Infrastructuring Public Consultation in Town Planning— How Town Planners Translate Public Consultation into a Socio-Technical Support System

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Abstract. For public consultation in town planning, town planners can employ various software systems to improve the dialogue with citizens. This article looks at attempts to do so by following the work of a team of municipal town planners across four stages of public consultation held between 2012 and 2015. The study is based on detailed semi-structured interviews, field notes from regular visits to the planners’ office, and a database of public consultation comments and attendance at consultation events across the stages. Using an approach that considers planners’ work in the selection and implementation of software within institutional objectives and constraints as “infrastructure” work, we examine the joint deployment, use and effects of nine software tools and arising practices for public consultations. Our findings demonstrate how the infrastructure work of planners involved numerous interpretations about the possibilities for software adaptation and the effects of software use, which were enabled and constrained by consultation and planning requirements. The results also indicate a role for researchers in helping planners mediate between formal processes and public concerns, and illustrates how this technological-institutional struggle in infrastructuring work forms an essential part of town planners’ practice.

Keywords: Infrastructuring, Public consultations, Software use, Town planning

1. Introduction

In town planning, public authorities in England regularly consult with diverse sets of individuals with different political agendas and expertise to shape the design of towns and cities. As a critical interface between local government and the public, municipal consultation practices have recently received recognition in the collaborative systems literature as a significant domain for the participatory design of technical interventions that change consultation and engagement practices (e.g. Saad-Sulonen 2014). Despite the importance of this critical interface, Williamson and Parolin (2012) show that the digitisation of town planning has struggled to achieve meaningful and equal public consultation. Thus, the ability and promise of overcoming the difficulties of engaging the public in planning practice is a pressing matter.

To help shape future research and interventions, we set out to articulate the range of software and associated practices that arose during public consultations in the development of town plans.

In the tradition of in-depth ethnographies in the literature on computer supported collaborative work (CSCW), we conducted a long-term study of the consultation processes in town planning to capture the diversity of information handling practices, and the complexity behind the choices and activities involved in delivering public consultations, within the institutional constraints of local government organisations. The overarching research objective was to understand **how planners' infrastructural work with technology are realised within and through institutional factors**. This overarching objective is explored through three detailed questions: how did planners attempt to support public consultations with software and what were the associated practices?; who makes infrastructural choices for public consultation?; and what support do key actors need, including municipal town planners, to realise the possibilities for digital innovation in public consultation practice?

This article provides CSCW researchers with insights on the selection and use of software in public consultations for town planning, examining both the challenges and opportunities to support municipal planners as key infrastructural agents. To support municipal planners' work, our study systematically articulates the practices involved in shaping public consultations. Analytically, our work crosses infrastructure theory, participatory planning literature, and the institutional aspects of town planning. We use the term 'infrastructuring' to look at the decisions and activities of municipal planners to translate their consultation requirements into socio-technical arrangements to support the delivery of public consultations (compare Simonsen et al. 2020). We study the practices involved in the provisioning and linking of nine different software tools from a process point of view to explain how consultation requirements shaped the infrastructure over time (Karasti and Blomberg 2018).

The article is structured as follows. We introduce *infrastructures* as a mesh of social, technical and institutional influences; and briefly introduce aspects that characterise participation in planning and the role of planners in shaping public consultations in town planning, with a particular focus on the English planning system. We present the methodological approach of our longer-term study, and the details of the study presented here. We then present three key findings. First, we summarise the emerging installed base of software tools and associated practices in the case. Second, we then chart the plan development across four consultation stages to demonstrate how consultation requirements shaped the practices and software produced from the infrastructure and infrastructural work. Finally, we discuss the role of town planners as infrastructural agents in the setup of public consultations.

2. Background literature to ‘infrastructuring’ planning consultations

2.1. On the concept of infrastructures and the institutional turn in studies of information infrastructure

Lee and Schmidt (2018), in their review of the evolution of the infrastructure concept, found that initial studies of infrastructure tended to focus on technology, such as enterprise-level resource planning (ERP) systems, which provided cross-departmental functions; or in the context of the Internet, technological standards for the information superhighway. However, as computing systems are strongly intertwined with the organisational settings that emerge alongside and in close interplay with technical structures, the interpretation of infrastructure as purely technical struggled to capture the socially embedded nature of infrastructures and infrastructural work. A narrow definition focused on the technology itself, meant that studies overlooked the many practices required for the setup, use, and maintenance of software. As a result, the term ‘infrastructure’ expanded to include the social aspects of infrastructures (Lee and Schmidt 2018).

In response, revised views of ‘infrastructure’ emerged that acknowledged the socio-technical nature of infrastructures through associated practices across a wider space and time. Star and Ruhleder (1996) introduced the notion of information infrastructure, stressing that technical IT structures are always deeply intertwined with social processes. Especially, in the social sciences, studies began to acknowledge that infrastructures are the work of diverse, variable, and complex user bases with typically conflicting agendas, using various technologies and infrastructuring practices to sustain collaboration (see Monteiro et al. 2012). Bowker (1994) proposed the notion of ‘infrastructural inversion’, where infrastructure studies would focus on existing practices and their various configurations with technical artefacts (including software) as the ‘*installed base*’. In this case, infrastructures are viewed as the sum of individual practices associated with technology that draw on pre-existing social arrangements (see Simonsen et al. 2020, p. 120). Noting that these socio-technical constructs are inherently complex and socially produced, studies of the efforts to change practices associated with technical systems and vice versa became referred to as ‘infrastructuring’. Research on ‘infrastructuring’ began to highlight the design efforts “for guiding technology [...] to identify and inform possible translations and transitions” between practices and a range of existing software that make up the installed base (see Karasti et al. 2018, p. 17).

However, these resulting infrastructure studies, focused on exploring infrastructures as socio-technical ensembles, have resulted in definitions lacking clarity and posing the risk that anything and everything is infrastructure (Lee and Schmidt 2018). ‘Local practices’ are part of the installed base and have the capacity to shape the infrastructure at higher levels, but can also sit within the context of larger formal organisational structures and technical artefacts outside of their control. For example, in the context of ‘fasting time’ in a health care setting, recent studies have attempted to address this limitation by tracing how

local practices, that initially seem mundane, relate to the shaping of structures at higher ‘levels’ (Simonsen et al. 2020). Seeing information infrastructures as socio-technical, these studies incorporate detailed tracing of processes with a greater sensitivity to the structures of human organisation in terms of formal processes and ‘levels’ to account for the bureaucratic and process-orientated context of local government (see Huybrechts et al. 2017).

Research studies have also emphasised institutional arenas by incorporating the notion of ‘levels’ in their methodology, such as Agid (2018) who analysed practices at a ‘local level’ and at a ‘larger level of policing’; or Seravalli et al. (2017) who focused on ‘operational’ and ‘management level’. Institutional approaches have been traditionally associated with studies of governance, and this approach is complementary to studies on public consultation practice. Related studies typically recognise the institutional processes set forth by law that influences practice (compare Huybrechts et al. 2017; Lyle et al. 2018; Seravalli et al. 2017). Here, ‘infrastructuring’ has also been used to refer to efforts that build relations between stakeholders (Seravalli et al. 2017), and where software use is implied, the effort to negotiate common objectives. For example, Lyle et al. (2018, p. 2) citing Huybrechts et al. (2017) states that “a focus on institutions goes hand-in-hand with the participatory design of digital technologies”. Therefore, this paper here draws on notions that infrastructuring simultaneously works to create consultation structures and shapes the wider organisation around individual consultation activities performed by town planners.

2.2. On the ‘technology’ involved in town planning consultations and the role of planners as infrastructural agent

In their review of papers published over a 10-year timeframe, Williamson and Parolin (2012) show that the digitisation of town planning has struggled to achieve meaningful and equitable public consultation. A part of the problem may be typical institutionalised practices that restrict the possibilities for digital technology. For example, in government, time-restricted consultation, in which respondents comment on already-prepared policies, persists (Innes and Booher 2004). Typical online consultation bears similarities to ‘crowdsourcing’ in which an organisation issues an open call for participation with constraints on the permitted responses (Seltzer and Mahmoudi 2013). The organisation may choose to constrain the consultation responses to specific sections or questions, but unfortunately the impact of any responses on the process and plan is rarely clear. Planning authorities create document drafts and invite the public to make suggestions and comments on these drafts, which ideally is to be incorporated in final document versions. For planning authorities, this method of consultation is cost-efficient and bears low risk as planners retain firm control over timescales and content of a consultation. Typically, participation is rendered reactive, and planning consultations can appear to be tokenistic (Arnstein

1969) with limited two-way dialogue (Innes and Booher 2004). Participants, therefore, face significant hurdles with established practices.

In supporting public consultations and the potential for digital transformation, the role of town planners as infrastructural agents is rarely recognised. As we will illustrate, the infrastructuring practices of town planners have significant relevance when one considers the pressure for local governments to change and innovate. Increasingly, planners are expected to provide interactive and dialectic methods of participation, and to support civic groups in self-organising around shared themes (Boonstra and Boelens 2011). Self-organised town planning has been increasingly emphasised after recent planning reforms in England that introduced ‘neighbourhood planning’, which brings in many new participants, often with little experience in planning. Conceptually, this has changed the municipal town planners’ role from an expert in planning practices to “platform coordinators” (Bannon and Bødker 1997) who are meant to enable civic groups. For computer-supported participation, planners would need to become infrastructural agents, beyond co-authoring policy documents with input from citizens, to developing formats and tools for public consultation in town planning. In this situation, various dilemmas exist in the (re)configuration of typically disjointed software to support open-ended participation through digital media (Saad-Sulonen 2012). In the healthcare domain, research has charted the importance of internal teams in shaping and configuring infrastructure within organisations with complicated social and technical settings (Davidson and Chiasson 2005). Similarly, for planners to succeed with the realisation of digital technology in town planning, they need to mediate between their planning practices, institutional requirements, the installed base of available software tools, and citizen expectations about public consultation.

2.3. On the town planning framework in England and the consultation practices of municipal town planners

Under the English town planning system, public consultation is widely mandated in the preparation of a wide range of policy documents and intermediary drafts. In England, at the time of the study, municipal town planners are required to regularly publish an overview, referred to as the Local Development Scheme, summarising the compulsory planning documents to be produced during planning (Cullingworth and Nadin 2006). It is accompanied by a “Statement of Community Involvement” specifying the authority’s consultation plans for different stakeholder groups and different consultation stages (Cullingworth et al. 2014). Recent national planning guidance further increased the importance of public consultation at every step in the planning process (Department for communities and local government 2012). Based on this indicative schedule, municipal town planners compile a local vision and ‘core strategy’, outlining a broader long-term vision, followed by a set of supplementary planning documents. These include local development policies, describing development priorities and detailed criteria, and land allocations, where development

priorities are attributed to specific sites. The latter is not required, and councils can steer development through general policies instead of specifying land for development.

Although only the procedures for the final examination stage are explicitly described in English planning law, planning processes are largely similar across all 336 local authorities in England, especially the consultation stages. This conformity is encouraged by national scrutiny of each document, and the best practices propagated to local authorities through professional bodies such as the Royal Town Planning Institute (RTPI) and various planning guidance notes. However, the lack of prescription for specific consultation methods allows municipal town planners to adapt their participatory activities to the requirements of their locality, to their staffing capabilities, and to the software available to them. As a result, the capabilities and capacity for adaptation vary considerably across municipal governments, as do institutional arrangements. For example, in England, there is a hybrid system of local governments, in the form of unitary authorities, two-tiered county councils and subordinated district councils (Cullingworth et al. 2014).

In general, the planning system has been critiqued for its slow speed in producing results. Given the scrutiny and the typical complexity involved in planning, the production of town plans is difficult. In the 1990s the average time taken to make a plan in England was five and a half years, with the shortest being three and the longest being ten years until approval (Cullingworth and Nadin 2006). Given the pace of change in the planning environment and the difficulty of producing such documents, some authorities never produce a local plan, as national government priorities change faster than the speed of the local planning team.

3. Methodology

The data for this study arose from a study of a local planning authority involved in a planning activity over 36 months, through regular visits, observations, in-depth interviews, and documentary evidence. The following sections outline the methodology for this case; an expanded version has been published in Weise et al. (2017).

3.1. Context to the case study

The study focuses on the Lancaster district in the North West of England. The offices of the local planning authority, the primary case site, are based in Morecambe. From their offices, the municipal town planners arrange and coordinate consultation activities across the district, with a range of diverse communities, and their needs and aspirations. By the start of primary data collection in late 2012, a 'core strategy' had been agreed for a new plan. This strategy served as a vision document for two complementary planning documents that would introduce the necessary detailed planning policies for developers and communities: a spatial plan to determine land for residential, employment, and infrastructure developments, and a document

outlining a development management strategy and the criteria for evaluating any future building applications. These planning documents were core to the case study.

3.2. Data sources and the case database

The primary data for the present study included seven in-depth interviews with five town planning officers on the team that prepared the plans, and a detailed archive of comments and event attendance by members of the public. In total, the team of planners consisted of nine planning officers, of which five officers were interviewed for their direct roles in the document preparation process (two officers were interviewed twice). This was complemented by more than 20 informal visits to the planners' offices, five library drop-in sessions for residents, a citizen survey, 10 interviews with planners, and observations of interactions at three public events captured in field notes. The research continued until 2018. The people that were involved were:

- the head of planning policy, who guided the activities of the team and kept an overview of the plan development process. He was an experienced planner with several years of experience in the local authority, with an excellent reputation locally and regionally. He was responsible for reporting to council-internal meetings on a regular basis.
- an officer with expertise in geographic information systems, who served as an infrastructure manager, updating websites, configuring and linking software tools, and handling citizen comments. This member of the team was technically trained in managing various software tools and databases, especially the Geographic Information System (GIS), to host and produce maps. The interview included an examination of the flow of information across email inboxes, the website, and various database and consultation tools.
- three officers who were the writers of the two planning documents. They were also involved in processing citizens' feedback on their respective planning documents and were responsible for making choices on future actions in response to comments. They planned the consultation events and decided on the software to use for public consultation.

Secondary data was compiled and linked in a case database. Relevant archival data included documents that explained consultations and workshops, outcome reports, and the Statement of Community Involvement (SCI). The database also consolidated the consultation records for 597 respondents across four consultation stages, including workshop attendance records and consultation comments submitted for the latter two online consultation phases (June 2010–October 2012).

To help recall and analytical accuracy, AeonTimeline was used to create a searchable timeline of all publicised consultations and public events. In

differentiating the modes of consultation (e.g. online, stakeholder meetings with specific audiences, and open public meetings), the timeline enabled the search and scrolling through various parts of the plan-making process (Yin 2009). The timeline was used to annotate individual consultation activities with observational notes and to enhance the analysis of the study data.

All documents were analysed using AtlasTI, a qualitative coding package for textual analysis. Interview accounts were coded using process, perceptual, and descriptive coding techniques (Miles et al. 2014), which are explained next.

3.3. Analytical framework and thematic analysis

Similar to Seravalli et al. (2017), we differentiated between ‘operational’ and ‘management’ levels when considering changes to the installed base of software tools, and the practices, arising from our socio-technical approach to infrastructure. We use the term ‘infrastructuring’ to look at the decisions and activities of municipal planners to translate their consultation requirements into socio-technical arrangements in order to support the delivery of public consultations across the four stages (compare Simonsen et al. 2020).

Process codes highlighted respondents’ activities in relation to specific software and data. A long list of activities was documented based on respondents’ explanations. Through a second pass, planners’ consultation work practices were abstracted into conceptual categories such as ‘organising’, ‘informing’, ‘maintaining’, ‘mediating’, ‘receiving’, and ‘authoring’ (see Table 6 in the Appendix). Similarly, specific software was given generic functional names and grouped by whether they were accessible to the public via the Internet or not. Co-occurrent coding of consultation work practices and software tools used enabled us to tabulate actions performed with specific software, by looking at code overlaps. The result of the co-concurrent coding analysis matching consultation work practices to software tools used is presented in Table 1 of the analysis. We also provide a conceptual visualisation of the planners’ engagement infrastructure and the information flows during consultations in Figure 1. This analysis provides a generalised view on the activities and software tools that came to play during consultation activities.

Alongside, we mapped all consultation events in a timeline to develop a process perspective on the overall consultation programme. Descriptive codes were used for any instances of consultation events (and consultation stages), individual/group actors (specific planners), and any specific software and information artefacts. In exploring and understanding the wider consultation programme and influences on the shaping of individual consultation activities, the analysis draws on adapted analytical categories for recurrent practices in institutional approaches (Ostrom 1986), where a similar set of consultation work practices would be applied with adaptations in new consultation phases. For the structure of the overall consultation plan, we took inspiration from the four consultation stages during which the municipal planners built the plan. For

each consultation stage we captured key consultation arrangements that framed the consultation activity (see Table 7 in the Appendix).

The qualitative captured a wide range of infrastructuring practices related to setting up software, or the processing of information received or issued by planners and others for public consultation. In the process, the analysis documented perceived challenges in accessing consultation events, the performance of the planning team, and the ease-of-use of the software tools used for public consultation.

4. The process of infrastructuring planning consultations

Here we briefly summarise the socio-technical support system that the planners established and adapted throughout the four consultation stages. Figure 1 provides a schematic overview of the information flows that were reported during the third and fourth consultation stages when online consultation emerged as a critical consultation method for the emerging plan. Table 1 listed the critical software tools from Figure 1 according to the practices and activities that were mentioned in association with them. These tools and practices represented the “installed base” of the infrastructure (compare Marttila and Botero 2017; Star and Ruhleder 1996). The figures make apparent that the online proposals map and the consultation portal (both accessible to the public via the Internet) were mentioned frequently in relation to practices of ‘infrastructuring’ (“Linking ICT tools”, “Deciding information system changes”). For civic engagement, planners employed and (re)configured a range of initially disjointed and incompatible in-house software with third-party online services. These components served very different purposes and applications in their work. In summary, nine different infrastructural components were mentioned across the interviewees which were critical for online-mediated civic engagement (see differentiating between their uses, as mentioned by planners, and their accessibility to external respondents).

As indicated, there were four public-facing consultations through which information about the planning process was made available to respondents for consultation, albeit mostly through uni-directional messages with the planners. Of those, the online proposals map along with an online consultation portal (for commenting on document drafts) emerged as crucial technological mechanisms for consultation responses (they are indicated as “planning portal” and “online proposals map” in the illustration). From the schematic overview (Figure 1), the grey top bar indicates the software tools that supported the consultation activity online. Each tool was hyperlinked with each other. Respondents would come to the respective consultation page on the municipal website, which would include links to the draft plans hosted on an external online PDF reader. Geographic policies that applied to specific development sites were presented in an online proposals map and referred to with policy text in the draft document of the town plan. Participants could click on hyperlinks in the draft plans to reach the online proposals map and vice versa. Having reviewed the various information, respondents would submit comments

Table 1. Reported actions arranged into families of practices observed (second row) and software (third column). This data was derived through co-occurrent coding (Saldaña, 2012), meaning that the actions in a row were mentioned in association with the software tools listed in the first column. The families of practices (top row) were derived inductively through grouping reported actions.

Software tools used	Consultation work practices				
	Organising	Informing	Maintaining	Mediating	Receiving
Not publicly accessible via the Internet	Shared drive	Archiving responses			
	Doc digitising service		Deciding infrastructure changes		Archiving responses (letters)
	Deciding infrastructure changes		Authoring plans; drafting responses		
Publicly accessible via the Internet	Shared email inbox	Archiving responses			
	Online PDF reader			Monitoring reader stats	
	Contact database				
	Planning portal	Sending newsletters	Updating contacts		
			Deciding infrastructure changes; hyper-linking tools	Generating response reports	Checking responses; inputting reposes
			Upd at i n g web pages		Authoring plans
	Planning web pages	Publishing plans			
	O n l i n e proposals map	Creating maps	Hyper-linking tools

Figure 1. Conceptual visualisation of the planners' engagement infrastructure and the information flows during the final online engagement campaign. The grey bar on the top indicates the interface with the public comprising four different online applications. The purple boxes to the bottom include all non-public, internal software applications. The bold black arrows demonstrate the primary flow of information planners employed, from comments to the final report.

via a form on the planning portal (at the third stage) or a simple response form (at the fourth consultation stage).

For the team of town planners, regular weekly meetings presented significant ‘design moments’ when the authority, resources, and expertise was brought together in order to make informed infrastructure choices on behalf of anyone who would want to be involved in consultations. Here planners deliberated on how ‘much’ participation is enough and how to resolve competing interests. Based on the analysis of interviews, planners’ public consultations were seen as key. However, the choice of consultation activities by the planners remained tied to known and traditional practices that were seen as workable (given the tools and resources available).

The whole process was thus broken into known consultation stages (see Figure 2), and the planners began to engage with known local and required national

Figure 2. A breakdown of the critical consultation stages that made up the plan preparation. The blue-shaded boxes are considered the main consultation stages, whereas the orange coloured boxes present critical decisions made by the municipal town planners that influenced each of the participation moments.

stakeholders, whom they involved in more interactive face-to-face activities, such as round tables and mapping workshops. These activities were known by and open to better-informed citizens. Later-stage consultation activities took the shape of public exhibitions combined with online consultation. Here the manageability of response was the key determining factor in the choice of consultation methods. For the town planners, setting up and maintaining the various links (in the form of hyperlinks, consistent branding, and explanations) required considerable staff time. Also, any change called for a manual update of numerous hyper-links to documents and software tools. Planners were also challenged to present progress by reporting outcomes from earlier consultation stages, to demonstrate progress and movement, despite significant gaps between consultation activities.

The next sections step through the four consultation stages in the consultation and preparation of the planning documents. We focus on crucial turning points that led to the modification of the information infrastructure and to new engagement opportunities arising from team decisions (which are referred to as ‘team decision situations’ in Figure 2 above). At the beginning of each consultation stage, a summary table identifies the consultation arrangements (Tables 2, 3, 4, 5). For instance, the tables summarise the roles of actors in the public consultation (‘positional roles’), who could take those roles (‘boundaries to participation’), and what they could do or influence during the consultation (‘choices available’). It also includes practices used to define insights from all consultation responses (‘aggregation of outcomes’), the methods to access information on the consultation activities (‘information circulated’), the possible rewards (‘incentives and pay offs’) and the scope of the possible changes (Weise et al. 2017).

4.1. First consultation stage (June 2010)

At the outset, the first consultation stage was facilitated with the council’s consultation portal, collecting comments on a 10-page published document on a set of key questions. Sixty individuals submitted 269 comments via the online commenting

Table 2. Operational consultation arrangements at the first stage which involved an open-ended consultation on a simple 10-page document with potential themes the plan might address.

Positional roles	Planners, other officers, respondents
Boundaries to participation	Planners (formal contract, member of policy team), other officers (employed by the municipal authority and invited by the town planners), respondents (key known stakeholders with access to the town plan drafts)
Choices available	Respondents could submit open responses using a form [6 weeks]; Planners analysed and stored comments.
Aggregation of outcomes	Planners developed key themes —“ we drafted objectives and put them to internal officers.”
Information circulated	Letters/emails sent to the consultee database, “everything online”, press releases.
Incentives and payoffs	Participation enabled early influence and involvement at workshops at the next consultation stage.
Scope for change	“was really vague [...] they could virtually put anything down.”
Software involved	Planning web pages, consultation portal, a contact database, and shared email address were the key software tools used at this stage.

facility on the initial document that outlined broad priority areas. The planning policy team leader pointed out that this consultation had no “remit”, it was not legally required, and it was used as an opportunity for an informal beginning. For another local planner in the team, the stage was “really vague [...]” and “(respondents) could virtually put anything down” as a suggestion. The planner and document author noted that comments were aggregated manually to “subject areas which interested people most and which got the most response” and were used to determine priority areas for the emerging plan. In a closed October 2010 meeting, 25 council officers were selected to attend a feedback session, and as a result, planners agreed on five themes for thematic workshops at the next stage. Furthermore, for boundary setting in future consultation stages, the planning policy team lead noted how this stage “made us aware of people who had an interest” and indicated that “we quite cleverly used that stage to identify people who had opinions, thoughts, arguments, and we then used them very much in supporting the next stage” of workshops. Beyond information on the website, very little formal work was undertaken to support online consultation at this stage. Most individuals who engaged were known to the council as required respondents (“statutory consultees”) or representatives of local groups.

4.2. Second consultation stage - workshops (October 2010–March 2011)

In the second stage, eleven workshops were run involving detailed and time-consuming consultation activities. In total, planners involved about 150 individuals

Table 3. Operational consultation arrangements at the second stage, which was primarily focused on spatial and thematic workshops with members of the public.

Positional roles	Planners, other officers, respondents.
Boundaries to participation	Same as before, but attendees are selected by planners based on earlier contributions.
Choices available	Planners can decide on the number and type of events held; attendees could deliberate face-to-face on a topic of their choice, or during one of several mapping workshops.
Aggregation of outcomes	Planners summed up the key issues (one planner per document); for preferred land allocations, participants distributed chips on sites they preferred to be allocated.
Information circulated	Select number of attendees invited, outcome reports shared with all.
Incentives and payoffs	Early participation enabled more “strategic influence”. Direct face-to-face contact with officers.
Scope for change	Discussion facilitated by a set of proposed development sites and defined topics.
Software involved	Planning web pages, a contact database, and shared email address were the key software tools used at this stage.

across 11 face-to-face sessions (see Figure 3). These events required significant resources to run, to document, and to analyse session outcomes. As one planner noted, “the mechanics of collecting information were all done in a very informal way (through) facilitators and people who were transcribing”. They “were not asking them (the public participants) for representations or any formal comment. They have to take the time and effort to write down.” In the process, only the content of the conversations was documented. Although unsupported by any of the planners’ software, the off-line interactions and their associated information artefacts, mainly written notes and annotated maps, were an integral part of the process. Access to the workshops was restricted to registered attendees. However, as per legal requirements, planners produced outcome documents and subsequently shared them through the planners’ website, and directly with the 900 semi-active and active individuals who were registered in the planner’s database by that time.

Software tools were increasingly essential to managing the project at this consultation stage. In terms of back-office software, planners had maintained internal databases and began to develop complex file structures on shared drives, to store and share document drafts, evidence, and consultation-related documentation. The planning officer who was the lead plan document author noted “the drive is what everyone can access. It is where everybody stores information [...]. All the minutes and everything would be on that [...] drive so everybody can access them [...]. It is where everything is stored basically in the draft and in final form”. In the earlier consultation stages, a shared mailbox served as the main point of contact for the public, and as the teams’

data archive of emailed responses. The planning officer responsible for process support noted that “all the emails that we received went to the (shared email address). We have got our own inbox for that, and all the emails we received are all stored in there, and so that is a kind of archiving system [...]”. External participants had no direct access to those responses and lacked “editing permissions” for information artefacts (listed in the next section). At later consultation stages, plan documents were authored via a dedicated ‘planning portal’, an online-hosted software the council had subscribed to, along with standard word processing software.

4.3. Third consultation stage - “developing the options” (July 2011)

After clarifying the priorities for the emerging plans through the workshop discussions, two planning policy officers authored initial drafts of the two planning documents. As the process became more formalised, there was a noticeable shift to traditional forms of participation based on written document drafts, described as “review and comment interactions” (Innes and Booher 2004), combined with public exhibitions (see Figure 4). In terms of the operational consultation arrangements (see Table 4), consultations required all respondents to disclose personal details such as their real name and organisational affiliation and address, along with formal written comments on a particular section in the plan document corresponding to a theme or a locality. Participation was constrained to a nine-week period within which 332 respondents made 1202 comments.

Table 4. Operational consultation arrangements at the third stage which involved lengthy document drafts along with a set of physical sites that might be allocated for development in the draft town plan.

Positional roles	Planners, Respondents
Boundaries to participation	Planners (formal contract, member of policy team), Respondents (anybody with access to online document drafts)
Choices available	Respondents could submit formal comments on document drafts during a 9-week consultation period.
Aggregation of outcomes	One planner reviewed all comments. Difficult comments were discussed by the team.
Information circulated	Notifications sent to the consultee database; documents made available via a consultation online portal.
Incentives and payoffs	Possibility of influence - vague. Professional respondents - financial reward and the allocation of sites.
Scope for change	Document drafts provided a limited set of locations and policy options for comment.
Software involved	The consultation portal, the online proposals map, and the consultation database were the key software tools used at this stage.

At this point, a new set of software tools became active. In terms of online access, the web pages on the local administration's website became the focal point for publishing the new draft documents and the outcome reports, and for articulating planners' activities and progress. Each of the planners on the team produced content that was then edited and uploaded by two planning assistants. On first appearance, the web pages could be seen as solely a catalogue of documents and comments on planning progress. However, for the planning policy team leader, the web pages were critical in providing an overview of the work to various members of his team, providing a "library" on which documents, data, and project schedules were organised in chronological order by document and day/time updates, at regular intervals. From here, planners also sought to build a consistent interface for the public by linking to other components such as a council-hosted software for the online proposals maps, and to the 'consultation portal' where plan drafts were published for external feedback.

Planners made some critical choices that influenced the form of consultation. In preparation for the online consultation, the officer responsible for process support inserted web links to the consultation portal on their website and then emailed a notice to citizens registered in the contact database. A local and formally registered resident who managed a local shopping centre noted that the planners were "pretty good at that". All residents were sent a postcard and informed by a notice in a newspaper. While responses by letter and email could be submitted without procedural hurdles, the consultation portal required respondents to register for an account before they could comment (boundary rule). However, this served as a substantial barrier for infrequent and inexperienced respondents. One respondent noted that "merely to comment has taken a long time and has involved engaging in a series of complex procedures to register, find the plans, work out how to comment (no readily accessible button or similar link on the appropriate page where the plans are located) and so on." He speculated that "it is as if the people setting up this website did not want comments". On the other hand, other interviewees pointed out "the use of a threaded comments website [...] is very very much appreciated as it allows an ongoing dialogue with people" to help long-term engagement.

After the consultation concluded, the consultation portal became indispensable in enabling citizens to review others' comments. An interviewee who spoke on behalf of a local community group, as well as a principal developer, reported going through others' comments to understand complementary and conflicting points. While it was difficult for the system to support many respondents, for some it supported a sense of collective awareness since all online submissions were immediately accessible, as planners manually entered additional submissions from emails and letters. However, this practice was poorly supported by institutional practices. For example, adding comments manually took considerable time, sometimes with comments appearing only 15 weeks after the consultation ended. At this point, no further comments could be made, thereby preventing further public dialogue.

4.4. Final consultation stage – “preferred options” (October 2012)

In a closed weekly meeting, the planners decided that the portal was problematic for the public to use, based on public feedback from the previous consultation. The planning policy team leader noted “we just talked it through [...] at team meetings [...]. I remember asking the officer responsible for processing support if she fancied approaching it (by) writing down all the things that the online commenting portal does and then think about, is this something that it does that we will miss when we no longer have (it). I think her approach was quite different. She [...] knew in her head what the online commenting portal does, and she is working to replicate each of those processes through alternative means [...] it is probably not perfect. We are [...] discovering things that once it is switched off, we will no longer have access to.” The removal of this tool initiated a gradual shift towards a revised infrastructural setup, which caused a significant internal effort to replicate the functionality of the consultation portal through other, typically manual methods (see next stage).

There was then a year-long period of very little engagement with the public which one of the planners described as a “grey area” as more detailed documents were drafted. A resident who was the manager of a local shopping centre speculated that “you get a collecting of the information and then no activity for quite a period while it is compiled and produced into a report to go back out.” The authoring of complete versions of the two planning documents thus took nearly five months between

Table 5. Operational consultation arrangements at the fourth stage which now included lengthy policy document drafts which included a coloured section with aspects still open for debate.

Positional roles	Planners, Respondents.
Boundaries to participation	Planners (formal contract, member of policy team), Respondents (anybody with access to online document drafts).
Choices available	Respondents could submit formal comments on document drafts during a 9-week consultation period.
Aggregation of outcomes	One planner reviews the comments and drafts the responses in a spreadsheet. Difficult comments are discussed in the team to decide whether to change the document or not.
Information circulated	Notifications sent to the consultee database, documents made available via the online portal, and a 3rd party online document reader.
Incentives and payoffs	Possibility of influence - vague. Professional respondents - success for their developer client if their site was earmarked for development.
Scope for change	Changes could be made to specific sections and in relation to questions that town planners placed in the draft documents.
Software involved	A free to use online PDF viewer, the online proposals map, and the consultation database were the key software tools used at this stage.

January and May 2012 and required additional closed meetings with external specialists and council experts on specific matters. In fact, one of the planners who authored the spatial document described it as “quite a busy period even though [...] things were not actually that (visible) to the public. A lot was going on in the background”. Progress was slowed by changes to planning priorities at the national level. The team leader commented that: “We have our evidence, we have our process, and the context we are working in from the position of national guidance changes around us, and quite often we need to take people with us on that journey.” Thus, time was of the essence. Having come this far, the team leader considered this stage the first “real” consultation as the document’s content was now close to its final form. For the planner who authored the general policies document, it was “the detailed document going out for the first time and some of it was a shock to people. All the stuff in the past has always been very [...] light touch in terms of ‘yea, you still got a chance to influence it’ [...] This one (referring to the draft documents), in particular with the land allocation [...], identified sites that we felt were suitable for development.” Given the significant change in emphasis, citizen contributions and their ability to influence the outcomes were now considerably constrained as the process neared completion.

As a consequence of the collective decisions described earlier, the planner responsible for process support noted that the online commenting facility was now complemented by a free-to-use online publishing platform which made plans easier to browse as PDF documents. Specific sections were marked up with coloured boxes asking key questions in certain sections. Responses needed to be submitted by email by a specific date. The boundary rule for registration was removed because the online PDF reader did not offer a commenting facility. Instead, the planners would have to

Camforth Spatial Planning Event

Figure 3. Mapping workshops were arranged as part of the interactive second consultation stage, see Section 4.2 (Source: Lancaster City Council).

Figure 4. Public exhibition on Lancaster Market Square, arranged as part of the third and fourth consultation stages (Source: Lancaster City Council).

receive and edit the comments from viewers, manually. This time, respondents would be able to access others' comments only after the consultation closed via the published consultation report. The planner responsible for supporting the process noted that the setup was “stuck all together, but it is not quite as smooth as it could be”. As the online consultation platform was being phased out, hyperlinks in the council's proposal map would soon be outdated. Thus, dropping a key component in the technical infrastructure created substantial and additional work to replicate lost functions across different and incompatible software systems available to the planners. Despite this, the revised setup encouraged planners and respondents to consider how future consultations using software systems could work.

5. Discussion of the planners' effort to establish a suitable infrastructure to support public consultations

The planners reported that successful public consultations depended on the fast circulation of information to a wide range of individuals (some, primarily known professional bodies were explicitly mentioned in the consultation strategy). The policy team leader explained a “huge amount of evidence (has) to be gathered on a huge number of subjects [...] which at a point in time (needs to be) sufficient in its breadth, so it covers all the subjects, and (is) up-to-date [...]. We need to have momentum in the system for producing the plans because if we delay, then the evidence base becomes out of date”. Between 2011 and 2014, the team had been publishing five interim plan drafts, nine outcome reports, and 200 additional evidentiary documents. Six hundred respondents, including residents and various

organisational representatives, generated 2500 comments through email, postal letter and the online planning portal. The scope of the project demonstrated how civic engagement required careful timing and care in providing and configuring the software components and practices to support participation.

As shown in the findings, infrastructuring practices involving the manual integration and setting up of various software was a paramount concern throughout, and it created significant workload in reviewing and double-checking the accuracy of information and hyperlinks in and across the software. This work was often invisible to the public. Manual work at each stage demonstrated the recurring need to build a revised socio-technical infrastructure for each stage of the planning process. The planning policy team leader noted, “a large amount of time is spent on managing the process which may distract from the content”. The effort of setting up at times exceeded the time involved in going through the responses. In this, ‘accessibility’ in terms of ‘user-friendliness’ and ease-of-use was either a lesser concern or too challenging to realise with the tools available. ‘Accessibility’ was mostly addressed through consistent branding and styling of communication, and extensive explanation and written guidance, instead of the redesign of the software tools involved.

The availability of staff and funding also influenced the number and forms of consultation activities. The team leader noted, “it is time and people and resources. [...] If we had a team of twenty people we could do twice as many exhibitions”. Given the constraints, planners unavoidably had to make judgements as to how to organise, enable and time public access. Especially in the later and formal consultation stages, the town planners’ consultation involved mostly low-cost consultation methods. For those consultations, legal requirements, through a set of information rules, stipulated the publication and circulation of outcome reports after each stage. These outcome reports were meant to prompt responses to the many complex concerns raised within the consultation responses.

The study ended in early 2014 at which stage planners were busy preparing one of the two consultation documents for the final examination. Eventually, at the end of 2016, the general policies document was approved and adopted after formal examination by a government inspector to determine the document’s compliance with all legal requirements, including public consultation. However, the land allocations document, the spatial plan defining the allocation of various locations for different types of development, was still waiting approval after a change in national housing supply requirements. This change was unexpected and at the midpoint of the project, and required the evidence on available housing supply required re-doing. This setback effectively eliminated three years of work and resulted in additional effort to communicate the change to the public. In 2017, the council moved to a new website, offering an opportunity to consider how consultations and urban plans are presented online. In early 2018, the land allocations document eventually was published for the final examination.

In the next few sections, we will reflect on the case and consider the implications for research and practice, by addressing the three research questions.

5.1. How did planners attempt to support public consultations with software and what were the associated practices?

Planners draw on a broad range of consultation formats and processes to achieve consultation objectives (Alterman 1982). In this study, the objective of a public consultation, and the ideal consultation method, changed throughout the programme of plan preparation. Initially town planners applied more interactive, value-based, discursive methods and then followed those with more closed, defined, and limited consultation methods. As the consultation methods varied greatly, the town planners brought different software into play at different times in the process, and adapted their approach to fit changing consultation requirements. The study documented that town planners aim to create a ‘rhythm’ of consultation activities, which then unfold following a similar set of practices, as each consultation requires publishing, monitoring, analysing, and reporting (see Figure 1 for the general flow of activities across the various software employed by planners).

The study documents the challenges of supporting public consultation in its various forms with a suitable socio-technical infrastructure. The software used was limited in its ability to enable dialogical engagement between citizens or values-based discussions online; ‘dialogical’ engagement could not be ‘infrastructured’ easily by linking available software tools together, so planners organised more face-to-face interactive consultation methods in the second consultation stage. In the later third and fourth consultation stages and in keeping with process requirements, planners retreated from participants and dialogue that could challenge the principles of the draft plans, trying to focus on creating final policy drafts, focusing only on those online tools that could gather public feedback quickly and efficiently on the basis of the documents drafts.

We also found that purpose-built software tools such as the consultation portal and the online proposals map were still too rigid for planners, and not useful if used independently, and so the planners created a mashup by hyperlinking between their various tools to provide participants with interactive map visualisations besides the static text. To do so, planners attempted to adapt, combine, and find workarounds with the software tools available in house, or on the Internet. The planners found flexibility and value in drawing on freely-available tools online that could be used and deployed easily, albeit with substantial manual effort to gather and store the data after use. These off-the-shelf and free-to-use tools such as PDF readers were used for presenting documents rather than gathering participant information or responses. In contrast, planners used in-house software for any aspect of the consultation that required the collection of sensitive personal details from members of the public (such as postcodes, names, and organisations). This ability of municipal planners to experiment with software and processes was crucial as existing software was perceived to be more easily and cheaply reworked for consultation needs.

Our results illustrate how planners are constrained and enabled by technological capabilities and institutional structures, that are handled through and during

infrastructuring work. This work requires greater recognition in the emerging literature on digital platforms for public consultation. For example, attempts to address perceived barriers to consultation with the public resulted in the removal of a critical consultation portal, and an attempt to emulate the missing functionality through other readily available platforms (a PDF reader and a form-based survey tool). Planners' practices exhibited 'infrastructuring' in stitching together alternative software resources to replicate the perceived loss in functionality arising from the abandonment of the consultation portal. For external respondents, this was experienced as an increased fragmentation of publicly available information, resulting in temporary limitations which required public users to learn and adjust to such changes. It also meant that council officers spent hours transferring information from one database and associated software, to another.

5.2. Who makes infrastructural choices for public consultation?

As shown, the infrastructure for consultation was constantly remade by the planners from mundane and existing software components, and in-house systems for data collection, informed by and affected by existing and revised practices to render socio-technical configurations that met the constraints and requirements of their multi-stage consultation processes. Huybrechts et al. (2017, p. 151) observed that research into local government processes needs to examine those strong organisational requirements which guide town planners, such as "legislation-checks, policy-checks, fund-raising, partnership-forming, reporting and assessments in relation to all parties involved". For public consultations in town planning, this involves recognising the planners' as an infrastructural agent, navigating and pulling together socio-technical configurations across the installed base of: practices, software, team sizes and composition, and the required consultation programme. They are obliged to do this work alongside the 'clock-work' apparatus of various committees and public arenas where their work needs to be approved by elected members. While planners accept the delivery of public consultations as a core part of their work, they are often not given proper recognition for their role as infrastructural agents that they perform alongside their operational roles as authors of planning documents. This kind of work, often considered to be simple 'administrative' tasks, is a central function of their civic work. While acknowledging that other actors such as researchers and citizens, can play a significant role in using digital tools for planning (see Wallin et al. 2010), planners in their formal status in the planning system have a unique role at the centre of these activities.

Despite the planners' active infrastructural role, our results also illustrate an opportunity for the public to have influence over the consultation methods at the outset. However, in order to support the publics' role in influencing the town planners' practices, town planners lacked suitable ways to involve the public in their approach to public consultation. The planners used their weekly meetings to define key infrastructuring actions, but those meetings excluded the wider public. The lack

of active involvement of the public in defining and shaping the consultation methods means that values underlying the choice of those methods are driven by the town planners' functional requirements. For example, the present case demonstrated that 'usability considerations' of the software for the public played an essential but subordinate role in deciding which software to use. Instead, town planners often had to use what was available, either because it had been purchased or it was freely available, and needed to build links between the various software to enable a technical infrastructure to allow for communication and responses from the public.

Local government purchasing departments could play a significant role in influencing any revision in the infrastructure for consultations when it comes to replacing integral software. In the instance here, planners decided to discontinue their use of the consultation portal, but then could not easily replace its functionalities with a new specialised tool as it would require a lengthy tender exercise to buy new software. A conversation between citizens and planners around software used and the desired format of consultation practice would take time, but it is ultimately essential in shaping the requirements for the council to invest in any new software for its consultation activities. This is naturally a lengthy process and will require significant effort and proactive definition of the town planners' current shape of the infrastructure.

5.3. What support do key actors need, including municipal town planners, to realise the possibilities for digital innovation in public consultation practice?

As research in participatory design is returning to the routine work of local government, we need to recognise the embedding of users' practices, infrastructural work and infrastructures within institutional frames, such as the plan stages (Huybrechts et al. 2017). The study showed that innovative changes in the consultation practices of local government are not dependent on intervention by technical experts or the introduction of advanced software systems, but dependent on the actors themselves, and their incentives and abilities to change. Without favourable institutional environments, planners will favour the preservation of existing practices through existing technical infrastructures. We would suggest that, in the absence of technical silver bullets, planners need to be supported to take active charge of their role as infrastructural agents, and to see 'infrastructuring' as part of participatory design to shape their consultation practices. Approaches to participatory design could facilitate an open exploration of the "adaptation and appropriation" of software within local policy frames and constraints around planners (compare Seravalli et al. 2017). However, in the long run, this approach will likely not overcome the lack of suitable software for public consultation.

Given the substantial effort required to create a suitable consultation infrastructure, our study suggests the merits of regular and detailed appraisals of the software used by planners in relation to the practices needed for consultation. The result of such an approach was presented in Figure 1 and Table 1 and involved mapping the practices often required at each stage of the lifecycle of public consultation. This

relates to the consideration of the ‘design’ of the public consultation, using the institutional lens we considered as an extension of the ‘social’ in the socio-technical assemblages view of infrastructures (Huybrechts et al. 2017) (who can get involved and how, what are they offered to do, what are the incentives for their participation, and how will the responses be evaluated). On the other hand, it also highlighted the merit of noting the ‘rhythms’ of formal government processes and the core activities which recur during public consultation, and the different software tools that are used (Figure 1). If a combination of tools could be designed and integrated to provide a suitable facility for each of the core practices of planning, then the chances for meaningful bi-directional and peer-to-peer interactions can be increased.

In the practice of town planning, politics, the lack of clearly defined incentives, incompatible software, and concerns with internal approval processes both shapes and often restricts the adoption of innovative practices and infrastructures. The lack of clearly defined incentives to innovate their infrastructural setup for public consultation requires planners to become self-motivated ‘institutional entrepreneurs’, speaking for the members of the public and knowledgeable of technologies, advocating for infrastructural change in order to increase engagement. Although planners are less likely to develop novel technical solutions (i.e. they are not computer scientists), as infrastructural agents they demonstrate an ability to innovate by creating new socio-technical arrangements with the software and processes they control.

The transfer of information from one software to another manually creates a burden on resource-constrained planners. Few of those manual tasks are apparent to citizens; neither are the large-scale manual information processing planning involved. This suggests there are potential benefits for interventions that enable town planners to articulate and discuss the ‘installed base’ of existing infrastructure and the institutional forces which influence planners’ work. It may also suggest the need for innovation programmes offered by public sector bodies to help planners share their capabilities and challenges working with the various software involved in public consultations. In the UK, this has been partly addressed through novel organisations, such as the Connected Places Catapult and innovation funding from, for instance, the Planning Delivery Fund which provide dedicated innovation programmes and incentives to drive innovation in the planning system. Our study demonstrated that it is paramount to work with the town planners on shaping these potential innovations directly. Hence, we conclude that while new technologies will not undo the role of the town planner, the town planner’s role will likely need to evolve to take greater recognition of her/his role as an infrastructural agent in shaping the infrastructures for consultation and engagement in town planning.

6. Conclusion: building planners’ capacities to infrastructure public consultations

The study of planners’ practices demonstrated how the use, deployment, and configuration of various software translates into infrastructure assemblages to support

the planners' public consultations. It outlined the effort of linking routine and incompatible software in an attempt to enable public consultations by town planners. Our study points to the complexity of supporting public consultation with digital systems, in a process that can last between three to five years until final outcomes are produced. Contrary to the view of infrastructure as a smooth and well working technical system, the study demonstrates how public consultation work in municipal authorities depends on creativity, imagination and laborious work, in making the best use of available software, including freely available online tools in addition to already existing council-owned software, within a complicated and changing institutional environment. Most of the freely available online tools were repurposed for the planners' intended purposes (such as publishing a document) alongside the council's own software tools. The result is infrastructural work within and beyond the technical infrastructure, to form and create a socio-technical and institutional infrastructure for public engagement.

The study also demonstrates that the rules of municipal planning regulations and expectations towards consultation stages have a significant influence on the shaping of the consultation setup. The length of the process of creating a municipal plan (typically two to four, often many more years) provides municipal planners with the obvious challenge to document and also communicate progress made on the town plans. Ongoing reworking of the consultation setup means that the presentation of information from earlier stages needs to be archived and packaged up after each stage in light of any progress made on the content of the emerging municipal plan. The flexibility of manually linking various software tools compensated for a lack of any bespoke technical system that might support all the diverse consultation requirements for the municipal plan. Here, the analysis shows that many formal hurdles in the town planning process (e.g. formality of the process, difficult technical knowledge), consultation requirements, and the manual linking of software components for consultation activities (i.e. 'infrastructuring') shape public consultation.

From our study, we noted an absence of a clear picture of the infrastructure constructed from various software tools and practices; and a lack of common understanding about this installed base constrains innovation in planning. Since there is no financial reward for residents to participate, their level of response is most likely heavily dependent upon the ease of access, and interaction support. But it is more than that: the key to infrastructural success is in enabling public officers to change their practices from the capabilities provided from technological change; and from a recognition that municipal town planners are attempting to do so. The study calls for further research into the possible ways for supporting planners by seeing their work as infrastructural, and infrastructural work as socio-technical, arising from within an institutional setting. This is a call for us to consider and reflect on public responses to existing and future methods of consultation. In this call, technologists and planners are encouraged to collaborate on the development of technologies to increase consultation and engagement, and through it, to

increase overall public consultation and engagement on the development and future of towns and cities.

In terms of public participation in infrastructure adaptations, citizens should have the opportunity to influence planners' consultation plans early on. For this, town planners in local government should be given sufficient opportunity to regularly consider how to ideally engage with the public, by trying to make explicit the consultation methods they intend to use. Additional research could be done to document precisely what conversations arise in relation to documented consultation practices and what citizens think about the methods used. In this case, the council's consultation 'manual' ("Statement of Community Involvement"), while out for consultation, was most likely poorly understood in terms of its significance and the possibilities for people to shape the consultation process. Often these documents focus on the frequencies and timings of consultations, and less on the specific techniques and software that could be used. Perhaps they should.

Our study also suggests that, in practice, the feedback planners received through the official consultations had a strong influence on planners' adaptations to practice, beyond the consultation manual. To them, weekly meetings enabled 'design moments' when the authority, resources, and expertise required them to make informed technical infrastructure choices on behalf of everyone who would want to get involved in consultations. Here planners deliberated on how 'much' participation is enough and how to resolve competing interests. Planners clearly attempted to listen to their constituents but rarely communicated this publicly. Again, this raises the possibilities that town planners could benefit from a more systematic appraisal of their consultation methods and support structures, perhaps including advice on agile development and other design methodologies. It raises questions about the tailoring of infrastructures, and what future software may be employed that is sufficiently adaptable, open, and flexible to planning process needs. This is a significant and exciting challenge to be addressed by the designers of collaborative technologies.

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1. Appendix

The following two tables explain the analytical categories applied during the qualitative analysis of the planners' processes.

Table 6 provides an overview of the categories for consultation work practices that were derived through consolidation process codes.

Table 6. Overview of the families of practices under which we grouped all process codes of consultation work practices the planners performed in association with arranging and running consultations including the software involved.

Categories of consultation work practices	Description
Organising	Bringing order to the received responses (e.g. archiving) or creating assets for consultations that shape the responses obtained (e.g. producing site maps).
Informing	Communicating externally and raising awareness (both to already identified respondents and to the public at large).
Maintaining	Updating the linkages between various tools to provide a consistent external experience of the response options available at each consultation stage.
Mediating	Facilitating and increasing the understanding of responses and interpreting responses in the context of the consultation purpose.
Receiving	Logging and cataloguing responses so that they can be interpreted, retrieved, and published later.
Authoring	Producing replies to consultation responses and the active redrafting of sections in various town planning documents under consultation.

Table 7 shows the analytical categories to summarise consultation arrangements. These categories are adapted based on work by Ostrom (1986).

Table 7. Overview of the aspects used to document consultation arrangements that we coded using descriptive codes per consultation stage.

Consultation arrangements	Description
Positional roles	An abstraction of the roles available in the respective consultation stage, reduced to the role of planner and the role of participants.
Boundaries to participation	How those roles for participants are defined.
Choices available	The opportunities for influencing the content of the materials during consultation.
Aggregation of outcomes	The choices and actions the participants can take.
Information circulated	The means or techniques by which any participants' actions are put together to achieve outcomes (e.g. a consultation report).
Incentives and payoffs	The motivators for participants to participate in the consultation.
Scope for change	The potential for responses to influence the contents of documents drafts.

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