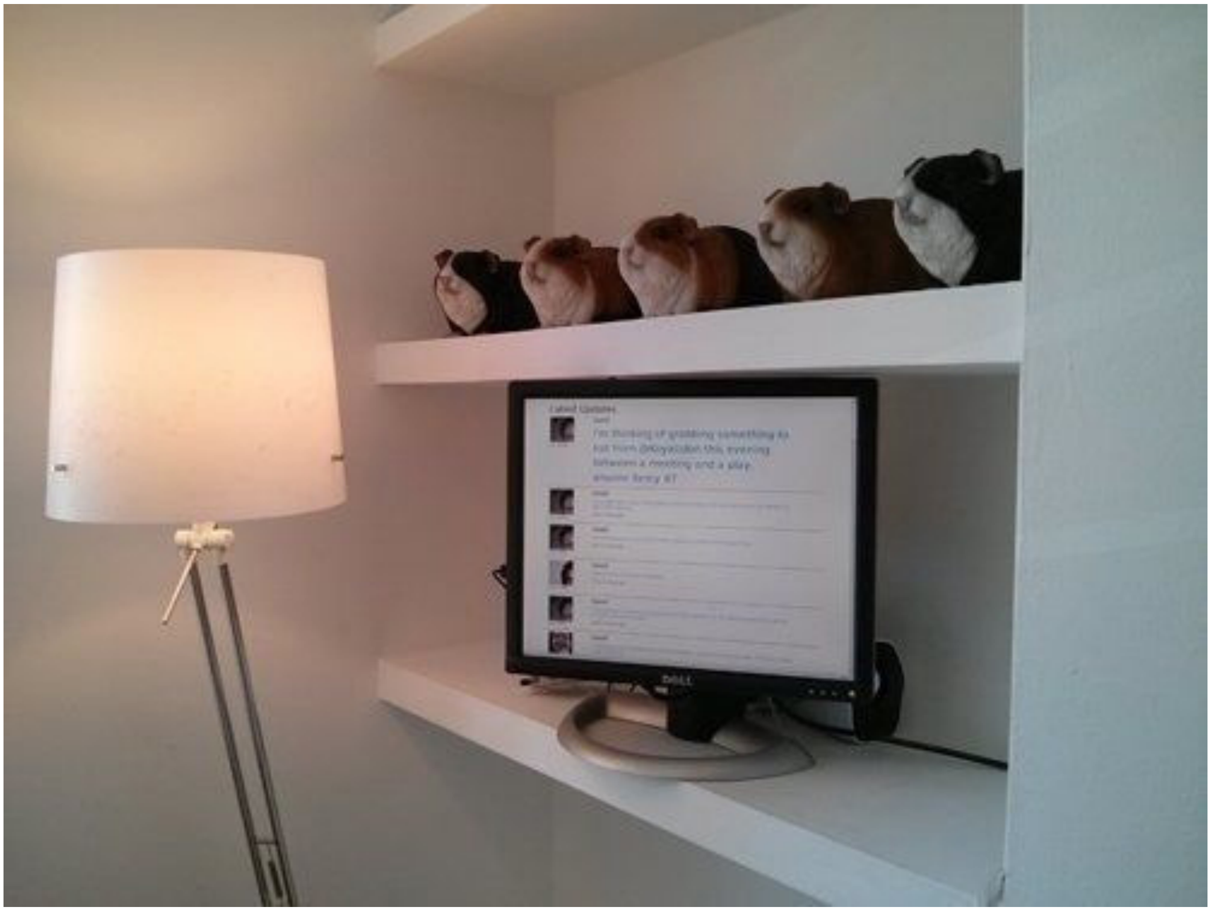

Figure 17. Screen in the RCA CX office

A similar screen was placed in the dedicated office for the CX students based at Newcastle University. The system was based on Raspberry Pi computers.

4.7 CX 'Annunciator' evaluation

While the project was only taken to an early prototyping phase, it highlighted how difficult it can be for an ambient display to capture users’ attention. The display quickly became part of the furniture, and even with the audio alerts few users of the space looked at the screen regularly.

One of the benefits of this project, which became apparent only subsequently, was the speed at which it was developed. This pace was possible because the small number of partners involved limited the time spent coordinating between the parties. In subsequent case studies with more partners, project management became significantly more time-consuming.

4.8 Reflection

Taking both prototyping projects together, the practical work was indicative of the complexity of deploying robust physical prototypes.

Case study objective: sustaining institutional engagement

The two prototypes indicated the idea of a ‘charismatic prototype’, used to help articulate LocalNets to local government, might be difficult to implement. Three specific lessons supported these conclusions:

- The Kensington and Chelsea prototype highlights the difficulties of communicating the content of individuals’ tweets without the Twitter context. This triggered an exploration of different kinds of visualisations in subsequent work.

- Having a physical prototype in the workplace context does not automatically mean that prototype will have an impact, a point that the CX Annunciator project reinforced.

- Creating physical prototypes that are robust and work reliably without manual intervention is time consuming.

Theory ingraining and development of ADR practice

The provision of the ambient screen interface ingrained theory from ambient display research; further, both the printer interface and the large screen had the potential, if pursued, to draw on group psychology. However, this ingraining was transient, as the large screen and printer interfaces were not chosen for further development or used again. While a low-fidelity prototype cannot provide definitive evidence, both experiences suggested that giving LocalNets a physical presence in a shared space at a partner institution might not necessarily generate a level of engagement that could provide evaluative feedback to inform improvements. However, such feedback is an essential component of the ADR methodology, and also characteristic of the type of close cooperation required in ADR.

The level of institutional engagement was not sufficient to address the research questions using the ADR method, and the shift away from physical prototypes in the subsequent case studies responds to this observation.

Development of the software practice

The prototyping projects refocused the software development practice – which at this stage included integrating hardware with the LocalNets software. The complexity and time-intensity of working on even low-fidelity prototypes indicated that the research would probably have to choose between deep institutional integration with a range of partners and working on physical prototypes. In the subsequent case studies, the practice focuses on using the LocalNets software with a range of partners and contexts, and away from the physical prototyping and hardware integration. The opportunities to work with partner institutions presented by the Creative Exchange research programme informed that decision.

5. Hounslow case study

The Hounslow case study functioned as an opportunity to test the quality of the data that LocalNets was gathering from Twitter. It was the first case study with multiple partners.

The ADR cycle was influenced by the RSA's commitment to asset-based community development. Functionality to code tweets to indicate references to community assets was added to LocalNets during the cycle. The results were compared with the RSA's survey of community assets in the area.

5.1 Problem formulation

Selecting research partners in response to previous case studies

This case study represents a deliberate step away from the limitations of physical prototypes of the type used in the previous case study. The ‘Reflection’ section at the end of Chapter 4 describes the complexity of implementing physical prototypes, such as the Little Printer and the ambient screens. The Hounslow case study instead focuses on understanding the nature of the data generated through LocalNets. The RSA was identified as a suitable partner for such a research focus because of their pre-existing data from a detailed demographic survey carried out in Hounslow. It was anticipated that the Hounslow case study would compare offline perceptions of community, embodied in the RSA’s ethnographic survey, with information generated by LocalNets.

Case study overview

The Hounslow case study took place between March 2014 and March 2015 in the London Borough of Hounslow, UK, in collaboration with the RSA and part-funded by NESTA. It was the first ADR cycle in which theory was developed in detail. The research resulted in a NESTA working paper and was part of a NESTA-published report titled *Data for Good*.[224,225] The case study formed part of the RSA’s Connected Communities project, which sought to help ‘people experience greater wellbeing and other benefits from the better understanding, mobilisation and growth of “community capital” in their neighbourhoods’.[226] The RSA’s approach drew on Kretzmann and McKnight’s work on asset-based community mapping, which sees communities as a network of resources – people, places, organisations and events. Kretzmann and McKnight advocate mapping communities’ assets and the network of social connections between them to inform interventions.[227] To this end, the RSA had already carried out an on-the-ground asset mapping survey in Hounslow.

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[224] Marcus, & Tidey, 2015
[225] Baeck, 2015
[226] Parsfield, et al., 2015, p. 7
[227] Kretzmann, & McKnight, 1996

Partners

Partner	Goal	Contribution to research
Jimmy Tidey	Testing LocalNet's ability to produce information relevant to non-market institutions, integrating with the RSA's research program.	Providing and analysing data from the LocalNets software
RSA	Research in Hounslow as part of their *Connected Communities* report	Ethnographic data on the community in Bretton
Hounslow Borough Council	Research on the Cranford ward of Hounslow	Hounslow Borough Council were not directly involved in the research aspects of the project
DCLG	Support of the Community Rights legislation	Observers
NESTA	Understanding 'Below the Radar' social activity	Funding

Table 4. Hounslow project partners

Case study objectives

Working with the project partners, the following objectives were identified:

1. To test the assumption that locally relevant data could be extracted from blogs and Twitter to support asset mapping.

2. To test whether LocalNets could generate data compatible with the RSA's wider theoretical approach: assets-based community development and social capital.

The intention was to meet Objective 1 by collecting tweets, hand-coding mentions of community assets, and comparing the results with the ethnographic survey conducted by the RSA. The use of a comparative approach for evaluating LocalNets data is described in Chapter 3, ‘Methods’. It was felt that a broad similarity between the two datasets would indicate that the online and offline pictures of the community were not completely independent of each other. Objective 2 was open-ended and exploratory, and was intended to respond to the RSA’s existing theoretical position regarding social capital.

Case study structure

This case study focused on the London Borough of Hounslow, and, in particular, on the ward of Cranford. London is divided into 32 boroughs; wards are administrative divisions within London boroughs. Cranford, known as ‘the Meadows’ or ‘Beavers Estate’ locally, was considered an area of special interest: it is a triangular ‘urban island’, cut off on two sides by major roads and on a third by Heathrow airport.

The RSA had already conducted an ethnographic survey in Hounslow as part of their Connected Communities project, which included a commitment to carry out interventions in seven locations across the UK, including Hounslow, and in Peterborough, the site of the next case study.[228] The NESTA grant allowed the RSA to expand their study in Hounslow to include the use of LocalNets.

The RSA’s research in Cranford consisted of an ethnographic study, participant observation and a door-to-door survey that gathered social network data. Nine community researchers were recruited and trained, and carried out the door-to-door research on 16 days between July and September 2014, while the RSA lead researchers conducted ethnographic interviews during the same period of time. The overall process included responses to 170 surveys; 50 people participated in focus groups, and there were six in-depth ethnographies of individuals. This process generated a list of 980 community assets including all the research participants as well as other private individuals, community leaders, locations, services, organisations and events. The research used an asset-based community development methodology adapted from

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[228] Parsfield, et al., 2015

McKnight and Kretzmann.[229] The ethnographic survey included a ‘name generator’ section, as described in Chapter 3.

The RSA’s Connected Communities research was predicated on the idea that ‘people are embedded within local networks of social support’, and that, rather than focusing on individuals, ‘concentrating resources on networks and relationships’ generates ‘positive contagion’.[230] The RSA describes this approach as ‘community capital’, which they describe as ‘building on the primary research from this programme and academic and practitioner theories of social capital’.

The RSA extended the collaboration to include Department for Communities and Local Government (DCLG), who were particularly interested in using social media for community asset-mapping. The collaboration with The RSA and DCLG was developed further in the Peterborough case study. In Hounslow, DCLG were acted as observers and were briefed on the research as it went.

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[229] Kretzmann, & McKnight, 1996

[230] Parsfield, et al., 2015

5.2 Theory and design decisions

Design overview

LocalNets sought to identify community assets from tweets, the first case study objective. The second case study objective concerned using this data to apply asset-based community development theory and the connected concept of social capital theory.

Design decisions regarding LocalNets were positioned in relation to well established theories of social capital, rather than the RSA's own formulation of community capital advanced in their Connected Communities report. This decision was taken in order to ensure LocalNets would be relevant in institutional contexts beyond the RSA.

Theory: Social Capital

Social capital is often formulated explicitly in terms of the underlying social network structure – a network in which people are the nodes, connected to one another by social interaction. The data derived from Twitter is of this kind, although by its nature it shows only a fragment of an individual's social interactions. Ronald Burt develops a strictly network-centric understanding of social capital, asking researchers to 'cut beneath the social capital metaphor to reason from concrete network mechanisms responsible for social capital'.[231] Adler gives a definition of social capital that also invokes a network model:

> Social capital is a resource for individual and collective actors created by the configuration and content of the network of their more or less durable social relations.[232]

Due to its explicitly network-oriented foundation, Burt's concepts of brokerage and closure were applied as a means of understanding social capital in the context of LocalNets in the Hounslow case study.

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[231] Burt, 2007, p. 6

[232] Adler, 2000

Brokerage

Brokerage is Burt's term for benefits arising from ties that 'bridge': for example, knowing someone who no one else in your friendship group knows, or having a business connection that no one else in your office does. Burt draws on wide-ranging research to suggest three key advantages that brokerage can bring:

1. Access to a diversity of information.
2. Control of information flows between groups.
3. The choice of when or if to bring groups into contact with one another.

Burt notes that his research echoes Granovetter's insights into how people find job openings in suburban settings.[233] Granovetter finds that jobs are often found through 'weak ties' – a social connection that an individual has, but few of their friends or relatives have – because these ties have a greater potential to deliver information unknown to one's peers. Brokerage is aligned to the concept of bridging social capital, although Burt does not use this term.[234]

Closure

Closure defines the opposite condition to brokerage, that is, the advantages of having a dense, tightly knit network. Such a network creates trust; for example, Coleman looks at community credit organisations, in which informal groups lend money to one another to cover large purchases.[235] Such organisations, he posits, can only exist in the presence of dense networks that generate trust. In this way trust is the foundation on which resource sharing can occur between individuals. In another scenario, Coleman explores how dense networks increase school attendance, which he puts down to the network of parents who look out for each other's children, responding when they see children not at school when they should be.

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[233] Granovetter, 1973
[234] Bartkus, & Davis, 2010, p. 2
[235] Light, & Bonacich, 1991

Burt gives examples in which such dense networks have created innovation, such as Ericsson's isolated research team in Lund, Sweden, noted for their innovation in mobile phone technology, or the Lockheed Skunk Works teams responsible for many aerospace breakthroughs.[236] Burt concludes that both brokerage and closure are beneficial network properties. Closure is similar to the concept of bonding social capital, although, like bridging social capital, Burt does not use this term.[237] Appendix G discusses social capital literature in greater detail, including its relation to public policy.

Applicability and related work

Social capital relates to individuals' interpersonal connections, and the question of whether social capital can shape, or is shaped by, social media arises regularly. The impact of social media technologies has been widely studied: for example, a survey paper from 2015 identifies 140 papers reporting statistical connections between social capital and social network behaviours.[238] However, the use of social capital to inform design decisions in social media analytics tools for the public sector is less well studied.[239]

Theory ingraining and design decisions

In order to reveal a network of individuals and the community assets they mentioned, functionality was added to the LocalNets platform to allow manual the coding of tweets and blog posts by hand to indicate mentions of community assets. These design choices 'ingrained' the theory of social capital. LocalNets came to 'reflect the sociopolitical context of the design situation' – its design responded to the style of research that the RSA was developing.[240]

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[236] Burt, 2007, p. 113

[237] Bartkus, & Davis, 2010, p. 2

[238] Liu, et al., 2016

[239] Porwol, et al, 2018

[240] Sein, et al., 2011

Further design choices

Visualisation functionality was added. The RSA used the Gephi network visualisation software package to generate visualisations.[241] This network visualisation approach reflected the underlying conception of communities as networks of individuals whose connections led to social capital formation. Functionality was added to LocalNets to allow data to be exported to Gephi so that the software could generate similar outputs. This design decision aimed to help integrate the LocalNets tool into the RSA's existing workflow for community research.

It was considered that functionality allowing the community assets to be geographically located would be beneficial, and would allow the subsequent investigation of a wider range of analysis and visualisation. Therefore, an interface was added to allow the person coding the community assets to indicate on a map where a community asset was located.

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[241] https://gephi.org

5.3 Build

The previous prototyping case study developed LocalNets to a stage where it was ingesting content from blogs and Twitter.

In preparation for the Hounslow case study an interface was added to allow a researcher to code blog posts and tweets. The interface allowed the researcher to indicate whether the text contained a mention of a person, place, event or organisation. These categories aligned with those used in the RSA survey, and were collectively termed ‘community assets’. A ‘free text’ area allowed the user to name any new community assets mentioned in the text, and there was also a drop-down menu of all previously named community assets. The ability to export data to the Gephi network visualisation software package enabled network analysis aimed at discovering social capital-related features, such as connectivity statistics and ‘clusters’, or sub-communities.

Summary of features added during the ADR cycle

- Functionality for coding tweets and blog posts by listing any community assets mentioned in them.
- A new page showing a list of the community assets and how often they were referenced, again responding to DCLG and the RSA’s interest in community assets
- Gephi export functionality, responding to the RSA’s existing process for network mapping
- A Google Map for locating the community assets as part of the coding process, again responding to DCLG’s interest in mapping community assets

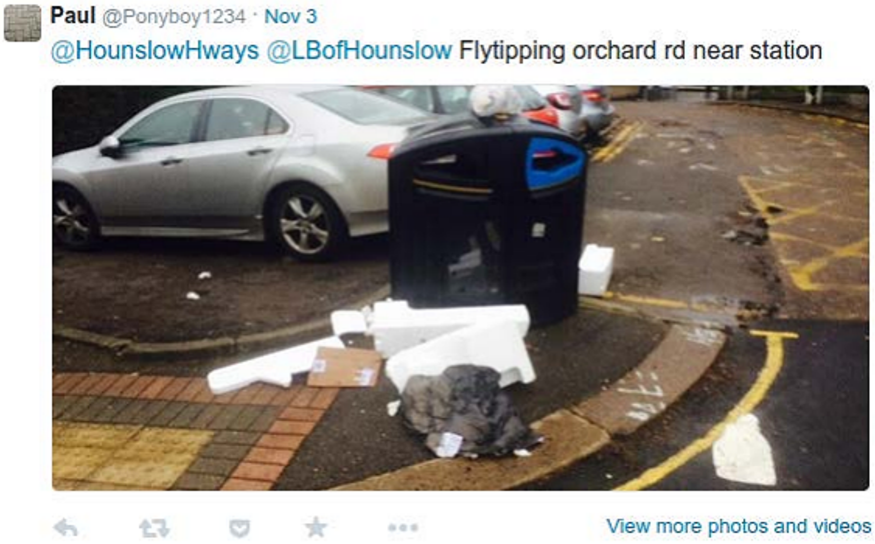
5.4 Intervention and Evaluation

Planning

The funding application for NESTA was undertaken by the RSA team, who also managed the connection with DCLG.

LocalNets in use

Relevant Twitter accounts were discovered using a process that would be repeated on subsequent projects. Using Google Maps, churches, parks, schools, libraries, cinemas and theatres were identified across Hounslow for use as search terms. Google Search was used to identify whether these institutions had a Twitter account or blog associated with them. In addition, local place names were used as the basis of a search for relevant blogs and Twitter accounts. When a blog or Twitter account was discovered, it was added to LocalNets, which then collected recent updates so they could be coded; 1,911 tweets and blog posts were coded manually, revealing 294 community assets. Data was gathered from across the borough of Hounslow, as Cranford itself was found to have very little social media activity associated exclusively with it.



Paul @Ponyboy1234 · Nov 3

@HounslowHways @LBofHounslow Flytipping orchard rd near station

Figure 18. Example of locally relevant tweet, reporting a fly-tipping incident to Hounslow Borough Council.

Comparing the RSA's ethnographic asset map with LocalNets' Twitter-based asset map

The RSA survey categorised community assets into four types: people, places, organisations and events. Levels of similarity between the two datasets are markedly different between the categories, so they are explored separately. Organisations and places were found to overlap significantly, while people and events did not.

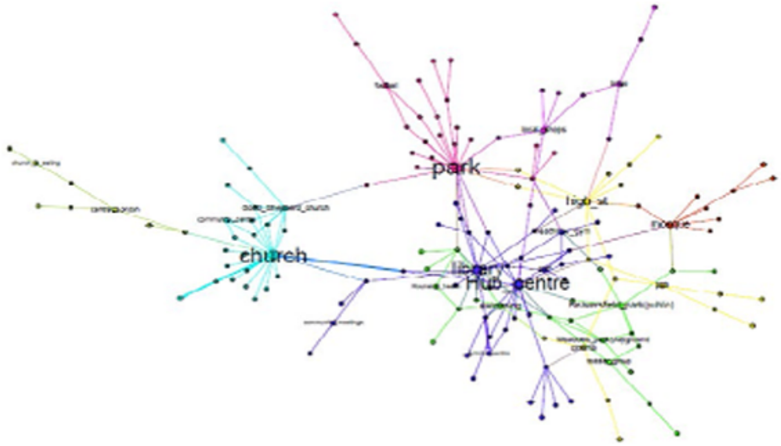

park
church
Hub
centre

Figure 19. Hounslow offline network diagram (from RSA ethnography)

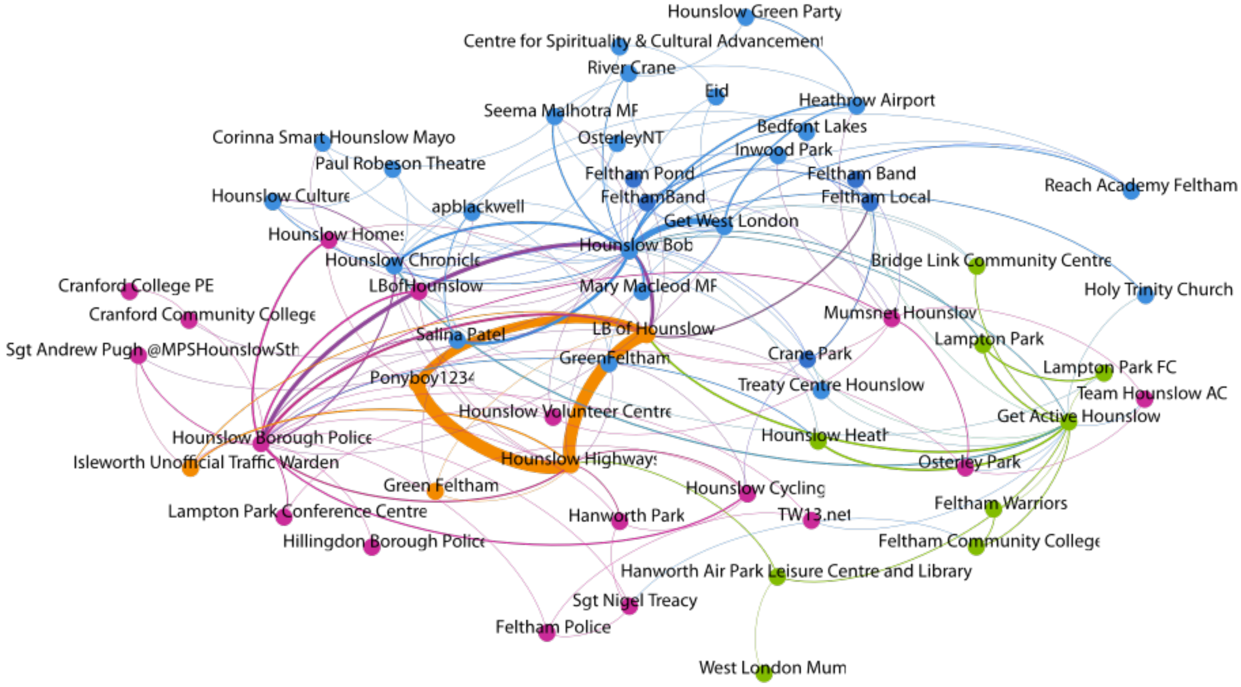

Hounslow Green Party
Centre for Spirituality & Cultural Advancement
River Crane
Eid
Heathrow Airport
Seema Malhotra MP
Corinna Smart Hounslow Mayo
OsterleyNT
Bedfont Lakes
Inwood Park
Paul Robeson Theatre
Feltham Pond
Feltham Band
Reach Academy Feltham
Hounslow Culture
FelthamBand
Feltham Local
apblackwell
Get West London
Hounslow Homes
Hounslow Bob
Hounslow Chronicle
Bridge Link Community Centre
Cranford College PE
LBofHounslow
Mary Macleod MP
Holy Trinity Church
Cranford Community College
Mumsnet Hounslow
LB of Hounslow
Salina Patel
Lampton Park
Sgt Andrew Pugh @MPSHounslowSth
GreenFeltham
Crane Park
Ponyboy1234
Lampton Park FC
Treaty Centre Hounslow
Team Hounslow AC
Hounslow Volunteer Centre
Get Active Hounslow
Hounslow Borough Police
Hounslow Heath
Isleworth Unofficial Traffic Warden
Hounslow Highways
Osterley Park
Green Feltham
Hounslow Cycling
Feltham Warriors
Lampton Park Conference Centre
Hanworth Park
TW13.net
Hillingdon Borough Police
Feltham Community College
Hanworth Air Park Leisure Centre and Library
Sgt Nigel Treacy
Feltham Police
West London Mum

Figure 20. Hounslow Twitter network diagram. Visualised using the Gephi network visualisation package using data imported from LocalNets.

Events

Digital asset-mapping discovered 25 community events. Comparing the events found with LocalNets to the ethnographic survey data revealed no matches between the two datasets. During the digital coding process it is often hard to distinguish between a specific community event (‘The Goan Festival’) and a generic event, which may have many, or no, local manifestations (‘Eid’). Generic events were not coded, reducing the tool’s sensitivity in this area.

People

LocalNets discovered 72 people, a combination of private individuals on Twitter, bloggers, local councillors, religious leaders, the mayor and three local MPs: Mary Macleod, MP for Brentford and Isleworth; Seema Malhotra, MP for Feltham and Heston; and John McDonnell, MP for Hayes and Harlington. It was determined that testing for matches between private individuals might breach the confidentiality agreement made with survey participants, so this was not carried out. Looking at public officials, only one match was found: one resident in the RSA’s ethnographic research referred to their local MP, Seema Malhotra.

Organisations and places

Organisations and places are taken together because they yielded very similar levels of comparability. LocalNets found 168 locations and organisations in the Hounslow area. The ethnographic survey found 51 relevant locations and organisations. Some items were excluded because they were too vague to match (‘football’, ‘gym’, ‘central London’, ‘local shops’, ‘swimming’, ‘zumba’), others were outside Hounslow and could not reasonably have been detected by LocalNets (‘Kew’, ‘Uxbridge’, ‘Park Royal Leisure Centre’, ‘Runnymede’, ‘Windsor Stables’, ‘Southwest Wimbledon Pentecostal Church’).

LocalNets picked up 20 per cent of the assets mapped offline, with ten good matches between the two datasets. With a further six probable matches, it is reasonable to say that 31 per cent of the place and location assets mapped offline were discovered by LocalNets.

Additionally, another two assets were uncovered by LocalNets which are mentioned in the ethnography, ‘Hounslow Community Foodbox’ and ‘Hounslow Civic Centre’. Matches are bound to be limited since the LocalNets tool looked at the whole of Hounslow, while the on-the-ground data focuses on the smaller area of Cranford, but the 31 per cent overlap between the two approaches suggests that the LocalNets had successfully uncovered relevant local data.

5.5 Reflection

Case study objective 1 – extracting locally relevant information

The hand-coding process provided evidence that tweets can be used to derive information about community assets. It also highlighted how resource intensive it was to complete this work manually. This observation inspired the work on automation in the subsequent Peterborough and Bretton case study. Overall, the project was taken to provide a tentative endorsement of the hypothesis that twitter data could be processed to discover locally valuable information. DCLG and the RSA remained enthusiastic about the work and the partnership formed the basis of the Peterborough and Bretton project. Initial concerns included the lack of Twitter activity associated directly with the Cranford ward; however, as the comparison of the survey data and LocalNets data demonstrated, most Cranford residents made extensive use of community assets across the borough. The findings from this case study objective fed in to the implementation findings presented later in this thesis, particularly the findings regarding data quality. Those implementation findings respond to research question 1.

Cast study objective 2 – LocalNets, asset-based community development and social capital

The Hounslow case study demonstrated that LocalNets could generate data relevant to the RSA's asset-based community development approach. Functionality to export data to the Gephi visualisation package was added to LocalNets so it became compatible with the RSA's approach to visualising community asset networks, again underlining its applicability to asset-based development research. However, community capital theory and the allied concept of social capital theory was not applied during the case study. Social capital was applied in the subsequent case studies. The findings from this case study objective did not directly address the research questions, but enable the continuing partnership with DCLG and RSA in the Peterborough and Bretton case study, which generated findings regarding both of the research questions in this thesis.

Theory ingraining and development of ADR practice

Reflecting on the ADR concept of theory ingraining, the Hounslow case study was the only case study in which a partner explicitly articulated a theoretical position. The RSA's pre-existing commitment to asset-based community development was formative in shaping the design decisions deployed in LocalNets, particularly its focus on networks and on coding community assets. This led to a 'formalisation' of the outcomes of the research process in the language of ADR. Information about community networks, presented as network diagrams, was presented in a NESTA report Data for Social Good, and subsequently in the RSA's Connected Communities report.[242, 243]

The asset mapping aspect of LocalNets persisted throughout the rest of the research. Approaches to visualisation initiated in this case study are relevant to research question 1 and informed implementation findings regarding the most effective ways to communicate information about network structures. The social capital perspective initiated in this case study went on to address research question 2 concerning design principles. Though the social-capital based approach was initiated in this case study, drawing on the RSA's development of the concept of 'community capital', the application of social capital theory occurred in the two subsequent ADR cycles. Two situated design principles drew on the application of social capital theory, SDP1 and SDP2.

Development of software practice

During the second ADR cycle the focus was on providing a user interface for coding tweets, and support for exporting data to the Gephi network visualisation software package. The addition of these features exemplifies the way in which the software development responded to an institutional context guided by the ADR approach.

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[242] 2015 Baeck

[243] 2015 Parsfield, et al., 2015

6. Peterborough and Bretton case study

The Peterborough and Bretton case study developed from the Hounslow study, retaining DCLG and the RSA as partners. It represents the third ADR cycle, and focusses on automating the process of identifying community assets developed in the Hounslow case study.

LocalNets functionality developed significantly during this case study. Functionality was added to automatically parse tweets for mentions of people, places, organisations and events - community assets. It ranked the assets by the number of times they were mentioned. When Twitter accounts were frequently mentioned, they could be added to the set of accounts from which tweets were collected. A more user-friendly interface was developed in conjunction with TABLEFLIP, and this included a tool for shortlisting Twitter accounts of interest, for example, accounts of individuals to be invited to the focus groups.

The approach to automation drew on costly signalling theory, which became ‘ingrained’ in the software. Interventions were conducted through two focus groups. Automated community asset detection was also tested across Peterborough and four other pilot communities selected by DCLG.

6.1 Problem formulation

Selecting research partners in response to previous case studies

The Hounslow case study instilled confidence that Twitter social media analytics could generate information relevant to the RSA. However, the manual coding process meant that scaling the research was difficult, as coding required a significant amount of time. The Peterborough and Bretton case study responds to this limitation by automating the asset discovery process to obviate the need for manual processing. It also builds on the Hounslow case study by continuing the relationship with DCLG and the RSA. In both cases the partners felt that there was scope for further investigation of the ways that LocalNets could contribute to their institutions. For DCLG this included moving from a broad investigatory phase to the specific goal of finding ACVs in Peterborough and in four further exploratory test sites.

The CX program, which supported this PhD research, offered resources to work with non-academic partners. At the outset of the Peterborough and Bretton case study, an opportunity was identified to draw on these resources to engage a web development company. The web development company, TABLEFLIP, worked to improve the user interface for LocalNets so that it would be sufficiently user-friendly for other researchers to use it; to this point, I had personally operated the LocalNets software. This goal was not in itself a research objective. Instead, it was anticipated that increased use of LocalNets could generate more institutional feedback in future ADR cycles by allowing more researchers to use it. The work with TABLEFLIP did not draw on theoretical considerations. As it remained separate from the work addressing the research objectives, the collaboration with TABLEFLIP is treated separately throughout the write-up of the case study.

Case study overview

This third case study took place in the city of Peterborough, UK, between January 2015 and January 2016. Within the city, administrative divisions of the council are known as parishes. In addition to considering Peterborough as a whole, the research focused specifically on the parish of Bretton. Focus groups were conducted in both locations. The case study also examined four other pilot areas selected by DCLG, in which LocalNets was used to identify community assets but focus groups were not conducted. Along with the Hounslow case study, the research in Bretton featured in the RSA *Connected Communities* report.[244]

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[244] Parsfield, et al., 2015

Partners

Partner	**Goal**	**Contribution to Research**
Jimmy Tidey	Automating LocalNets' community asset identification function, testing LocalNets in non-market institutional context	Providing data from the LocalNets software; conducting focus groups; analyzing focus group results; testing LocalNets ability to detect community assets that could be subject to ACV legislation
RSA	Research in Peterborough as part of their *Connected Communities* report	Ethnographic data on the community in Bretton in Peterborough
Dr Manjit Bola, School of Social Work, Care and Community, University of Central Lancashire	Research focusing on Mental Health, Equality and Diversity, Health and Social Care	Facilitation of the Bretton focus group
DCLG	Promoting of the Assets of Community Value legislation	Feedback on LocalNets improvement
TABLEFLIP	Developing user interfaces for LocalNets	Software development
Peterborough Civic Society	Promoting the understanding of community legislation	Members came to the Peterborough-wide focus group
Civic Voice	Promoting the understanding of the Localism Act	Led the Peterborough-wide focus group
Mitchell Centre for Social Network Analysis, Manchester University	'Critical friend' to the research through CX program	Provided advice on survey techniques

Table 5. Peterborough project partners

Case study objectives

In Peterborough, the goal was to investigate ways of using LocalNets data, moving beyond validation towards active use. Four case study objectives emerged from the planning discussions with the partners:

1. To evaluate visualisations of social media data with DCLG and the focus groups.

2. To evaluate the potential for ‘community assets’ to be automatically identified using the Twitter data, also working with DCLG.

3. To evaluate community members’ recognition of the community assets that LocalNets indicated were prominent within the community.

4. To test LocalNets as a tool for creating effective focus groups, drawing on social capital theory.

Case study structure

The Peterborough project was the first research project formally signed off through the CX process for working with partners. This allowed funds from the CX to be used to appoint an external software development company to assist with development of LocalNets. In an initial meeting, DCLG indicated that one of their key objectives was to increase the uptake of the recent community rights legislation. The Localism Act 2011 grants a set of rights to individuals to give them more control over their local community. DCLG believed that awareness of these rights was low, and the department wanted to increase their use. In particular, the Assets of Community Value (ACV) aspect of the Localism Act was thought to be fertile ground for promotion. ACV status can be conferred on a building within a community when 21 residents sign a petition confirming its value to the community, providing it meets other criteria, including that it is currently in use by the community. This grants a range of protections to the asset. For example, the community have six months to buy the building at market price if it comes up for sale.

During the planning process for this project, the decision was taken to run two focus groups, a city-wide one in Peterborough and another restricted to the parish of Bretton, within Peterborough. This reflects two of the partners' divergent goals: the RSA's prior commitment as part of their *Connected Communities* project to investigate community capital and social connections in Bretton and DCLG's existing outreach work at the level of the whole city. Partners were then sought to help deliver both focus groups.

Finally, the Mitchell Centre for Social Network Analysis at Manchester University was approached as an academic partner, in line with the CX model that intended to include academic and industry partners for projects. The constrained time scales meant they could not be formally engaged, but Dr Elisa Bellotti and Dr Susan O'Shea were able to offer methodological guidance in relation to the sociometric surveys.

6.2 Theory and design decisions

Design overview

Case Study Objective 1 (visualising data) drew on existing functionality, specifically the ability to export to data to Gephi, the network visualisation tool.

Case Study Objectives 2 and 3 required new functionality to be added to the software. Responding to DCLG's interest in the Assets of Community Value legislation, LocalNets set out to investigate the possibility of discovering community assets relevant to ACV legislation from Twitter data. Manually coding community assets across five sites would be prohibitively time consuming, as would manually finding Twitter accounts focused on the local area. Approaches to automation were investigated to address this challenge.

Case Study Objective 4 could be met by the existing functionality of LocalNets, but served as an opportunity to further investigate the social-capital-informed design decisions built into LocalNets in the previous case study.

Theory: costly signalling

The case study drew upon the theory of 'costly signalling' to support the automation of community asset detection. Donath outlines the idea of costly signalling in her paper 'Signals in Social Supernets'.[245] It borrows from the field of biology, where costly signalling is used to explain phenomena such as peacocks' extravagant tails or very large antlers on moose.[246] Large antlers are metabolically expensive to create and carry, yet they are not useful for fighting or foraging. Rather than directly helping the moose survive, the antlers serve a signalling function: to demonstrate to potential mates that the underlying genetic fitness of the animal is so great that it can survive despite the size of its antlers.[247] Zahavi describes this using the – possibly outdated – phrase 'handicap principle’.[248] Antlers are a powerful signal precisely because they are ‘costly’, in the sense that there is no way to cheat and create large antlers without incurring the metabolic cost and subsequent inconvenience. A peacock’s tail functions the same way: the energy used to create the cumbersome tail signals the animal’s fitness.

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[245] Donath, 2007
[246] Dawkins, 1993
[247] Donath, 2007

The concept can also be applied to human behaviour: for example, Donath highlights Spence’s analysis of job markets through signalling theory.[249] In terms of less directly market-oriented behaviour, Donath gives the example of tanned skin as a signal that one can afford expensive holidays. Tanned skin is a signal that has been subverted: ‘Once tanned skin became a signal of status and luxury, humans invented tanning beds and spray-on skin coloring’. [250] In social networks, Donath gives an analogous example of the status that accrues to people with a large number of ‘friends’ on a social network, a signal that is subverted when ‘users invented fake friends and software for automating connections’. This example is directly relevant to LocalNets, in which the goal was to find community assets that were authentically valued by a community, rather than those that appeared to be highly valued because of artefacts of the data gathering process.

Applicability and other work

Xie and Mao draw on Donath’s application of costly signalling to evaluate the perceived trustworthiness of Airbnb profile pages.[251] They conclude that ‘Our findings have direct implications for improving the design of profile pages on sharing economy sites and services’. Their work highlights the potential application of costly signals to designing software where trust is a design consideration. Guo et al. categorise interactions across six social media sites into two sets: ‘articulated friendship’, that explicitly indicates a social relationship: for example, ‘following’ on Twitter – and communication interactions – for example, @mentions on Twitter. In their research they draw on a signalling model, stating that ‘Signaling theory helps explain why certain online communications are more reliable than others based on their associated costs', and find that communication interactions are more socially influential than articulated friendship relationships. They do not apply their work to a specific context, but state that it is relevant to 'social media marketing as well as the management of virtual communities'.[252] The application of signalling theory in social media analytics for non-market contexts is less well explored, conforming with the wider paucity of investigation into social media analytics for 'everyday life' circumstances in the public sector.[253]

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[248] Zahavi, 1975

[249] Spence, 1978

[250] Donath, 2007

[251] Xie, & Mao, 2017

Theory Ingraining and design choices

This section reflects on the extent to which costly signalling was, in the language of ADR, ingrained in LocalNets.

One approach to finding suitable Twitter accounts for LocalNets to collect tweets from was to start with a small set of accounts known to be relevant to Peterborough. LocalNets could then automatically 'discover' other Twitter users who followed, or who were followed by, the initial set of accounts. This process could be used to increase the number of Twitter accounts from which LocalNets collected data, helping to reduce the manual work of finding relevant Twitter accounts. An alternative approach would have been to start with the same initial set of relevant Twitter users and automatically 'discover' other accounts that frequently exchange @mentions with the initial set.

The theory of costly signalling suggests that the more time or resources an activity takes, the more accurately the activity signals a person's intentions. In this case, it was felt that maintaining a flow of messages takes more time than the one-off act of 'following' someone, and therefore would more accurately reflect their social connections.

Donath's 'costly signalling' concept suggests that two users who have exchanged many messages are likely to be investing time in their relationship. Conversely, for one user to follow another demonstrates only a very low level of time investment. Following also represents a binary – following or not following: a user cannot ‘double follow’ someone if they are particularly interested in them. However, they can exchange many messages, which can be taken to express something about the intensity of the relationship and the amount of time invested in it. Following someone means you will have to see their subsequent messages on your timeline, but for accounts that only send a small volume of tweets this may rarely happen. For these reasons, the subsequent research focused on the network of Twitter users who @mention one another, rather than the network of Twitter users who follow one another. This decision is supported by evidence that Twitter users typically follow more individuals than they mention. It is also supported by Guo et al.’s work showing that messaging behaviours are more effective a predicting group membership than explicit ‘following’ behaviours.[254,255] Costly signalling theory was ingrained by the choice of mentioning behaviours, rather than following behaviours, to find community assets using Twitter data. While costly signalling shaped design decisions in LocalNets, the software did not seek to quantitively evaluate theory of costly signalling.

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[252] Guo, et al, 2015

[253] Bødker, & Zander, 2015

Further design choices and work with TABLEFLIP

TABLEFLIP were engaged to accelerate the development process and improve the user interface. It was hoped that an easier-to-use interface would allow a wider range of people to understand and operate LocalNets. The ambition was that independent researchers or local government employees might able to use the tool, increasing its utility and also providing more extensive feedback for further improvements.

TABLEFLIP were also asked to add specific functionality to allow the ‘shortlisting’ of individuals who might be chosen to attend a focus group or who indicated interest in a particular topic. This functionality was requested in response to previous work, where the ‘shortlisting’ process was carried out using spreadsheets and became slow and unwieldy.

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[254] Guo, et al, 2015

[255] Kato, et al., 2012

6.3 Build

This section describes the mature version of LocalNets, and provides a high level of detail to fully articulate the underlying structure of the platform. The manual processes used in the Hounslow version were automated as described below. The structure of the database was also improved. Before the Peterborough and Bretton case study, the LocalNets database stored two very similar types of data separately: the network of interactions between Twitter users in one table, and the community assets and their connections to Twitter users in another. The new structure combined both types of data, making it easier to interrogate.

LocalNets technical architecture

Figure 21 describes the technical architecture of LocalNets, showing the database tables, processes and interactions with external services.

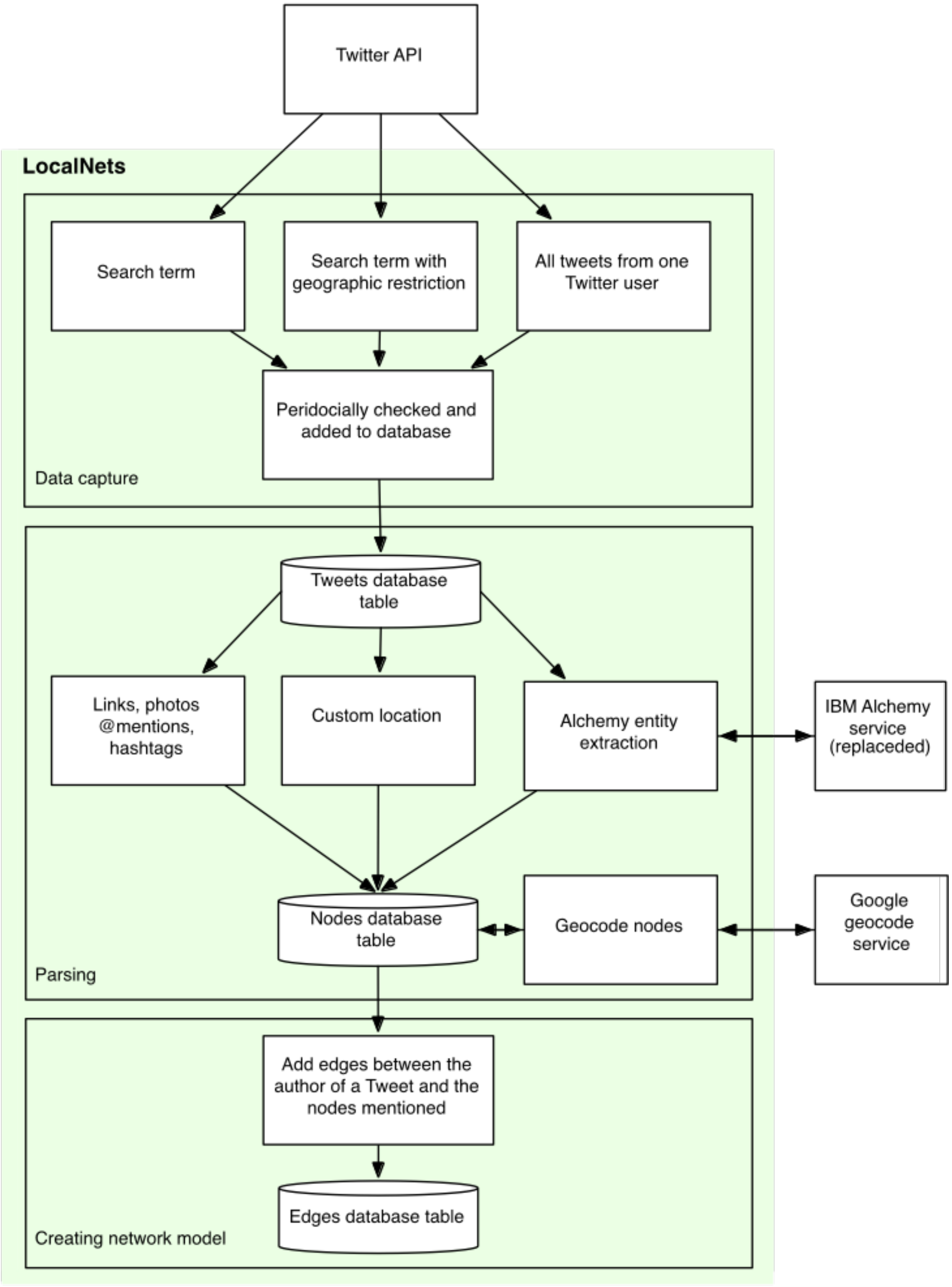

Twitter API
LocalNets
Search term
Search term with geographic restriction
All tweets from one Twitter user
Peridocially checked and added to database
Data capture
Tweets database table
Links, photos @mentions, hashtags
Custom location
Alchemy entity extraction
IBM Alchemy service (replaceded)
Nodes database table
Geocode nodes
Google geocode service
Parsing
Add edges between the author of a Tweet and the nodes mentioned
Edges database table
Creating network model

Figure 21. Simplified diagram of LocalNets behaviour. The IBM alchemy service was subsequently replaced with an open-source equivalent. This decision is described in the fourth case study.

The LocalNets software is based on a network-oriented architecture, in line with the network structure of Twitter users mentioning one another. This notion is extended to include a network not just of Twitter users but also of the things they talk about, such as hashtags, places and links. All of these items are considered nodes in LocalNets, and they are connected by edges to create a graph structure.

In the data capture part of the software, a timer regularly checks for new data on Twitter. The frequency of checks has to be limited, because Twitter will block an application that makes too many requests. LocalNets offered three possible sources of data. First, all tweets from one Twitter user can be collected; second, all tweets using a particular term can be collected – often that term will be a hashtag. Search terms frequently return a large number of tweets, so a third option allows the results to be limited to tweets which contained the search term and which Twitter had located as within 10km of a location. To this end, a user interface was provided to enter a latitude and longitude of the project. Any duplicate tweets are automatically discarded.

The nodes and edges database model

Once tweets were collected they were parsed to see if they contained relevant nodes. Nodes were extracted from the tweets in three ways. First, Twitter provides a list of 'entities' automatically - if a user mentions another user, uses a link, hashtag or adds a photo, Twitter extracts that data from the text of the tweet and provides data on that entity in the dataset returned from the API. This list of entities added to the database includes the author of the tweet. Each of these entities was added to the database table of nodes. When adding to the database of nodes, if a node already existed, no action was taken. Secondly, the text of the tweet is sent to an automatic entity extraction system called Alchemy, provided by IBM. The data is regularly sent to the Alchemy service, which returns a list of any 'nouns' mentioned, and what type of object that noun refers to, such as a person, place, company or country. These were added to the database table of nodes. Finally, it was observed that many place names went unrecognised. Therefore, an additional system was added which looked for uses of a predefined list of words often associated with places, including 'street', 'st.', 'road' and 'park'. It then checked to see if the preceding words were capitalised. If they were, the whole phrase was taken to be a place name. These place names were added to the database table of nodes.

For every new node added to the database (except nodes representing Twitter users), the name of the node was sent to the Google geocoding API. The geocoding API attempted to identify the latitude and longitude associated with that term using Google’s database of place names and coordinates. If the term was found to be within 10km of the project, the node was given a location property.

The nodes were joined by ‘edges’. Edges are said to exist between a Twitter user’s node and any nodes that are contained in a tweet that they authored. Taken together, the nodes and edges form a network.

Two other steps are taken when this process is completed. First, location is assigned to the individual tweets where possible. Some tweets have a location associated with them by Twitter itself. If the author of the tweet has enabled location sharing, the user’s location at the time they tweeted is made available as metadata through the API. If that metadata is not present, but a node mentioned in the tweet has a location, the tweet itself inherits the location of that node.

Twitter is queried periodically to obtain data about every node that is a Twitter user, including an up-to-date photo and biography. LocalNets then attempts to locate that Twitter user geographically, first by using metadata supplied from Twitter (Twitter users can state their location as part of their Twitter profile), second by parsing their biography for place names, and finally by taking an 'intelligent' average of the location of all of their tweets, excluding geographic outliers.

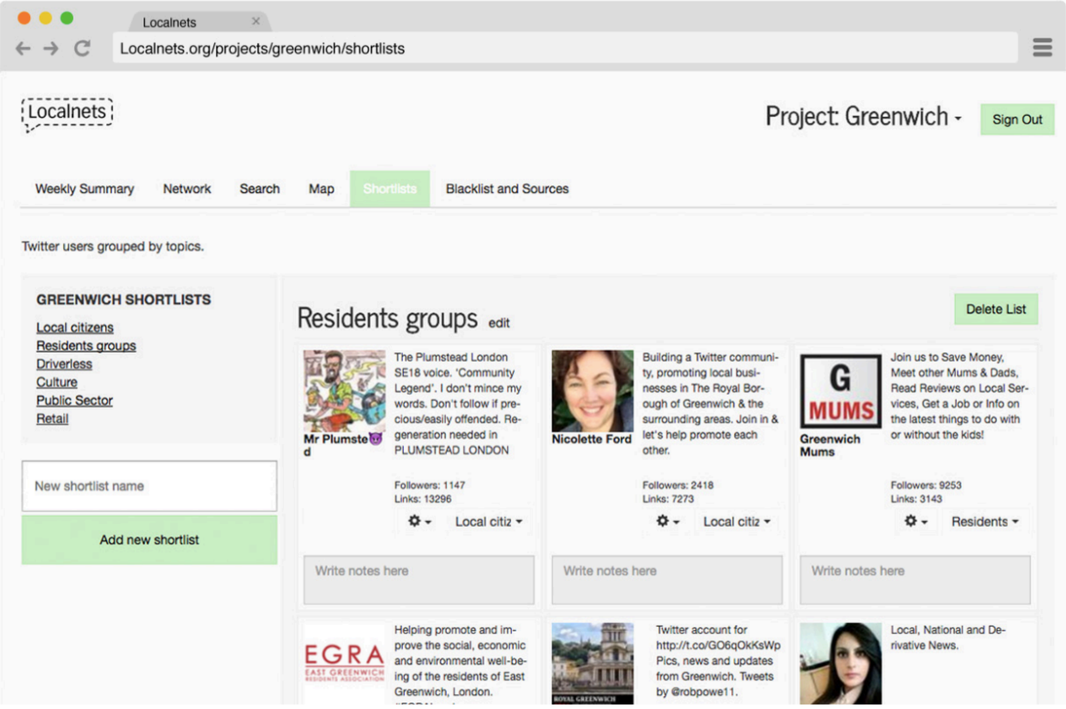
Working with TABLEFLIP to build the ‘public-facing’ user interface

TABLEFLIP worked on adding a new user interface using the existing LocalNets database. The final design was, subjectively, easier to use and allowed projects to be created and monitored more easily. Figures 23 and 24 show a comparison of the same page in the admin section of LocalNets. This design work did not change the underlying database, or any of the processing algorithms.

Although the TABLEFLIP pages acted as the primary interface after their creation, the old interface was retained because it had some functionality not available in the new interface. The old interface was subsequently referred to as the ‘admin’ interface.

Working with TABLEFLIP to add shortlisting functionality

As part of the ‘user-facing’ interface, functionality to create shortlists of Twitter accounts was added. During projects, it was often useful to create a shortlist of Twitter users who, for example, were potential candidates to attend a focus group. Profile images, Twitter names and profile descriptions would be presented to project partners and discussed, and, if appropriate, those Twitter users were approached to complete a survey or attend a focus group. Before TABLEFLIP added shortlisting functionality, spreadsheets had been used. This feature made projects easier to manage. The direct quantitative comparisons made in the Hounslow case study were not changed by the introduction of this new user interface (shown in Figure 22).


Localnets
Localnets.org/projects/greenwich/shortlists
Localnets
Project: Greenwich
Sign Out
Weekly Summary
Network
Search
Map
Shortlists
Blacklist and Sources
GREENWICH SHORTLISTS
Local citizens
Residents groups
Driverless
Culture
Public Sector
Retail
New shortlist name
Add new shortlist
Residents groups
edit
Delete List
Mr Plumsted
Nicolette Ford
Greenwich Mums
Local citiz
Local citiz
Residents
Write notes here
Write notes here
Write notes here
EGRA EAST GREENWICH RESIDENTS ASSOCIATION
ROYAL GREENWICH

Twitter users grouped by topics.

Mr Plumsted: The Plumstead London SE18 voice. 'Community Legend'. I don't mince my words. Don't follow if precious/easily offended. Regeneration needed in PLUMSTEAD LONDON

Followers: 1147
Links: 13296

Nicolette Ford: Building a Twitter community, promoting local businesses in The Royal Borough of Greenwich & the surrounding areas. Join in & let's help promote each other.

Followers: 2418
Links: 7273

Greenwich Mums: Join us to Save Money, Meet other Mums & Dads, Read Reviews on Local Services, Get a Job or Info on the latest things to do with or without the kids!

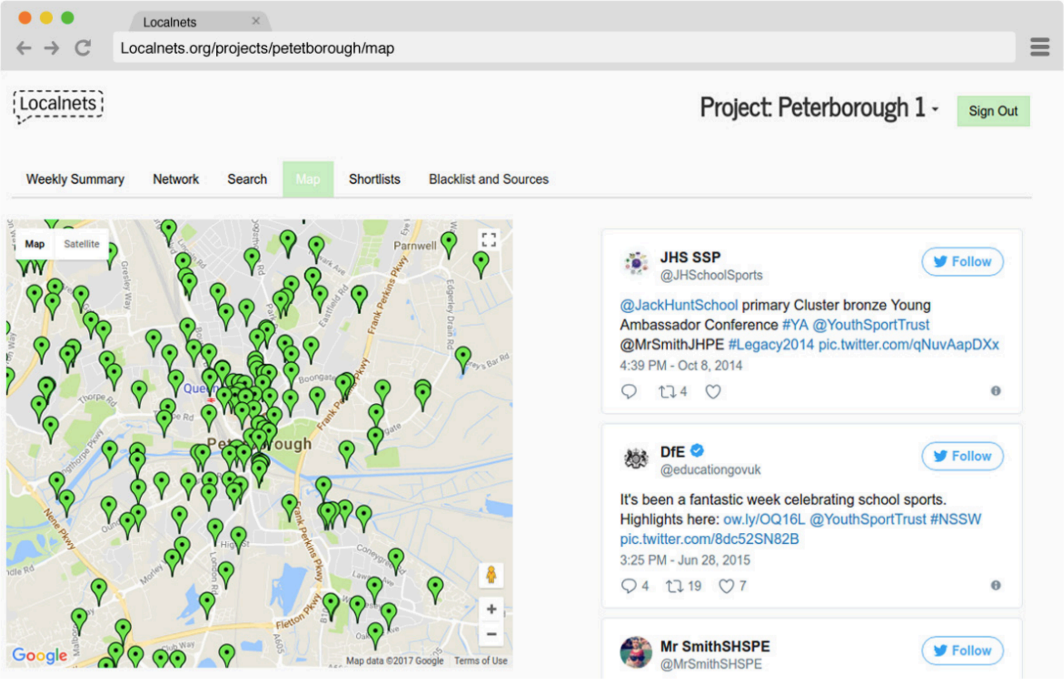
Followers: 9253
Links: 3143

Helping promote and improve the social, economic and environmental well-being of the residents of East Greenwich, London.

Twitter account for http://t.co/GO6qOkKsWp Pics, news and updates from Greenwich. Tweets by @robpowe11.

Local, National and Derivative News.

Figure 22. LocalNets front end, showing shortlists view


Localnets
Localnets.org/projects/petetborough/map
Localnets
Project: Peterborough 1
Sign Out
Weekly Summary
Network
Search
Map
Shortlists
Blacklist and Sources
Map
Satellite
Parnwell
Peterborough
Frank Perkins Pkwy
Nene Pkwy
Fletton Pkwy
Thorpe Rd
London Rd
Google
Map data ©2017 Google
Terms of Use
Follow
Follow
Follow

JHS SSP
@JHSchoolSports

@JackHuntSchool primary Cluster bronze Young Ambassador Conference #YA @YouthSportTrust @MrSmithJHPE #Legacy2014 pic.twitter.com/qNuvAapDXx

4:39 PM - Oct 8, 2014

4

DfE
@educationgovuk

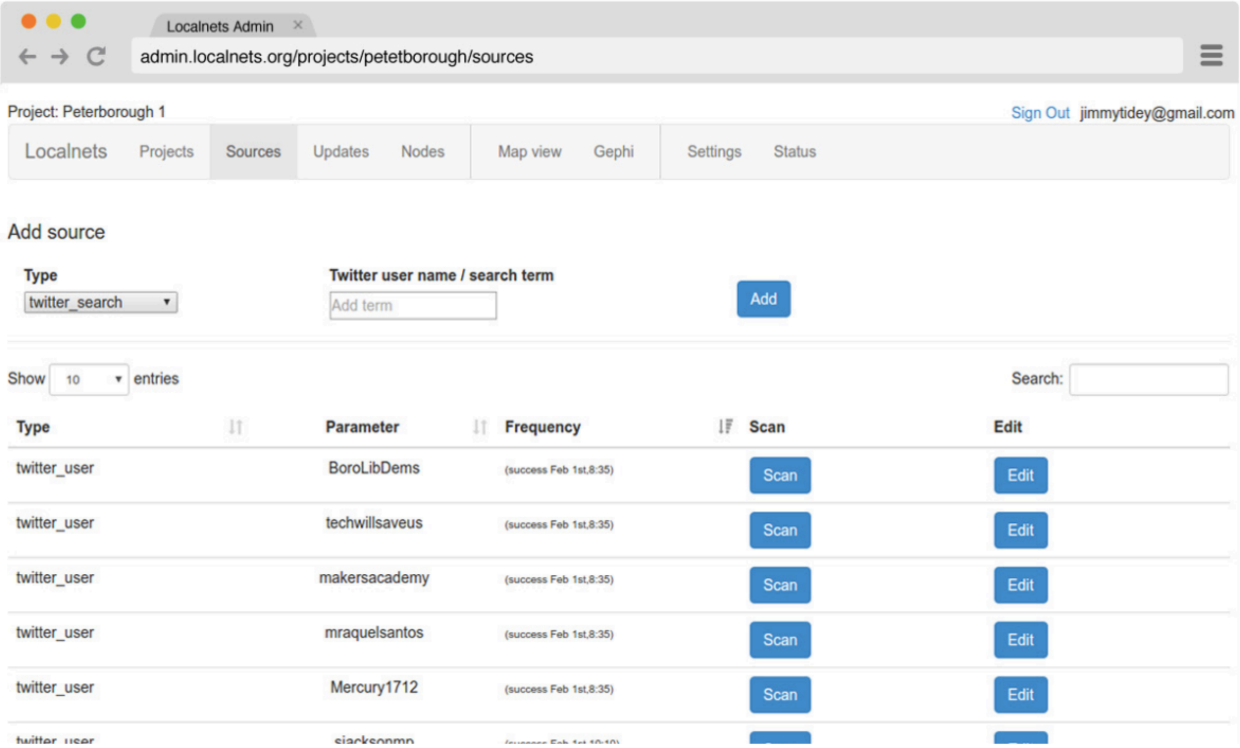
It's been a fantastic week celebrating school sports. Highlights here: ow.ly/OQ16L @YouthSportTrust #NSSW pic.twitter.com/8dc52SN82B

3:25 PM - Jun 28, 2015

4 19 7

Mr SmithSHSPE
@MrSmithSHSPE

Figure 23. LocalNets front end, built with TABLEFLIP, showing map view


Localnets Admin
admin.localnets.org/projects/petetborough/sources
Project: Peterborough 1
Sign Out
jimmytidey@gmail.com
Localnets
Projects
Sources
Updates
Nodes
Map view
Gephi
Settings
Status
Add source
Type
twitter_search
Twitter user name / search term
Add term
Add
Show 10 entries
Search:

Type	Parameter	Frequency	Scan	Edit
twitter_user	BoroLibDems	(success Feb 1st,8:35)	Scan	Edit
twitter_user	techwillsaveus	(success Feb 1st,8:35)	Scan	Edit
twitter_user	makersacademy	(success Feb 1st,8:35)	Scan	Edit
twitter_user	mraquelsantos	(success Feb 1st,8:35)	Scan	Edit
twitter_user	Mercury1712	(success Feb 1st,8:35)	Scan	Edit

Figure 24. LocalNets admin tool, screen for adding new Twitter accounts as sources. This interface was built in the prototyping case study and remained present throughout.

Improvements to the ‘admin’ interface

The community nodes page of the LocalNets platform was improved during the Peterborough case study and the list of community nodes was made searchable. It also displayed a ranking of each node’s prominence in the network in terms of the number of times it received an inbound message, and, next to it, an indicator of whether that account was already a ‘source’: that is, whether the system was recording messages from that account (their tweets may have been collected because an existing source was @mentioning them). Through this list, the user could find and quickly add relevant accounts and build a more comprehensive picture of the local conversation. Hashtags could also be found this way, and the number of inbound links to a hashtag represented the number of times it had been mentioned.

Summary of features added during the ADR cycle

- Automatic detection of community asset ‘nodes’ using Twitter metadata
- Automatic detection of community asset ‘nodes’ using natural language processing
- Automatic detection of community asset ‘nodes’ using a custom filter to find place names
- Ranking of community assets by number of mentions
- Ability to add frequently mentioned Twitter accounts to list of accounts from which tweets were being collected.
- Geocoding of community nodes
- New database model based on a graph of community nodes
- ‘User-facing’ interface with shortlisting functionality - the ‘front end’ developed by TABLEFLIP

As described in the ‘Design choices, constraints and partners’ section of this chapter, these features responded to the ambitions of DCLG and the RSA in this case study, as well as to the theoretical consideration of costly signalling. The evaluation of the interventions in, and reflection on, the case study considers how the theories played out in the case study.

6.4 Interventions

This section will discuss the interventions that were undertaken in order to address the research objectives identified in the problem formulation.

Meetings were planned with DCLG to evaluate LocalNets' success in visualising community assets (Research Objective 1), and also in identifying community assets for listing as assets of community value, both in Peterborough and the four other pilot areas (Research Objective 2).

Further, two focus groups were agreed, one run by Dr Bola in the Bretton parish in Peterborough, the site for the RSA's *Connected Communities* project, and one in the city centre. This second focus group was delivered through DCLG's existing contract with Civic Voice, a national charity that supports civic activity in the UK. In both focus groups a survey was administered to establish how data from the LocalNets tool matched participants' understanding of their community (Research Objective 3). The survey also asked participants about their social connections to one another, to understand from a social capital perspective how LocalNets shaped the formation of the focus group (Research Objective 4).

The timing of the focus groups had to be considered in light of the upcoming May 2015 general election in the UK. Before the general election a period of 'purdah' meant that DCLG was unable to engage in any contact with the public that could be seen as influencing voter opinion in the upcoming election. Purdah began on 30 March, and initially it was believed that focus groups could not be conducted during this time. Ultimately it was agreed that focus groups would not be construed as influencing voters and therefore could be conducted during purdah.

LocalNets In Use

This section describes how LocalNets was deployed in Peterborough. Search terms and Twitter accounts had to be chosen, referred to in the software as 'sources'.

In total, 133 sources were added:

- Fifty-six of these were discovered by LocalNets automatically. Starting with the Twitter account for Peterborough City Council (@peterboroughcc), the software automatically detected other accounts the official city council account was interacting with. These could be added as sources, which generated a snowball effect. This process also led to the discovery of two local hashtags (#Pboro, #lovepeterborough). This process used the feature of LocalNets that drew on signalling theory: that is, it reflected the number of 'mention' interactions between Twitter users and the Peterborough City Council Twitter account.

- Keywords of interest to DCLG. DCLG provided 36 search terms – for example, 'recreation ground' – which were of particular interest to them.

- Manual adding, as described in the Hounslow case study.

- Finally, the data from the RSA's ethnographic survey was used to find institutions with Twitter accounts that could not be found any other way. This resulted in the addition of five more accounts.

Peterborough

The Peterborough focus group was held on a Saturday morning in a town centre location. It was hosted by Peterborough Civic Society, and focused on articulating the Localism Act to their members. In Peterborough it proved difficult to get participants to attend by inviting them on Twitter. There were only six attendees out of 54 invitations sent through Twitter; the remainder were invited through Peterborough Civic Society's network.

A facilitator from Civic Voice ran the focus group event. He spoke on the topic of the Localism Act and the provision for ACVs, giving practical examples of instances in which his organisation had helped to register assets. Attendees were provided with a survey as a handout with questions about social connections between those attending, both online and offline. Participants were also given a list of Twitter accounts identified as prominent in the local community by LocalNets, and asked if they had social connections with the owners of the accounts or the institutions the accounts belonged to.

Bretton

In the Bretton case study, six people were invited to a focus group, all of whom had a presence on Twitter that was discovered through LocalNets. They were selected on the basis that they were active in Bretton and had the highest number of messages exchanged with other accounts, indicating their prominence in the online social network around Bretton. While some of them had personal Twitter accounts, others came as representatives of local organisations that were found on Twitter. Two were teachers: one of these had a personal profile, while the other ran the school's Twitter account. A local minister came, who was also invited via a personal profile. Bretton Parish Council had a presence on Twitter and sent two councillors to the meeting; the local library sent one person who ran their institutional account.

In Bretton, finding participants was easier than in the Peterborough-wide focus group: seven out of ten invitees were able to attend. The teachers were able to provide space in their school, a location that everyone knew and was able to get to. Assistance with transport costs was offered, but no one accepted this. Dr Bola coordinated the invitation process, sending invitations to institutions including the school, library and parish council. Rather than attending informally or as volunteers, individuals came in a professional capacity during work hours. This may have contributed to improved attendance, as may the fact that the library and the parish council were asked to send someone, but not a specific person, allowing more flexibility in the invitations.

Structure of the evaluation

For the first three case study objectives, either the distinction between the two focus groups is irrelevant (1, focusing on visualisation and 2, on finding community assets), or the results can be better addressed together (3, recognition of community assets). Objective 4 pertains to social capital in the focus groups individually, and so is discussed separately for each focus group.

6.5 Case Study Objective 1: visualising data

Data visualisation was undertaken for use in the focus groups and for DCLG to evaluate. Responses to the visualisations were used to inform improvements in LocalNets.

Visualising data for focus groups

The focus groups represented an opportunity to collect feedback on the visualisations being generated.

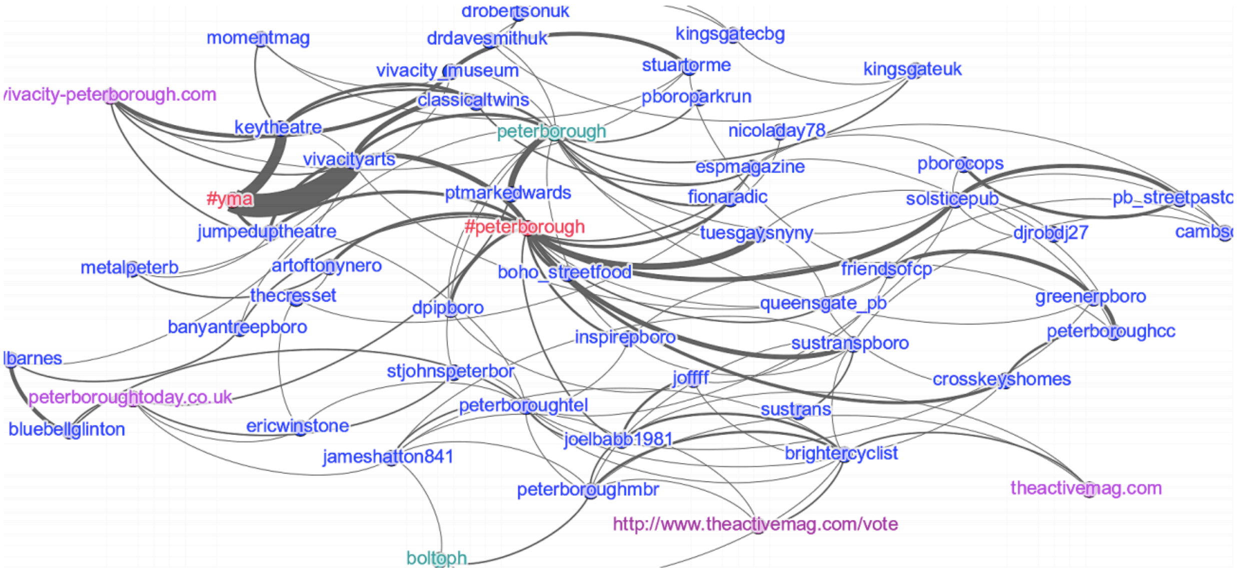

drobertsonuk
momentmag
drdavesmithuk
kingsgatecbg
vivacity_museum
stuartorme
kingsgateuk
ivacity-peterborough.com
classicaltwins
pboroparkrun
keytheatre
peterborough
nicoladay78
vivacityarts
espmagazine
pborocops
#yma
ptmarkedwards
fionaradic
solsticepub
pb_streetpastc
jumpeduptheatre
#peterborough
tuesgaysnyny
djrobdj27
cambs
metalpeterb
artoftonynero
boho_streetfood
friendsofcp
thecresset
greenerpboro
dpipboro
queensgate_pb
banyantreepboro
inspirepboro
peterboroughcc
sustranspboro
lbarnes
stjohnspeterbor
joffff
crosskeyshomes
peterboroughtoday.co.uk
peterboroughtel
sustrans
bluebellglinton
ericwinstone
joelbabb1981
brightercyclist
jameshatton841
theactivemag.com
peterboroughmbr
http://www.theactivemag.com/vote
boltoph

Figure 25. Bretton Network. In this diagram line thickness indicates the number of connections (mentions) between two nodes. Colour represents type: red is a hashtag, pink is a website, green is a geographic location and blue is a Twitter account.

The number of tasks that had to be completed in the focus group meant that only limited time could be spent on the data visualisations. Participants were asked simply to reflect on what they thought of the diagrams. A structured approach to evaluating the visualisations would have been preferred, in which participants could have been asked to complete a task, such as identifying the most linked nodes, or relating the visualisation to the geography of the community. These kinds of tasks are often used in the research presented in Appendix F.

Instead, participants were asked for their views on the diagrams after an explanation of the colours, line thicknesses and node names. Neither group was predisposed to sustain discussion on the meaning of the network diagrams.

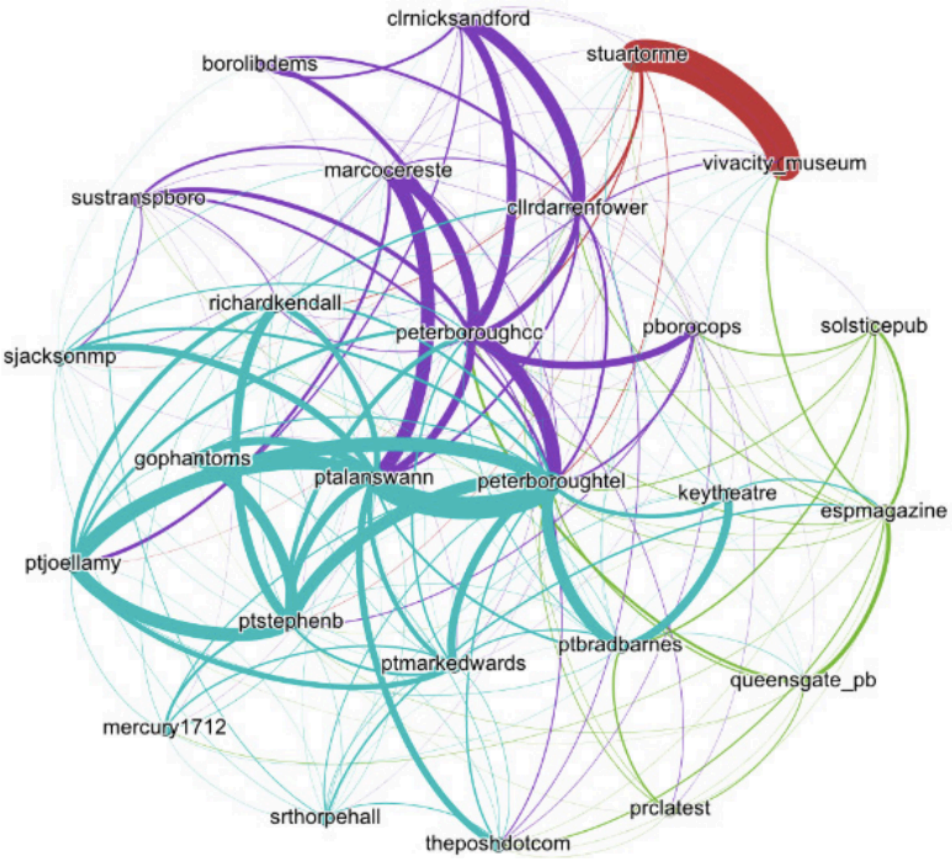

clmicksandford
borolibdems
stuartorme
vivacity_museum
marcocereste
sustranspboro
cllrdarrenfower
richardkendall
peterboroughcc
pborocops
solsticepub
sjacksonmp
gophantoms
ptalanswann
peterboroughtel
keytheatre
espmagazine
ptjoellamy
ptstephenb
ptbradbarnes
ptmarkedwards
queensgate_pb
mercury1712
prclatest
srthorpehall
theposhdotcom

Figure 26. Peterborough-wide network. Diagram shows only Twitter accounts. Line thickness indicates the number of mentions in the network, and colour represents algorithmically determined communities using the Gephi modularity function.

Visualising data for DCLG

DCLG was interested in understanding what topics were being discussed, and expressed an interest in a ‘Wordle’ of the data rather than the network visualisation. Wordles are typographic representations of keywords in which the size of the font represents the frequency of the keyword. As a fast prototyping technique, text data from the whole of the Peterborough area was extracted and fed into an online Wordle-generating service (textisbeautiful.net). The text used was the entire content of the most recent tweets until the date of the meeting, limited to 50,000 (a limitation of the website).

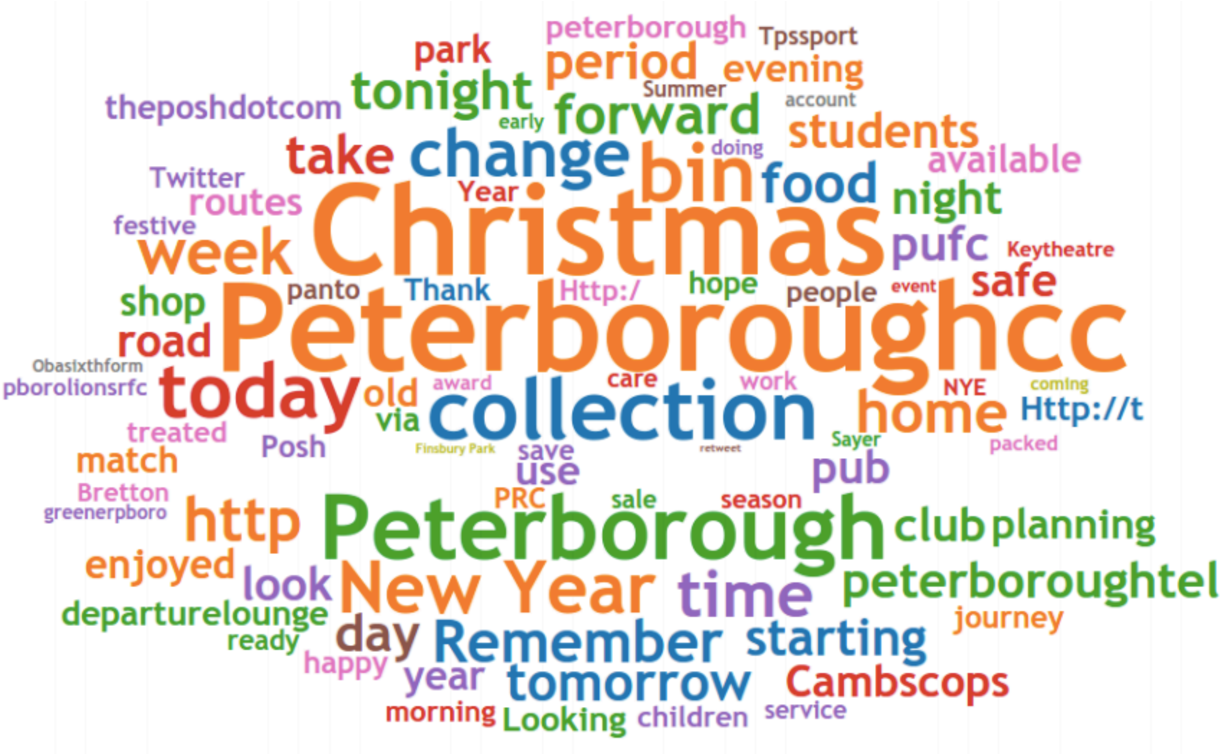


Figure 27. Wordle. Word frequency is represented by size: colour represents algorithmically derived groupings. From TextisBeautiful.com.

DCLG felt these diagrams failed to convey much useful information. It was possible to identify some relevant themes from the keywords, having already become familiar with the issues in the area. For example, ‘club planning’ in the Wordle relates to the closure of the only three nightclubs in Peterborough at the time the data was collected. It would be difficult, however, to understand the relevance of this key phrase out of context.

It is hard to draw conclusions about the visualisations themselves; rather, the problem of identifying local topics of interest stemmed from deficiencies in the underlying data. Data was gathered with a primary concern for network structure, not topics. The ‘Data quality limitations’ section of Chapter 8 addresses this issue, and collects together the experience of using visualisations across the projects undertaken.

6.6 Case Study Objective 2: finding community assets

Promoting the Assets of Community Value (ACV) legislation was a key motivating factor for DCLG's participation in the Peterborough project. DCLG wanted to investigate whether Twitter data could be processed to discover community assets that are eligible for protection by local government under the ACV legislation. DCLG could then contact community groups close to those assets and encourage them to begin the listing process. Beyond Peterborough, four more locations were selected as pilot areas, one from each of the four types of area DCLG designated to help target their ACV campaign:

- Tower Hamlets (Urban growth pressure area)
- Bracknell Forest (High value area)
- Plymouth (Medium value area)
- South Ribble (Weaker land market area)

In each location LocalNets was used in the same way as it had been in Peterborough. As described in the 'Build' section, the tweets were processed by the Alchemy natural language processing service to extract nouns. The Alchemy service also provides categories for the 'noun' terms it returns. Nouns that were assigned the category 'facility' were found to be the only good fit for the concept of a community asset and were taken as relevant 'key phrases'. Place names were also often key phrases that could refer to community assets. Only key phrases identified as facilities or place names were used in the analysis. Additionally, only key phrases that appeared more than twice were used, to avoid a large number of non-relevant terms appearing.

	Key phrases	**Potential ACVs**	**Listed as ACVs**	**Total ACVs in area**
Tower Hamlets	30	9	0	10
Bracknell Forest	42	19	0	5
Plymouth	30	18	0	5
South Ribble	27	20	0	0
Peterborough	164	124	3	9

Table 6. Detection of assets of community value

Table 6 shows the number of raw key phrases identified and, within these, the number of pubs, shops and other places of interest that were potential ACVs, selected by evaluating the list by hand (many key phrases were road names, which cannot be ACVs). 'Listed as ACVs' indicates the number of potential ACVs that have already been awarded ACV status, and 'Total ACVs in area' shows the total number of ACVs in that city or county council.

Conclusions

Finding community assets that would be appropriate for DCLG to act upon requires a series of criteria to be met:

- Those that meet the legal criteria have to be identified;
- Assets need to be under threat;
- Assets must not already have been listed.

The LocalNets platform was not able to meet these criteria at a sufficiently high rate to be useful to DCLG; however, there were signs that further development could make it more effective. More potential ACVs were found in Peterborough than anywhere else, and three of the assets discovered by LocalNets were already listed as ACVs. The higher rate of detection is likely to be influenced by the larger amount of data gathered there. This may indicate that if the system ingested more Twitter data in the other locations it might be more effective.

6.7 Case Study Objective 3: Twitter account recognition

In the Peterborough and Bretton focus groups, a survey was carried out asking participants to indicate whether they recognised any of a list of Twitter accounts that LocalNets had determined were prominent in the local area. Participants could also have been presented with a full list of community assets detect by LocalNets, including those not associated with a Twitter account. This approach was not selected as the goal of the survey was to compare the results with @mentioning behaviour. For each of the Twitter accounts, participants were asked to select from the following options: ‘Don’t know’, ‘Know on Twitter’, ‘Know online (other)’, ‘Know offline’. The goal of the survey was to establish the correlation between data from LocalNets and individuals’ perceptions of the community.

In the Peterborough-wide focus group, participants were presented with the 58 Twitter accounts that had the highest number of connections within the network. In Bretton, the top 44 accounts were presented, but the list also included any institution found in the network with a specific geographic link to Bretton (as determined manually). This was because the small geographic area of Bretton had relatively few locally relevant accounts, and obtaining responses to local accounts was considered important. Over both groups, 45 per cent of the Twitter accounts, or the people or institutions they represented, were recognised by more than half of the participants.

Twitter accounts were presented with their @username and their extended name. Twitter accounts can represent people or organisations, which hinders the analysis of Twitter networks as a pure, single-mode social network representing a single consistent set of entities. In the absence of further data, and because organisational Twitter accounts can reply and are mentioned in the same way as individual people, this analysis does not attempt to distinguish between organisational and personal Twitter accounts.

Type	**Average percentage of Twitter accounts reported as having this type of connection**
Know from Twitter	12
Know from online (not Twitter)	16
Know offline	26
Any kind of connection	45

Table 7. Recognition of Twitter community data

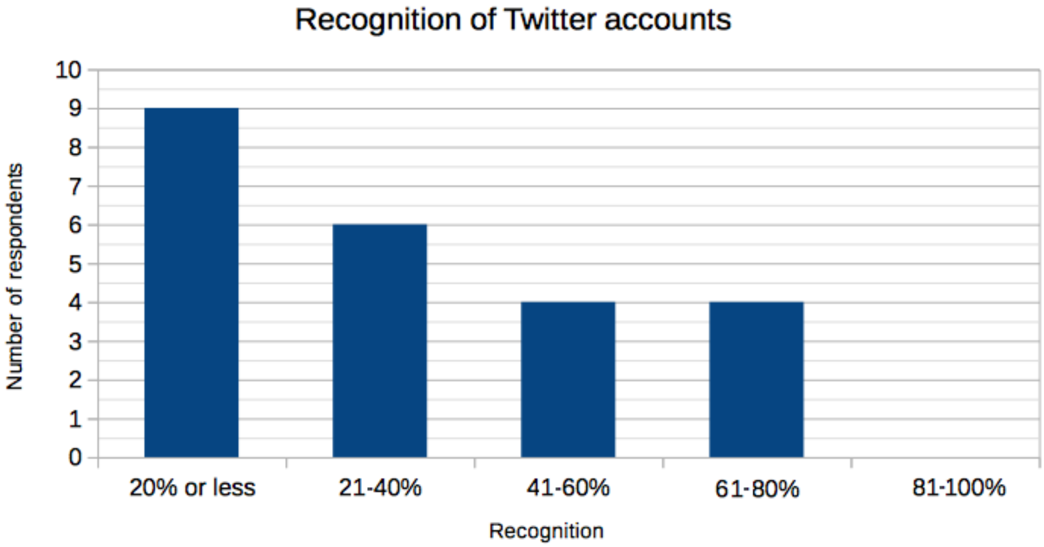


Figure 28. Histogram of the recognition of Twitter accounts (all kinds of recognition)

A Twitter account was ‘recognised’ when a participant gave any response except ‘don’t know’. Pearson’s correlation coefficient was used to evaluate the level of correlation between the number of times a Twitter account was recognised by participants and the metrics of that Twitter account’s importance within the network data generated by LocalNets.

	In Degree	**Out degree**	**Weighted Indegree**	**Weighted Outdegree**	**Betweenness Centrality**
Peterborough	0.55	0.15	0.12	0.07	0.28
Bretton	0.46	0.32	0.31	0.31	0.41

Table 8. Correlation between rates of recognition and network metrics, using Pearson's correlation coefficient

Both weighted and unweighted degrees were considered. The weighted degree measures include the raw number of connections between Twitter accounts ('@mentions'), while the unweighted ones only count unique '@mentions'. For example, in a simple network with two nodes, where Node A has five connections to Node B (A has @mentioned B five times), Node A has a weighted outdegree of five and Node B has a weighted indegree of five. There is only one unique connection between Node A and Node B, so the outdegree for Node A will be one and the indegree for Node B will be one.

'Betweenness centrality' is sometimes used as a metric of the significance of a node in a network.[256] It measures how often a particular node lies on the shortest path between all the other pairs of nodes in the network. Betweenness centrality is shown for comparison with the other metrics.

Overall, the indegree is more predictive of recognition then the outdegree, which is unsurprising because it indicates the number of times a Twitter user has been mentioned by other Twitter users and correlates with how well known they are within the community. A Twitter account with a high outdegree simply mentions a lot of other Twitter users, which might correlate with their activity level on Twitter, but is not directly connected with other users' interest in messaging them. Again, betweenness centrality does not correlate as well as indegree, showing that recognition levels depend on the volume of an individual's inbound messages, regardless of whether those messages are from other accounts which themselves receive a substantial number of inbound links.

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[256] Freeman, 1977

Weighted measures are less correlated than unweighted ones. Unweighted measures are larger for nodes with a diversity of connections, where weighted measures simply measure the total number of connections made. This means the weighted measure might be very high for two Twitter users who are having a long discussion with each other and mentioning each other many times. In this way, an institution or individual who is particularly significant to only one person (or a few people) can achieve a high-weighted degree, while remaining insignificant to the community at large. This may account for weighted measurements' weaker correlation to recognition.

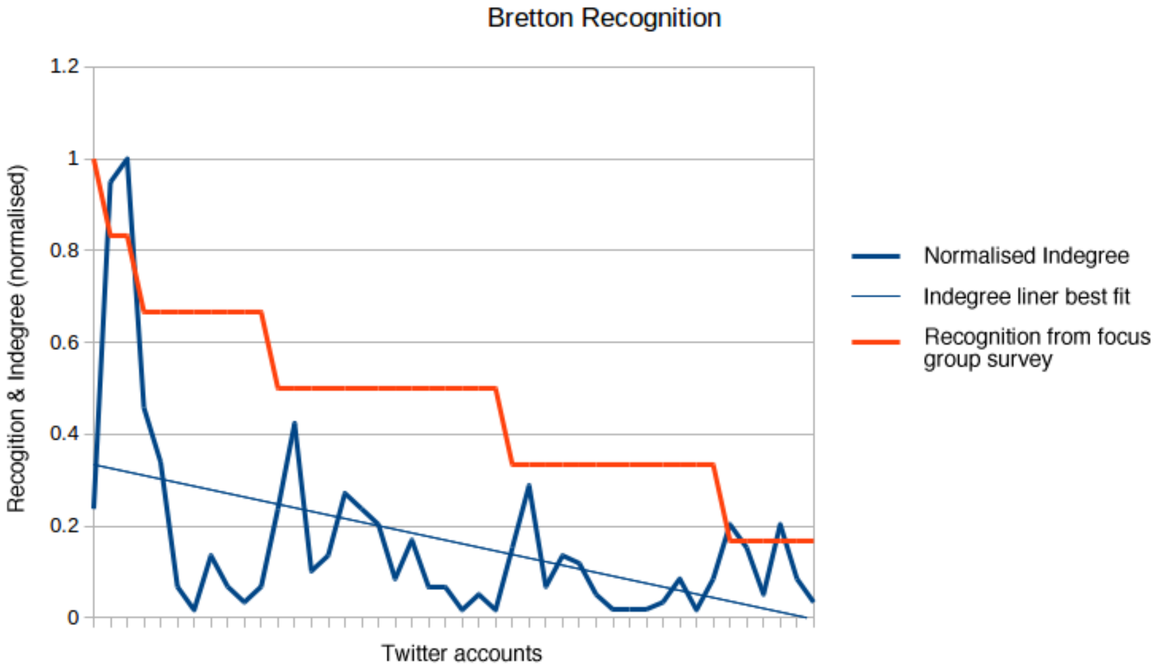


Figure 29. Graph of Twitter recognition in Bretton

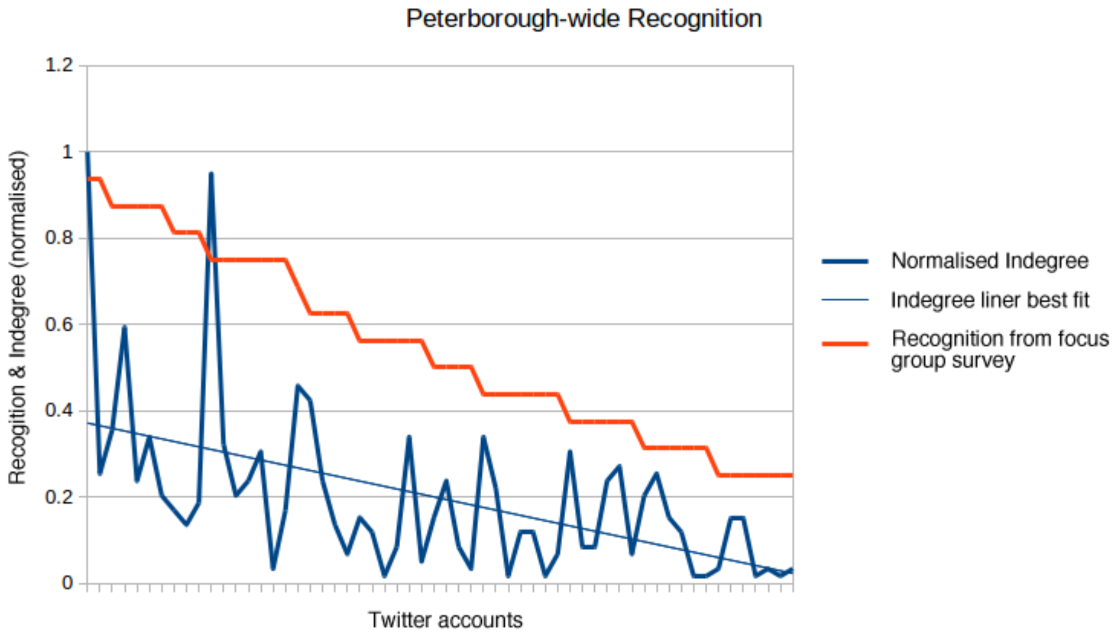


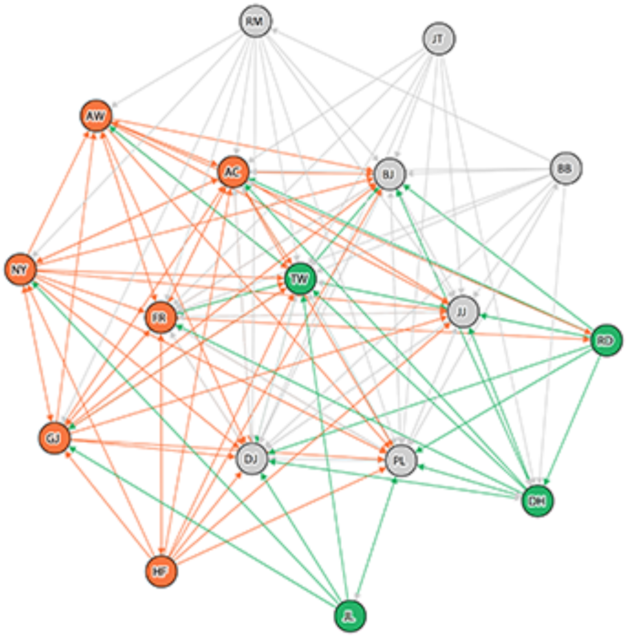
Figure 30. Graph of Twitter recognition in Peterborough

Although the correlation is weak, this does provide evidence that Twitter data can be used for asset discovery, and that network metrics such as indegree do correlate with citizens’ perceptions.

6.8 Case Study Objective 4, Peterborough: focus group structure

Case study Objective 4 concerned the testing of LocalNets as a tool for creating effective focus groups, drawing on social capital theory. For this analysis, the group has been broken down into three sets. Below are three network graphs of participants and their relation to one another. Orange circles indicate the participants who were identified to participate in the focus groups through LocalNets. In the survey, participants were asked for their Twitter account name if they had one. Green circles represent participants who had a Twitter account, and when subsequently checked, the account was in the LocalNets list of community assets. Only the most @mentioned Twitter accounts, as indicated in LocalNets, were invited. These users fell below that threshold. Users represented by green circles, therefore, were not invited through Twitter, but if a different selection method had been used, they could have been. Finally, participants represented in grey were not invited via Twitter, and could not have been, because they do not use it. All users who had Twitter accounts were in the LocalNets list of community assets, even if some of them had only been @mentioned infrequently.

Overall, no strong division between Twitter and non-Twitter participants was observed. It is notable that Toby Wood, who had a strong Twitter presence, is more central in the online and offline networks, in terms of numbers of connections, than even Peter Lee, who led the group and runs Peterborough Civic Society.


RM
JT
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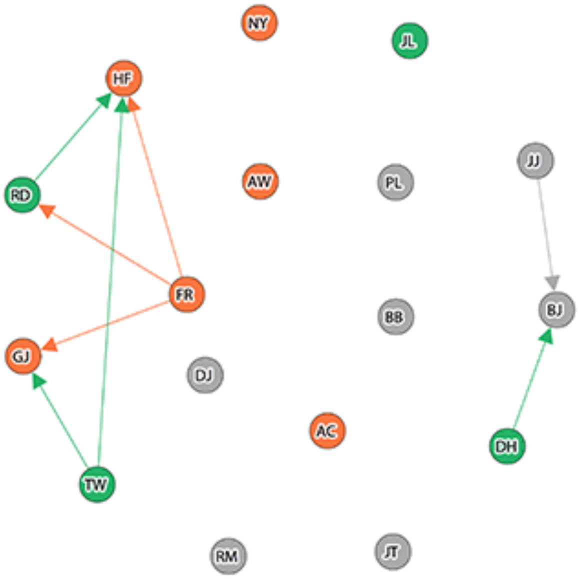
HF
JL

Figure 31. Graph of Peterborough participants who knew each other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BJ
GJ
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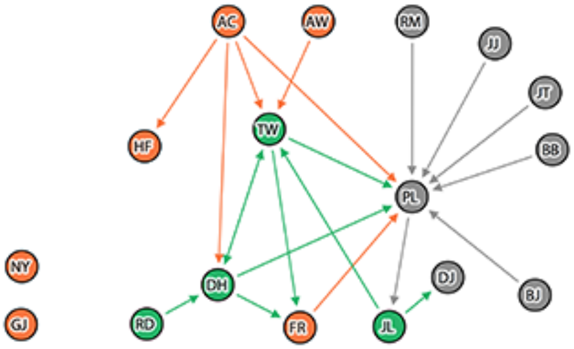
AC
DH
TW
RM
JT

Figure 32. Graph of Peterborough participants who knew each other online only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JT
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BB
HF
PL
NY
DH
DJ
BJ
GJ
RD
FR
JL

Figure 33. Peterborough collaboration graph. Network graph of participants who said they would like to work together, but who have not done so previously. Peter Lee was leading the session, so this may have contributed to his centrality in the graph

Social capital

Overall, the network structure examined in these diagrams indicates a strong possibility of brokerage: that is, that there are 20 connections between individuals who would like to work together, but had not done so previously. According to Burt's theory of brokerage, this is the type of structure that is likely to increase individuals' access to new information and better enable social coordination. While the theory suggests a potential opportunity, it appeared that no further action arose from this focus group.

Type	Number of Links	Density %
Know from Twitter	15	6
Know online (not from Twitter)	15	6
Know offline	47	17
Have collaborated	30	11
Would like to collaborate	36	13
Would like to collaborate, met offline before	17	6
Would like to collaborate, didn't know before	3	1
Did collaborate	0	0

Table 9. Structure of the Peterborough focus group (density indicates the ratio of actual connections to the total number of possible connections)

Data reliability

For social capital assessments to be made, it is important that the survey responses are true reflections of the respondents' social connections. Two means of testing this were identified, as discussed in the 'Network analysis' section. Firstly, LocalNets could test whether individuals had recently interacted on Twitter. If a participant reported that they did not know someone online, but the Twitter data showed that they were interacting, this might cast doubt on the survey response. No Twitter interactions were observed between participants, and so there was no data to compare with the self-reported Twitter connections in the group. Secondly, it might be expected that if person A reported that they had worked with person B, person B also ought to report they had worked with person A. This was not found to be true: there were several unreciprocated links. This, however, is relatively common, and could reflect individuals' imperfect recall,[257] or ambiguity regarding what constitutes working with someone else (discussed in Chapter 3).

Outcome of the focus group

Through the focus group participants became more aware of the community asset listing process, and had the opportunity to talk about their own personal interests. The group requested that a mailing list with all the participants be initiated, and a Google Groups list was set up; however, subsequently there was no activity on this list. Further outcomes of the Peterborough focus group are discussed in contrast to the subsequent Bretton case study.

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[257] Bernard, et al., 1980

6.9 Case study Objective 4, Bretton: focus group structure

Case Study Objective 4 concerned testing LocalNets as a tool for creating effective focus groups, drawing on social capital theory.

A survey was administered to find out how well participants knew each other. It demonstrated that most of the attendees were only weakly connected. There were only three mutual connections reported, and two of those represented people who worked together. The minister and community organiser were unknown to everyone, while the teacher was known only to the assistant head. Each attendee knew either one or two other people. A question asking whether participants had worked together before showed an even weaker network. Outside of those who worked at the same institution, there was only one instance of collaborative work between the organisations.

The lack of pre-existing social connections may indicate that a Twitter-based approach to finding participants has more potential for creating bridging social capital, that is creating new social connections that improve access to information and resources between individuals who were not previously connected. In contrast, bonding social capital, which brings trust benefits by deepening existing links, may have less potential, as there were fewer existing links to strengthen.

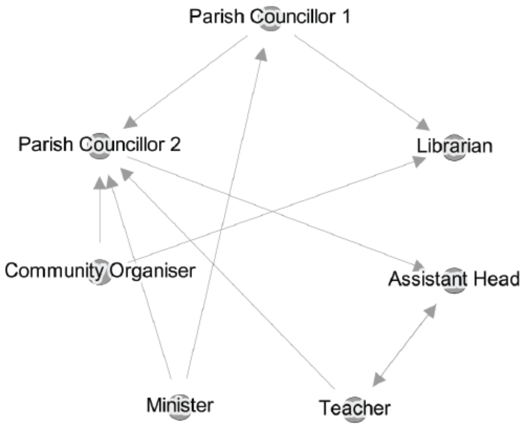
Parish Councillor 1
Parish Councillor 2
Librarian
Community Organiser
Assistant Head
Minister
Teacher

Figure 34: Graph of Bretton participants who knew each other

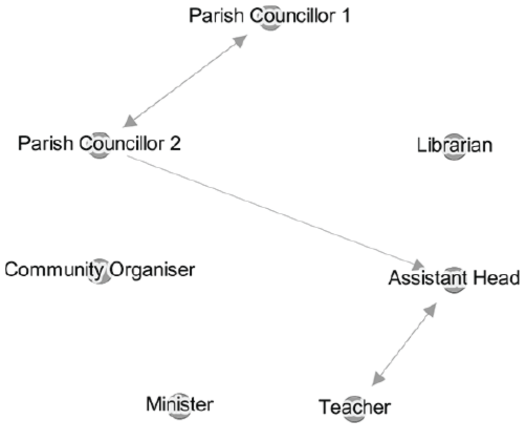
Parish Councillor 1
Parish Councillor 2
Librarian
Community Organiser
Assistant Head
Minister
Teacher

Figure 35: Graph of Bretton participants who have worked together

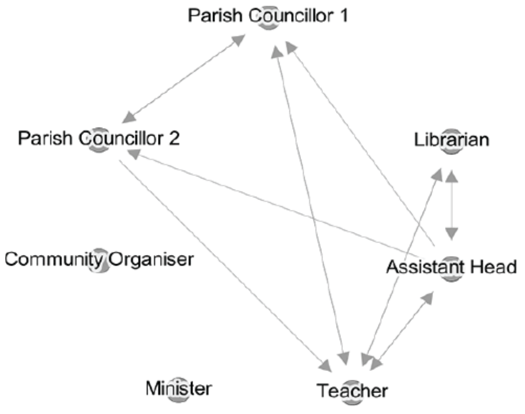
Parish Councillor 1
Parish Councillor 2
Librarian
Community Organiser
Assistant Head
Minister
Teacher

Figure 36: Bretton participants who would like to work together

Type	Number of Links	Density
Know from Twitter	1	2%
Know from online (not Twitter)	0	0%
Know offline	9	21%
Have collaborated	4	10%
Would like to collaborate	2	5%
Would like to collaborate, only met offline before	0	0%
Would like to collaborate, didn’t know before	0	0%
Did collaborate	6	14%

Table 10. Structure of theBretton focus group (density indicates the ratio of actual connections to the total number of possible connections)

Social capital

As in Peterborough, brokerage opportunities occurred in the Bretton focus group. In contrast to Peterborough, following the focus group event a collaboration occurred between the librarian, schoolteachers and parish councillors. The social network diagrams show there was no direct connection between the librarian and the school, and only one (unreciprocated) connection between the schoolteachers and one of the parish councillors. Under a ‘brokerage’ interpretation, the collaboration that occurred might be said to have been influenced by the participants sharing new information at the focus group.

Data Reliability

As in Peterborough, the Twitter data was analysed to see if behaviour measured on Twitter matched the survey responses. In this case, there were no instances in which individuals had messaged each other but reported that they did not know each other on Twitter in the survey. Nearly all the relationships were reciprocal – there were three instances of unreciprocated claims of one person knowing another. It might be that the smaller focus group allowed the survey to be administered in a more controlled manner, resulting in higher quality data than that from Peterborough.

Outcome of the focus group

During the focus group, the parish councillors discussed a survey that they were asking local residents to complete with the goal of generating a better understanding of the community. This effort was frustrated by a linguistic barrier: many residents spoke Polish as a first language but the parish council could not afford to translate the survey. The schoolteachers pointed out that bilingual students did volunteer work as part of the Duke of Edinburgh Award and might be able to help. To this end, with the permission and support of the Jack Hunt School, sixth-form students were trained to administer the survey. Some of the students were bilingual and so used these skills. Others knew ethnic minority residents and completed the survey using face-to-face interviews. This process, initiated following the focus group, resulted in more than 50 surveys being administered. This collaboration contrasts with the situation in Peterborough, where a collaboration did not occur.

In Bretton, the library staff also suggested that Duke of Edinburgh Award students could assist in the library's 'read aloud' sessions for children. Unfortunately, the contact at the library was made redundant due to local cutbacks before this collaboration could take place.

Invitation response rates were higher in Bretton than in Peterborough. While in Peterborough attendees had been invited from a personal Twitter account (@jimmytidey), potentially decreasing the credibility of the invitation, Dr Bola's personal invitations appear to have been more effective in Bretton. Further, it is possible that residents are more invested in the geographically smaller area of Bretton and respond to invitations accordingly. By comparison, perhaps fewer citizens of the city of Peterborough consider themselves part of a 'Peterborough community'. As a result, an invitation to discuss Peterborough as a whole might have appeared less compelling, though this speculation cannot be supported with the data.

One anticipated outcome did not occur: data from LocalNets gathered after the focus group indicated that the participants did not go on to interact with one another more on Twitter after the focus group, even those who worked together.

6.10 Reflection

Case study objective 1: Visualisation

The case study did not provide firm findings regarding visualisations. While the Gephi-based network visualisations were the focus in the initial case studies, here the focus shifted away from a graphical approach and towards using the shortlisting functionality built by TABLEFLIP. This transition is discussed in the Implementation findings section on visualisation.

Case study objective 2 and 3: Automated community asset detection

DCLG suggested four regions to trial LocalNets' capacity for discovering community assets relevant to the Assets of Community Value legislation. LocalNets was able to find 190 potential assets, including three already listed as assets of community value. Time limitations meant it was difficult to take this work forward, but the applicability of the costly signalling approach was demonstrated.

In the focus groups, participants recognised over 50% of the Twitter accounts identified as belonging to prominent community assets, and the rate of recognition weakly correlated with LocalNet's estimate of prominence. This suggests the applicability of costly signalling theory, even though this case study cannot support quantitative claims correlating costs of social media behaviours with perceived prominence of community assets.

The design of the automated community asset discovery drew on costly signalling theory. While no quantitative claims are made, the case study does demonstrate the application of signalling theory to deliver functionality for non-market social media analytics. SDPs 3 and 4 describe the use of Donath's signalling theory in this context. The SDPs respond to research question 2, which concerns design principles.

Case study objective 4: social capital and focus groups

In Bretton, the focus group lead to a collaboration between the parish council and the secondary school. Potential for brokerage social capital was also evidenced in the Peterborough focus group survey. Brokerage social capital is the subject of SDPs 1 and 2.

Other observations

The complexity of running the Peterborough and Bretton case study suggested that working with local government institutions might be prohibitively resource intensive. While it had been anticipated that barriers might reduce as the LocalNets product became easier to demonstrate it remained difficult to connect with local government organisations. These findings, along with observations about geography and demographics from this case study, are included in the implementation findings section, which corresponds to research question 1 regarding social media analytics for non-market institutions.

Working with TABLEFLIP

The ‘shortlisting’ functionality added to LocalNets by TABLEFLIP was a helpful addition to the tool that was used in the subsequent projects. TABLEFLIP also created an interface that was easier to navigate. However, the ambition to make LocalNets ‘public-facing’ was not fulfilled. There are two reasons for this:

1. During the Peterborough and Bretton case study it became apparent how expensive it was to store the quantities of data LocalNets was producing, and have it processed by the IBM Alchemy API. If more researchers started using LocalNets the cost would have become increasingly unsustainable.

2. Although the new design had a focus on improving usability, and was, subjectively, easier to use, the interface was still difficult to understand. Using LocalNets required a detailed understanding of how to select appropriate search terms and Twitter accounts. LocalNets collected data on a scheduled basis, so the user had to make selections and then subsequently come back once data had been

collected; this is not congruent with the immediacy users might expect. It is also noted that the BrandWatch tool used by DCLG required staff to have specialist training to use it.

Development of the ADR practice and theory ingraining

The Peterborough ADR process was the most extensive and complex ADR cycle of the four case studies. The project included two separate institutions providing feedback – the RSA and DCLG, external academic contributions and four Research Objectives, as well as two focus groups. It was the first case study using a survey to gather feedback. It was also the only project conducted as a formal Creative Exchange project. This required the partners to sign contracts and for the Creative Exchange board to sign off against the Research Objectives and to agree to work with each of the partner institutions. To structure the case study and support the decisions made by the Creative Exchange team, a project document was agreed, giving timelines, stating all the partners' objectives and listing the deliverables. This level of documentation proved to be highly useful in ensuring the cycle was successful and met all the partners' needs, whilst also underlining the value of the Creative Exchange infrastructure.

In contrast to the Hounslow survey, the theoretical 'costly signalling' approach was developed independently from the partners, responding to the requirement to increase the scale of asset identification through automation. The case study did not undertake a qualitative evaluation of the cost of signals and how cost correlated with perceived prominence of community assets. However, costly signalling theory became 'ingrained' in LocalNets through the application of costly signalling theory to add functionality to identify community assets. Responding directly to DCLG's policy objectives around Assets of Community Value, a policy that itself stems from the Localism Act, led to what Goldkul describes as 'policy-ingraining' by LocalNets.[258] That is, by working in collaboration with DCLG, public policy informed and shaped LocalNets as a software artefact.

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[258] Goldkuhl, 2016

Development of software practice

The Peterborough and Bretton case study developed the software practice in two ways. Firstly, the focus on automation moved the software development process away from gathering and presenting the data and towards processing it. In the Peterborough and Bretton case study, more effort went into redeveloping the database structure to support network analysis, and using that network analysis to find the most significant nodes: for example, presenting the most linked nodes to DCLG as potential community assets. Another substantial departure was working with TABLEFLIP to develop another view of the data, as presented at LocalNets.org. This process was structured as an agile process, with two sprints, where each sprint lasted two weeks. The agile approach is often connected with ADR, as described in Chapter 3. This approach ensured that the software development could be responsive to feedback from partner institutions generated through the ADR approach.

7. Newspeak House case study

The Newspeak House case study formed the fourth and final ADR cycle. It marked a transition away from multi-partner projects, and toward non-market institutions that were not part of the public sector. The case study sought to apply ‘common-pool resource’ theory; however, the application of that theory did not ultimately become a substantive part of the case study.

7.1 Problem formulation

Selecting research partners in response to previous case studies

The Newspeak House case study responded to the Peterborough and Bretton case study in two ways. Firstly, as highlighted in the 'Reflection' section of the Peterborough and Bretton case study, the previous case required a substantial time commitment to coordinate with the partners. By working with a single partner institution, and a single point of contact within that institution, the Newspeak House case study aimed to take an approach which could focus directly on deploying LocalNets and gathering feedback with a reduced organisational overhead. This was particularly important in the context of the wider Creative Exchange programme, which was coming towards the end of its funded period. A project that took a year, like the Peterborough case study, would not have been feasible to develop so close to the completion phase of the CX programme.

Secondly, ADR emphasises the importance of deploying a software artefact in relevant institutional settings. The research questions refer to 'non-market institutions', but the partner institutions in the previous case studies were either local government institutions or, like the RSA and DCLG, were working in coordination with local government. The Newspeak House project aimed to broaden the institutional context beyond local government, while remaining in the wider context of 'non-market institutions'.

Case study overview

Newspeak House is an event and co-working space in Bethnal Green in east London. Its goal is to generate innovation at the intersection of technology and politics. Members pay a fee and are issued with a pass so they can access a co-working space. The membership fee also helps to fund a seven-person residential fellowship scheme. The 'About' page of the Newspeak House website describes it as follows:

> TL;DR I am trying to set up a hackspace for politics. I own a building, but I need help with running costs. It's a shop with flats above, the idea is to have activist residencies in the flats, and community space + events downstairs.[259]

Newspeak House openly takes a data-centric approach to creating social connections between members. Members are able to unlock the front door using an RFID chip embedded in a ring intended to be worn on the finger, which logs members' arrival. Members are also invited to supply Facebook and Twitter names so that data from these sources can be captured. This data is used to enhance Newspeak House's ability to create deeper social connections between the members. The ironic Orwellian branding of Newspeak House is designed to evoke a 'surveillance' theme and the whole project is a constant reminder of members' agreement to participate by sharing data.

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[259] www.nwspk.com/about

Partners

Partner	**Goal**	**Contribution**
Ed Saperia / Newspeak House	Explore using network data to improve cohesion within the group and to discover potential new members	Assist with organising the focus group, provide the location and network data for the focus group
Jimmy Tidey	The research questions concern 'non-market institutions'; however, the research partners in the first three case studies only feature local government partners. In this case study the partner was a non-local government non-market institution. This case study was also used to investigate applying 'common-pool resource' theory, though it was not found to be applicable.	Using LocalNets to find focus group participants; providing data visualisations for discussion at the focus group; administered survey at the focus group.

Table 11. Newspeak House project partners

Case study objectives

Working with the partners, three case study objectives were formulated:

1. To test the applicability of Ostrom's common-pool resource design principles, identified as a relevant theoretical framework to understand a non-public sector, non-market institution.

2. To continue to test community members' recognition of Twitter accounts and the individuals and organisations they represent.

3. To continue the application of social capital theory and the use of LocalNets to select participants for focus groups.

Case study structure

This case study used the LocalNets tool to find participants for a focus group session, using Twitter accounts that interacted with the Newspeak House Twitter account, and in addition the Twitter accounts of members, when known. In the focus group, participants answered a questionnaire similar to that used in the previous two case studies.

7.2 Theory and design decisions

Design overview

The Newspeak House members club aims to connect individuals with backgrounds in technology and politics in a physical space and forge new social connections between members. The goal of the case study was to investigate how LocalNets might support Newspeak House's mission.

Newspeak House provided an opportunity for LocalNets to be deployed in a new context – a members' club where members have access to shared resources. Newspeak House is a non-market institution in the sense that, while it seeks to remain solvent, it is fundamentally predicated on goals other than profit-seeking.[260] Unlike the partners in the other case studies, Newspeak House is not a public sector institution. Both research questions concern non-market institutions, and the ambition was for the scope of the research to go beyond the public sector and include other types of institution. This case study sought to engage a non-market partner from outside the public sector.

Newspeak House members share a variety of resources, including hot desks and the use of the Newspeak Hall space for presentations and events. Therefore, it was anticipated this case study could provide an opportunity to apply commons-based accounts of resource-sharing, drawing on Ostrom's theory of common-pool resources. Such an approach was considered relevant because of the way Newspeak House members must agree amongst themselves what constitutes legitimate use of the shared resources. It was anticipated that this existing functionality could support a common-pool resource style analysis, drawing on the discussions that arose in the focus group and the data gathered by LocalNets. It was hoped application of common-pool resources theory might become a design principle in line with RQ2, though this did not transpire.

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[260] www.nwspk.com/about

The modifications to LocalNets that did take place were driven by the need to reduce the cost of running the software to remain within the constraints of the CX budget, rather than the specific requirements of using LocalNets at Newspeak House.

Theory: Common-pool resources

A well-known example of a shared resource allocation is that of common pasture land in a village, often cited as a ‘tragedy of the commons’ parable. In this example, all of the people who live in the village see an advantage to grazing as many sheep as they can on the common pasture. Even as they watch it being over-grazed, they see that their own personal best interest is served by continuing to graze as many animals as they can, even to the point of destroying the pasture. Ostrom’s research suggests this model is unhelpfully simplistic; she argues that in many real-world scenarios villages will often cooperate and enforce sustainable use of the shared resource. Her work considers resources such as fisheries, ground water and irrigation systems. Beyond Ostrom’s own work, studies on common-pool resources provide a huge empirical literature, stretching to 5000 case studies in Fenton Martin’s bibliographic work on the subject.[261]

In her 2009 book *Governing the Commons*, Ostrom provides a list of eight design principles for functional systems of common resources distilled from that body of empirical research:

1. Define clear group boundaries.
2. Match rules governing use of common goods to local needs and conditions.
3. Ensure that those affected by the rules can participate in modifying the rules.
4. Make sure the rule-making rights of community members are respected by outside authorities.
5. Develop a system, carried out by community members, for monitoring members’ behaviour.

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[261] Martin, 1992

6. Use graduated sanctions for rule violators.
7. Provide accessible, low-cost means for dispute resolution.
8. Build responsibility for governing the common resource in nested tiers from the lowest level up to the entire interconnected system.[262]

Applicability and related work

It was anticipated that some of these principles might become relevant during the work at Newspeak House, either in the focus group or from the data that LocalNets generated. In the context of the digital, Ostrom and Hess compiled a book considering academic publishing as a knowledge commons, where digital access profoundly modifies both the rivalry and the excludability of traditional publishing.[263] This has been developed still further by Frischmann et al.,[264] and generalised to a wider range of digital contexts by Morell.[265] Williams and Hall apply a common-pool resource framework to a Hackerspace, and also a members' club where resource sharing must be negotiated. They particularly focus on how new technologies can increase the effectiveness of resource management:

'Through an ethnographic study of a hackerspace, we show how technology is crucial for management of the 'space'. In addition, we highlight how technology is used in hackerspaces to satisfy three of Ostrom's design principles for stable CPR management, as listed above.[266] Williams and Hall go on to discuss 'digital methods enabling long distance communication', but also the way camera monitoring systems and door entry systems are technologies that the hackspace deploys to enable common-pool resource sharing.

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[262] Ostrom, 1990, p. 90
[263] Hess, & Ostrom, 2011, p. 10
[264] Frischmann, et al., 2014, p. 13
[265] Morell, & Mayo, 2014
[266] Williams, & Hall, 2015

Relation to public policy

The UK already has legislation for non-digital commons: the last act was passed in 2006.[267] Ostrom's work specifically targets public policy, and her Nobel Prize address makes clear her intention to influence policy discourse.[268] Digital technology is making commons-type goods more prevalent (see Chapter 2), and policymakers are seeking to adopt approaches that move from centralised provision to more cooperative approaches (see Chapter 1).

Theory ingraining and design choices

Theory was not ingrained in this case study – LocalNets was not modified in light of common-pool resources. As described above, this case study explored the similarity of common-pool resource theory and notions of community assets. It was anticipated that LocalNets could be modified in the light of findings from the case study; however, as described in the conclusion, such findings did not become apparent.

Further design choices

Reducing the server costs associated with running LocalNets was the key requirement during the build phase of this case study.

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[267] Rodgers, 2010

[268] Ostrom, 2010

7.3 Build

The cost of running LocalNets needed to be addressed. Two means of achieving this were identified:

1) Reducing the size of the database, as the cost of maintaining the database is proportional to its size
2) Removing the dependence on the IBM Alchemy service used for natural language processing, which charged in proportion to the amount of data sent to it.

Reducing database size

In LocalNets, every time a Tweet mentioned a term that was considered potentially relevant (as determined by the Alchemy API, Twitter metadata or the filter that checked for place names) it was added to the list of community assets. A link was also added to the ‘edges’ table to indicate which Twitter user mentioned it (details are provided in the Build section the Peterborough and Bretton case study). Over time, many terms that occurred only once in a tweet were added to the database. Often, these were terms that were not related to the particular community under investigation – if they were relevant, more frequent mentions might be anticipated. To reduce the size of the database, community assets that were only mentioned once were regularly removed from the database.

If a community asset was removed in error – that is, it was significant in the community – it would mentioned again in the stream of tweets and be added back into the database. Once it had been mentioned multiple times it would no longer be eligible for deletion. These changes were made after the ACV evaluation in the Bretton and Peterborough case studies, where they could have complicated the analysis.

Removing the IBM Alchemy API

Alchemy was replaced with the Stanford NLP software, which performs a similar function and can be freely downloaded and run on a local computer. This change was necessary as the amount of data to be processed in the Newspeak House study and other practical work that was underway would have been prohibitively expensive using the IBM service. While this could alter the data generated, the performance of the two services was compared and found to be highly similar. In part, this work was carried out to support the increasing interest in identifying assets, which in turn was viewed as relevant to the common-pool resource theory being investigated in the Newspeak House ADR cycle.

In March 2016, a bug was discovered, which meant that entities identified by the IBM service were not being sent to the Google geocoding service. This was fixed. The consequences of this were addressed in the data comparison presented in the Newspeak House project.

Summary of features added during the ADR cycle

In the Newspeak House case study, no features were added. Instead, as described above, the software practice focused on reducing running costs and removing a bug.

7.4 Intervention

LocalNets in use

Starting with the @nwspk Twitter account, LocalNets was used to map the community Twitter network. Relevant hashtags and prominent users within the network were added. In this case, unlike the other case studies, a list of community members' Twitter accounts was available because members are optionally asked for their Twitter details when they join. These Twitter accounts were also added to LocalNets. LocalNets was used to derive network diagrams and geographic maps for use in the focus group, and to select participants for the focus groups.

Organising the focus group

The focus group was organised by using Twitter's direct message functionality to contact the most prominent Twitter accounts, as measured by LocalNets using the frequency with which they messaged other accounts within the network. The messages explained the context of the research and provided a link to web pages explaining more details. Twenty participants received invitations; ten signed up to come and seven attended. It was observed that attendees grasped the nature of the invitation more easily than in the case of local communities. Most of those invited had made a conscious choice to opt into a 'tech and politics' community, as evidenced by their Twitter activity, but also through the descriptions they provided of themselves on their Twitter biographies – the short descriptive text Twitter allows users to supply. At the workshop a brief introduction to the research was given, and then a handout was circulated with a consent form, two diagrams of the Newspeak House network, two geographical maps of the network and a survey for attendees to fill out. As with the Peterborough surveys, respondents were asked to indicate their connections to other attendees, and then separately to indicate how well they knew a variety of other nodes identified through LocalNets. This prompted around two hours of further conversation about possibilities for Newspeak House to provide a better service for its members.

7.5 Evaluation

An evaluation similar to the Peterborough and Bretton case study was carried out on the Newspeak House data.

Recognition of Twitter accounts

The survey asked participants to indicate their familiarity with the 42 most active Twitter accounts within the community as detected by LocalNets. This section is analogous to the Objective 3 section in the Peterborough and Bretton case study and, as before, was designed to test the correlation between LocalNets data and individual perceptions of the community.

Type	Average percentage of Twitter accounts reported as having this type of connection %
Know from Twitter	11
Know online (not from Twitter)	7
Know offline	24
Have collaborated	19
Would like to collaborate	19
Any kind of connection	58

Table 12. Newspeak House Twitter account recognition

Unlike the Peterborough and Bretton data, there was no correlation between levels of recognition and levels of Twitter activity. Overall, the rate at which respondents reported any kind of connection is 13 per cent higher than in the Peterborough and Bretton case study. Newspeak House members are likely to be self-selecting as unusually active on social media, so this might account for the higher level of recognition. The higher level of recognition might also hide a correlation between the LocalNets data and individual perception: if a longer list of accounts were offered in the survey, a correlation may have emerged. Alternatively, the number of links in the LocalNets data may not correlate with individual perception.

Focus group structure and social capital

Type	Number of Links	Density %
Know from Twitter	5	12
Know online (not from Twitter)	1	2
Know offline	12	29
Have collaborated	7	17
Would like to collaborate	25	60
Would like to collaborate, had met offline before	11	26
Would like to collaborate, didn’t know before	9	21

Table 13. Newspeak House focus group structure (density indicates the ratio of actual connections to the total number of possible connections)

From a brokerage perspective, there was a significant opportunity for collaboration to arise from the focus group, as shown by the nine links indicating that participants had not known each other previously but would like to work together. Due to the time constraints of the PhD research, this opportunity was not pursued.

Survey reliability

Unlike the Bretton case study, although in line with the Peterborough one, almost no reciprocity was observed in links between individuals claiming to know one another, either online or offline. Even in the question asking participants if they have worked together, three of the six links were not reciprocal.

Looking at the Twitter data, it was possible to see that people who said they did not know each other from Twitter had communicated with each other, in some cases many times.

It is possible to speculate that participants took the question about knowing someone from Twitter to mean either ‘I met this person on Twitter’ or ‘I primarily know this person on Twitter’. Where people reported that they did not know each other on Twitter, but did interact on Twitter, the survey data responses indicate that they knew each other offline. This could indicate support for both of the above proposed interpretations of the question.

7.6 Reflection

Case study objective 1: common-pool resources

The topic of resource sharing within the community did not emerge in the Newspeak House focus group. For this reason, Ostrom's common-pool resource design principles could not be applied. Due to time limitations imposed by the conclusion of the Creative Exchange programme, it was not possible to engage in further exploration of this theoretical strand. The Common-pool resources section in the Situated design principles chapter discusses future research using common-pool resource theory in the context of social media analytics for non-market institutions.

Case study objective 2: Community asset identification

As with Peterborough and Bretton, focus group participants were able to identify over 50% of the Twitter accounts that LocalNets detected as representing community assets. While quantitative analysis of costly signalling theory was not undertaken in this case study, the automated community asset detection does demonstrate the application of Donath's signalling theory. Application of Donath's signalling theory is the subject of SDPs 3 and 4. In turn, the SDPs respond to research question 2, which concerns proposing design principles for non-market social media analytics.

Case study objective 3: Social capital theory

The potential for brokerage social capital was in evidence in the Newspeak House focus groups. There were nine instances where a participant said they would like to work with someone they had not previously met. This finding supports SDPs 1 and 2, regarding brokerage social capital.

Other observations

The case study did conform to the expectation that there would be fewer logistical difficulties than in working with a non-local government partner; the organisational complexity of the project was much lower than in previous case studies.

Theory ingraining

Removing the Alchemy API exchanged one text processing API with another less costly option and did not ingrain any new theory. Reducing the database size also helped reduce the cost of running LocalNets. Removing such data drew on costly signalling theory, in the sense that potential community assets were removed from the database when they were not regularly mentioned – a behaviour framed as a ‘costly signal’ in the previous case study. However, this is a consequence of the previous design decisions regarding costly signals, so does not ingrain a new theoretical position arising from the Newspeak House case study.

Development of the ADR practice

One of the goals of the Newspeak House case study was to run a less time-intensive ADR cycle with a less complex set of partners. The Newspeak case study confirmed that highly targeted projects with fewer partners allowed the ADR cycle to run over a shorter period of time – the Newspeak House case study took approximately four months, while the Peterborough and Bretton case study took 18 months.

In terms of the survey administered to focus group participants, and in terms of the functioning of the software, the Newspeak House cycle was similar to the Peterborough and Bretton cycle. This was useful in allowing comparisons to be drawn between the two contexts, as discussed in Appendix I, which compares the stability of the data collected. This was only possible in the latter two ADR cycles because the software and research practices had begun to converge toward approaches that were providing evidence to address the research questions. Further ADR cycles could have helped to hone the approach further and provide increasingly robust results. However, given the Creative Exchange was drawing to a close, further ADR cycles were beyond the scope of this research.

Development of software practice

During the final case study no new features were added to the software. However, a cost-saving optimisation was undertaken and did develop the practice in a new and unexpected direction. ‘Premature optimisation’, a term used to describe the costly process of optimising computer code in the early stages of a project, is often seen as a risk.[269] In the instance of LocalNets, and bearing this risk in mind, it was not initially considered that the quantities of data it was gathering would require any special technical approaches beyond those supported by the Meteor web development platform. However, the difficulty of storing and processing large quantities of data grew over the course of the research – in particular, paying for large amounts of server space. In the Newspeak House case study, modifications were deployed to address these issues as described in the ‘Build’ section. With regard to the software practice, these modifications demonstrated the need for software architecture that can address issues of scalability. There is a need to provide time and resources to ensure a software artefact can be frequently reviewed and enhanced with a view to reducing the cost of running it.

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[269] Hyde, 2009

8. Implementation findings

This chapter describes the findings that emerge from the implementation of LocalNets in the four case studies. Some findings also draw on the projects undertaken during the PhD research that were not conducted as action research and, therefore, not described using the formal ADR cyclical structure of a case study. Where this is the case, the project is briefly introduced where relevant. A full list of projects and their descriptions is given in Appendix A.

Gregor and Hevner suggest that the ADR method leads to findings that can be structured into three levels of generality: ‘situated implementation of artifact’, ‘nascent design theory’ (including design principles) and ‘well-developed design theory about embedded phenomena’.270 The implementation findings presented in this chapter fit into their category of ‘situated implementation of artifact’ – that is, they are tightly related to the context in which LocalNets was deployed.

These findings address research question 1, ‘How can Twitter social media analytics tools support non-market institutions?’

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[270] Gregor, & Hevner, 2013

8.1 Data quality limitations

A variety of limitations in the data derived from Twitter were observed and are discussed in this section. The table provides a summary of which case studies and other projects led to the findings.

Finding	**Case studies**	**Other projects**
People, not issues	Peterborough and Bretton	Greenwich Driverless Democratic Society / NHS Citizen
Geography - location types	Peterborough and Bretton (finding community assets)	Democratic Society / NHS Citizen
Independent retailers		Bold Street Democratic Society in Coventry
Demographics	Peterborough and Bretton	NHS Birmingham
Dynamic vs static data	Peterborough and Bretton, Newspeak House	

Table 14. Mapping findings to case studies and other projects

People, not issues

Prior to conducting the case studies, it was anticipated that LocalNets might uncover detailed opinions regarding community issues directly from Twitter data. This expectation was partly due to familiarity with community web forums from the Heresay project initiated before the PhD research began, as described in the introduction. Web forums often contain long posts that go into detail about local issues.

However, collecting data from local forums is difficult, requiring custom integration or making inconsistent use of the RSS format.[271] Additionally, subjectively it appears that independently run local forums are increasingly migrating to Facebook or being displaced by it, and Facebook itself is not easy to gather data from due to its closed architecture. For these reasons data was not gathered from web forums by the LocalNets web app.

In contrast to discursive, long-form writing on web forums, Twitter is, for the most part, too fragmented to provide a rounded picture of a person's opinion on a particular issue. This caused the focus to move from finding individual opinions directly from social media activity to finding individuals who could be expected to have a relevant opinion for further research. This occurred in the Peterborough case study, in which focus group participants were recruited on the basis of their level of activity in the local network, rather than their interest in assets of community value – either the assets themselves or the legislation in general – as had been anticipated. This phenomenon was also apparent with the Greenwich Driverless project, which used LocalNets as a part of a trial of a prototype driverless vehicle in Greenwich, London. In this project, residents who were politically active concerning local issues were prominent in the network of local Twitter accounts, but there was much less evidence of a response to the driverless car trial itself. The NHS Citizen mapping project sought to find local residents talking about health issues in four locations: Tamworth, Telford, South Staffs and Birmingham. It was conducted with a local government digital strategy consultancy called Democratic

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[271] www.whatisrss.com

Society, who were themselves working with the NHS. Again, detailed health-related conversations were limited and the project was not taken further.

It is possible to use Twitter to discover people's engagement with issues; however, it is frequently difficult to discover the nuances of their concerns. This finding is specific to Twitter. It is likely that a medium that encourages longer-form discussion, such as Facebook, has data that could be used to directly inform local government or civic decision-making, if the difficulties of collecting it could be overcome. A further discussion of this is presented in the section 'Working with third parties'.

Geography – what kinds of locations worked best?

Initially, it was hoped that it would be possible to draw generalisable conclusions about the geographic contexts in which LocalNets worked best: for example, concerning the issue of how big a population needs to be in order to support a level of Twitter activity that LocalNets can detect and use. The evidence gathered does not support these types of conclusion. In each location LocalNets was used to achieve different goals. In South Ribble (population 100,000) and Bracknell Forest (population 116,000), the asset-finding process was moderately successful, as discussed in Chapter 6. In South Staffordshire and Tamworth (population 110,000 and 76,000 respectively), LocalNets struggled to find the level of activity that could help Democratic Society target digital interventions.

Independent retailers

Independent local, or non-chain, shops are associated with social media activity, as was demonstrated on Bold Street in Liverpool, where vibrant activity was observed on the two occasions that data was collected from that area. In the Coventry project, conducted with Democratic Society and commissioned by Coventry City Council, five sub-regions were selected for investigation. Of those, significant activity was observed in Fargo Village, a shopping centre specifically for independent shops, and Earlsdon, which also has a high street with independent shops. Looking at the content of tweets in these areas, it seems likely that promotional activities carried out by independent shops on Twitter drive this effect. Using Twitter to garner attention for your business means committing time to the platform and drawing the attention of local residents. One way to achieve this is to discuss local community issues. This creates a community-oriented discussion that subsequently attracts private citizens. At FACT gallery in Liverpool, a local business owner commented on the LocalNets tool, which was exhibited on an iPad, to say that she was able to gain prominence for her business by becoming part of the Bold Street Twitter conversation, even though her business was located elsewhere in Liverpool, as she could not afford a central location.

Demographics

The demographics of the Twitter users involved in the research roughly reflected the demographics of Twitter users in general, as discussed in Chapter 3. In a survey conducted via Twitter as part of the NHS Birmingham project, of 18 respondents 17 were white (94 per cent) while Birmingham as a whole is 64 per cent white. The average age of the respondents was 41. Six of 18 respondents were female (33 per cent).

In Bretton, one parish councillor expressed the view that younger and better-off residents were some of the least likely to engage with the community, while they also had the greatest capacity to contribute. This point of view is supported by a census of parish councillors conducted by the Local Government Association in 2013, indicating that the average age of a parish councillor is 60; 12 per cent of parish councillors are under 45; 22 per cent are over 70.[272]

Many methods of public engagement suffer demographic bias. For this reason, LocalNets would probably have been perceived as a more valuable tool if it had improved access to ethnic minorities and those with lower than average incomes, neither of which was demonstrated. In terms of democratic engagement, Twitter has a valuable ability to access a younger audience but, taking a subjective view of discussions I have experienced, in many respects Twitter’s demographic skews away from groups that are considered to be in need of improved representation. In the projects focused on communities of interest, such as Newspeak House and OpenCare, this concern was, subjectively, a less prevalent issue. This observation indicates LocalNet's sensitivity to context and the importance of evaluating LocalNets with a range of institutions.

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[272] Kettlewell, & Phillips, 2014

This connects with findings from Bødker and Zander's findings in their paper 'Participation in Design between Public Sector and Local Communities', in which they suggest that in the context of web 2.0, the public sector should 'identify and work with early movers, and not just representative citizens' in order to take advantage of the democratic potential of social media.[273]

Dynamic vs static data

The network data generated by LocalNets remained highly stable over time. Appendix I shows the stability of the data derived from the Peterborough and Bretton and Newspeak House projects. Across the communities tested, the top 40 most active nodes changed by about 40 per cent month to month, with the most active nodes remaining even more stable. This reduced the value of LocalNets, since after the first use it seemed that referring back to the data was unlikely to reveal much new information. A more sophisticated approach could look at rates of change in order to try to identify not the most popular Twitter accounts, but those whose popularity is increasing fastest.

Relation to existing research

The finding of *people, not issues,* concerns using Twitter to find people for further consultation, rather than trying to understand issues directly from social media. This contrasts with a design recommendation by Schneider and de Souza to 'Follow stories, not people'.[274] In their work on social news curation, they emphasise that focusing on a set of individuals can create an overwhelming and uncoordinated flow of social media updates, and their prototype platform instead draws the user towards following stories. This underlines the highly contextual nature of design findings with regard to social media. One aspect of Schneider and de Souza's work that might have led to this alternative design recommendation is that their work mostly deals with the curation of professional journalism, where LocalNets focused on smaller issues that were mostly not written up on news websites. This may have made finding and grouping tweets pertaining to particular stories comparatively harder.

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[273] Bødker, & Zander, 2015

[274] Schneider, & De Souza, 2015

The finding regarding the importance of *independent retailers* connects with findings from the Livehoods project, which compared data gathered from qualitative surveys with analysis of Foursquare check-ins and Twitter data.[275] Their clustering of tweets and check-ins around geographic locations also indicated that social media activity can be indicative of independent retail locations.

The finding around *dynamic vs static data* reflects the social network analysis of Facebook behaviours, Viswanath et al. find that ‘even though the links of the activity network change rapidly over time, many graph-theoretic properties of the activity network remain unchanged’.[276] Further research would be required to discover how strongly Viswanath’s findings regarding Facebook apply in the context of Twitter. The results on the stability of data from LocalNets are highly context-specific; however, it is possible that similar network effects are at work. Designers of social media analytics tools may wish to respond to the rate at which the underlying data changes, for example in approaches to visualisation.

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[275] Cranshaw, et al., 2012

[276] Viswanath, et al., 2009

8.2 Visualisation

This section considers the findings relating to data visualisation. It draws on the Prototyping case study. It also considers the case study in Hounslow, where the Gephi export functionality was developed, and Peterborough and Bretton, where tabula views were developed. Support for these conclusions is also given by drawing on evidence from the OpenCare project and the Bow Arts Centre project, which were not written up as case studies but are listed in Appendix A as part of the practical work.

Three methods of sharing information from LocalNets were examined, each with varying degrees of effectiveness:

1. Printed or screen-based views of the text contained in tweets
2. Network diagrams
3. Tabular data

Printed and screen-based views

In the Kensington and Chelsea prototype, it was observed that people cannot easily grasp the meaning of a printed tweet. This may be because of the style in which tweets are written, limited to 140 characters, often in reply to contemporary events that are not explicitly mentioned and using terms that may not be widely known. The same difficulty in parsing the decontextualised Twitter context might account for the CX Annunciator project's failure to capture attention.

This was underlined in an exploratory project focused on Bow Arts Centre in east London, undertaken in 2015 with Dr Theodore Zamenopoulos and Dr Katerina Alexiou from the Open University. A mapping exercise successfully discovered a vibrant Twitter community and, as intended, provided a list of community assets to form a starting point for a focus group. However, in that project it was difficult to find a way of presenting the network and the data derived from it in a way that was legible to people who do not use social media, and as a result the data was not used.

Network diagrams

Networks can be represented using visually complex graphics, showing many links between a large number of nodes. When proposing a new project to potential partners, such a visualisation often captured the imagination and appeared to motivate participation. Such diagrams can emphasise the sheer volume of data available, and can also give clues as to groups within the overall social network, a phenomenon that was particularly clear in the OpenCare project. A network graph produced for that project shows clear clustering into groups. Groups, represented by colours, are automatically generated by the Gephi software’s modularity function.

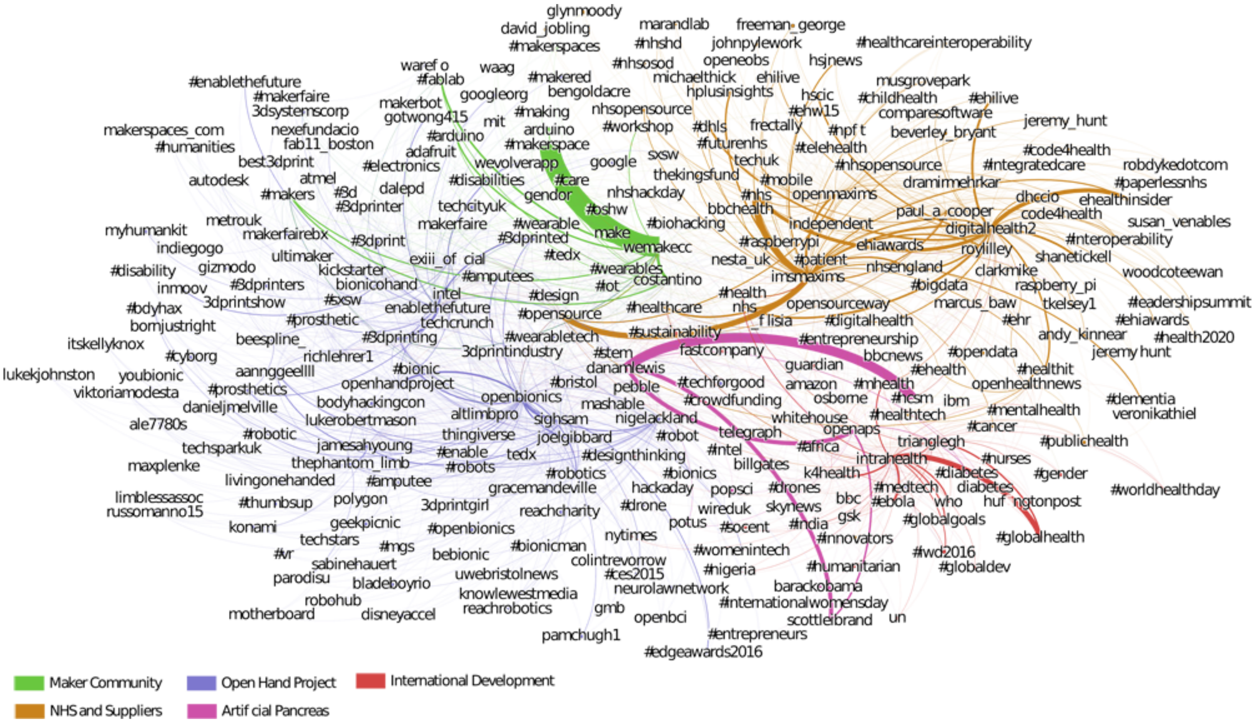
🟩 Maker Community
🟪 Open Hand Project
🟥 International Development
🟧 NHS and Suppliers
🟪 Artificial Pancreas

Figure 37. OpenCare Twitter network graph

Tabular data

Network diagrams rarely became the basis of practical work. For example, when inviting participants to a focus group, or selecting participants to survey, lists are easier to use and share. In response, the list functionality was added to the LocalNets platform, as described in the build phase of the Peterborough and Bretton case study. However, lists remove contextual data that can be helpful, particularly the network connections that were used as criteria for inclusion in a particular table. One of the richest aspects of graph data, its ability to convey heuristic information about the community and make the data visually legible, is missing in such tabular formats.

Further options

The challenge of communicating the data in an effective manner is an area where a variety of further options might be explored. Solutions might involve a more interactive approach, where users could select and then view the personal network of single individual in a table. In a focus group setting, this would have to be presented on a tablet or laptop. Another option is simply to present the networks in very large format, allowing more detail to be shown. A newspaper format might offer such an opportunity, for example. The newspaper concept was explored but rejected in the Newspeak House project since it was not congruent with their wider strategy.

Relation to existing research

The finding regarding the importance of tabular data to increasing network clarity is echoed by Guerra-Gomez et al., who list six design innovations to help understand large network data, one of which suggests ‘Allowing the navigation of nodes in a tabular display’.[277]

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[277] Guerra-Gomez, et al., 2016

8.3 Participation

As noted in the ‘Data quality limitations’ section under the heading ‘People, not issues’, LocalNets functioned most effectively as a tool to find participants for further consultation. Based on evidence from the NHS Birmingham project, the NHS Citizen event and the Newspeak House ADR cycle, this section observes that at consultation events questions of representativeness often arose. In these projects, participants reached the conclusion that they were not representative of the group on whose behalf they were supposed to be acting.

In Newspeak House, participants identified themselves as highly active within the Newspeak House community and worried that they were not reaching out to less engaged members. In the NHS Citizen project, 250 people attended from across the UK, including patient groups selected to represent minorities. Assistance was provided for those with disabilities, and all the literature for the event was provided with a low-literacy pictorial alternative. Even so, many participants questioned whether the group was truly representative.

This is a paradoxical effect: in every case, the composition of the group was selected to better reflect the composition of the community than the normal decision-making apparatus. One explanation is that projects such as citizens’ panels make the subject of representation highly salient, drawing attention to the inevitable shortcomings of the panel. This will occur even if the panel is an improvement over an existing system. One response might be to ensure all participants are made aware of the method by which they were selected, the systems in place to address representativeness, and the quality of the alternatives, allowing participants to draw better informed conclusions about representativeness.

Relation to existing research

Participation in design processes immediately raises the question of the way that participants are informed and empowered (e.g. Abelson,[278] Björgvinsson[279]). The findings regarding participation connect with such concerns, suggesting that participants in participatory processes can benefit from transparency in the way they were selected in order for them to make their own judgements about the legitimacy of the process.

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[278] Abelson, et al., 2003

[279] Björgvinsson, et al., 2010b

8.4 Working with third parties

This section draws on evidence from all the ADR cycles. Concerns about the availability of data from Twitter were exemplified in all the ADR cycles, as LocalNets fundamentally required access to such data. The Greenwich Driverless project, which was not presented as a case study, is also drawn on (listed in Appendix A). The subheading relating to the public sector further discusses a nascent project that could not be undertaken, and how that project reflected the difficulty of working with public sector institutions.

Twitter and other data sources

CommonPlace, who were partners on the Greenwich Driverless project, asked if Instagram photos could be collected alongside Twitter data. Investigation indicated that the Instagram API requires anyone who wants to use it to make an extensive and detailed request, including a video describing their intentions. Such requests can be denied for a wide variety of reasons, and it was not clear whether our application would be likely to succeed. After consulting with CommonPlace, we decided that integration was not worth pursuing, and abandoned it.

Instagram added these new and more onerous requirements after it was acquired by Facebook, which brought it in line with Facebook's own policy of offering limited integration options for third parties.

In October 2016 it became clear that Twitter's management was considering selling the company, and this too raised the prospect that a new owner would change the terms on which third parties could access their API.[280] Twitter already had a bad reputation with those building applications that relied on their data.[281]

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[280] Guardian, 2016

[281] Lunden, & Olanoff, 2015

Uncertainty regarding access to essential data makes it hard to commit to developing applications using third-party social media data sources. Research into a particular platform could be rendered obsolete if the data source it relies on becomes unavailable, or the data could be turned off during the research project. This is a political and commercial issue that researchers cannot easily influence. There was an opportunity to share these concerns through an OpenDemocracy.net blog post on the topic.[282] The theoretical discussion of designing digital systems for cooperation presented here is intended to help articulate the value of stable and open-data sources and their relation to non-market sector undertakings.

One way of reducing this risk would be to make a strategic estimate of the likelihood of a data source remaining open. For example, github.com, a social coding platform, has a strong open-source ethos and a business model based on charging users directly for accounts on the service. As such, it is perhaps less likely it will turn off its API to monetise its data. Instagram, however, makes no charge to users. Using its data to target adverts is its only source of income and its owner, Facebook, makes no similar commitment to open-source politics. Organisations with a profile like Instagram may be more likely to curtail access to data.

Public sector

As the project timeline (Figure. 4) shows, at the end of 2015 LocalNets was deployed in four local government-oriented projects, with five of them paying a fee to use the service. This reinforced the initial view that local government could benefit from social media analytics tools, and further that there was an appetite for such innovation. This impression was, however, misleading, and subsequent attempts to grow engagement met with difficulties.

A potential project with Hackney Borough Council focused on community building around London Fields park exemplified the difficulties. After around six months of intermittent negotiations, the council opted to use Facebook adverts instead. Other possible projects proceeded in a similar manner. Discussions that seemed acceptably resource-intensive in the context of a one-off research project became very burdensome when trying to increase the number of organisations using LocalNets as a paid service.

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[282] Tidey, 2017

There were many examples of the fragility of community organisations. In Peterborough, the RSA's attempts to work with community organisations were delayed several times as organisations shut, or staff were made redundant. This may link with the context of austerity and local government spending cuts discussed in the 'Practice and context' section of the introduction (Chapter 1).

Commercial aspects

When the research began, it was noted that services such as BrandWatch required substantial payments for access to their tools. However, during the research less expensive options became available, such as CrowdTangle, which offers an entry-level service for £500 per month.[283] The cost of running LocalNets was also higher than was foreseen: the database frequently had around 18GB of data, which, using a managed service, was expensive. The combination of these factors made the goal of offering LocalNets as a commercial package to local government organisations less viable, particularly in the era of public sector austerity, a context noted in the introductory chapter.

Connections to existing research

On the topic of working with social media data from third-party commercial companies, boyd and Crawford note that 'those with money – or those inside the company – can produce a different type of research than those outside. Those without access can neither reproduce nor evaluate the methodological claims of those who have privileged access.'[284] LocalNets instantiates two issues raised by boyd and Crawford. As noted under the 'commercial aspects' heading, costs can be prohibitive for non-market institutions –

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[283] www.crowdtangle.com

[284] boyd, & Crawford, 2012

particularly for the research projects that could help design appropriate software for the non-market sector.

Uses of social media data in the non-market sector also face questions of accountability. As boyd and Crawford suggest, it can be challenging to verify the accuracy of the data from a third party. In the instance of LocalNets some concerns may be alleviated as the data derived from the Twitter API mirrors Twitter user’s public activity, and so, in principle, can be checked. Nonetheless, diligence is essential if non-market institutions are to base decisions on social media analytics tools.

9. Situated design principles

This chapter draws on the theory applied through practice in the case studies to propose six situated design principles (SDPs).

The term ‘situated design principles’ adds to the framework of the ADR method, suggesting a category of findings between ‘situated findings’ and ‘design principles’. The principles remain situated in the context of the case studies, but have potential application in the design and development of social media analytics tools for non-market institutions beyond LocalNets. The first section of this chapter articulates what is meant by the term situated design principle and why the findings presented here belong in this category. The subsequent sections describe the six situated design principles.

Common-pool resources, a theory investigated in the Newspeak House case study, was not successfully applied. Therefore, no situated design principles are proposed drawing on common-pool resources. The final section of this chapter discusses common-pool resources and future research that could apply this theory.

9.1 Situated Design Principles and ADR

ADR aims to ‘generate knowledge that can be applied to the class of problems that the specific problem exemplifies’. According to Gregor and Hevner, ADR results in three levels of findings, each of increasing generality: ‘situated implementation of artifact’; ‘nascent design theory’ (including design principles); and ‘well-developed design theory about embedded phenomena’.[285]

Level 1 contributions are ‘situated implementation of artefact’ which include ‘software products or implemented processes’. LocalNets – the instantiated artefact – and the findings arising from its use in non-market institutions are presented in Chapter 8 and fall into Gregor and Hevner’s Level 1 category. Gregor and Hevner draw on a paper by Agrawal et al., ‘Mining Association Rules between Sets of Items in Large Databases’, as an example of their ADR findings categories.[286] The paper concerns algorithms to find patterns in customer purchases, as recorded by supermarket databases. Agrawal et al. built software with a partner supermarket to test their algorithms. Hevner considers the building of the artefact and the description of that process as a Level 1 contribution.

Level 2 contributions are ‘nascent design theory’, described in ‘abstract terms’ that lead to ‘empirical generalization’.[287] This level of contribution to knowledge includes ‘Constructs, methods, models, design principles, technological rules’.[288] Agrawal et al.’s paper goes on to describe their algorithm for processing supermarket transactions in abstract, generalisable terms. Again drawing on this example, Gregor and Hevner propose that this is a Level 2 contribution.

Situated design principles fall between Level 1 and 2. The situated design principles have not been instantiated beyond the context of the non-market institutions described in this thesis and so remain situated. However, the situated design principles are not described with reference to the specific features of Twitter data; instead, they are expressed in terms of social media data in general to demonstrate both their situatedness within the research and their broader potential applicability. For example, rather than being expressed in terms of ‘following’ or @mention behaviours specific to Twitter, they are expressed in terms of social interactions in the abstract; social interaction will be present in social media datasets from networks other than Twitter. For this reason, they could, in principle, be tested with social media data other than Twitter data. Gregor and Hevner state that one property of level 2 findings is that they can be expressed in ‘abstract terms without having recourse to the specific software’. For this reason the situated design principles are advocated as having more potential for generalisation than Level 1 contributions to knowledge, but not as fully-fledged Level 2 findings, which would imply that their applicability had been tested more widely than was the case in the project work.

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[285] Gregor, & Hevner, 2013
[286] Agrawal, & Swami, 1993
[287] Gregor, & Hevner, 2013
[288] Gregor, & Hevner, 2013

9.2 Situated design principles drawing on Burt’s brokerage social capital

The application of social capital theory in the case studies has its origin in the RSA’s *Connected Communities* research program.[289] The Hounslow and the Peterborough and Bretton case studies were undertaken in partnership with the RSA and those case studies contributed to the RSA’s *Connected Communities* report. [290]

The concept of ‘community capital’ was developed in the *Connected Communities* report, which builds on ‘academic and practitioner theories of social capital’.[291] The concept of community capital, as it used by the RSA, is specific to their work on *Connected Communities*. So that the situated design principles can stand independently of the RSA’s report, they draw on the more widely applied, but closely related, concept of social capital.

Two types of social capital – brokerage and closure – are discussed in the Hounslow case study. Brokerage concerns the formation of social connections between previously disconnected individuals or groups, allowing them access to new information or resources. Burt says of brokerage, ‘Social capital is created by a network in which people can broker connections between otherwise disconnected segments.’[292] The term ‘Brokerage social capital’, as it is used in this thesis, is intended to denote social capital created by connections between previously disconnected individuals or groups.

Closure concerns reinforcing existing connections, which can result in, for example, increased trust between individuals. No evidence of closure social capital formation was found in the case studies; however, evidence regarding brokerage social capital formation was found. Brokerage social capital forms the basis of two situated design principles (SDP1, SDP2). These are outlined below and their basis in the practical work is then described.

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[289] Parsfield, et al., 2015
[290] Parsfield, et al., 2015
[291] Parsfield, et al., 2015
[292] Burt, 2017

Situated design principles

SDP1. Designers of social media analytics tools can respond to non-market institutions' interest in social capital by providing functionality to highlight groups or individuals who share interests but who may not be socially connected, as indicated by their interactions on social media. Non-market institutions could use this functionality to inform interventions.

SDP2. Designers of social media analytics tools can respond to non-market institutions' interest in social capital by providing functionality to highlight social media activity occurring between previously unconnected individuals subsequent to interventions such as focus groups. Non-market institutions could use this data to indicate the effectiveness of interventions.

SDP1 in the practical work: actual and potential brokerage social capital

The clearest instance of brokerage social capital formation was in the Bretton focus group: the newly formed connection between the parish council and the school enabled a collaboration that would not have otherwise been possible. The parish council were able to use the school students, who wanted to volunteer as part of their Duke of Edinburgh programme, to administer a survey to residents, including communicating in Polish. In this case, a new social connection secured access to a resource – namely, volunteers. The new social connection increased the community's capacity to achieve its goals – in this case, to administer the survey that could be used to evidence the need for increased funding from Peterborough City Council. The new connection occurred between participants selected for the Bretton focus group using data from the LocalNets tool.

In the focus groups in Peterborough, Bretton and Newspeak House, a sociometric survey was administered to focus group participants. The survey was designed with input from the Mitchell Centre for Social Network Analysis at Manchester University, who were partners on the Peterborough and Bretton project. It was designed to capture existing social connections (‘I know this person from Twitter’), but also considered future intentions (‘I would like to work with this person in the future’).

In the Peterborough focus group, direct brokerage social capital formation was not observed. However, the potential for social capital formation through brokerage was observed. There were 17 participants in the focus group, and the survey responses indicated that there were 20 connections between pairs of individuals who would like to work together, but had not previously done so.

For the Newspeak House focus group, seven participants were selected using LocalNets. Within the group, nine pairs of individuals indicated through the survey that they had not previously met but would like to work together. As with the Peterborough focus group, this demonstrates the potential for brokerage social capital formation.

SDP2 in the practical work: social media data indicating brokerage social capital formation

Art Hackathon was an event which brought artists and programmers together to engage in creative activity on a weekend in May 2015 at Ravensbourne College.[293] Participants were asked for their Twitter usernames, and LocalNets was used to collect their Twitter activity. A ‘before and after’ measure of Twitter interactions between participants was used to generate evidence about the effect of this event on the structure of the social network. Similar data could have been gathered using a survey, as it was in the case studies; however, the Art Hackathon event had around 100 attendees over two days – reliably administering a survey would have been difficult.

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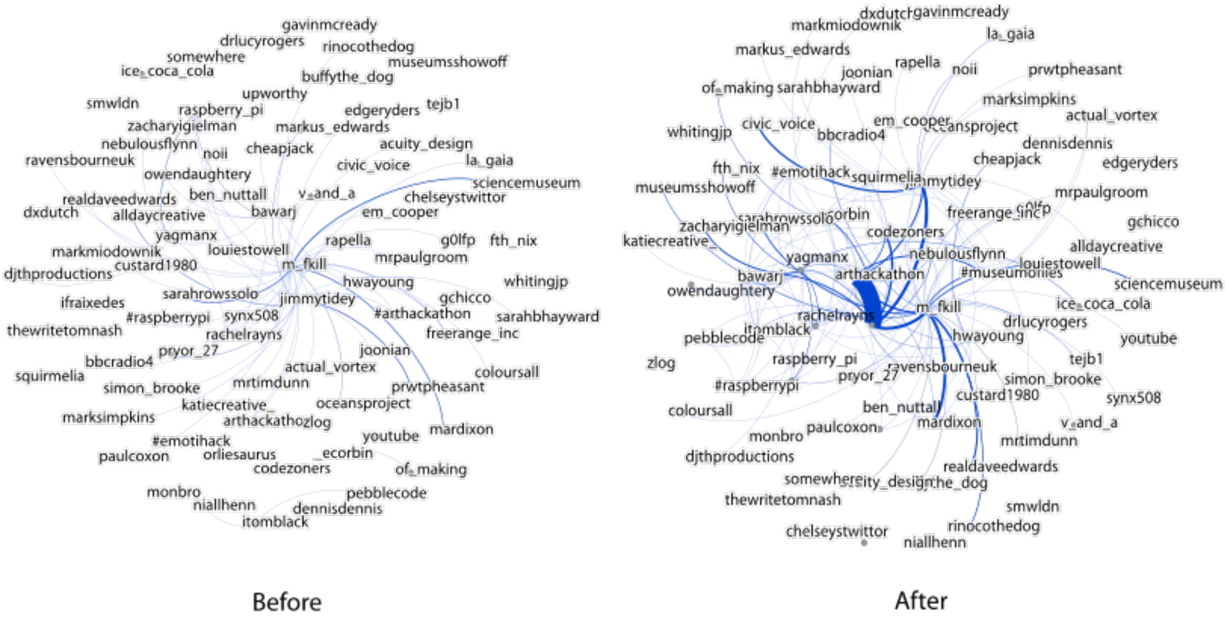
[293] Ravensbourne, 2015. ‘Art Hackathon’

The ‘before and after’ measurement of Twitter activity can help to mitigate confounding factors such as an individual’s propensity to interact on Twitter. As indicated by Figure 38, more social interactions between participants are observed on Twitter after the event than before. Such an approach could be valuable in providing evidence of how effective an event has been at improving social connections.

In the case studies, which were smaller than the Art Hackathon with respect to participant numbers, a survey was administered to gather data about social connection formation. The cases studies, therefore, mostly provide support for SDP1. However, in the Bretton and Peterborough and Newspeak House studies, Twitter data was used to confirm respondents’ answers to questions regarding whether they knew each other on Twitter, supporting the claim that Twitter data can be used to provide evidence for social capital formation embedded in SDP2. More in-depth investigation of the ‘before and after’ approach to using social media data to indicate brokerage social capital formation is suggested in the ‘Further work’ section.


gavinmcready
drlucyrogers
rinocothedog
somewhere
museumsshowoff
ice_coca_cola
buffythe_dog
upworthy
smwldn
raspberry_pi
edgeryders
tejb1
zacharyigielman
markus_edwards
nebulousflynn
noii
cheapjack
acuity_design
ravensbourneuk
civic_voice
la_gaia
owendaughtery
sciencemuseum
realdaveedwards
ben_nuttall
v_and_a
chelseystwittor
dxdutch
alldaycreative
bawarj
em_cooper
yagmanx
markmiodownik
louiestowell
rapella
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fth_nix
custard1980
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mrpaulgroom
djthproductions
hwayoung
whitingjp
ifraixedes
sarahrowssolo
jimmytidey
gchicco
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synx508
#arthackathon
sarahbhayward
thewritetomnash
rachelrayns
freerange_inc
pryor_27
joonian
bbcradio4
actual_vortex
coloursall
squirmelia
simon_brooke
mrtimdunn
prwtpheasant
katiecreative_
oceansproject
marksimpkins
arthackathon
zlog
youtube
mardixon
#emotihack
paulcoxon
orliesaurus
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codezoners
of_making
monbro
pebblecode
niallhenn
dennisdennis
itomblack
dxdutch
gavinmcready
markmiodownik
la_gaia
markus_edwards
joonian
rapella
noii
prwtpheasant
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sarahbhayward
marksimpkins
actual_vortex
whitingjp
civic_voice
em_cooper
bbcradio4
oceansproject
dennisdennis
cheapjack
edgeryders
fth_nix
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squirmelia
jimmytidey
museumsshowoff
mrpaulgroom
sarahrowssolo
ecorbin
freerange_inc
g0lfp
gchicco
zacharyigielman
katiecreative
codezoners
alldaycreative
yagmanx
nebulousflynn
louiestowell
bawarj
arthackathon
sciencemuseum
owendaughtery
ice_coca_cola
rachelrayns
m_fkill
drlucyrogers
pebblecode
itomblack
hwayoung
youtube
zlog
raspberry_pi
tejb1
pryor_27
ravensbourneuk
#raspberrypi
simon_brooke
custard1980
synx508
coloursall
ben_nuttall
mardixon
v_and_a
monbro
paulcoxon
mrtimdunn
djthproductions
realdaveedwards
somewhere
acuity_design
buffythe_dog
thewritetomnash
smwldn
rinocothedog
chelseystwittor
niallhenn

Before

After

Figure 38. Art Hackathon before and after comparison

Limitations

A key limitation of a social media analytics approach is that it cannot capture communication that is not present in the data it draws on. In regard to SDP1, two individuals may not have interactions on social media, but may none the less have strong ties either offline or on another social network. In regard to SDP2, two individuals may meet at a focus group and form a strong connection, but if they do not subsequently interact on a social network this information will not be available to social media analytics tools. However, most approaches to recording social interactions will fail to capture a comprehensive dataset, for example surveys may suffer from respondents' unreliable recall. Social media analytics tools can offer another perspective and can cost relatively little in comparison with other ethnographic approaches, as demonstrated in the Hounslow case study. Lower cost approaches may be attractive to non-market institutions, however, the richest picture of a community is likely to emerge from deploying a variety of methods with complimentary strengths.

Social capital can have negative aspects, such as formation of cliques, and these are discussed in Appendix H.

Future work

Using social media analytics tools to increase brokerage social capital

In the case studies, focus groups were used to convene groups of people who shared similar interests. Surveys were used to measure the formation of new social links during the focus group. Further research could target improving the criteria LocalNets used to select participants for the focus groups with the goal of creating new social links that drive brokerage social capital. Further work could also consider how factors such the size of the focus group or the types of communities from which the participants are drawn affect the formation of social capital through brokerage processes.

Further evaluation of using social media data to indicate social capital formation

Further research could also provide an opportunity to test how social links detected through social media relate to individuals' reported experience of social connections. Survey data that could be compared with data from LocalNets might address this.

Focusing on geographically dispersed networks

The OpenCare project drew attention to the benefits of working with a geographically dispersed community. The geographic dispersion decreases the likelihood that the institutions and individuals know each other from physical settings. In comparison with geographically close communities, dispersed communities may present more opportunities for social media analytics tools to discover individuals with shared interests who do not have social connections, offering scope for further testing of SDP1 and SDP2.

9.3 Situated design principles drawing on Donath's signalling theory

The SDPs emerging from the application of signalling theory have their origin in the Hounslow case study, a project that was shaped by the RSA's interest in mapping community assets. In this case study, community assets were coded from tweets manually by reading each Tweet and noting mentions of people, places, organisations and events, in line with the RSA's approach to community asset mapping. Mentions included using the name of the asset in a tweet and using the Twitter specific @mention syntax. In the Hounslow project, LocalNets collected tweets from a shortlist of hand-selected accounts chosen for their relevance to Hounslow.

In the Peterborough and Bretton case study, DCLG and RSA proposed using LocalNets across multiple sites. Running numerous sites would increase the workload of manual coding to an impractical level. Responding to this issue, functionality to automate community asset coding was developed. In Hounslow, identifying suitable local Twitter accounts to collect tweets from was also time-consuming. It therefore was required that Twitter accounts coded as representing community assets would automatically be suggested for the 'shortlist' of Twitter accounts from which tweets were collected.

Twitter data records many user behaviours that could be processed to automate community assets coding. Two prominent behaviours are following and mentioning, though there are many others, such as sharing images of a community asset or 'liking' tweets relating to the asset. Due to time limitations, it was not possible to build functionality to analyse multiple behaviours; particularly because different behaviours require different methods of processing and interpretation. A design decision had to be made about which behaviours would be most effective at automating the discovery of community assets.

Donath's costly signalling theory was invoked to make that decision. Constructing a message that includes a mention takes longer than following, which requires a single click. Costly signalling suggests that the costlier an action is, the more truly it will represent a users' dispositions because the user will be less inclined to fake it. For example, while one might follow a Twitter account belonging to a charity out of goodwill, sustaining a conversation with the same Twitter account might indicate a deeper level of commitment. Research by Kato et al. indicates that @mentioning is less common than following, which could also suggest that @mentioning is 'costlier' for users. For these reasons, mentioning behaviour was chosen to indicate which community assets were perceived to be most prominent in a community.[294]

Quantitative evaluation of the correlation between the perceived prominence of a community asset by community members and the 'cost' of the signals detected by LocalNets was beyond the scope of the PhD research; such an approach would require quantifying users' perceptions of the cost of social media activities. Time constraints also ruled out a comparative approach: as discussed above, it was not possible to add functionality to process multiple Twitter behaviours (e.g. following and mentioning) so that their effectiveness at reflecting community perceptions could be compared. For these reasons, the case study did not support situated design principles based on the quantified costs of signals.

However, the Peterborough and Bretton and Newspeak case studies indicated that automated community asset coding functionality was relevant to non-market institutions, and that the logic of signalling on social media can be applied to make design choices regarding the processing of social media activity to code community assets. Drawing on Donath's signaling theory, which encompasses costly signalling and other kinds of signalling (assessment and conventional), two situated design principles are proposed. The two SDPs reflect the way signalling was mobilised in the case studies but do not suggest that the case studies evaluated how the costs of signals correlate with perceptions of community assets. Instead, these SDPs suggest that qualitative reasoning drawing on Donath's signalling theory can help designers of implementing functionality to identify community assets in social media analytics tools.

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[294] Kato, et al., 2012

The case studies demonstrated the difficulty of building functionality to quantify signalling behaviours. Responding to this, it is not proposed that designers apply a cost-based approach, which they may also find difficult to evaluate. Instead, the two SPDs suggest that designers apply Donath's signalling theory as a qualitative means of considering which social media behaviours are reliable indications of users' perceptions of community assets.

Signalling theory beyond costly signals

Alongside costly signals, Donath proposes the concept of assessment signals and conventional signals. Donath describes signals as follows:

> Whether face-to-face or online, much of what people want to know about other people is not directly observable. We rely instead on signals, which are perceivable features and actions that indicate the presence of those hidden qualities.[295]

In the face of possible deception, signalling theory attempts to explain how communication can be trusted. Assessment signals are signals which can be trusted because they cannot be faked in reasonable circumstances. For example, if someone picks up a very heavy object, it is a very good signal that the person in question is strong. Conventional signals are signals which can be trusted at least to some degree because, even though they can be faked, lying about them invites social opprobrium. A person could tell a lie about having run a marathon, but, if discovered, that person would be likely to be held in reduced esteem by their peers. Assessment and conventional signalling are mechanisms that can confer trustworthiness on a signal, alongside costly signalling.

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[295] Donath, 2007

Social media decreases the cost of communicating, which makes every kind of signal easier to fake, if only by increasing the number of attempts at deception an individual can make.[296] This effect increases the value of determining which signals reflect community members' perceptions of community assets, for example in the case of designers attempting to build tools to identify community assets using social media data.

Through the mobilisation of signalling theory in practical work, two situated design principles that draw on Donath's work are identified.

Situated design principles

SDP3. Designers building social media analytics tools to discover community assets can apply signalling theory to prioritise which social media behaviours best reflect community member's perceptions of community assets (eg. liking, following, commenting etc.).

SDP4. Designers building social media analytics tools to discover community assets can use signalling theory to decide what social media data can be deleted while maximising the effectiveness of community asset detection if resource constraints make the retention of all data impossible.

SDP3 in the case studies: Donath's signalling theory and community asset discovery

Surveys administered in the case study focus groups asked users to respond to a list of Twitter accounts (listed with the person or organization the account represented), stating their familiary with the person or organisation. The survey responses indicated that LocalNets was detecting community assets that focus group participants recognised. On average, across the Peterborough, Bretton and Newspeak House focus groups, participants said they recognised the community assets identified by LocalNets approximately half of the time.

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[296] Shirky, 2008

Case study	Number of Twitter accounts presented	Recognition rate %
Peterborough	58	45%
Bretton	44	45%
Newspeak	42	58%

Table 15. Overall Twitter account recognition.

DCLG identified promoting Asset of Community Value legislation as an objective. Using LocalNets to identify assets that could be protected by the legislation was case study objective 2 of the Peterborough and Bretton case study. Four areas were chosen to pilot LocalNets: Tower Hamlets, Bracknell Forest, Plymouth and South Ribble. The goal was for LocalNets to identify assets suitable for protection under the legislation – for example, pubs or sports facilities. In addition to the @mention functionality, which can only reference other Twitter accounts, LocalNets used mentions of community assets detected using natural language processing (at first using an IBM service, and later using Stanford NLP open-source software). LocalNets was able to identify 190 potential community assets, including three which had already been listed under the legislation.

SDP 4 in the case studies: reducing the size of the database

As described in the Newspeak House case study, the quantity of data recorded by LocalNets became too expensive to store as it accumulated over time. The primary method of removing unnecessary data was to remove community assets with very low numbers of mentions. This strategy – using mentions to indicate a potential community asset's relevance to the community – draws on signalling theory. In the Newspeak House case study, periodically removing records of community assets that were mentioned only once was found to significantly reduce the size of the database. Removing these assets from the database did not impact on the performance of LocalNets - very low-ranking community assets were not used in the focus group surveys or in the visualisations.

Relation to brokerage social capital

Building social capital relies on forming social ties to communicate information reliably. Signalling theory can help to describe the types of communication that individuals are likely to trust as reliable sources of information. In *Signals in Social Supernets*, Donath cites Burt's work on brokerage to articulate how network structures can influence signalling behaviour, highlighting the connection between the two theories.[297]

Limitations

Interpreting signals

Donath states that 'interpretation of any signal is subtle and subjective'.[298] In the case of costly signals, the theory relies on accurately understanding how users perceive the time or other resources they dedicate to a particular behaviour. Different users may have different resource budgets, for example 'an unemployed acquaintance may spend many hours a day keeping up with online correspondents, while a close but busy friend may seldom do so.' [299] For conventional signals, designers will need to understand how concerned users are about breaking conventions. Some users, perhaps particularly if they are able to act anonymously, may not feel bound by social conventions, or may be playing to a specific audience whose social norms are different from or unknown to the designer. In these cases, designers maybe mislead by applying the concept of conventional signals. Of signalling theory, Donath says 'For designers of future systems such knowledge is a tool, not a blueprint'.[300]

Strategic deception

If social media activity is used by non-market institutions to make decisions, social media participants may modify their behaviour to achieve strategic goals. For example, if an increasing number of mentions of a particular community asset increases the probability of local government spending money to protect that asset, community members may respond by changing their online behaviours to manipulate the system. In this case, a social media behaviour that previously correlated with community perceptions might cease to do so, thus rendering the social media analytics tool less accurate. This reflects the dynamic and proactive nature of social media behaviours and the complexity of implementing social media analytics to inform non-market institutions.

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[297] Donath, 2007
[298] Donath, 2007
[299] Donath, 2007
[300] Donath, 2007

Limited data

It is intrinsic to the nature of the social media analytics tools that they cannot capture behaviours not occurring on social media. This means that the data they draw on represents the behaviours of social media users, who cannot be assumed to be demographically representative of a community as a whole. As the Hounslow case study began to explore, this could be addressed by using multiple approaches to understanding a community, for example combining social media analytics with an ethnographic approach.

Future research

Conventional signals

Further work could investigate the role of conventional signals in discovering community assets from social media activity. Conventional signalling suggests that individuals will not behave deceptively if they believe it will invite the disapproval of their peers. The concept of conventional signalling could be applied to Twitter data by, for example, assigning increased 'weighting' to the importance of community assets mentioned by someone with a large number of followers within the network of locally relevant Twitter accounts.

Signalling theory literature

By moving beyond the specifically 'cost' oriented theory applied during the Peterborough and Bretton case study and towards the broader field of signalling theory, designers are also able to draw on a wider range of research. For example, Parigi and Ma draw discuss design solutions that 'better protect gig workers and mitigate the risks participants face' and suggest that ‘[o]ne useful framework to address this design challenge gig economy platforms face is signaling theory’.[301] They go on to outline how review systems can use assessment signals and conventional signals to help ‘gig workers’ ensure their customers are trustworthy.

Through the case studies, the original focus on costly signalling has evolved to include a wider range of signalling behaviours. This reflects the way signalling theory was applied, but also allows designers working on social media analytics systems to draw on a wider range of existing research to inform design decisions using signalling. Future work could consider how approaches such as Parigi and Ma’s can be applied to social media analytics for the non-market sector.

Further evaluation of signalling theory and community asset discovery

The correlation between social media behaviours and perceptions of community of community assets is an empirical question. Further work could investigate which behaviours on Twitter, or on other social networks, most closely reflect subjective reports of community assets. Such research might address whether designers should prioritise conventional, assessment, or costly signals when building social media analytics tools, and in what types of communities these approaches are most successful. However, as the case studies indicate, it can be complex and time consuming to implement functionality to compare and measure numerous social media behaviours.

Responding to this observation, however the empirical work is conducted, it could focus on qualitative guidance that can help designers working on identifying community assets in social media analytics tools. This might help avoid prohibitively complex quantitative measurement and validation when the guidance is implemented.

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[301] Parigi, and Ma, 2016

9.4 Situated design principles drawing on the network flow model

In their paper *On Network Theory* Borgatti and Halgin describe the 'network flow model'.[302] The model aims at 'characterizing how network reasoning works'. Borgatti and Halgin state that 'much of network theory (and methodology) is based on the flow model, which is now well elaborated and serves to unify large portions of network theory.' Designers working on social media analytics tools for non-market institutions may need to build features that draw on network-oriented theories, such as brokerage social capital and signalling theory. The network flow model can help designers build abstract network-oriented theories into software tools.

Interest in the network flow model arose from the case studies through the ADR principle of 'emergence' which 'emphasizes that the ensemble artifact will reflect not only the preliminary design created by the researchers but also its ongoing shaping by organizational use.' [303] Through design cycles with the institutional partners, it became apparent that non-market institutions may seek to apply social network-oriented theories to social media data, for example the RSA interest's in asset-based community development. Two situated design principles drawing on the network flow model emerged from the case studies.

Borgatti and Halgin's network flow model

In the flow model, a substance (liquid or electricity provide suitable physical analogues) is imagined flowing along a network's edges. The flowing substance represents social features of the network, for example, information, trust or influence. The substance experiences friction as it moves around the network, so that its range is limited and time passes as the substance moves. Theories, such as social capital, are described as an 'ornament' on top of the flow.[304]

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[302] Borgatti, & Halgin, 2011

[303] Sein, et al., 2011

In their paper, Borgatti and Halgin discuss two seminal models of social capital – Burt's brokerage and Granovetter's weak ties. They demonstrate that both use an 'underlying model of a social system as a network of paths that act as conduits for information to flow.' In such a model 'structure and position play fundamental roles' so that 'nodes that are far from all others will, on average, receive flows later than nodes that are more centrally positioned'.[305]

Brokerage social capital and network flow models

Brokerage social capital was applied in LocalNets from the Hounslow case study onwards. The flow model can be applied to understand how the structure of networks shapes social capital. Borgatti and Halgin suggest modelling brokerage as a flow: information is generated at every node on the network, and flows from those points along the edges ie, social connections. In the model we can see that an individual connecting two otherwise separate networks is uniquely placed to receive two distinct flows of information. This may well be advantageous to them. An individual in this position is said to be benefitting from brokerage social capital.

Signalling theory and network flow models

Signalling was applied to automating the discovery of community assets in the Peterborough and Bretton case study. The flow model can be applied to signalling theory. For example, in their paper 'Public Displays of Connection', Donath and boyd describe how signals flow around social network sites.[306] Donath develops this concept in *Signals in Social Supernets*, a paper that was formative in the application of signalling theory in the Peterborough and Bretton case study, as discussed above.

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[304] Borgatti, & Halgin, 2011
[305] Borgatti, & Halgin, 2011
[306] Donath, & boyd, 2004

Situated design principles

SDP5. Designers of social media analytics tools can use network flow models to help structure databases to make ‘flow’ type queries easier, for example identifying which person has the most social connections. Such structures can support functionality relating to social capital and signalling theory.

SDP6. Designers of social media analytics tools can use the network flow model to consider how social network-oriented theories beyond brokerage social capital and signalling theory could be applied.

SDP5 in case studies: structuring the database

The network flow model emerged from the other SPDs and after the case studies were completed, and so was not used as a theoretical principle to guide the design of decisions during the creation of LocalNets. However, the restructuring of the database described in the Peterborough and Bretton ‘Build’ section reflects some aspects of the flow model. Borgatti and Halgin state that ‘In practice, the kinds of ties that network theorists tend to focus on can be categorized into two basic types: states and events’. The new database structure recorded a set of nodes, with flows of information (@mentions) recorded by what Borgatti and Halgin called an ‘event-type tie [which] has a discrete and transitory nature and can be counted over periods of time’, that is – in the context of this research – @mentions in tweets.[307] While LocalNets focused on @mentions, one of the most prominent alternative designs was for it to focus on ‘follow’ relations between Twitter accounts instead. This alternative approach is discussed in the Peterborough and Bretton case study. Borgatti and Halgin’s flow model classifies the Twitter ‘follow’ relationship as a ‘state-type tie’, where ‘States have continuity over time… they have an open-ended persistence.’[308] The flow model is applicable to both ‘@mention’ and ‘follow’ behaviours, demonstrating its flexibility in mapping social theory to social network analytics tools.

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[307] Borgatti, & Halgin, 2011

[308] Borgatti, & Halgin, 2011

SDP6 in case studies: supporting application of network-oriented theory

Cirado et al. describe the goal of public social media analytics as the ‘co-production of services and public policies, crowdsourcing of solutions to social and political problems’, while sales and customer support are suggested as the goals of commercial social media tools.[309,310] This distinction suggests that public sector social media analytics tools need to be sensitive to networks of information exchange between citizens, a context to which the flow model is applicable. The future work section below discusses the application of the network flow model support common-pool resources analysis of communities.

Limitations

Some limitations to this model should be noted. Networks of individuals can behave in ways that break the intuitive flow model. Cook and Emerson describe a laboratory experiment in which individuals in a network negotiate trade deals with one another. In this lab-based game-playing structure active nodes can generate patterns that are not easily or intuitively modelled as a flow.[311] Designers should not use the network flow model in bargaining scenarios where it is not applicable; however, this is a very different context to that of LocalNets.

As Borgatti and Halgin point out in relation to network structures, ‘Occupying a certain structural position carries certain potentialities, but the actual outcomes may depend on a number of additional factors, including how the actor plays it’.[312] The network flow model can help designers conceptualise how social media analytics tools can integrate

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[309] Criado, et al., 2013

[310] Culnan, et al., 2010

[311] Cook, & Emerson, 1978

[312] Borgatti, & Halgin, 2011

network-oriented social theories, but it does not consider the unique skills and attributes of the individual actors.

Future work

Extending the network flow models to support nascent design theories

SDP6 proposes that designers can use the network flow model when building network-oriented theory into social media analytics tools. One example is Ostrom's theory of common-pool resources, which was introduced in the Newspeak House case study. Though the case study was not able to give empirical support to common-pool resources as a situated design principle, future work could develop this area further, and that work could draw on the flow model. Network models of common-pool resources describe how information and trust flows between community members to support common-pool resource management. A survey paper by Groce et al. finds 15 articles using social network analysis to understand systems of common-pool resource management, and uses Borgatti and Halgin's model to structure its analysis of these articles.[313]

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[313] Groce, et al, 2019

9.5 Common-pool resources

It was anticipated that common-pool resources could provide a set of principles to inform the design of social media analytics tools. In the research, however, there were no strong examples of resource-sharing facilitated by, or measured by, LocalNets. As a result, no situated design principles based on common-pool resources are proposed. However, this is considered a fertile area for future work.

Future work

Retrospectively, a thorough common-pool resource analysis is unlikely to be successful while it only considers social media data, which does not typically contain detailed enough information about resource use and sharing to apply the theory. During the focus group at Newspeak House, the following additional sources of data were identified that could be combined with social media data to provide a richer dataset:

- Hackspaces provide websites where members can submit jobs for 3D printers or laser cutters; others use online calendars to coordinate and share access to tools.[314] These systems record data on how much members use these shared resources.
- Hackspaces often use RFID cards and electronic locks to control access to the space, creating a digital record of the members' presence in the space.
- Hackspaces and coworking spaces could use logs of what devices are connected to the Wi-Fi network to infer members' presence in the space.

Research has applied common-pool resources theory to hackspaces.[315] Future work could consider how social media analytics, combined with other datasets, can help measure resource use otherwise contribute to the management of coworking spaces by drawing on common-pool resource theory. In building common-pool resource theory into a social media analytics tool, designers could consider using the network flow model, as described in SDP5 and SDP6. For example, the flow model could help to better understand the flows of resources and trust involved in a commons.

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[314] Häußge, 2017

[315] Kostakis, et al., 2015; Smith, et al., 2013; Allen, & Potts, 2016

After formal practical work had ended, a commercial project was undertaken with SUSD, an architectural practice focusing on the interior design of co-working spaces. The project investigated the Twitter networks around existing London co-working spaces and members' clubs, further underlining the potential of this area of research.[316]

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[316] www.susd.co.uk

10. Conclusions

To bring the research presented in this thesis to a point of closure, this chapter begins with a brief summary of the findings. The subsequent section describes possible next steps for this research. The final section offers reflections on the research as a whole.

10.1 Summary of findings

The ‘Research framing’ section of Chapter 1 indicates a relatively lower volume of research into social media analytics for public sector institutions by comparison to the private sector. This research gap has been discussed in three overlapping kinds of literature: eGovernment, information systems and design research. In my research, the category of ‘public sector’ has been broadened to ‘non-market sector’, to accommodate institutions that are not in the public sector, but nonetheless play important civic roles. My research aims to contribute specifically to the understanding of the way Twitter-based social media analytics can support non-market institutions (responding to RQ1), and to propose a collection of situated design principles that could be applied to designing social media analytics tools for non-market settings (responding to RQ2). These research questions respond to the identified gaps in the literature: that is, as Bødker, & Zander put it, a lack of research into the use of social technologies in the ‘“everyday business” of municipal work’.[317]

Research question 1: How can Twitter data analysis support non-market institutions?

Community size

There was no clear threshold for the population of a community below which social media analysis became ineffective: instead, different communities had social media activity levels appropriate to different types of analysis. In South Ribble, with a population of 100,000, it was possible to find community assets through Twitter analysis (Chapter 6). In Coventry, with a population of over 300,000, insufficient activity was found for Democratic Society’s goal of increasing community engagement. This suggests that when developing a Twitter-based social media analytics tool for non-market institutions, community population should not be used as guide to how effective such a tool might be.

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[317] Bødker, & Zander

Retail

An observation made across multiple geographic areas is that local independent shops often run their own Twitter accounts. To promote their stores, owners of retail outlets tend to be active on social media. Examples of this occurred in Coventry, where, of the five communities investigated, the two with a large non-chain shopping area were most active. Again, the same phenomenon was observed around Bold Street in Liverpool. 'Visualizing Social Media's Impact on Local Communities', an article published in *Visual Communication*, provides a detailed portrait of how a local cafe's social media presence catalysed a community.[318] This finding suggests that for Twitter-based analytics tools, the number of independent retailers may act as a guide to how rich the data generated by a social media analytics tool will be, and, in turn, how useful it might be to non-market institutions.

People & structures, not opinions

At the beginning of the research it was anticipated that Twitter analytics might directly provide information that could be used to help support the community: for example, tweets expressing opinions about planning issues. The projects demonstrated that this was not the case. Instead, the Twitter analysis was able to find individuals who had expressed an interest in a particular topic, but not to the extent that their views were clearly understood, as Twitter's fragmentary messages are often ambiguous. Such individuals could, however, be invited to participate in further discussion.

Geographic distribution

When LocalNets identified two individuals in a local area who were not communicating via Twitter, there remained a high probability that they were aware of each other through meeting in person or other media beyond Twitter. This may be less likely to occur in geographically dispersed communities: for example, in the OpenCare project looking at open-source healthcare across Europe. In these cases Twitter data may more accurately represent the social connections between individuals and therefore offer a more accurate information to non-market institutions using data from social media analytics tools.

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[318] Bingham-Hall, & Tidey, 2016

Distribution over time

Looking at the structure of a Twitter network before and after an intervention proved to be a useful way of identifying the effect of a particular event, demonstrated in the case of the Art Hackathon. The approach allows a baseline to be established so that the connections generated between participants during the event can be more accurately measured. Non-market intuitions using Twitter data could draw on this finding to measure the impact of interventions or community events.

Visualisations

Network visualisations are powerful tools for articulating the nature of networks and the density of data contained within them. Network diagrams were less useful when it came to pragmatic tasks, such as organising focus groups, where tables and spreadsheets could be more easily shared and annotated. This finding suggests the importance of multiple modes of visualisation in articulating and using data from Twitter in non-market settings.

Analysis of the stability of local Twitter activity over time (Appendix I) indicates that it is generally quite stable. For this reason, ‘dashboard’-type interfaces that attempt to provide weekly updates on local activity might struggle to find sufficient fresh information. Instead, this finding would suggest, other cadences of reporting might work better. For example, reports tied to events anticipated to modify social connections in the community may be a more appropriate approach.

Working with third parties

Relying on data from commercial social networking platforms proved to be a potentially fragile arrangement. This finding was underlined when the terms for accessing

Instagram data changed during the research. When implementing social media analytics tools using Twitter data, the ongoing accessibility of that data should be considered.

Research question 2: What design principles might support designing social media analytics tools for non-market institutions?

Six situated design principles for non-market social media analytics tools are proposed, drawing on Burt's brokerage social capita, Donath's signalling theory and Borgatti and Halgin's network flow model. They are presented below in Table 16.

Background & Theory	**Situated design principles**
Situated design principles drawing on Burt's brokerage social capital	
Non-market institutions may want to increase a community's capacity to act collectively to achieve their goals, referred to as 'social capital'.[319] Burt classifies social capital into 'closure' social capital related to reinforcing existing social ties, and 'brokerage' social capital related to formation of new social ties.	**SDP1**. Designers of social media analytics tools can respond to non-market institutions' interest in social capital by providing functionality to highlight groups or individuals who share interests but who may not be socially connected, as indicated by their interactions on social media. Non-market institutions could use this functionality to inform interventions.
No evidence of closure social capital formation was found in the case studies; however, evidence regarding brokerage social capital formation was found. (e.g. Peterborough & Bretton case study and Art Hackathon.)	**SDP2**. Designers of social media analytics tools can respond to non-market institutions' interest in social capital by providing functionality to highlight social media activity occurring between previously unconnected individuals subsequent to interventions such as focus groups. Non-market institutions could use this data to indicate the effectiveness of interventions.

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[319] Woolcock, &Narayan, 2001, p3

Situated design principles drawing on Donath's signalling theory	
Non-market institutions may want to understand the community assets – such as people, places, events, organisations – that community members value. Donath's signalling theory suggests that social media activities that are time consuming or require other resource investment on the part of the user are more likely to reflect users' preferences. In the case studies (particularly Peterborough and Bretton and Newspeak House), signalling theory was used to inform the design of the functionality to discover community assets.	**SDP3**. Designers building social media analytics tools to discover community assets can apply signalling theory to prioritise which social media behaviours best reflect community member's perceptions of community assets (eg. liking, following, commenting etc.). **SDP4**. Designers building social media analytics tools to discover community assets can use signalling theory to decide what social media data can be deleted while maximising the effectiveness of community asset detection if resource constraints make the retention of all data impossible.
Situated design principles drawing on network flow models	
Non-market institutions may want to apply social network-oriented theories to social media data, such as social capital and signalling theory as described in the previous situated design principles. Borgatti & Halgin's concept of the network flow model is a means of making design decisions to apply social network-oriented theories. These synthetic situated design principals draw support from across the practical work.	**SDP5**. Designers of social media analytics tools can use network flow models to help structure databases to make 'flow' type queries easier, for example identifying which person has the most social connections. Such structures can support functionality relating to social capital and signalling theory. **SDP6**. Designers of social media analytics tools can use the network flow model to consider how social network-oriented theories beyond brokerage social capital and signalling theory could be applied.

Table 16. Summary of situated design principles

10.2 Future work and limitations

This section discusses some limitations of the research and how future work could address those limitations and extend the research. Future work specific to the situated design principles is discussed in the Situated design principles chapter.

Due to the limitations of the PhD research time-frame, this research is wholly conducted using data from Twitter, and the extent to which the findings may be applicable to other social media platforms was not tested during the project work. It is also context-sensitive, both to the geographic locations where the research took place and also to the research partners with which the LocalNets tool was deployed. Drawing on Gregor and Hevner's delineation of 'levels' of research findings from ADR, results are presented at two levels of context-sensitivity, with the implementation findings relating to RQ1 being highly context-sensitive, while the situated design principles, which draw on multiple case studies, have the potential for wider applicability.[320]

Limitations and the design framing

The 'Comparison of design framings' section in Chapter 2 outlines the reasons why an ADR framing was selected for the research, and surveys other framing for design research related to social media and non-market institutions. The choice of ADR, which specifically targets software development in institutional settings, shapes the types of findings that arose. Twitter, the people who use it and the publics that arise in response to issues as discussed on Twitter, could have been framed through the ANT approach and may have generated a different set of findings regarding the affordances of Twitter and the affordances non-market institutions value in social media analytics. An adversarial or participatory lens would have shaped the research differently, particularly in regard to the findings in the sections on participation and working with third parties. Simon's Design Science is less immediately applicable, but is included for its role in the research journey, where it led to cost-benefit ethical framing and, through ‘revealed preferences’, to signalling theory. However, use ADR approach is justified by its focus on researching software artefacts in institutional settings.

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[320] Gregor, & Hevner, 2013

Future work using datasets from multiple networks

Networks other than Twitter could be used to perform social network analysis: for example, Meetup, EventBrite, GitHub and medium.com. These platforms all provide APIs that are accessible and can provide network data, which could be used in a manner comparable with Twitter interactions. Such an approach would require additional development work that was not feasible in the time-frame of the PhD research, however could combine to give more accurate picture of users’ behaviours and intentions.

Future work exploring the positive social effects of local businesses

From the situated findings, the observation that local businesses’ Twitter interactions may be key to forming a sense of local community stands out as particularly fertile. It resonates with the idea that chain stores fail to provide an intangible social function formerly supplied by local shops which have been displaced by low-cost chain store alternatives.[321] This observation could provide an opportunity for further research investigating businesses’ contributions to communities through their social media activity.

Ethical framings

Non-market institutions have ethical responsibilities to the communities they serve. They frequently have frameworks, such as cost-benefit analysis, to navigate those responsibilities. Social media analytics tools intended for non-market institutions will have to articulate their suitability in relation to those frameworks. Beyond the general ethical sensitivities of the non-market sector, social media analytics also brings specific concerns around privacy. The cost-benefit analysis section of the Context review discussed the prevalence of cost-benefit analysis as an ethical framework in non-market institutions.

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[321] Portas, 2011

Exemplifying this, cost-benefit analysis (CBA) formed a part of the RSA's Connected Communities project, which included the Hounslow and Peterborough studies.[322]

The cost-benefit analysis section also noted the shortcoming of cost-benefit analysis, particularly the difficulty of assigning values to costs and benefits in monetary terms. In the Capability Approach section, Sen's capability approach is proposed as a way forward, noting Oosterlaken's capability-sensitive design theory.[323] The capability approach has the potential to connect with cost-benefit analysis as used by non-market institutions but can also be expressed in relation to contemporary design theory.

However, the work with partner institutions, including the case studies and focus groups, did not support findings regarding the capability approach. Further work should focus on developing an ethical basis for social media analytics in non-market institutions. The capability approach remains a potential way forward in this area.

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[322] Parsfield, et al., 2015

[323] Oosterlaken, 2009

10.3 Conclusion

This research set out to explore the use of social media analytics tools in non-market institutions. Making use of an ADR method, a social media analytics tool named LocalNets was built and developed across four case studies. The objective of the work was to address two research questions:

1. How can Twitter social media analytics tools support non-market institutions?
2. What design principles might support designing social media analytics tools for non-market institutions?

A series of Action Design Research findings address the first research question, drawn from using the LocalNets tool with non-market institutions. The importance of local independent retail in driving community-oriented social media activity emerged as a key finding. Demographic factors, such as the population size of a community that generates sufficient Twitter activity to support meaningful analysis, were found to be highly sensitive to the type of analysis the partner institutions wanted to conduct. The second research question is addressed through the development of six situated design principles, two drawing on Burt's brokerage social capital, two drawing on Donath's signalling theory and two synthetic design principles drawing on Borgatti and Halgin's network flow models.

The Creative Exchange and the research narrative

The CX research programme provided a model for this practice-based PhD which drew on industry and academic partnerships. This did not result in a linear approach to design research, but rather one which positioned partnership projects firmly at the heart of the PhD. The partnerships helped drive the research and provided the context for the application of theory through a series of case studies. Using the ADR framework, the partnerships were opportunities to gain access to research contexts in which the LocalNets tool could be deployed and to generate feedback from the institutions in which the software was used. Using the ADR principle of 'guided emergence', three theoretical positions were identified which led on to six ‘situated’ design principles. Combining theory and case studies in this way responded to the research partnerships approach that was embedded in the Creative Exchange programme. As a foundation, and to position the emerging research, a contextual review was undertaken to examine similar work, define terms and identify a research method.

By contrast, a more linear research approach might have used the literature review to set the parameters of the theory to be addressed and framed case studies investigating a predetermined theoretical territory. Such a narrative might have been easier to explicate in the format of a thesis and may have led to a more conventional case-study-oriented thesis. However, the research presented here specifically concerned the context of non-market institutions, and the CX provided a crucial platform that was well suited to design challenges requiring institutional collaboration and access to institutional contexts.

In line with CX’s ambition to situate academic research in relation to commercial contexts, it was anticipated that LocalNets might become a commercial product. LocalNets was deployed in commissioned projects, including one with Birmingham South Central Clinical Commissioning Group and one with Demsoc (further details of commissioned projects are presented in Appendix A). These projects indicated some appetite for a commercial product. Ultimately, however, LocalNets was not turned into a product during the course of the research, due to time constraints and the administrative complexity associated with becoming a commercial supplier for non-market institutions, which presents a particular barrier with local government.

The challenge of designing a social media analytics tool for non-market institutions led to a design research project that has drawn upon a wide range of disciplines: social capital has its origins in sociology, while signalling theory has origins in economics and biology. The development of six situated design principles and the implementation findings from the ADR case studies constitute my contribution to new knowledge in field of design research. These findings seek to guide design practitioners working on social media analytics tools for the non-market sector.

11. Appendices

11.1 Appendix A: Full Project List

Tables listing major projects and conferences and events are presented below. Major projects are either projects that have been written up as case studies, or which otherwise warranted inclusion because of the amount of work done on them. Conferences and Events are the short-term network mapping projects undertaken during the research, while the category of exploratory projects collects work that tested the viability of a mapping project.

Project	**Locations/ Communities**	**Description**	**Date**
Major projects			
Makerspace Network Analysis	Makerspaces across UK	Collaborative project initiated with Elizabeth Corbin from UCL. Ongoing with RCA Future Makerspaces in Redistributed Manufacturing research project.	September 2016
Newspeak House	Members of Nwspk House and wider tech and politics network	Nwspk House is a membership organisation and event space focusing on politics and digital. The project mapped the Twitter activity of the members culminating in a focus group on the uses of their data.	August 2016
Democratic Society in Coventry	Coventry	Democratic Society project commissioned by Coventry City Council to explore digital engagement in five different communities. LocalNets was used in a mapping of locally-oriented Twitter activity in the city.	January 2016

Greenwich Driverless	Greenwich Peninsula	Monitoring social media activity around driverless car trial in Greenwich. A project with Commonplace, Transport Research Laboratory and RCA Helen Hamlyn Centre.	November 2015
NHS Birmingham	South Birmingham	Collaboration with Birmingham South Central Clinical Commissioning Group, as part of their citizen consultation strategy	September 2015
Peterborough and Bretton	P'boro city / Bretton	Twitter mapping plus two focus groups with RSA, DCLG and Dr Bola from Lancaster.	December 2014
Department for Communities and Local Government asset finding	Tower Hamlets Bracknell Forest South Ribble	Pilot study finding community assets in four areas identified by DCLG	December 2014
Hounslow data validation	Hounslow / Cranford	Undertaken with RSA with NESTA funding with DCLG. Manually testing the value of Twitter data.	March 2014
CX 'Annunciator'	CX Students	'Ambient display' in RCA and Newcastle CX offices.	February 2014
Kensington and Chelsea Micro Newspaper	Kensington & Chelsea	Physical prototype in partnership with Mark Simpkins RBKC.	January 2014

Work with other researchers			
SPENCE modelling	Bowes and Bounds / Herne Hill	With Caroline Halcrow from Southampton University, providing data to support her doctoral research on Online / Offline communities.	Ongoing
Shakespeare in Shoreditch	Shoreditch / RIFT theatre community	With Benjamin Koslowski from the CX and Rift theatre company, resulted in the StoryMap installation.	August 2016
John Bingham-Hall collaboration	Brockley / New Cross	Working with John Bingham Hall at the Bartlett resulting in a paper being published in *Visual Communication*.	May 2016
Bow Arts Centre focus group	Bow	With Dr Zamenopoulos and Dr Alexiou from the Open University, providing data to support their focus groups at Bow Arts Centre.	April 2015

Conferences & Events			
Fact Gallery	Bold Street, Liverpool	StoryMap installation at CX final show with Benjamin Koslowski.	June 2016
EU Traders Program	Genk, Belgium	Demonstration mapping of the Genk community for EU Traders researchers symposium.	January 2016
Cumbria floods	Cumbria	Network visualisation of community reacting to flooding event.	December 2015
NHS Citizen	Conference attendees	NHS Citizens Assembly, run by Involve and Tavistock Institute	November 2015
Metalondoners	Clerkenwell, Bethnal Green, Brixton, Limehouse, Hampstead	Data to support Metalondoners project for Across RCA with Dr Ferrarello. Across RCA is a week-long set of projects for students to work across disciplines and schools.	September 2015
#CTSummit	Creative Time Summit Attendee	Mapping conference hashtag (also attended)	August 2015
Arthack	Art Hackathon - artists and hackers attending	Sponsored by Ravensbourne University, weekend-long hackathon	May 2015
SMSociety15	Conference Attendees	Experimental mapping	July 2015

Exploratory Projects			
Aylesbury Estate	Aylesbury Estate, Elephant and Castle	Demonstration project for Social Life, a placemaking agency.	June 2016
Olympic Park	Olympic Park, Hackney Wick	Demonstration project for Future Cities Catapult, for their work on the Olympic Park as an IoT testbed (The Capstone Project).	April 2016
Croydon BME organisations	Croydon	Experiment with Houda Davies at Public-i, consulting with local government on digital issues.	September 2015
Democratic Society / NHS Citizen mapping	Tamworth Telford South Staffs Birmingham	Exploratory mapping of locations involved in the NHS Citizen project. NHS Citizen is a programme to build more public feedback into NHS planning.	July 2015
Coldharbour and Vassall	Coldharbour and Vassall	Test with Folk Labs, socially focused web development agency.	April 2015
Cornelius Foundation	Cornelius members	Mapping the Twitter activity of members of the Cornelius Foundation, a think-tank focusing on the power of art for social change.	Sep 2015

Table 17. Full project list

11.2 Appendix B: Coase, Ostrom & the digital

Coase's paper 'The Nature of the Firm' is the origin of the institutional economic models deployed in this research.[324] It has been widely used to understand the impact of digital technology on social cooperation. Coase questioned why firms exist at all: if the market is effective at generating efficient outcomes, as it is sometimes held to be, we should just see individuals contracting with each other to provide goods and services. Instead, economies in developed countries are mostly composed of firms. Coase resolves this tension by invoking transaction costs. Setting up contracts between large numbers of individuals is costly, and it is preferable to minimise this expense. One way to minimise transaction costs is for individuals to set up long-term contracts between each other to form an organisation – to create a firm. That firm can then collectively arrange contracts with other firms, thus reducing transaction costs.

In *Here Comes Everybody*, Clay Shirky describes a 'Coasian floor', a term he uses for the idea that there are cooperative activities where the benefit to the individuals are outweighed by the transaction costs that Coase identified.[325] When this happens, an activity that could have been beneficial to that individual will not be undertaken. Shirky identifies the Internet as a tool to lower the Coasian floor by enabling lower-cost cooperation. Benkler, in *The Wealth of Networks*,[326] and Tapscott and Williams' *Wikinomics*, make very similar points.[327] As the Coasian floor is lowered, individuals no longer have to become employees of firms to minimise transaction costs to the same extent. Coordinated action that was before prohibitively difficult to organise outside of institutions becomes possible for individuals.

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[324] Coase, 1937
[325] Shirky, 2008
[326] Benkler, 2006, p. 59
[327] Williams, & Tapscott, 2011, p. 55

The Ostromian and Coasian traditions work together here, and Benkler also references Ostrom's work at length.[328] In common-pool resource situations, individuals must coordinate to share a resource, but the profit motivations of the market fail. A lowering of transactions costs, therefore, makes common-pool resources more viable.

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[328] Benkler, 2006, p. 59

11.3 Appendix C: Collective action

This appendix concerns the term ‘collective action’, which is widely used in the literature referenced in this research. Ostrom uses the term ‘collective action’ in the title of her book,[329] which in turn draws on Mancur Olson’s work on the same topic and is also closely related to the theory of social capital developed in the Hounslow case study.[330]

‘Collective action’ functions as a general term to encompass phenomena designated by terms such as ‘competition’, ‘cooperation’ or ‘collaboration’. These usually imply that participants are either working against each other or with each other, concepts which themselves have ethical implications. Collective action does not carry those same implications, which is useful because many situations are ambiguous in this regard – the term ‘collective action’ allows judgement to be suspended.

A collective act might, for example, have cooperation and competition ‘nested’ inside one another. In a football game, two teams expend their energy competing against one another, and yet both teams agree to be bound by the rules of the game, to arrive to play at the same time, to play in a league – all forms of cooperation. An important example is that of a market. Economists since Adam Smith have conceptualised the market as simultaneously cooperative and competitive, a contradiction encapsulated by the famous quotation:[331]

> It is not from the benevolence of the butcher, the brewer, or the baker that we expect our dinner, but from their regard to their own interest.

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[329] Ostrom, 1990

[330] Olson, 1965

[331] Smith, 1776, p. 17

The philosopher John Searle has investigated the fundamental underpinnings of institutions and their relation to collective intentions and collective action (Searle is responsible for the football analogy above).[332] For him, collective action requires collective intentions, which themselves require a further explanation of what intention is, and when it can be said to be collective.[333] It is beyond the scope of this research to explore this literature further, except to note that Kutz, responding to Searle, provides a highly inclusive definition of collective action:[334]

> I argue here instead for a minimalist account of collective action, which explains collective action across a broad range of contexts by reference to individuals' overlapping "participatory intentions," i.e., intentions to do one's part in a collective act.

For the designer, the idea of collective action, and Kutz’s broad definition, may be useful even if there are philosophical nuances it cannot capture. Collective action allows ethical judgements to be deferred. Designers should ask which system of collective action has an acceptable outcome in terms of their chosen ethical system, without reference to ideas such as competition and cooperation. This is a semantic point, but one that was often salient. During this research, many discussions occurred around ways in which design ought to promote cooperation rather than competition. As described above, this is not a clear distinction and this might not be the most productive way to evaluate ethical claims about collective action.

In addition to freedom from ethical connotations, collective action provides a common point of reference across disciplines. It arises in the design literature as a way of referring to social coordination design problems,[335] in social capital literature,[336] and in the literature on institutional economics.[337] In Le Dantec's book *Designing Publics,* the term 'collective action' is used extensively in this way – as a way to designate all participatory undertakings:

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[332] Searle, 2005
[333] Searle, 1990
[334] Kutz, 2000
[335] Le Dantec, 2016
[336] Burt, 2007, p. 126; Putnam, 2001

> Threaded through the book has been an inclination toward reimagining forms of collective action and the role that design might play as means toward such action.[338]

Searle notes that the philosophical work on these topics is nascent, and that unresolved problems remain. These he takes to be sufficiently significant for him to argue for a 'philosophy of society' that is held in the same esteem as a philosophy of mind and other prominent fields within that discipline.[339] This need is perhaps especially acute in the context of research, such as this thesis, which draws from a variety of disciplines, where there is the greatest danger of technical terms being misused or misunderstood. Hodgkin's book *Following Searle on Twitter* uses Searle's theoretical framework to describe Twitter as a digital institution. This book could indicate a growing awareness of the need to understand digital collective action in fundamental terms.

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[337] Ostrom, 1990; Olson, 1965
[338] Le Dantec, 2016, p. 111
[339] Searle, 2010, p. 5

11.4 Appendix D: Information Systems Design Science as Design Research

The term 'design science' is used in different ways within the different literatures drawn upon in this research. Design science in the information systems (IS) literature is not construed as science in the sense that it uses a scientific method, or that it generates objective truth of the kind that science is sometimes held to. Instead, a variety of interpretations are possible.[340] In Hevner's original paper he specifically intends the addition of 'design' to the term 'science' to distinguish it from natural science.[341]

In contrast, within the discipline of design research Cross uses 'design science' to designate a kind of scientism that he advocates that the design research community should move away from.[342] Bannon and Ehn, in *The Routledge International Handbook of Participatory Design*, discuss these two connotations as follows:

> The notion of a "design science" has resurfaced in the field of Information Systems as a result of work by Hevner … our initial opinion on this approach is that their "design science" concept is used in ways which appear rather removed from the design concerns of Cross and others.[343]

This issue is further developed by Hovorka and Germonprez, who make the case that in IS's design science 'the role of the humans who will use the system has been marginalized to that of a source in a requirements elicitation process'.[344]

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[340] Goldkuhl, 2012
[341] Hevner, et al., 2004
[342] Cross, 2001
[343] Simonsen, et al., 2014
[344] Isomäki, & Pekkola, 2011

Hovorka and Germonprez's perspectives on design science were published in the same year that Sein's work on the ADR methodology appeared. ADR endeavours to address exactly these issues in IS design science. Sein says that design science 'takes a technological view of the IT artefact, paying scant attention to its shaping by the organizational context.' As an antidote, they recommend that IS adopt the ADR method which 'conceptualizes the research process as containing the inseparable and inherently interwoven activities of building the IT artefact, intervening in the organization, and evaluating it concurrently'.[345] This is explicitly related to action research: 'We propose a solution in the form of a new research method for DR that draws on action research (AR) and call it action design research (ADR)'. In this way, Sein's work addresses Hovorka and Germonprez's criticism that the human context of technology software artefacts is insufficiently considered in IS design science. This reconfiguration of design science as a type of action research makes it well suited to framing contributions to design research. Swann underlines the applicability of AR to design processes, stating that 'action research and the action of designing are so close that it would require only a few words to be substituted for the theoretical frameworks of action research to make it applicable to design.'[346]

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[345] Sein, et al., 2011

[346] Swann, 2002

11.5 Appendix E: Action Design Research examples

The following table presents a survey of ADR papers that are particularly relevant to the research, either because they use social media, because of their development of software with a view to supporting a particular community, or because they are targeted to a public-sector institution.

Paper	**Authors**	**Topic**	**Year**
‘Social Data Analytics Tool (SODATO)’	Hussain & Vatrapu	Social media analytics for business intelligence	2014
‘How to prevent reinventing the wheel? – design principles for project knowledge management systems’	Schacht & Mädche	Software for sharing information within institutions	2013
‘Building an evaluation framework for social media-enabled collaborative learning environments (SMECLEs)’	Doyle et al.	Social media in digital learning environments	2015
‘Developing a health and wellbeing platform in a living lab setting: An action design research study’	Keijzer-Broers et al.	Digital platform to help elderly people access care services	2015

‘Inter-organizational social networks: an action design research study’	Mullarkey et al.	Social networking between organisations	2013
‘An action design research approach to developing emergency management systems’	Meum	Social media and disaster management	2014
‘The action research vs design science debate: reflections from an intervention in eGovernment’	Papas et al.	Internal eGovernment systems	2012
‘Engaging citizens with news stories through social curation: A design research project’	Schneider & De Souza	Social media and news circulation	2015
‘Action design research in practice: the case of smart cities’	Maccani, et al.	Smart Cities	2014

Table 18. Examples of Action Design Research

11.6 Appendix F: Network visualisation

Many of the projects include data visualisations which attempt to convey the network data gathered by LocalNets. This appendix will discuss some of the research conducted into network visualisations.

Styles of visualisation

Frequently, social networks are visualised as network graphs.[347] In the data visualisation literature, network graphs are often contrasted with matrices as an alternate way of presenting social networks.[348] It should be acknowledged that network representations are considerably more widespread.

In a matrix, a table of every possible combination of links is presented and cells in the table are coloured (or otherwise distinguished) to indicate visually which links are present within the network. Some evidence suggests that matrices are easier to read for tasks such as finding the most linked node or counting the total number of nodes, particularly for graphs with more than 20 nodes.[349] Matrices perform less well for 'path-finding' tasks, where a test subject is asked to follow a route through the network.

Researchers have attempted to combine both approaches in various ways; unfortunately, such hybrid solutions were found to be prohibitively complex to implement for this research.[350] Primarily, the visualisations were presented on paper, so dynamic 'zooming' approaches that rely on interactivity were also precluded by practicalities.[351,352]

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[347] Henry, et al., 2007
[348] Henry, & Fekete, 2007, Henry, & Fekete, 2006
[349] Ghoniem, et al., 2005
[350] Henry, & Fekete, 2007; Henry, et al., 2007
[351] Shneiderman, 1996
[352] Henry, & Fekete, 2006; Elmqvist, et al., 2008

In choosing between the matrix style and the network graph style, consideration was given to the fact that, for smaller networks, the two styles are roughly equally easy to read, except in the path-finding tasks, where network graphs are usually easier. Many of the graphs generated through LocalNets had fewer than 20 nodes. Further, it was noted that the research on graph reading has often been conducted on students, sometimes computer science graduate students, possibly reducing its relevance for wider populations (eg. Huang and Eades,[353] Ghoniem[354]). The textual density and clinical appearance of a complex matrix may make it unappealing to those not used to interpreting large quantities of data.

Finally, matrices are not as effective at showing edge ‘weight’. If two nodes have many connections, this can be indicated visually on a network graph with a thicker line between those nodes. There is no commonly adopted approach to indicating connection weight in matrix visualisations. For reasons of clarity and familiarity a network graph style was chosen for all the visualisations.

Reducing visual complexity

Because of screen and print resolutions, ‘zooming out’ of a visualisation of a whole network would have rendered it illegible: LocalNets sometimes generated networks with hundreds or thousands of nodes. Showing so many nodes would have given visibility to many practically irrelevant nodes while rendering the relevant ones invisibly small. Instead a filtering approach was taken.

Nodes were filtered by the number of inbound links. This choice was made on the basis that there was no justification for more complex analysis, and was supported by the findings in the Peterborough and Bretton case study, where other more sophisticated measures (PageRank, centrality) generated similar rankings to the inbound link approach. Nodes were filtered by inbound edge count until only the most linked nodes remained. The filter threshold was set to present the maximise the number of nodes while retaining clarity: for example, leaving legible labels on an A4 print-out.

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[353] Huang, & Eades, 2005
[354] Ghoniem, et al., 2005

In all cases the nodes were filtered to only include the ‘giant component’. The giant component is the largest linked group of nodes. In all the graphs observed, the giant component was much larger than any of the other components: typically, there would only be single small networks of two or three nodes outside it, and they would naturally be excluded by filtering for the most connected nodes. In smaller networks, sub-networks of one, two or three nodes can remain, isolated from the main community – in these cases such islands were excluded.

Laying out network graphs

Graph visualisation was carried out in Gephi, a desktop software package that specialises in this area. An export function was added to LocalNets which generated files in a format that Gephi can open.[355]

Gephi offers many different options for visualising graphs. Choosing how to position nodes on the page for maximum clarity is a complex problem. It is desirable for labels not to overlap so they can be read, and user testing also indicates that features such as reducing line crossings and number of bends in edges improve readability.[356]

A common solution is to use a ‘force directed’ approach, where an algorithm mathematically simulates the replacement of links with springs (‘spring embedding’). In some examples, the algorithm also assumes a repulsive force between the nodes. This approach is notably described by Tutte and gives an aesthetically pleasing effect in which the nodes with the most links between them are naturally drawn closer by the ‘stronger’ imaginary spring between them.[357] Clusters become visible, and repulsive and attractive forces are balanced so that node labels are still legible and the graph does not spread out too much.

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[355] Bastian, et al., 2009
[356] Purchase, et al., 2002
[357] Tutte, 1963

Two kinds of ‘force directed’ algorithm were used to lay out the network graphs. The first is Gephi’s Force Atlas 2, a hybrid algorithm combining multiple techniques with the objective of creating the most legible graphs.[358] This approach was found to be best when distinctive sub-communities were found, as it makes them particularly visually apparent.

The drawback with this approach, particularly when preparing graphs for printing, is that nodes tend to become spread out and create an irregular overall shape. In workshops where it was desirable to present a large number of nodes to participants, the ‘Fruchterman Reingold’ algorithm was used.[359] This algorithm has the advantage of generating a circular layout that is more compact and regular than Force Atlas 2. This means it can be printed more easily.

Colouring Network Graphs

Data was presented using a variety of colouring schemes. Colour was assigned to nodes, and edges emanating from that node inherited that colour (nodes themselves were often obscured behind labels). For example, in the work with Newspeak House, colour was used to distinguish between those individuals with membership and those without. It was also used to discriminate between ‘community assets’ (hashtags, places, events, etc) and Twitter users.

Colour was also used to highlight ‘communities’ within the network using Gephi’s modularity class function.[360] This function automatically detects ‘communities’, where a community is a collection of nodes that are more linked to one another than to the network as a whole. Gephi allows colours to be assigned to such community, and this functionality was used in the handouts for all the focus groups.

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[358] Jacomy, et al., 2014
[359] Fruchterman, & Reingold, 1991
[360] Blondel, et al., 2008

11.7 Appendix G: Social capital theory

Portes attributes the term ‘social capital’ to Bourdieu[361] in his essay ‘The Forms of Capital’,[362] translated into English in 1986, but sees antecedents stretching back to the origins of sociology in Durkheim and Marx. According to Bourdieu, social capital is:

> The aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalised relationships of mutual acquaintance or recognition.

The term came to particular prominence with Putnam’s paper ‘Bowling Alone’[363] (published in 1995) and his subsequent book, which addressed what he saw as declining social capital in the United States. Putnam’s work demonstrated statistically that membership of clubs and other collective activities in the United States was declining. He suggested the result was a worrying lack of the type of civic engagement necessary for a functional democracy. The idea apparently resonated with President Bill Clinton, who met with Putnam to discuss his findings.

Views differ on whether social capital is a property of individuals or groups,[364] and its relation to other kinds of capital – human, cultural or monetary – has also been construed variously.[365] Another source of theoretical divergence is in the types of networks that social capital can occur in: some authors (Bourdieu, Coleman, Putnam) suggest that it only meaningfully occurs in groups which are densely connected.[366] The relationship between different types of capital will not be explored here. The idea that social capital can only occur in densely knit groups is undermined by the observation that ties between two people who are not otherwise part of the same group are often very important – a phenomenon of particular relevance in social network analysis – so the definition of social capital deployed will follow Lin and allow social capital to occur in any network structure.[367] On the question of whether the 'unit of analysis' ought to be the group or the individual, Adler points out that these are not mutually exclusive.[368] In the data collected from Twitter, Twitter accounts can represent an individual or institutions; however, in this research they will be treated as an individual as further analysis is simply not possible – no network data revealing an internal structure of an organisation can be derived from Twitter. Where this limitation is relevant it will be noted.

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[361] Portes, 2000

[362] Richardson, 1986, p. 241

[363] Putnam, 1995

[364] Castiglione, et al., 2008, p. 50

[365] Adler, 2000

[366] Adler, 2000

Social network data has been seen as a way to understand social capital almost as soon as online social networks became popular. Facebook was launched in 2004, Twitter in 2006; in 2007 a study of students at Michigan State University was published suggesting a correlation between Facebook use and social capital.[369] The study showed that Facebook Intensity (a combined measure of hours spent on the site and number of Facebook friends, a survey instrument derived from work by Quan-Haase and Wellman[370]) increased social capital (both bridging and bonding, roughly analogous to Burt's brokerage and closure).

In 2015 a survey identified 140 papers reporting statistical connections between social capital and and social network behaviours.[371] These papers were filtered and sub-divided into two groups for the analysis, with 50 papers on bridging social capital and 43 papers on bonding social capital.

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[367] Castiglione, et al., 2008, p. 50
[368] Adler, 2000
[369] Ellison, et al., 2007
[370] Quan-Haase, & Wellman, 2004
[371] Liu, et al., 2016

The authors conclude that social network use has a moderate association with bridging social capital and a weaker association with bonding social capital. The analysis further considers the types of social network activities that contribute to social capital formation, finding that publishing photos and updates (‘self-disclosure’, in their terminology) is associated with bonding social capital, while seeking information and replying to others are more associated with bridging social capital, though all types of activities were somewhat important to both kinds of social capital.

Putnam has suggested that online activity might have a very limited capacity for impact on social capital (albeit before social networking was widespread);[372] this claim appears to be disproven by empirical evidence – although concerns about the ‘digital divide’ and the ways in which digital mechanisms can substitute for offline ones remain valid.[373]

Prevalence in policy debate and benefits

Social capital also is frequently invoked in public policy settings. The UK’s Office for National Statistics (ONS) provides annual national measurements of social capital,[374] using a definition it adopts from the OECD:

> Networks together with shared norms, values and understandings that facilitate co-operation within or among groups.[375]

The World Bank also publishes research on the importance of social capital, its measurement, and policy options for increasing social capital.[376] The policy interest in social capital is due to its connection with positive economic outcomes,[377] health,[378] and self-reported well-being.[379] The report on the RSA *Connected Communities* project also found that a measure of social connectedness was related to self-reported well-being.[380] Some of the potentially negative consequences from social capital are discussed in Appendix G.

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[372] Putnam, 2001, p. 170
[373] Hudson, & Theocharis, 2014
[374] Office for National Statistics, 2017
[375] Foxton, & Jones, 2011
[376] Hamilton, et al., 2016
[377] Knack, & Keefer, 1997
[378] Nieminen, et al., 2013

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[379] Helliwell, 2006

[380] Parsfield, et al., 2015

11.8 Appendix H: Criticisms of social capital

Two classes of criticism of social capital are discussed here. Firstly, critics have suggested that the concept of social capital is in some way defective or ill defined. Secondly, the concept of social capital seems to at least imply that higher levels of social capital are desirable – this may not be true in every context.

Conceptual issues for social capital

On a conceptual level, Portes has pointed out social capital's vulnerability to circularity.[381] In Portes' view, Putnam's widely cited work on declining social capital in the United States has a fatal flaw: 'social capital is simultaneously a cause and an effect.' Putnam says that declining membership of groups and clubs is both causing society to become enfeebled, and is the effect of that enfeeblement. Portes notes a similar phenomenon in other social capital research, where a correlation is noted between two social features that are similar or identical – thus having little explanatory power. Vigilance toward circularity in social capital-based reasoning should be maintained, but it is not the case that all social capital is exclusively circular. For example, Burt's empirical work correlates network structure (particularly brokerage opportunities) with phenomena such as workers being promoted within a company, thus avoiding circularity.

At a political level, social capital has been criticised as a convenient scapegoat for the failure of economic policies. Ben Fine suggests that in developing countries unsuitable economic policies are frequently imposed, often with negative outcomes.[382] Policymakers, frequently the same ones that imposed the unsuccessful economic policies, then point to declining social capital as the cause of the failure, which, they argue, disrupted what would otherwise been a successful economic strategy. Fine argues that a decline in social capital is not an exogenous problem, but part and parcel of an inappropriate economic strategy. Specifically, attempts to force strongly market-oriented economic policies on developing countries will necessarily erode social capital, in Fine's view.

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[381] Portes, 2000

[382] Fine, & Lapavitsas, 2004

This critique clearly touches on important issues, but this research is not about apportioning blame, and it would not be appropriate to abandon the explanatory power of social capital in design scenarios because it has, on occasions, been misused.

Negative consequences from social capital

Another class of problem for social capital is the possibility of negative consequences flowing from high levels of social capital. Geertz gives examples of successful entrepreneurs in Bali becoming 'welfare hotels'.[383] Strong networks and social norms create a situation where those who do well for themselves can expect friends and relatives to make many claims on them for hospitality. As a result, the rewards of entrepreneurship are quickly redistributed to the community, and the motivation to run a successful enterprise is diminished. In the long run, this may lead to slower development or more persistent poverty, though a case could also be made that this is an unwarranted value judgement about Balinese society, not a problem to be fixed.

A dense network, high in social capital, may also enforce illiberal conformity, a situation which the individuals involved might find oppressive. Extreme cases are described as 'downward levelling norms' – where a community seeks to undermine those who are successful because of a perceived betrayal. Bourgois describes such a scenario in Puerto Rican gangs in Harlem, where those who eschew the gang lifestyle and take conventional jobs are seen as rejecting their own racial identity, and may be shunned by the community for doing so.[384] On this analysis, strong community identity, enabled by strong social networks, generates negative outcomes.

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[383] Geertz, 1991

[384] Bourgois, 2003

Finally, there is the danger of ‘cliques’ forming.[385] Such a clique can take control of a business or public service. For example, research has looked at the way in which Irish, Italian and Polish immigrants have historically exerted control over the fire and police services in New York. This can be unjust and exclusionary, and in the case of business it can also allow apparently discrete businesses to engage in monopolistic practices.[386]

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[385] Waldinger, 1995

[386] Min, 1990

11.9 Appendix I: Data stability

Over time, the data showed stability month-to-month. Comparing a list of the top 40 nodes by inbound links in January with the same in April, 50 per cent of the nodes were the same. The same applied to the list of the top 10. It also applied to all nodes, and only Twitter user nodes.

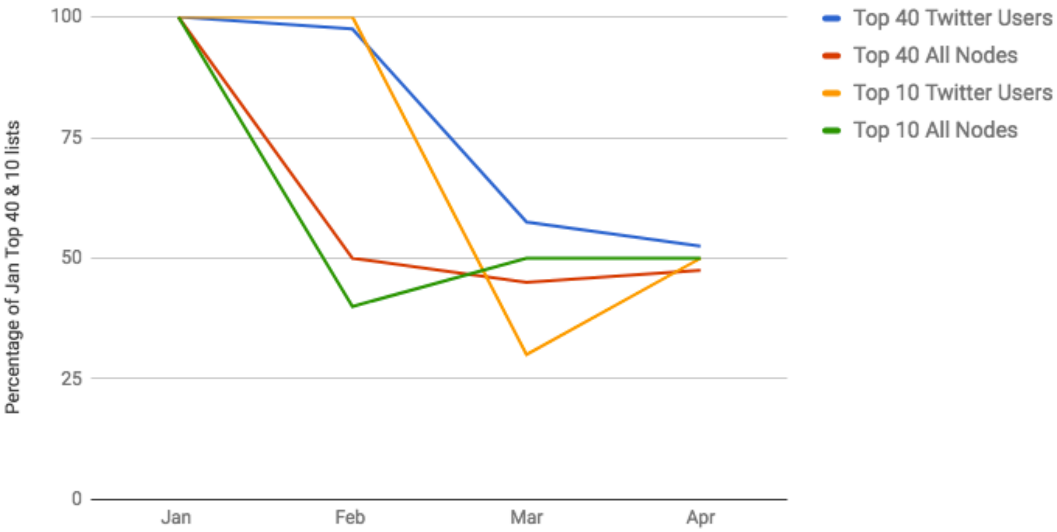

Figure 39. Peterborough and Bretton data stability. Graph shows change of the nodes with the most incoming links in the network over time. It compares a list of the top 40 and top 10 nodes with the most incoming nodes for the first full week of each month, showing percentage similarity over time. All comparisons are with the first week in January. All nodes, and nodes that represent only Twitter users, are shown.

Again, with Newspeak House the data shows a high level of stability. This is of interest because one feature of the software showed a week-by-week list of the most popular nodes. The goal was to help LocalNets provide a more dynamic picture of the community. However, week-to-week, and even month-to-month, changes were observed to be relatively small.

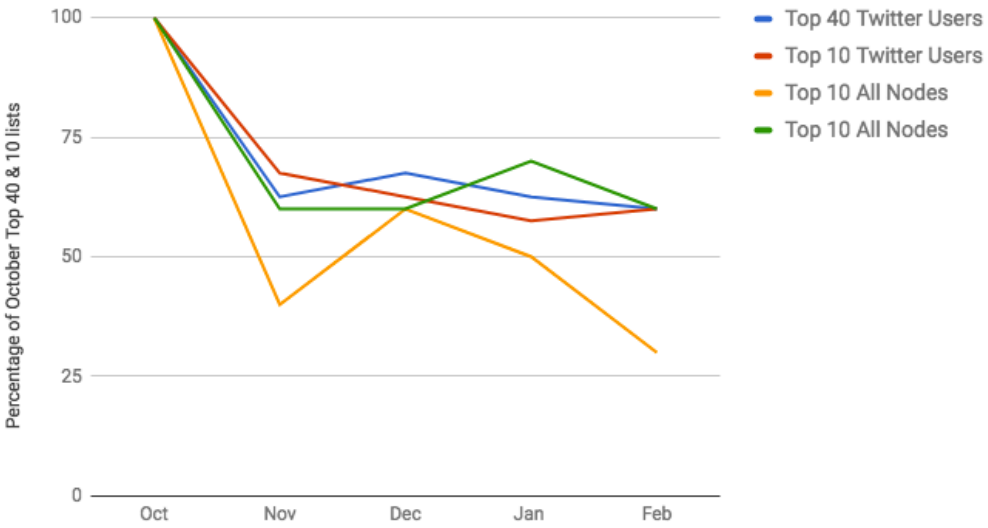

Figure 40. Newspeak House data stability. Graph shows change of the nodes with the most incoming links in the network over time. It compares a list of the top 40 and top 10 nodes with the most incoming nodes for the first full week of each month, showing percentage similarity over time. All comparisons are with the first week in January. All nodes, and nodes that represent Twitter users, are shown.

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