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Designing in between Local Government and the Public – Using Institutional Analysis in Interventions on Civic Infrastructures

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Abstract. Adapting and changing the systems and technologies involved in civic engagement with local government is among the key challenges of collaborative technologies for political participation. In such contexts, both existing sets of technologies and ingrained, often formalised practices, the 'rules of the game', constrain any opportunity for intervention. Additionally, 'civic' and expert groups with conflicting agendas and divergent demands on public choices assert their influence in these transformation programmes. The article argues that established methods in collaborative systems design have thus far overlooked the role of recurring actions involved in public participation as well as the formal rules and ingrained practices that construct them. Yet, such patterns present a valuable resource for design interventions. Thus, based on an institutional approach, the article outlines a methodology for requirement gathering by mapping the relations of actors, software and their use along identifiable action situations. The method called for a dialogue between socio-technical-spatial contexts of public service and specific actions taking place within it. Drawing on a case of organising civic engagement in urban planning, the article discusses how to find and trace existing practices across social settings, information technologies and material contexts where engagements take place. The approach underscores the existing institutional contexts in inspiring, opening and constraining the opportunities to support 'civics'.

Keywords: Civic infrastructure, civic participation, ethnographic methods, institutional analysis, local government

1. Introduction

Technical interventions such as the deployment of new technologies and systems involving local government, the private sector and civic actors are inherently multi-site and multi-institutional endeavours. With the increasingly pervasive digital augmentation of global cities, some hope for more inclusive forms of civic participation (de Lange and de Waal 2013) with both government and citizen-led campaigns, where acts of political participation become a natural part of everyday life (Korn and Voida 2015). Recent projects, such as low-cost voting devices (Vlachokyriakos et al. 2014) or digital mapping applications (Saad-Sulonen 2012) have come a long way and indicate potential for substantial government transformation. For such software,

comprehensive deployment strategies seem necessary so that concern of significant civic interest can be addressed flexibly (Le Dantec and DiSalvo 2013) and, in turn, to ensure software deployments remain in use (Chilana et al. 2015). In local government transformation, multiple challenges exist. These include the difficulty to reconcile 'action and social change' and 'design and development' (Bilandzic and Venable 2011); the diverse political and commercial interests of relevant audiences (Ojala et al. 2010); and the complex interactions between audiences, places and points of services (Monteiro et al. 2012).

Based on experiences from a three-year-long collaboration with a local authority, this article addresses the question of how the politically loaded settings of public service delivery can be better understood to plan for suitable interventions between local authorities – as the formal administration – and 'civics' groups. 'Civics' are groups of interest indirectly and seriously affected by a matter of concern so that they may achieve recognition by others and themselves (Dewey 1927). In making public choices, civics, local authorities and commercial actors often find divergent answers as to how digital technologies should be deployed and subsequently applied. For 'digital civics', public services could, for example, seek to devolve selected responsibilities to external groups or involve them in setting political priorities (Olivier and Wright 2015).

The paper points to the underdevelopment of suitable ethnographic approaches for public services where researchers benefit from awareness for *political structures* that influence the deployment of digital technologies and where user groups may not initially be readily identifiable. Relating to the patterns in cooperative work (Martin and Sommerville 2004), the methodological strategy outlined in this article draws on recurring patterns of interaction between public service and the public as sources for design. In collaborative work, patterns arise from recurring sequences of actions where particular interest is in the 'mechanisms' through which participants coordinate and gain awareness of collaborative actions (Martin and Sommerville 2004). In this, our paper draws out (1) *civic infrastructures* as the set of software involved in establishing, mediating and sustaining civic participation; and (2) '*institutions*' as recurring sets of practices among actors, infrastructure and interaction. Based on institutional concepts and ethnographic methods, the article takes *practices of infrastructuring* as opportunities for intervention (Le Dantec and DiSalvo 2013) and suggests a methodological strategy for exploiting those opportunities.

2. Considerations in the development of civic infrastructure

In the burgeoning literature on new forms of participation in the public sector, many different understandings of 'civic technologies' exist. One interpretation that the authors of this paper found useful was that by Handler and Conill (2016), who linked 'civic technologies' with large public-accessible datasets and the re-purposing of a set of web technologies towards achieving civic goals. For example, in the investigation of the expense claim scandal of the British House of Commons in 2009, the

Guardian produced a simple web tool that enabled the public to browse individual records in a large dataset to flag those of perceived importance. In 80 hours, 20,000 users reviewed 170,000 entries of a total of about 450,000 to help prioritise the investigation. Handler and Conill (2016) use the term 'civic technology' to suggest that it may be described by an assemblage of (1) many-to-many or many-to-few interactions online; (2) large datasets with open access to the public; (3) and the combination of mature web technologies. While perhaps short of a definition, Handler and Conill (2016) suggest such technologies 'are specifically created to enable, facilitate, and enact civic participation' (p. 161). While other techniques of civic participation including hackathons have been acknowledged, in our article, civic technologies are collaborative software that support open calls for participation around shared concerns, mostly by local government and civic groups. Unlike the workplace or home, such applications of web technology are assumed to be ubiquitously accessible to various publics and increasingly sufficiently mature to be used by even those with low technical skill (Bilandzic and Venable 2011).

From this, we can establish a set of characteristics: (1) they address both the 'community or societal level', as argued in community informatics (Bilandzic and Venable 2011), while they link in with formal processes of political organisations (Bødker and Zander 2015). (2) They depend on voluntary participation (Goodchild 2007). The interactions these technologies support are performed in the public domain by various civics, often outside the constraints and incentive schemes of business organisations. This has been demonstrated by the 'cold start problem' of publicly accessible geospatial technologies depending on buy-in of actors dispersed across various locations (Rattray 2006; Bao et al. 2013). From this, they exhibit (3) distinct modes of interaction, such as 'crowdsourcing' (Howe 2006) and 'peer-to-peer collaboration' models (Benkler 2007). In those modes, an open call for participation is addressed to a large audience given a series of participation requirements. (4) Designs should thus account for flexible and spontaneous formation of publics on shared concerns (Le Dantec and DiSalvo 2013).

The question of *who* is involved in their design takes on a political dimension when a system is developed and deployed. The design itself may be (1) intentional and commissioned, or (2) occur through day-to-day decision making and 'design-in-use'. In the former case, problematic questions may arise around the ownership of data/technology stemming from the agenda and goals of the commission organisation. In the example by Handler and Conill (2016), the call to participation was made by a private company that used the capacity of civic action to their own means. In local government, pervasive critique is directed at the fact that most government-organised participation remains constrained by rules set by government (Boonstra and Boelens 2011). The latter case is influenced by actors with both informal influence (e.g. residents and their representative community groups) and formal authority, such as planners and other officials (Saad-Sulonen 2012). Tensions over ownership and influence may arise as digital infrastructures are shared among actors (Graham and Marvin 2001) and where incompatible communication standards are

employed (Monteiro et al. 2012). Public policy, guidelines set in law, and third-party terms and conditions over data access and ownership emerge as design considerations (Jackson et al. 2014). Consequently, the chasm between technological capability and socially desired requirements is hard to negotiate and appears in growing complexity due to the divergent attitudes of different audiences involved. For example, concerning participation, Korn and Voida (2015) discuss the issue that audiences at the periphery of political processes may feel an increasing sense of disenfranchisement.

Thus, it has been suggested to move attention beyond the focus on selected technologies or user groups to develop more systemic perspectives for 'infrastructures' comprised of sets of software and information in use (Monteiro et al. 2012). In their designs, designers could embrace the 'challenge of more open tasks, unanticipated user goals, new measures of system efficacy, and even conflicts among users in large communities' (Shneiderman 2011). To avoid a potential 'colonialisation' of local government through proprietary technologies, designers are encouraged to put non-experts at the heart of determining desirable technological scenarios (Hollands 2008). Instead of comprehensive technology solutions, participatory designers propose focusing on understanding practices of *infrastructuring* in the everyday life (of local government) and offer options for civic groups to take ownership of technology deployments (de Lange and de Waal 2013). The question arises: just how should the public get involved?

2.1. Considering the everyday and involving non-expert actors in design of civic technologies

In 'infrastructuring' participation, Le Dantec and DiSalvo (2013) introduce the concept of 'attachments' as a set of relations and commitments individuals make to a shared matter of concern. These attachments are voluntary, for the most part, informal and flexible. Dewey defined those 'civics' as groups 'indirectly and seriously affected for good or evil' who become 'distinctive enough to require recognition and name' (Dewey 1927). In the formation of civics in relation to shared concerns, Le Dantec and DiSalvo (2013) see 'infrastructuring' as a set of practices of enablement, self-recognition, appraisal of resources (software, information) and people available towards a revision of the present situation. Here, infrastructuring is described as distinct from participatory design, as it focuses more on a possible realisable future with the means available 'in place', where available (digital) technology is used as part of an intervention. Innovation and what is defined as 'new' is then very much included, embedded and explored in the everyday practices and, thus, what is 'new' goes beyond technology-focused definitions of newness. Le Dantec's argument reminds us of earlier iterations attending to everyday practices as interesting sources of designs (Star 1999; Suchman 2005). Perhaps it might also be exemplified in past endeavours in which participatory design activities were applied over a timeframe of eight years for the design of a media space (Dalsgaard and

Eriksson 2013). As a result, established methods of co-design took on a novel quality as they became embedded within and taken for granted by stakeholders involved in the construction project.

In practice, the distribution of 'ownership' in civic infrastructures and the work of 'infrastructuring' itself, across many different actors with formal and informal influence, quickly become a political matter. For example, in the development of a community network, researchers noted the irony that 'ordinary people' whom the project sought to empower were absent from early design discussions (Carroll 2005). In redesigning a semi-public space using media technologies, boycott by or turnover or resistance of key stakeholders was observed (Saad-Sulonen 2010). This may particularly be the case if there are very different expectations towards use of space. Furthermore, as developing and embedding any civic infrastructure is costly, it requires private investment and specialist skills, and will thus almost always be mediated through experts (Rattray 2006). Thus, perhaps the degree to which technology deployments can truly be driven 'bottom-up' by citizens may be limited (Townsend 2013). Often, intermediaries play a role by 'creat[ing] connections between [...] different tools' and the infrastructures they create are 'both technical building blocks and artful integrations' (Saad-Sulonen 2012, p. 23).

In the use of civic technologies, geographic space has greater influence in the politics of the design context (Dourish and Bell 2007) and is important in designing for everyday 'situated engagements' of public expression (Bohøj et al. 2011). For example, a review of 40 community websites around Amsterdam found that most websites are focused on informing, helping and asking for help, and connecting with neighbours; however, the review also identified resource sharing, organising activities and crowdfunding of community projects (Niederer and Priester 2016). Thus, the kinds of civics relevant to this article overlap with the material context, from which they draw power and legitimise demands for change in interaction with local government (compare Natarajan 2015). For example, the development of a street archive and description of practices of information collection heavily overlapped with the material contexts of the road, creating new interaction dynamics among social actors living there (Taylor et al. 2015). A resident took on the informal role of 'archivist', raising her 'power'. Subsequently, some residents chose to give their data only to the researchers involved who were perceived as neutral intermediaries. In public services, geographic proximity may also enable civic groups to form on matters of concern, as documented in a bridge repair project that helped groups of residents and a team of academics to combine to achieve a shared goal (Le Dantec and DiSalvo 2013). In the urban context, the material context thus remains of importance as a source for objects of contention, mutual interest and a sense of community.

If the goal is to change, for example, the established (political) institutions and digital infrastructures, as some demand, interventions that put community at their heart, working at a small geographical scale or as a single group, can struggle to make such 'vertical impact' (Taylor et al. 2015). In fact, research on local authorities'

planning processes found indications of a strong separation between information technology used at different levels of political administration (Weise 2016). Thus, community informatics, the study and embedding of software with local civic groups, perhaps disregarding local authorities' setup, 'is a necessary but not a sufficient condition' for new forms of participation (Staffans and Horelli 2014) due to the difficulty of scaling such 'bottom-up' initiatives to meet the workings of local government. Perhaps a better strategy is to give attention to the design of suitable technical interfaces and transparency within local government. Civic technologies offer opportunities to form ecologies of people, practices and 'data forms for generating, viewing and possibly analysing data' in matters of civic concern (Taylor et al. 2015). The question is how such practices can be better supported, for example by the process-orientated work of local government that is more directly driven by national laws and requirements. Where are the processes – not to mention the political action – that will enable such civic infrastructures to be formed and changed over time?

2.2. Towards awareness for political systems in collaborative systems design

Over the years, research on collaborative work has involved all levels of government. As a military psychologist, Hutchins (1995) worked for and with national government agencies studying coordination and cooperation on aircraft carriers through detailed ethnographic work. Engeström and Escalante's (1996) detailed longitudinal study of the 'postal buddy' self-service kiosk for the US postal service involved work with postal agencies broadly delivering an important public service. Bonnie Nardi's work related strongly to the role of public libraries as centres of communal learning (Nardi and O'Day 1999). Other studies charted the deployments of early local computing networks and public question-and-answer software as in Santa Monica's PEN project (Rogers et al. 1994). This is complemented by the rich work on participatory public geographic information systems, which developed in the 1990s alongside and often out of sight of the usual literature on computer-supported collaborative work. For example, Rattray (2006) discusses the deployment of an open-access web-based geographic information system across the whole of the involved US public-sector bodies. In this line of work, some academics also experimented with participatory approaches to let unskilled residents customise 'expert' software (e.g. a geographic mapping application) to help create civic maps for things like perceived public safety across a neighbourhood (Leitner et al. 2002).

While user involvement in software deployments has been a pertinent concern throughout the literature on participatory design, arguably there has been a change in the quality and intensity of research that has regained an interest in the boundary of the public sector (government) and the public at large (Bødker and Zander 2015). As shown by Handler and Conill (2016), socio-technical developments now make it likely to encounter large datasets online. The literature on open data and associated hackathons has been testament to this. Local government now grapples with being

accountable to publics who have increasingly become apparent online (Olivier and Wright 2015). In a take on participatory design in everyday civic life, the concept of 'infrastructuring' recognises that user involvement can also relate to the creative linking of a range of software particularly in low-resource and perhaps low-skill social contexts in civic groups (Le Dantec and DiSalvo 2013). Dismissing any comprehensive technical 'solutions', some useful approaches were made in studying organisational settings through contextual design, combing artefact study with prototype design (Beyer and Holtzblatt 1999) or the 'locales framework' emphasising the value of everyday practice as inspiration for design (Fitzpatrick et al. 1998). Added to this, hybrid methodologies have been proposed combining life logging and automated trend spotting to establish how issue-based publics form (Ludwig et al. 2016). In meta-design (Fischer et al. 2004), the wider socio-technical and socio-political contexts of institutional processes are the outcomes of design and, in turn, help to explain constrains to design choices.

In terms of participatory approaches with local government and civic actors, UrbanSim (US) and the Aarhus Media Space (Denmark) provide examples for prolonged engagement with political forces in a design project. Initially, the UrbanSim project aimed to provide a civic technology for developing multiple perspectives on quality of life with the ambition of letting anybody come up with their own assessment schema (Friedman et al. 2008). They recognise the impracticability of participatory methods that claim to involve everybody. They thus involved a set of civic groups in a 'targeted co-design process' by drawing heavily on forms, data schemas and assessment methods that those groups had developed already. Furthermore, the co-design of the Aarhus Media Space, a new library for the city of Aarhus (Denmark), counts as another example of longstanding, intensive engagement of the public, over a timeframe of eight years (Dalsgaard and Eriksson 2013). Through the long timespan and recurring participatory action, participation became seen as a normal, expected thing, part of the 'infrastructure' of the project if you will. Time, resources, committed leadership and understanding of the value of participatory activities were mentioned as key issues. The cases demonstrate (1) how software development tapped into existing datasets from local organisations (Friedman et al. 2008); and (2) how long-term projects relate to stakeholders and their processes (Dalsgaard and Eriksson 2013).

Short-lived design projects are more likely to discount the role of established practice and the diversity of audiences' different agendas. For a research strategy, the study by Dalsgaard and Eriksson (2013) pointed to the importance of developing a structured scheme through which to capture results from activities with various stakeholders, so to 'infrastructure' means to capture learning. This is a particular concern for the strategy outlined in this article also. Prior methodological approaches have perhaps failed to exploit these broader insights for guiding and shaping the design of their technical interventions. The argument of our paper is the underdevelopment of suitable ethnographic approaches for the design of civic infrastructures based on awareness of *political structures* that influence the deployment of digital

technologies and where user groups may not initially be readily identifiable. This underlies the need for social 'sustainability' of civic infrastructure, in the sense that any collaborative software is only effective if it speaks to the needs and concerns of the audiences it engages (Chilana et al. 2015) on a voluntary basis.

2.3. Suggested requirements for an approach to design civic infrastructure in local government

Essentially, this article suggests revisiting institutional concepts in systems design through a focus on *regular (*i.e. *patterns of) interactions* and the recognition of those patterns in design. This approach is particularly useful for work that takes the organisation of local government as a starting point, for example by relating to available public data or administrative processes issued by these organisations. The emphasis here is on looking at the interactions between local government and civic groups (Bødker and Zander 2015). Based on the available literature, we have attempted to group requirements towards an analysis strategy along three important characteristics of the civic infrastructure, the set of software involved in establishing, mediating and sustaining civic participation in local government. It is likely not an exhaustive list (see Table 1).

In response to these requirements, the rest of this article outlines working within local government contexts to generate insights on potential future interventions. The strategy relies on the observation of regular practices that may be influenced by existing regulatory requirements and that, in turn, may influence the designs of civic technologies that are made available to the public at large. When looking at the various ways in which research projects have approached political participation on local matters, the institutional approach outlined may thus lend itself to the kinds of methods that aim to work in collaboration with local government (Korn and Voida 2015). In participatory action originating with interests that diverge from local government actors, 'disruption' occurs where there is an orientation that does not fit the established political process and where political action is very much part of special moments. Korn and Voida (2015) note 'activist technologies often support immediate, short-lived campaigns and events that result in a number of individual protest actions'. Increasingly, this stream of work begins to recognise the importance of recurrence, raising the need for methods aimed at the *institutional* aspect of civic action. While this is an issue in the literature, what is essential in longer-term participatory design practice are plans for 'how to capture insights from participatory activities in a structured way' (Dalsgaard and Eriksson 2013).

3. Institutional analysis for civic infrastructure

Under the label of 'social institutional theories', approaches have become available to unpick the politics behind social interaction by applying institutional concepts

Table 1. Indicative requirements for an institutional approach to civic infrastructure.

Theme	Suggested requirements
Recurring actions	●Firstly, relating to Korn and Voida (2015), sensitivity to **recurring actions of local government and civic actors** is necessary, by probing for patterns in their interaction that serve as rules and describe how choices in relation to civic infrastructure are made. ●Designers need to understand the incentives for (voluntary) participation (Grudin 1988). Participants' motives for (non-) participation in local matters vary. This would account for (1) formally expressed requirements; (2) informal, commonly accepted practices; and (3) observed patterns of interaction during participation moments.
'Messy' information space	●Secondly, **'messy' information spaces** must be accommodated, supported by various digital artefacts (software and data) across diverse social settings (see Monteiro et al. 2012). ●In relation to a collaborative setting, 'information spaces' describe the overall sets of information artefacts in circulation across various social settings and sites (Bannon and Bødker 1997). ●To help identify opportunities for intervention, the approach should highlight the politics behind use and maintenance of the digital technologies and information involved at the boundary of local government and civic groups (Bødker and Zander 2015).
Capacity for 'self-organisation'	●Thirdly, the approach should recognise the potential of informal civic **self-organisation** (Taylor et al. 2015), as a tenet of civic collective action that may result in some form of 'commissioning' or influencing of public services provided by local government (Olivier and Wright 2015). Addressing the motives of user audiences provides a 'theory of social dynamics' on why different audiences engage with local government (Healey 1999). ●Through written policies, observation of practices and accounts of participants (Lowndes and Roberts 2013), interventions invite speculative changes to roles and rules based on existing practices. This view corresponds to the design-happens-during-use argument (Fitzpatrick et al. 1998).

with ethnography (Lowndes and Roberts 2013). Such an approach emphasises the study of informal *rules* and *roles* as observed through practices and narratives. Here, 'institutions' are broadly seen as patterns of interaction in recurring situations (Hess and Ostrom 2006). Thus, 'institutions' are strong forms of 'social organisation' showing 'stable, valued, recurring' patterns of social interaction over time (Lowndes and Roberts 2013). Importantly, as part of an analytical view on 'actions and change; humans acting in a world that is in a constant state of becoming' (Goldkuhl 2012), attention to established rules and roles can serve as a catalyst for change in complex urban contexts where technical interventions emerge as points of contention. For the institutional approach, we draw on concepts defined by Ostrom

(2005). Ostrom's version of institutional theory matches the design-in-use idea in that it suggests that changes in institutions (and the working of government) evolve incrementally, perhaps through day-to-day choices, rather than through political or economic shocks. This fits with the focus on everyday practices in what Galloway (2004, p. 400) described as transduction, encouraging us to 'shift our focus from ubiquitous computers as networked objects or artefacts, to ubiquitous computing as diverse *procedures* or *performances* in which socio-technical assemblages take shape' (italics added). This view encourages the understanding of the *social mechanisms* through which revisions to civic infrastructures are made.

3.1. Differentiating social systems into action situations

In the object-centred democracy that Le Dantec and DiSalvo (2013) describe, various civic issues become action situations to be supported by civic infrastructure. For example, in the Tenison Road project documented by Taylor et al. (2015), the group of residents who self-organised a data archive and analysis of the traffic movements through their street is part of a wider network of actors including, for example, the traffic planners at the municipality. Through the flows of traffic, their interests may be linked, and yet both groups act in different arenas associated with different rules, interests and incentives, facing the problem of traffic management from different viewpoints (compare Natarajan 2015). In a democracy focused on civics arising from the mutual recognition of matters of shared interest ('object-centered democracy'), Le Dantec and DiSalvo (2013) suggest that software and related data artefacts involve practices of 'infrastructuring' to support *civic participation*. Civic infrastructuring practices arise in recurring, often voluntary, participation in the linking, use and consumption of sets of software and data.

The institutional analysis and development (IAD) unpicks the interactions that make up these infrastructure choices. Ostrom (2005) breaks complex settings into several bounded *action situations* (e.g. a series of related events for which similar rules may apply) with the rationale that 'what is a whole system at one level is a part of a system at another level' (Ostrom 2005). For a methodological strategy, this implies studying the interaction between a range of actors across local government and civic actors across 'various locations on a micro-macro continuum' (Mjøset 2009). In this way, civic informalities and the process-orientated actions of local government may be put in conversation through the *participation practices* observed across local government and various interest groups. Imagine the example of interactions between civic actors of the Tenison Road project and relevant city council officials (Taylor et al. 2015). Thus, action situations occur on multiple levels. Levels have different agency and the rules they create may either perform as *authoritative enforcing links* (e.g. rules negotiated by local government affecting a civic group) or *sequential links* (one consultation building up on results from an earlier one) (Figure 1).

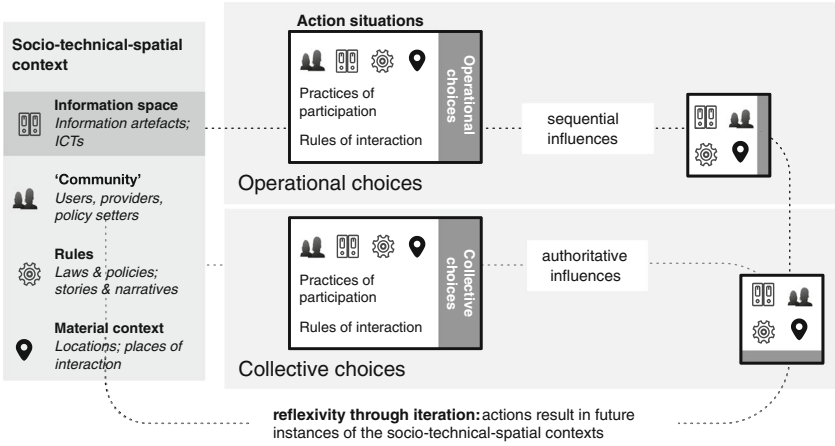

Figure 1. IAD framework adapted for information system analysis (adapted from Hess and Ostrom 2006; Ostrom 2005).

3.2. Levelling of the analysis

The institutional approach's strength lies in the awareness of how and where the design context originated, which define the social interactions we observe. Both local government and civic groups make '*operational*' and '*collective*' choices for how they like to organise, concepts that can be related to Fischer's idea of meta-design (Fischer et al. 2004). Meta-design aims at those contexts (rules, procedures, software) collaborators agree to temporarily fix to establish a series of collaborative moments. At the '*operational level*', practices affect the *content* of participation moments; for example, through the submission, evaluation and manipulation of information artefacts (e.g. files, documents, data). Conversely, on the '*collective choice*' level, action situations relate to *setting contexts* for participation; for example, by configuring the sets of software enabling participation moments. They include, for example, the participation in modifications to software that would have implications for all users. Opportunities for intervention exist on each level. If a local government tries an engagement campaign with new rules of participation, it may choose to formalise its use through agreements at the collective action level.

3.3. Institutional patterns per action situation

Interactions are analysed through (1) formal rules; (2) observable practices of actors; and (3) narratives (Lowndes and Roberts 2013). In addition, for civic tech, we also notice *where* the action is (both in a geographical sense as well as in the sense of social contexts). Ostrom (2005) suggests seven rules when looking for patterns of interaction for individual action situations. According to Ostrom, 'rules form a part of the structure of the situation rather than a solution to the [interactions] at that level' (Ostrom 2005). Thus, they become objects of study. The goal is to avoid *dogmatism* in relation to 'rules' and rather approach them as descriptors of any patterns *traced* by

asking relevant questions (see Figure 2). These categories of rules help to describe different *roles* and associated capacities to access information and participate in choices. From the perspective of collaborative systems, they influence how articulation and coordination work involved in interactions occurs.

In civic infrastructure, *positions* are the potential *roles* or *personas* that participants may take on within an action arena. From there on, it is possible to focus in detail on the practices of the actors in the various (e.g. how information access differs across several roles: admin, normal user, institutional user) in more general terms, by abstracting what information rules were in place. With an ethnographic approach, *rules-in-use* can be probed to understand the acceptable practices, habitual actions or actions that have been proven to derive beneficial outcomes between various social actors across social contexts and with various ICTs. A rootedness in everyday practices and procedures (Galloway 2004) implies the deployment of rules as sensitising devices in actor interviews. Thus, they are useful for *discerning* observed or reported patterns of interaction among various actors and ICTs within a specific context to *speculate* about potential interventions that provide a benefit, such as a faster process, greater satisfaction by the various participants and, lastly, *voluntary* participation.

4. Outline of a methodological strategy

Based on the authors' work and in reference to the rich literature outlined previously, in the following sections we describe the analysis in a sequence of six steps. These steps have been arranged in a sequential order for ease of comprehension, but it is useful to think of each step as part of two parallel iterative processes: one that

Roles for actors:	Which actors are there with which intentions and what's their relative strength in numbers?
Boundary rules:	How do participants claim these roles? If they are formal roles, how do they access and leave those?
Authority rules:	What can actors in their different roles do to affect the outcome?
Aggregation rules:	How are actions contributing to intermediary and final outcomes? Are there votes or does the decision reside with a particularly powerful actor? Is aggregation supported by a computer algorithm?
Information rules:	What guidelines or practices determine how information is communicated between whom and how? What information is accessible for participants in a particular position?
Payoff rules:	What benefits can individuals in respective roles expect? What criteria do they use to judge positive outcomes?
Scope rules:	What are the possible outcomes of the action situation? Are there any requirements (for example set by law) of what the outcomes should be?

Outcomes

Figure 2. The set of rules-in-use and associated analytical questions for probing the institutional context, based on Ostrom (2005).

establishes the wider socio-technical-spatial contexts, and a second process that establishes a dialogue between this context and specific patterns of action reported by participants and found in archival data. What is really important in this approach is an understanding of context that opens a window on the situatedness of civic participation in everyday life and the material contexts afforded by urban spaces (Korn and Voida 2015). Thus, this analysis appreciates that the materiality and positioning of actions in urban spaces are causes of political action. Material spaces can thus become a key part of the issue publics that were discussed by Le Dantec and DiSalvo (2013) in reference to object/issue-centred politics. In spatial planning, for instance, there is substantial evidence that participants in local government – officers operating within the formal structures of policy making, and those from groups and communities – form distinctly different views on material spaces (Natarajan 2015). Here, local communities provide 'a ground-level layer of detail' (Natarajan 2015, p. 15) often missing in the abstract process-orientated work of local government.

The article outlines each strategy in the following order: (1) choosing a problem at the intersection of a local government service and external groups; (2) mapping the socio-spatial context to this service and the 'civics' it involves; (3) engaging with participants through contextual interviews to establish practices of participation; (4) developing sets of categories that fit the observed practices of engagement; (5) building a structured dataset and action points. A successful analysis generates rich sets of categories, fitting the observed actors, technologies and their interactions, that can be used towards the development of technologies or systems designs. The steps we outline can be performed iteratively, both alongside and together with local government officials and civic groups in learning about *themselves*. In practice, this starts with a description of the 'bigger picture' context to the civic infrastructure (Pettigrew 1990); for example, through conceptual, actor or geographic mapping based on archival data. Then, through process tracing, significant events are used (as conclusive social wholes in themselves, such as a series of campaigns or participation action) to develop understanding of regularities in interaction.

4.1. How to choose an interesting social phenomenon involving infrastructure?

Digital mediation of civic interactions and the need for local government practices to adapt provide ample context for design. This is current in a wide range of domains and technologies, including, for example, mapping and crowdsourcing apps that seek to help publics gather by ways of commenting on places and spaces (Bohøj et al. 2011; Saad-Sulonen 2012). In the UK, for example, lower costs of online self-service (£8.62 for face-to-face vs. £2.83 for telephone vs. £0.15 for web) are among the factors driving local government transformation (Local Government Association 2015). Here, we look for projects at the boundary of local government and the public at large for example around a specific public service. This may be the case where services are redesigned to manage demand in different ways. For example, in the UK, local authorities consider which services are not *required* of them that could be

colonised by other actors instead. In the UK, 'neighbourhood planning' serves as an example where legislation enabled this to happen (Parker et al. 2014). This might imply asking how civics could take on 'self-governance' of their key concerns (Boonstra and Boelens 2011). Extending the argument of 'multiple participations' (Saad-Sulonen 2014), the roles of local government officials shift as capacities and responsibilities are shared out to other civic actors in the process. Thus, these changes call for development-orientated processes, both to design new rules of interaction but also technologies and systems that fit 'in'. This, we argue, is at the heart of the method presented here.

Whereas computer-supported collaborative work may set its focus on collaboration within and across defined organisations, civic infrastructures involve local government and various public groups trying to influence the design context. Thus, best cases are found by focusing on the interactions across and between multiple actors on choices affecting the outcomes for the wider public. For the case discussed in this article, the authors had several initial conversations with two planning officers regarding the key challenges in engaging with external audiences. Additional focus for a research priority arises from conversation with public representatives. However, what is mentioned here as challenges cannot be taken at face value. In the context of local government, they may well surface in public expressions made by individual participants voicing frustration, contestation of or dissatisfaction with existing practices. These public views can be easily corroborated but may well be contested by local government representatives referring to a divergent set of values, resources, capabilities and legal requirements. For example, we encountered the following comments when reviewing the documentation of a public consultation. These two comments were part of a set of official statements expressing confusion and sometimes anger towards the events they took part in (see Figure 3), and thus indicated a problem space to address:

4.2. How to consider the socio-spatial *context* to the civic infrastructure through data working?

In the formation and use of civic infrastructures, one of the crucial challenges to designers is the diversity of actors, material and social settings involved. This has

Citizen 1: "The communication strategy for consultation […] has been very poor and the internet site is long and unwieldy and difficult for those that are not computer competent. This in itself will limit the number of comments."

Citizen 2: "It is as if the people setting up this website did not want comments. Perhaps you are afraid of them? This process – in theory a 'consultation' – is in effect a means of pretending to take in comments while doing all that is possible to avoid [them]."

Figure 3. Comments made by two local residents in an official consultation (Source: Lancaster City Council 2014).

been recognised in the participatory design literature. For example, in a review of relevant studies, Halskov and Hansen (2015) differentiated between 'implicit' and 'explicit' involvement of 'users' that are taking and steering the design process. Increasingly, users may partake implicitly, for example, through the *selective involvement* of key audience representatives and the use of audience research from secondary sources, such as industry reports, but crucially also through feedback already provided to, for example, local government from official consultations (such as that the author encountered in their own work: see Box 1). However, beyond mere collation of such resources, work is required to draw links ideally *temporally* and *geographically*.

To situate social interactions, this methodology contends that material contexts are a key filter for actors who become involved in civic infrastructure projects. In the formation of public choices, material spaces serve as areas for sociality, interaction and political contestation. Alluded to in various examples, such as that of a street-level data archive for Tenison Road, design approaches for civic infrastructure could give greater recognition of the material situatedness of political expression (Taylor et al. 2015). Taylor et al. (2015, p. 2871) recommend 'think[ing] of structures that support some kind of representation of data's active presence in place. These might express how data travels geographically and between people, and when, where and with whom it gathers significance (traversing through the contours and across the boundaries of a social geography)'. Material structures and physical space perform co-constitutive roles for social exclusion, and material contexts have been rediscovered to play greater roles in policy making (Murdoch 2006). Applications of computing to the urban context rely on networks of people, technologies and the materiality of their *places* (Foth et al. 2011). These points give substance to the key argument to study context first through awareness of places, people and technologies involved.

Approached from the standpoint of public services, this calls for time to be spent on 'data work', collating the substantial corpus of relevant documents, including the various documents and media involved in the process under study. These policy documents, media, event attendee registers and records of public representations made from both public archive information and direct enquiry with organisations involved map onto the artefacts in circulation. They may include structured evidence, maps, action plans and process documentations. In our work, the materials of potential use are listed below (see Figure 4).

For the establishment of context, the key technique is then the identification and mapping of key entities within this dataset and, therefore, the establishment of person-place-material *linkages* across the data corpus. This relates to the advice to plan for capturing insights of later participatory events in long engagements (Dalsgaard and Eriksson 2013). For the establishment of the material contexts, a range of parsing techniques can be deployed that are increasingly automated. As mentioned, groups involved in civic infrastructure often exhibit a strong attachment to place (Bilandzic and Venable 2011); their material contexts present a source of power and legitimacy (compare Natarajan 2015). For example, for an analysis of civic participation in urban planning (overview provided in Figure 8), we parsed

Laws: Some processes are based on sequences mandated in law (e.g. certain steps as part of a public examination).
Local authority's process documentation: For example, method statements on how public responses are handled and processed.
'Raw data' on public events: For example, reports on public consultation comments, or attendance records.

Figure 4. Some potential data sources for an institutional ethnography based on authors' work (based on Weise 2016).

statements from public consultations to achieve a geographical view of key matters of concern. Based on public records, we could establish the patterns of interactions of citizens across a district, shaping the contours of activity underlying civic participation. The ability to view engagement with a public service in this way enabled us to recognise different forms of civic participation across individuals and established differing levels of participation across towns and hamlets of the district. This technique helped to identify potential participants for contextual interviews, carried out at a later stage. It has become ever easier to apply such methodological strategy to data sources online (Hecht and Gergle 2011). Most online datasets (including social media data) contain geospatial references facilitating the description of entities, places, localities and concerns in *space* (Hahmann and Burghardt 2013). This makes it extremely handy to establish understanding of the socio-spatial context to specific civic concerns within the overall landscape of engagement campaigns run by political organisations.

4.3. How to scope interactions leading to actions and consequences?

Often, the focus on a particular public service and its engagement with external audiences enables us to recognise patterns of interaction; for example, in the formally defined ways to become involved and obtain influence in and through this service. Usually, there are recurring events and meetings of various sorts that take place as part of government operations that we would have picked up through an earlier document review (see Section 4.2). The preparation of strategies of action and the associated consultations offer a myriad of rhythms, often expressed through processes structured into stages at which engagement moments become particularly well defined (see Figure 5). In the search for patterns, the gaps between recurring actions (e.g. sets of public engagements) are often the most interesting, as it is here where certain decisions are made. In the further exploration of the socio-technical-spatial context, the approach now looks explicitly for documentation of *process, including digital technologies involved*. In this step, it is key to encounter lack of documentation around technologies, artefacts and processes in use. Methods such as process tracing (Langley 2009; Mjøset 2009; Pettigrew 1990; Langley and Tsoukas 2010) are

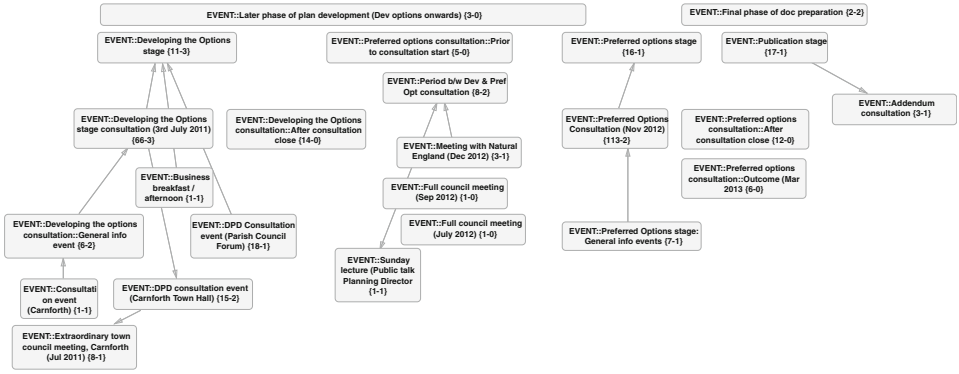

Figure 5. Overview of action situations identified in a study of engagement activities of a local authority. In this example, action situations mainly revolve around two major engagement stages and the undocumented void between those stages (Weise 2016).

of assistance. Here, we notice any sets of software and sources of data storage (which may well be non-digital) employed in mediating interactions across audiences. For designers, these artefacts of civic infrastructures become the central 'objects of contention' (Suchman 2005). Through ethnographic techniques, including mapping and tracing of actors' different roles involving the infrastructure, we can establish 'users' and 'providers' of ICT facilities and the 'producers' and 'consumers' of information artefacts.

An institutional approach employing a structured frame, such as the adapted IAD based on Ostrom (2005), helps in situating political action associated with civic infrastructure within a socio-technical context. It serves as a guide for the analysis and requires updating and customisation to the specific case at hand. Across a range of *action situations,* the analyst identifies the information artefacts, software and actors involved and determines *principles* that guide interaction. At times, abstract mapping, including sketches, may be appropriate to documented social interactions (Leitner et al. 2002). Recognising the social life of infrastructures, being in flux and co-constituted and instantiated through various everyday actions (Amin 2014), the analysis documents and maps out past events with knowledge of actors, ICT facilities and information artefacts involved and creates initial assumptions about the relations within the design context. For example, alongside the mapping of participants in the preceding section, event chronologies can be helpful in differentiating between online and a range of offline events, recurring events (such as monthly public meetings), and abstract patterns of interaction across the multiple social settings and sites over time. Through the longitudinal view, stable categories and rigid infrastructural arrangements appear more changeable and the 'logic' of the present setup is appreciated. In the context of local government, study of archival data is of importance. For example, in the authors' case (see Section 5), cross-linking data from official participation records across different engagement campaigns (action situations) enables us to establish who the contributors are, how many there are, how much they have contributed (both when and the number of comments) and what type

of stakeholders they are. Grouping is then possible by organisation membership (government, charity, commercial organisation) and location.

4.4. How to perform contextual interviews grounded in action situations?

The methodology calls for a focus on a select set of key action situations where contestations and interactions between local government and various civic actors may occur. Following the strategy suggested here, interviews are employed to provide insight into the sociality around and uses of *various technical artefacts* and *data components* encountered in the design space. After establishing actors, technologies, and key media and communications (referred to as 'constituents') from documents, databases and conversations with key actors, a range of stakeholders (officials, community representatives, technologists) are interviewed to investigate patterns of interaction across a range of action situations. Here is where the institutional framework helps to create a frame for the analysis, where it is both productive to (1) focus on actions and activities as carried out in contextual enquiries while also (2) looking for statements that indicate how decisions on particular events were taken. Using in-depth interviews (e.g. contextual interviews: Beyer and Holtzblatt 1999), we can reconstruct the patterns of interaction across a range of action situations (such as remarkable events) by looking for 'rules' introduced in Figure 2. In interacting with interviewees, we think about (1) practices, (2) stories and (3) formal rules that let us draw conclusions about the institutional setup (Lowndes and Roberts 2013).

Discussing the roles of various participants in 'data work' and relating the conversation to wide types of data from published records of comments made by the public to systematic statistical data is not necessarily obvious to participants. The interview excerpt below (Figure 6) portrays a situation the authors encountered when enquiring about the role of civic groups that played a prominent role in a case of civic infrastructure use. The excerpt demonstrates the starting point of the institutional frame for different 'roles' that organisations and individuals within these social constructs may play. In this excerpt, several roles are mentioned, including that of co-organiser, active contributors (and even local residents). In the next step, the interview discusses the rules applying to individuals contributing from different positions. As a result, the analysis perceives roles and associated responsibilities of various actors across different social settings.

A key part of the institutional approach is to understand dependencies, indicated by the differentiation between 'collective choices' (applying to all civics) or 'operational choices' (or only one group). In so doing, the analysis can consider instances where *narrative* accounts of participants going back months (see Pettigrew 1990) indicate constraints to the actions of a civic, and trace through where these constraints originated. Here, analysts can employ event chronologies, images of workshops and information on statements made in online consultations (with related information on the time and mode of submission) to help recall details of their interaction with other

interviewer: *How about the neighbourhood association?*

respondent: *Maybe you can put them as co-organisers. Actually I would say there is one person who is quite active and he was maybe the one who was the most aware of (the initiative) and helped with advertising it.*

interviewer: *How about the other residents in the area? How many were there?*

respondent: *It depends. Those who contributed to the [the platform] were active contributors but how many of them? Let me see... it is hard to say because you could use the urban mediator as an anonymous person and most people used it so so we cannot say for sure if the other people were different or the same people who logged in at different times. I would say very roughly maybe you could put about 60 people as active contributors.*

interviewer: *And otherwise in the district or neighbourhood, how many are there?*

respondent: *If you take the area at its maximum limits it would be around 6000 people.*

Figure 6. Interview excerpt demonstrating probing for roles of actors in an action situation collected as part of the authors' ethnographic work (Weise 2016).

actors, technologies and information artefacts in hindsight. Russell and Chi (2014) suggested that adherence to a walkthrough from the distant past to the near present, face-to-face modes of interviewing and avoidance of value-laden questions were helpful for retrospective reflection.

4.5. How to link context and action through a suitable coding scheme?

In the data synthesis, we then combine both data from the analysis of context and the detailed contextual interviews by development of a coding scheme with grammatical, process and rule codes (Saldaña 2012). The rule codes provide institutional categories and are inductive concepts (arising from the framework; see Figure 2). On the other hand, a markup of the chronology of actions taken by participants and official decision-makers over time establish a *chronology of action* (Baskerville and Myers 2014) arising from the dataset. Analysts could, for example, employ what Saldaña (2012) termed *process coding* to identify recurring interactions across a range of participants and action situations. He states that recurrence is 'both natural and deliberate – natural because there are mostly repetitive patterns of action and consistencies in human affairs, and deliberate because one of the coder's primary goals is to find these repetitive patterns of action and consistencies in human affairs as documented in the data' (Saldaña 2012). In terms of rules relating to recursive action situations, a *series* of related events with very similar rules of interaction may become apparent through this analysis.

Below is a suggested list of key coding classes that we developed from our own work and that can be applied to both archival data as well as contextual interview responses (Figure 7). Our final coding schema included seven code classes to establish linkages across the research data. In the application of the institutional

Code class	Applied when	Type
EVENT::	Any instances of events that are documented (in archival data) or alternatively mentioned by study participant. There are more specific events (one offs and particular instances) or more general ones (early stage of process). These codes provide a time dimension.	Grammatical codes
ARTEFACT::	Similar to the EVENT class, the ARTEFACT class was applied to segments that refer to an information object. For example, it was applicable to any documents that were mentioned but also specific parts of documents which have some informative function (such as a timeline).	Grammatical codes
ICT-FACILITIES::	Any instances of ICT that were mentioned in an identifiable, unambiguous way (for example, city council website, planning portal, mapping platform).	Grammatical codes
PLACE::	Similar to the EVENT class, the PLACE class applied were there is anything mentioned in reference to a place.	Grammatical codes
PARTICIPANT::	Any attributes of a particular study participant. This class is a grammatical code class. It is important since this study in particular focuses on individual participants as case studies in the wider case study.	Grammatical codes
PROCESS::	PROCESS codes are ideally applied when the participant did some action or had an interaction with another person or object. In the next stage, PROCESS codes can be generalised to reflect various aspects of data work.	Process codes; conceptualised codes
RULES::	RULE codes were derived from the theoretical framework employed for the work. These were thus induced codes.	Conceptualised codes

Figure 7. An overview of the code classes that can be used during the analysis of practices influencing civic infrastructure (Weise 2016).

frame, the 'rule' codes match the questions we introduced in Figure 2. The material relevant to rule codes had different qualities, depending on whether these were applied to data from the contextual interviews or documents publicly released by, for example, the local government officers. Especially if applied to interviews, this clarified patterns in practices. For example, regarding internal officer meetings, it became clear that there are some generally accepted assumptions that guided interactions in those meetings as to how public comments might be flagged and discussed in the team. Those interactions were not otherwise explicitly stated, but may be clarified through the artefact-focused contextual interviews. In terms of interventions in the public sector, the analyst notes that boundaries apply to who may join different events and inclusion/exclusion criteria are negotiated.

4.6. How to plan for action and establish opportunities for intervention?

We leave the analysis when sufficient information on recurring patterns of interaction has been gathered and when the *principles* of rules and roles of participants have been understood, so that crucial audiences, even though not identified through organisational membership, emerge as participants reflected in public records. For a technical intervention, the criteria for which intervention

might be beneficial are now outlined and argued for in reference to participants' experiences, values and requirements. As an outcome of the analysis, we will have described the patterns of interaction, understood the linkages between the different levels of interaction and their co-constituted taking of influence (operative and collective choice) and established a set of materials useful when planning for an intervention. Those materials can include the event chronologies, a mapping and potential recognition of various civics and, to some degree, a comprehensive well-structured set of data on surrounding interactions with and through the civic infrastructure that we set out to study. Ideally, the analysis establishes a potential data schema on which software development can be based. For documentation of potential alternate futures, the analysis serves as a basis for reflections that can be shared with the research participants for corroboration and to plan for actions, including potential future interventions.

4.7. Discussion and conclusion

Studies of civic infrastructure amass a large amount of heterogeneous data (e.g. qualitative and quantitative, geographically referenced, temporally placed) about the individuals, places, ICTs and information artefacts across a range of social settings. Throughout the projects, the generation of a database helped to map the various actors across action situations; so, as insights become available, they can be added so that its data schema becomes a template for a future intervention. For the multi-site, multi-institution research context of technical interventions in the urban context, databases consolidate data from different social settings, sites and technologies. Integrating information from a range of archival data facilitates a cross-linking and slicing of the data along different dimensions of interest (e.g. by events, participants, interactions). For example, to elucidate a socio-spatial context, information in archive materials and public data can often be geo-coded to link to a spatial analysis package establishing relations and linkages between people and places. A database where relevant data fields can be flexibly generated, changed and linked can emerge as an imperfect, interactive representation of the patterns of interaction and the information space itself, capturing important properties, statistics for actors and ICT facilities, as well as information artefacts. This is an iterative process and helps in combination with the development of design probes and prototypes to deploy in the research setting (Baskerville and Myers 2014). Thus, structured databases may present a 'structure' for a technical prototype and thus inform the technical intervention.

5. Application example: the civic infrastructure of urban planning

The previous section related to the authors' research in urban planning. Let us illustrate the methodological strategy here by referring more clearly to this example. The sample case we use concerned public engagement campaigns around spatial

strategies and was situated in the UK planning system. It was a case distinguished by many citizen participants, including experts, in the form of public planners at a local authority, various civic groups and local resident participants with non-expert status, as well as a range of expert participants from national and regional businesses, charities and governmental organisations. The example involved representatives from local government and various civics bound together through their involvement in the development of a spatial plan. The end products of this process were two planning documents that listed the collective aspirations and intentions for the region. Figure 8 below lists the key details.

To understand the case from a methodological standpoint, little knowledge of UK planning law is required. It is perhaps worth saying that patterns of interactions in urban planning are certainly influenced by formal rules (based on legal requirements) affecting informal interactions across local government and various civics. The key point is that this involves production, sharing and use of various media, some of which is by computer-aided means (Saad-Sulonen 2012), the mundanity of which means that this is often forgotten. Using 'tracing methods' (including geographic mapping, time-lining, retrospective interviews), we used institutional frames and concepts with the aforementioned strategy to make sense of influences on the civic infrastructure (comprised of software and media) through study of touch points, social settings and material contexts.

In terms of methods, event chronologies, spatial data analysis and retrospective contextual interviews were applied, aided by a structured database consolidating archival and primary data into one. In doing so, a case-specific data model was constructed that allowed for the production of prompts, such as geographic maps of events and participants. These prompts served as probes in

Duration	In the field for 8 months. Contact with planners continued beyond that.
Aim	**Analysing patterns at the interface between various publics and local authority planners.** Understand the perceptions of citizens of the mix of media and software they were served and how choices about those media and software were made by planners.
Data collection and tracing methods applied	*Participants out*: 21 retrospective interviews (with prompts from public records documenting their involvement).
	Technology out: (1) Spatial parsing of public records considering (1) postcode data of 450+ participants and (2) centroid location for development sites mentioned in the plan (as a matter of concern). Capture of attendance details for a sequence of recurring events (workshops & online engagement campaigns)
Analysis methods	*Participant interviews*: Process coding for actions reported by study participants combined with grammatical coding for mention of software, media, and key stakeholders. *Archival data*: Coding of rules (from institutional rule concepts); Analysis and spatial mapping of the spatial distribution of the participant network.
Embedded units of analysis	*Crowd-level*: Spatial distribution of participants in official consultations;
	Participant-level: Specific practices and the mix of software used by study participants across seven action situations

Figure 8. Example study undertaken with the approach outlined in this article (Weise 2016).

the interactions with individual research participants, each contributing a partial view of the bigger picture. The institutional approach uncovered the socio-technical mechanisms through which planners controlled the participation process. For instance, it elaborated on several constraints to peer-to-peer participation, as a single planner was tasked with the evaluation of citizen contributions, while another planner was responsible for hyperlinking a mapping software with a consultation software, providing for complex user experience to non-expert citizens. Knowing and accepting these practices of work division as 'rules' better lends itself to designing suitable technical interventions that speak to existing practice and change it over time.

The analysis described the uses and configuration of a set of largely incompatible software products used by planners to support participation and outreach. We argue that the adaptations and reconfigurations of the software tools that planners employed and the processing of citizen-contributed comments were evidence of infrastructuring practices (Le Dantec and DiSalvo 2013). The various ICTs involved in various participatory activities were often isolated and incompatible. For instance, municipal planners used four separate online services: (1) to collate public feedback; (2) to provide documents to read; (3) for maps; and (4) a website. Thus, we were dealing with a heterogeneous and messy collection of ICTs and an information space that was unequally accessible to various stakeholders that were participating in response to various matters of concern that arose though the planning process.

Here, the framework helped to differentiate two levels of participation through ICT. Most participants in official engagement campaigns were intent on shaping and influencing the content of the plans by providing an argument that the planners would consider; however, beyond that, several participants attempted to draw out a critique of the planners' practices and software used that subsequently led to a software product being discontinued and replaced by an alternative setup. Differentiating between different institutional layers, operational levels (community groups) and collective choice levels (ICT operators) helped to investigate the roles and practices involved in the effort to realise infrastructures for new forms of participation. On the basis of the data schema, we developed a mapping tool for public consultation data ('OpinionExplorer') that led to further discussion and probing of the planners' data work (Figure 9). The IAD's rule categories (particularly the category of *position rules*) highlighted how planners involved performed different roles in the maintenance of the software and media and how this can be analysed as 'infrastructure'. This then provided a basis for a dialogue about the design considerations that support the *sustainability* of a technological intervention.

6. Considerations in taking an institutional approach to civic infrastructure

On reflection, key methodological advances in the use of ethnography in workplace studies (Schmidt and Bannon 2013) remain useful for the study of civic infrastructure. The 'situatedness' of practices in particular *contexts*, the 'articulation work'

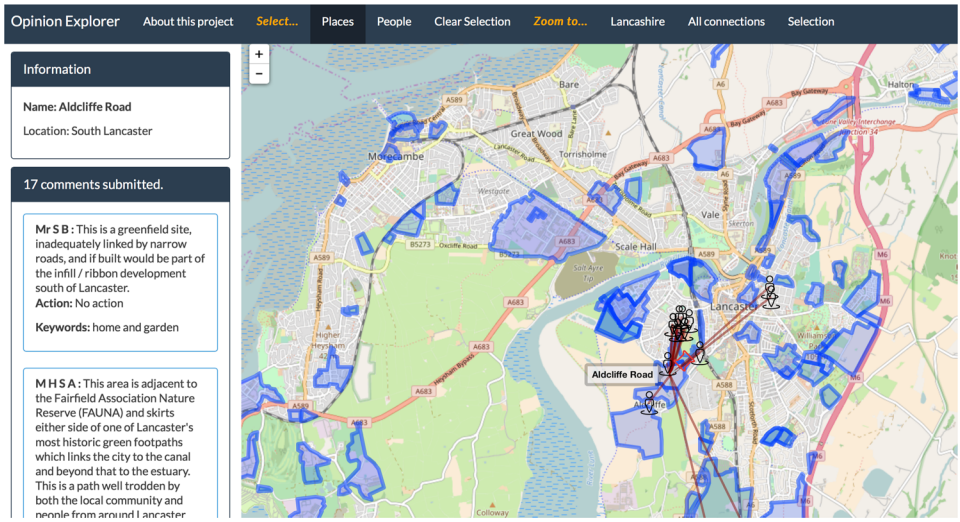

Figure 9. The OpinionExplorer prototype arose from the data schema derived as part of the study by Weise (2016). Through the markup of encountered participants by their location, the tool demonstrates a new capacity to recognise civics forming around key development sites. This tool can, in turn, be used for further exploration of potential alternative practices in future planning systems.

required in establishing and negotiating the means and ends of cooperation, and the ethnographic method are key for understanding interactions, as the case example has shown. By recognising recurring patterns and 'levels' of interaction, institutional frames help inform interventions by enlisting key user concerns and needs. We want to discuss several practical considerations.

6.1. The use of recognising institutional 'patterns' in systems design

The approach we outlined here, using institutional concepts and thinking in terms of ethnographic exploration of civic infrastructures, is centred on the premise of recognising the 'patterns' that form public choices. Democratic processes depend on formal codified rules, and even more so in informal, unspoken and perhaps undocumented agreements. An example of this is the life cycle many public choices in local government go through, often involving recurring moments of public engagement or political debate in set meetings, each often with recurring patterns of participation. Korn and Voida (2015) presented a well-formed discussion of the different bases on which moments of political expression may stand and, consequently, how designers may craft technology or systems supporting them. They suggest that political expression in everyday life may be aligned with local government (as a form of situated engagements, for example, using government-provided apps) or may be unaligned and thus provide various forms of 'friction' that speak to critique established local government processes. In the various ways in which

political expression may happen in the everyday, institutional approaches, one might then argue that designers would still benefit from recognising and describing the formation of patterns of engagement within these projects. We consider that even the most informally organised civic group may have many unwritten understandings of how agreements are made that concern the group and, increasingly, many run websites and other hyperlocal media platforms to make their voice heard (Niederer and Priester 2016). During the initial research and requirements stages, the levelling of action situations (as recurring participatory patterns) as well as their influence over outcomes (e.g. across local government and civic groups) helps to differentiate design requirements for different audiences.

6.2. Interpretative or pragmatic approaches and their influence on the styles of analysis

In respect of information systems research, Goldkuhl (2012) suggested that studies of technology can take a predominant interpretivist or pragmatist orientation. Ethnographic approaches in the design of technologies are usually focused on designing interventions. Such approaches, focused on action and change, are associated with 'pragmatist' ends. Pragmatism is a wide-ranging field, but has been hugely influential in design research (Dalsgaard 2014). However, other approaches may be more aligned with interpretivist traditions and are, perhaps, the kinds of studies that provide researchers and practitioners with food for thought; for example, by reworking and revisiting the successes and failures of previous deployments (for a good example see Engeström and Escalante 1996). Goldkuhl (2012) suggested that approaches from a pragmatist orientation and an interpretivist orientation can be combined, with each surfacing with a different dominance: he advised that '*either interpretivism is seen as instrumental for a pragmatist study or pragmatism is seen as instrumental for an interpretive study. This means that each paradigm can be the base paradigm allowing elements from the other paradigm to be used in an instrumental and supportive fashion*' (p. 144). Thus, in terms of the *desired ends* of a study, we choose a direction, and it is advisable to choose a pragmatist approach if the research outcomes are believed to create 'constructive knowledge' that may be useful in 'action'. Principally, if the study is purely aimed at generating knowledge that is *interesting* from a theoretical standpoint (Goldkuhl 2012), an in-depth retrospective study is worthwhile (an example for this is Engeström and Escalante's (1996) study of the postal buddy system in the US, a talking self-help kiosk developed with good intentions for the US postal service, but which failed to be adopted; see Engeström and Escalante 1996).

An interventional use can be coupled with action research intervention in the study context (Dalsgaard 2014; Mjøset 2009). For instance, work by Saad-Sulonen (2012) was an example of a follow-along (interventional) study. For several years, she tracked the use of an online platform for planning. In such contexts, it is usually of interest to consider not only direct end-users, but also the needs of those

sponsoring the technology, maintenance staff and operators. Design of ethnographic approaches include 'potential rationing'; in other words, a future design possibility as well as a co-design (Baskerville and Myers 2014). Here, the interactive template of the IAD helps to ask essential institutional questions necessary to embed the technical intervention across various actor groups.

6.3. The role of participants in digital civic infrastructures

The assertions of user empowerment found in the literature on participatory design is complementary with the approach described but, in addition, this institutional methodology emphasises the political context of the various social interactions involving civic infrastructure. Lowndes and Roberts (2013) contend that institutions can be studied as detached from the observed or reported practices and rules, but from the standpoint of user-centred design, it seems more desirable to become actively involved through document study and interact with participants; for example, through contextual interviews. Participants in the analysis become conversational partners and potential project champions that facilitate the success of an interventional approach that seeks to change existing patterns of interaction through technical support.

As these social settings often involve a large number of people, even co-design approaches have begun to take a nuanced stance to appreciate the value of representation of different user audiences through proxies and/or even archival data. For example, in the understanding of 'participation', Halskov and Hansen (2015) differentiate between 'implicit' and 'explicit' involvement of 'users' that are taking and steering the design process, and the idea of a 'mutual learning between users and designers' which may indicate a sort of middle ground of intensity in which users have an influence on the design process (Halskov and Hansen 2015). The 'macro-HCI' approach, by which specific patterns of interaction are derived from archival data and existing ICT facilities, provides a template to identify participants who partake more explicitly.

6.4. The role of the institutional approach

The underpinning of the institutional approach – its assumption of small iterative changes in practice – is suitable for everyday actions affecting civic infrastructure (Galloway 2004; Amin 2014). At its core, it is strongly concerned with the tracing of actions and rules. The philosophy lends itself to design research approaches, which feature a bias towards action and change (Dalsgaard 2014). In application, capacity building was involved and the underlying assumption was to distribute ownership over the technical intervention across institutional and community actors. Generating comprehensive relational data archives alongside the analysis helps in multiple ways. It helped us to learn about important challenges to technical interventions (and thus has practical relevance), it

elucidates the aforementioned actors' needs (and therefore has relevance for the intervention), and it has scientific relevance. It does so since explanations for success or failure are found by tracing patterns of interaction. Ostrom's principles of good governance for sustainable common pool resources are one example (Hess and Ostrom 2006). Given the experience of the authors, it may be easier to understand 'success' and 'failure' by looking at the history of the design context under study, since the concerns of local authorities and those of their respective areas can differ quite substantially.

Lowndes and Roberts (2013, p. 10) caution against 'overstretching' the use of what is 'institutional'. They state that an 'institutional explanation puts political institutions first'. Applied to the study of information systems, such an institutional perspective, based and explored through reported practices of individuals, their reflections on those practices and meta-data from ICTs, implies that institution(s) are probed through quantitative and qualitative sources and that the political is understood here in relation to the use of technical interventions on civic infrastructures. Given the political nature of civic infrastructure, the institutional dimension is useful for unearthing authoritative links, but it is important to view those as rather more informal arrangements, especially when civic groups are concerned. There is no use in trying to overly formalise an informal context, but being able to frame what describes the choice-making in civic groups helps to ensure all relevant stakeholders are properly considered in a project.

7. Final remarks

Building digital civic infrastructures has emerged as an important challenge for the design of collaborative systems in their urban applications. This article sits within the broader recognition that computing technologies become more commonplace in everyday urban life and, for the most part, play a substantial role in the mediation and coordination of actions in relation to local matters of concern. This article suggested that established user research methods for collaborative technologies (whether based on participation or co-design) benefit from frameworks that recognise patterning in political expression as a means to abstract the otherwise contested and diverse participations in public life. Thus, it was suggested that a methodological strategy, such as outlined in this article, is helpful for designers to spot interaction regularities and, therefore, design interventions around such interactions. This is more important where there is an interest in interventions that are more likely to be *adopted* into practice. Since such interventions affect a large and diverse public, various civics, established laws, policies, and third-party APIs' terms and conditions emerge as important design considerations (Jackson et al. 2014) and provide an extended design view (Monteiro and Hanseth 1996). Here, we suggested that the structure and concepts of institutional frames combined with ethnographic approaches aid the exploration of complex design contexts, including myriad politically loaded interactions.

Technical interventions should tell compelling and well-considered stories, involving non-expert views, to be successful (Rogers 2006). At the core of our suggested approach for designers and practitioners is to consider existing patterns of interaction as 'interaction rules' between users, sets of software and corresponding information artefacts when intervening technologically in participatory processes of local government. But there also needs to be a strong account of the spatial context to the various interactions that occur. Tobler's first law of geography can be adapted to say that agendas of individuals more proximate to each other tend to be more aligned than of those actors who are distant. Dewey made a similar point in his original work on the formation of publics (Dewey 1927). By mapping out a complex context through a structured approach along both spatial and institutional dimensions, researchers and practitioners raise their level of insight beyond seeing what happens, hopefully to *why* civic participation happens and, thus, raise the chances that their intervention transforms existing practice.

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