

Smart Publics

Public Perceptions of Smart Street Furniture in London
and Glasgow: insights for Policy and Practice



This research project was a collaboration between the University of Glasgow and the University of Sydney, led by Prof Bridgette Wessels (Professor in the Sociology of Inequalities, Sociology, University of Glasgow) and Dr Justine Humphry (Lecturer in Digital Cultures, Media & Communications, University of Sydney).

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Smart Publics: Public Perceptions of Smart Street Furniture in London and Glasgow: insights for Policy and Practice

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Executive Summary

Introduction

The Smart Publics project focused on the introduction and usage of smart kiosks and benches. The project explored public perceptions of the BT InLink kiosks and the Strawberry Energy smart benches, and identified emerging issues for the design and governance of these. The small-scale one year project was carried out by an interdisciplinary research team from the Universities of Glasgow and Sydney. The project was funded through the 'Partnership Collaboration Awards' between the University of Sydney and the University of Glasgow. The project ran from February 2019 to May 2020.

Addressing public perceptions of smart kiosks and benches

Smart kiosks and benches combine different aspects of street furniture, communication services, data connectivity, public information and advertising in new ways. To address the opportunities and challenges of these, the concept of 'recombinant' was used, which refers to the ways in which smart innovations combine physical artefacts, interfaces, digital infrastructures and data systems to create new forms of street furniture.

Methods and data collected

The project centred on three kiosks in Glasgow city centre and three benches in Southwark, in South London. Researchers observed the usage of these kiosks and benches, and conducted 75 short street vox pops with people walking by and/or using them, which were undertaken during two-hour sessions in the morning, lunchtime and afternoon. Semi-structured interviews were conducted with a representative of a community group, an activist, a commercial representative, a councillor and a planning officer. Furthermore, document analysis was undertaken of smart kiosks and benches in the grey literature.

Key findings

User perceptions of smart kiosks and benches

- Users felt there was an element of discovery in encountering new types of smart street furniture, but many were unaware of all their functionalities, and some had concerns about not knowing how to use the kiosks and benches.
- Generally, the smart furniture's design was liked. Respondents thought the kiosks and benches were well located in public thoroughfares, and some suggested that the benches could be located in parks.
- People appreciated the safety aspect of smart street furniture, in terms of the emergency button and USB chargers. This was considered especially important at nighttime.
- People recognised the wide public value of access to Wi-Fi, charging and calling facilities. This was seen as particularly important for certain groups, including homeless people, gig economy workers, students and tourists.
- Respondents expressed minimal concerns about using public Wi-Fi, expressing there was little concern about data safety and privacy.

Design and use

- Users perceived advertising as the primary function of the kiosks.
- Respondents suggested that public information and a directory of social services was important for vulnerable groups.
- Concerns were raised about the health risks of alcohol and fast food advertising.
- There were suggestions that the advertising space should be used for educational and community purposes.

- The free phone calls provided by the kiosks and benches were a lifeline for some, providing essential communication, particularly people without mobile phones, landlines at home (or a home), or those who had lost their mobiles, run out of data or power.
- Users found innovative ways to use the objects and their functionalities. Gig workers used them to charge their phones when cycling because of convenient access while on the move; office workers used the benches to rest and eat their lunch on whilst charging their phones; children played around both objects; and people leant on them for a smoke or chat. However, users needed to bring their own USB cables to use the charging facilities.
- Users noted difficulties in sharing the benches, for instance some people did not want to share them with others they perceived as being homeless.
- The universal design was a good start but there were design limitations: for instance, the digital tablet of the kiosk fitted into the narrow side of the kiosk, which was easy to miss, less comfortable to access, less intuitive, and did not offer privacy.

Data issues

- There were some concerns about data use and privacy – although only low-level concern in the study sample.
- Seamless connectivity was deemed convenient but there was a lack of awareness of if and when devices were connected to the Wi-Fi network and other services.
- Many placed their trust in the local authority's management of data privacy.
- Attention to data governance and privacy is needed as smart kiosks and benches develop.

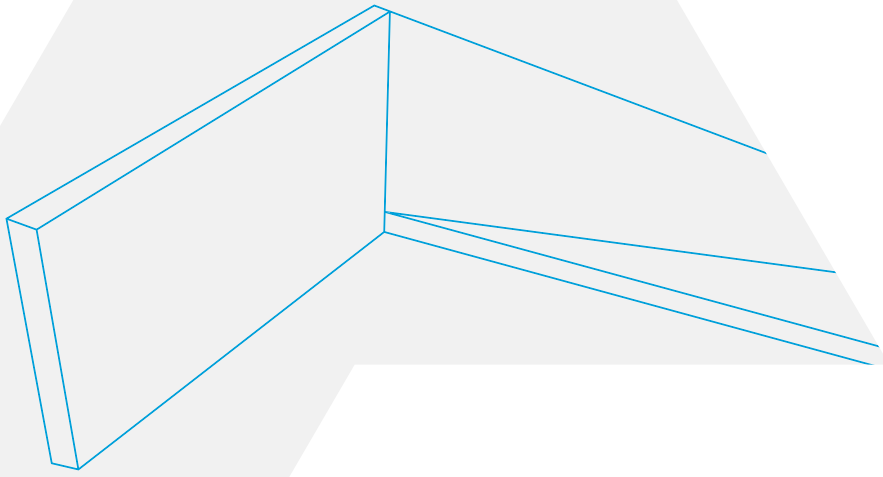
Questions to support further development and implementation of smart kiosks and benches

The findings suggest that it is important to address the following questions in further developments:

- **How to combine use:** Is there – or should there be – a primary use? If there is not a primary use, how can the different demands on a kiosk or bench be facilitated to an acceptable standard? What might such a standard be?
- **How to design to meet the requirements of a number of functions in a recombined form:** To what extent can universal design principles support recombined public street furniture? How do people learn about and develop confidence to use the new features? How is its design evaluated and adjusted over time?
- **How to ensure responsible and accountable governance of multi-functioning street furniture:** Who is responsible for the data gathered from benches and kiosks, and who is responsible for its use by others? Do these kinds of benches and kiosks require more than GDPR compliance?
- **Suitability of existing planning regulation for smart kiosks and benches:** In particular, what regulation might be needed for physical structures that combine advertising and information, data provision, and communication services? What new kinds of planning processes and laws might be necessary?
- **Recombinations of types of end users in retail and transport spaces:** Are kiosks and benches in the right places to meet some end users' needs, and do they fully address these needs? What are the combinations of patterns of use in different spaces, and is there any requirement for adaptations to fit specific space-place use?
- **Effects of combining public information and communication services with commercial advertising:** How can these free facilities be made financial viable, especially if there is an aim to limit advertising? How can they be made relevant and current for public consumption and service provision? How does this impact on perceptions of public space and inclusion?

Recommendations

1. A greater emphasis should be placed on the public and social values of smart street furniture at a local level (e.g. digital inclusion, enhanced connectivity, community-based information announcements) in local authorities' smart street furniture business models. This needs to be combined with an evaluative framework to assess the public and social value of the smart street furniture in the present and future, and modify it if necessary.
2. The smart kiosks' and benches' intended purposes need to be defined, assessed and documented, including how they address local needs and add value to existing cityscapes. This will allow local authorities and commercial providers to ensure appropriate signposting of their functions, taking into account their primary and secondary functions, and determining any added value that can be leveraged.
3. An officer role should be created at the local level, to continuously oversee the risks and opportunities offered by any public service information provision and data collection, sharing and reuse through smart street furniture.
4. A more proactive partnership approach should be taken to explore the possibilities offered by smart street furniture and link them to other service provision (e.g. to local homeless shelters, public libraries and other community services).
5. Local authorities and commercial providers should develop a public awareness and education strategy in order to support the discovery phase of smart street furniture and promote wider understanding of data collection practices and protections.
6. Existing knowledge gained at a local level from the early implementation of similar schemes should be compiled and circulated, in order to inform the fixing and fitting of kiosks and benches into specific suitable local spaces and contexts.
7. An assessment should be made about whether the universal design principles of smart street furniture meet the requirements of end users with specific needs in the context of public places, and to devise a method for public and local council input to be included in future design iterations and adjustments.



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Introduction: the Smart Publics Project

The Smart Publics project (hereafter ‘the project’) focused on the introduction and usage of smart kiosks in Glasgow and smart benches in London. Smart kiosks and benches are relatively new in city spaces and they provide new combinations of street furniture and communication and information services that are digitally enabled. They are, as such, examples of innovation within wider ideas about and implementations of ‘smart cities’. The project addressed smart kiosks and benches through a public lens rather than from an overarching city

perspective in order to grasp the experience of smart innovation for end users. The project was a one year small-scale project carried out by an interdisciplinary international research team that sought to identify and understand emergent issues in these developments, in order to inform further research and areas of development. It entailed research in Glasgow and London with members of the public and with service providers. The project was funded between February 2019 and May 2020.

The project team undertook research on InLink kiosks provided by InLinkUK in partnership with BT, which provide fast, free public Wi-Fi, phone calls, device charging and a built-in digital touchscreen tablet for access to city services, maps and directions. The service is paid for by advertising and is free at the point of delivery. We also undertook research on an urban furniture company's network of Strawberry Energy benches, which provide Wi-Fi hotspots, USB charging ports, wireless charging and a place to sit. These are powered by solar energy and have sensors that monitor air quality, noise, temperature and humidity. This environmental information is accessible via a downloadable mobile app, and the services are also free to use. These benches and kiosks offer new functionalities and generate new ways for people and data to connect with each other, however, little is known about how they operate in public environments, how people notice them and how they start to engage with them.

The project focused on three areas of inquiry: (1) how different publics use smart kiosks and benches as they move through a city and stay connected with data and services; (2) the challenges in designing inclusive, transparent and trusted smart street furniture; and (3) governance issues raised by the adoption of urban street furniture combined with digital advertising and new technologies of public data access and exchange.

A defining feature of these new artefacts and services is that they combine and recombine functionalities that exist in prior urban forms – like benches, public pay phones, Wi-Fi hotspots and charging stations, wayfinders and advertising billboards. They are also hybrid media objects, integrating a range of communication and information services, sometimes in new ways, such as the delivery of a service directory and air quality information. Combining functionalities in new ways raises questions about the management of these kiosks and benches and how people adopt and adapt them.

More knowledge is needed about the design, use and governance of smart kiosks and benches in ways that feature in wider planning and development issues and take into account how people engage and interact with smart street furniture. To address this need, the project focused on the ways in which people in streets encountered smart kiosks and benches to explore their perceptions of the design as well as actual usage. The project also addressed some of the issues in the vision, planning, and governance within wider digital and smart city strategies. Attention was paid to local authorities and the commercial organisations who produce the smart street furniture, as well as community groups and activists, to gauge wider responses around the public benefits and concerns of smart kiosks and benches.

This report summarises the key findings of the Smart Publics study and the discussion points that were identified through the research. It also provides directions for further research and development, as well as a set of recommendations.

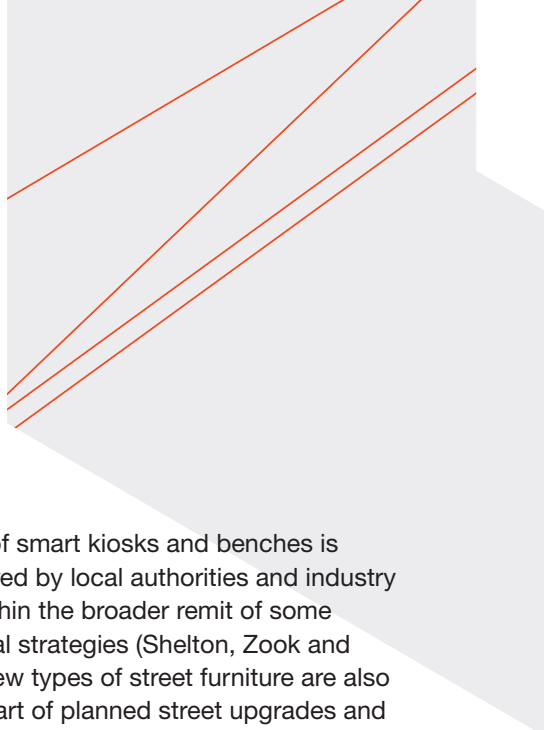
Background: contextualising publics and street furniture in smart city development

Smart kiosks and benches are examples of new types of street furniture in cities and, to some degree, are part of the emergence of ‘smart cities’, envisaged as the new and efficient management of cities utilising real-time data to inform responsive decision-making (Kitchin, 2014). They are also embedded within the development of mobile phones and urban communication systems (Wessels, 2001; 2007). While new technologies have facilitated the advancement of smart street furniture, smart kiosks and benches continue a longer history of provisioning cities with communication utilities and services such as pay phones and information kiosks. The development of digitally-enabled kiosks started during the mid-1990s when the Internet and World Wide Web started to go mainstream. These kiosks were developed for public service and community use, such as telematic kiosks across Europe which were used to produce a contact point that had a range of public information. There were also developments in consumer services, which sprang from user take-up of cash machines (Wessels, 2007; 2011). These public service developments were widespread, especially across Europe, Canada and the US.

Concern at this time was focused on the risks of inequality due to the characteristics of ‘the digital divide’, that is, the difference between those who have basic and digital skills and access to personal computers, mobile phones and other digital devices, and those who do not. There was also concern about making the design of interfaces intuitive and accessible for all. Another issue was how to bring

different information providers together in ways that would enable them to share information. Many of the development teams, usually comprising public services and private sector companies, learned from the early kiosks, and created supporting services such as better design and one-stop shops, and put in place governance frameworks (Cornford et al., 2004; Wessels, 2000; 2008; 2009). At that period, and from those developments, a consensus emerged about the remit and value of kiosks, which was that they could provide quick access to public information and should be used as a point of contact directing users to other services (Wessels, 2007). As mobile phones and home access to computers and the internet increased, public services moved to other information provision strategies, including online service portals. The change in focus also factored in developments in public internet provision by local councils, community centres, libraries, schools, and so on.

Smart kiosks and benches are the products of technologies and provisions with a long cultural and social past and the emergence of new technologies and social expectations. In this way, smart kiosks recombine the universal provision of public phone facilities (in the UK under the ‘Universal Service Obligations’, see Ofcom, 2005) and the long history of public advertising hoardings (Koeck and Warnaby, 2014; Stamp, 2014) with newer technologies and services such as digital directory and mapping services, broadband and 5G. Similarly, smart benches recombine the provision, affordances and cultural understandings of public benches (Kärholm, 2007)



with new technologies and sensors allowing Wi-Fi connection and the collection of a range of technical and environmental data.

Recent and current developments include smart kiosks and benches. For example, InLinkUK, the joint venture between Intersection, a US company with minority investor Sidewalk Labs, which is owned by Alphabet Inc., Primesight (now Global), a UK advertising agency and British Telecom (BT) formed in 2017¹. It sought to install smart kiosks to replace over 1,000 pay phones in major cities across the UK with an aim to ‘help to connect and improve local streets in urban areas’². As of March 2020, these kiosks, ‘InLinks’, have been deployed across major UK cities to create a national network of 487 active kiosks. InLinks are considered to be fixed and permanent infrastructures and therefore, according to UK planning laws, each of the kiosks requires full planning approval before being installed. An example of benches are those made by Strawberry Energy, a Serbian crowd-funded start-up company with a mission to develop solar-powered smart urban furniture for smart and sustainable cities around the world. The company was set up in 2011 and launched its first UK smart bench in 2015. It has now rolled out smart benches in 30 cities across 17 countries. As temporary street furniture (i.e. they can be removed or relocated by the company), smart benches are not subject to the same planning regulations as kiosks, and require only a licensing agreement which is negotiated with the relevant local authority. These two types of smart street furniture were developed, deployed and maintained by private companies, albeit in very different ways.

The potential of smart kiosks and benches is being considered by local authorities and industry developers within the broader remit of some city-wide digital strategies (Shelton, Zook and Wiig, 2015). New types of street furniture are also rolled out as part of planned street upgrades and initiatives (Dowling, McGuirk and Gillon, 2019). Local governments have promoted free public Wi-Fi to establish internet connectivity in urban centres. Wi-Fi is increasingly important for consumers’ city centre experience, and is also important for low-income individuals who rely heavily on mobile phones, such as people who are homeless (Humphry, 2014; Humphry and Pihl, 2016), some young people (Lambert, McQuire and Papastergiadis, 2013) and low-income households that lack home broadband (Mossberger, Tolbert and Franko, 2012).

Smart street furniture is envisaged as a way to improve digital connectivity – and therefore participation – and access to free public Wi-Fi. There are a number of questions in terms of access, such as how the ‘public’ in public Wi-Fi should be defined (Middleton, Clement and Longford, 2006); how designers envisage the end users of smart street furniture, and the governance of data through interactions with these technologies. In broad terms, attention to the ways in which these smart street devices fit into existing urban landscapes, public behaviour, commercial priorities and governance processes is needed (Joss, 2018).

1. Since this research was conducted, the InLinkUK joint venture has dissolved and the InLinks are now fully owned by BT, an arrangement that was announced in late December 2019.
2. InLink Product Statement V3.0, May 2019, p.4.

Conceptualising smart kiosks and benches

The presenting problematique

Smart kiosks and smart benches are multi-functional, combining different aspects of street furniture, communication services, data connectivity, public information and advertising in new ways. The recombining of artefacts, communication and information provision with digital infrastructures and data services creates new forms of street furniture. This raises questions about how best to approach and understand the challenges and opportunities they raise. To address this, the project used the concept of recombinant or recombining technologies, and applied this to our examination across the three dimensions of the design, usability, and governance of new types of street furniture.

The concept of recombinant and the value of its use

Understanding smart benches and kiosks requires research to consider the artefacts, practices and social arrangements of these innovations. This approach sees technologies as being socially shaped, in which technology is defined as ‘...a set of physical objects, human activities, and knowledge’ (MacKenzie and Wajcman, 1985, p.3). In terms of innovations, this refers to the ways in which technologies are developed – and take particular shapes – by technology companies and research organisations that are informed by market trends and social needs. These developments are further shaped by organisational users, whether public or private, and then end users as individuals, families, groups and communities further adapt and shape the technology through use (Karasti and Syrjänen, 2004; Humphry, 2019). To understand smart kiosks and benches there is therefore a need to examine their material and digital design, how people actually use them, and the knowledge that providers have of end users’ needs.

A key feature of smart technologies, as well as previous digital innovations, is that they involve recombination which, as Lievrouw and Livingstone (2006) write, is the ‘continuous hybridization of both existing technologies and innovations in

interconnected technical and institutional networks' (p.23). They argue that what we see in new media, and what we argue one sees in smart innovations, is that they involve recombinations of material and digital technologies, communication, social practices and social, cultural and economic institutions. Smart innovations can be seen as part of an ongoing cycle of human action and available technical and cultural resources, which means that digital, material and data systems are continuously being 'renewed'. They are usually created with particular purposes or uses in mind and they are also adopted and used in unanticipated ways; they can be reconfigured, resisted, adapted, or ignored.

This process of formal recombination in terms of product and service development, and informal recombination in terms of actual end use, creates a sense of novelty and discovery associated with the design and use of smart devices and services. New features and options are introduced into existing or revised digital and material forms that may elaborate on or extend existing functions in new and unfamiliar ways. There is a process in which established functionality, purpose and design are appropriated, refashioned or absorbed into new developments and forms, therefore simultaneously shaping the new and reshaping the familiar (Bolter and Grusin, 2000).

Smart innovations are products of the continuous recombination and hybridization of existing as well as new technologies, and they often involve new types of interconnection within social and institutional networks. Seen from this perspective, smart kiosks and benches involve material and digital innovations which are influenced by technological and social contexts. They may involve new kinds of public/private partnerships and infrastructural arrangements. They may have unintended as well as intended usage and consequences and, to a great extent, smart kiosks and benches are the result of human actions and decisions (Lievrouw and Livingstone, 2006). This viewpoint recognises that the development of smart kiosks and benches is social, which also opens up opportunities for publics, local authorities and service providers to shape further developments. The concept of recombining helps policy makers, planners and practitioners to think through the development, implementation and usage of smart kiosks and benches, as well as other smart innovations that stem from lessons learned from these recombinations of prior urban forms.

Methodology

The project adopted a mixed methods research design in order to better understand the different processes underlying the adoption and installation of smart benches and kiosks in specific localities. The research design aimed to capture the perceptions that passers-by and users had of smart benches and kiosks in public spaces, the imaginaries that they attached to them, and their usages (or lack thereof) of the devices. The research design was composed of street vox pops with passers-by and users, semi-structured interviews with stakeholders, site observations, and document analysis. The research was approved by the College of Social Sciences Research Ethics Committee at the University of Glasgow (Application Number: 400180241).

Sampling

The project focused on two types of smart street furniture in two UK cities, to empirically investigate the social, design, and governance implications of the emergence of smart street furniture in cities. We decided to focus on InLink kiosks in Glasgow and Strawberry Energy smart benches in London. This selection was made in order to develop an understanding of the different combinations taking shape through the incorporation of new technologies and services, and to explore and compare the ways in which people encountered, perceived and interacted with these new types of smart street furniture in existing urban landscapes. The sample consisted of three InLink kiosks in Glasgow and three Strawberry Energy smart benches in London.

Sample: locations

The three InLink kiosks were located in Glasgow's city centre. The first one was located on Sauchiehall Street, a busy pedestrianised shopping street with a range of high street retailers, food stores and other commercial outlets, including Pret a Manger, Poundland, Bank of Scotland, Burger King, Three (a telecommunications and internet service provider) and an Italian restaurant. The second kiosk chosen was located at the lower end of Buchanan Street, a pedestrianised street with an upmarket range of shops and a high footfall. The kiosk was near St Enoch Subway Station, the main train terminus, Central Station, and commercial outlets including HSBC, Zara, Hermes, Frasers and the high-end St Enoch shopping mall. The third kiosk selected was located at the intersection of Bothwell Street and Hope Street, in an area of the city populated with a number of office buildings, takeaways and restaurants. The kiosk was in the vicinity of Central Station, as well as a number of bus connection points.

The three Strawberry Energy smart benches were in the Borough of Southwark, in South London. The first was located on a tributary street of a main road used by commuters, directly adjacent to the arch of a railway bridge. The side street included various small independent shops and eateries. The second bench was set back from a main road in a small precinct of a former Royal Mail sorting office. The site was surrounded by offices, and was directly outside the entrance of a small supermarket. The third bench sat at the intersection of two busy roads, close to a minor entrance to a university campus building and within 100 metres of an InLink kiosk.

Sample: Smart kiosks and benches

InLink kiosks, referred to as 'InLinks' or more generically as 'smart kiosks', offer users free access to a fast Wi-Fi connection, a phone facility, two rapid-charging USB ports, an emergency 999 call button and a range of mapping and directory services via their built-in touchscreen tablet. The InLinkUK network is funded through advertising on the devices' two 135.7cm HD digital screens. InLinks have in-built sensors that monitor air quality and have the potential ability to gather real-time data, such as pedestrian counts and traffic measurements, air quality and other environmental factors.³ They have three in-built cameras (two in the digital displays and one in the tablet) that are not activated.⁴



Figure 1

InLink kiosk on the pavement at the corner of Bothwell Street and Hope Street in Glasgow.



Figure 2

InLink touchpad tablet and screen.

3. InLink Product Statement V3.0, May 2019, pp.24-25

4. InLink Product Statement V3.0, May 2019, p.9

The Strawberry Energy smart benches came in two designs, both of which consisted of a seat to sit on, free Wi-Fi and USB charging facilities. These were solar-powered and equipped with environmental sensors designed to collect real-time data about air pollution, noise level and temperature, which was made available to users via a free mobile app. They had the ability to provide local authorities with real-time data about the benches' usage via a dashboard.



Figure 3
Second generation smart bench in Southwark, South London.

Figure 4
Researchers with first generation smart bench in Southwark, South London.



Methods

Site observations

The observations were designed to gain insights into interactions, practices and types of usage and non-usage of the smart street furniture, as well as how the kiosks' and benches' designs fitted into their street context. Our observations focused on the local context in which a kiosk or bench was embedded (e.g. its surroundings, nearby transport facilities, commercial and retail buildings), to gain initial impressions of the place (e.g. type of passers-by, rhythms of use, noise levels, busy/quiet times), and whether passers-by noticed the smart furniture, whether they used them and, if so, how long they spent and what they used them to do.

Site observations were carried out by the research team at all six locations on two weekdays and one weekend day in the morning, around lunchtime and late afternoon. The devices were observed for a period of 30 minutes before conducting each of the vox pops. Passers-by and users were notified that observations were being carried out via a portable sign board. As part of their observations, the research team tested and recorded the different features of the smart kiosks and benches, including registration, obtaining Wi-Fi access, USB charging ports, information services and access to environmental data via the mobile app for the Strawberry Energy bench, and calls to advertised support telephone numbers.

Street vox pops

The vox pops were designed to capture the awareness of smart street furniture in specific locations by people who were in one of the sample locations at the time, their perceptions of this new type of furniture and of their benefits and disadvantages, as well as their uses (or lack thereof). Each vox pop session was conducted in the vicinity of one smart bench or kiosk. They began by asking passers-by if they had noticed the kiosks and benches in the city and what their first impressions were of the devices. Vox pops were then structured around more specific questions about the devices' functionalities, their (perceived) advantages and disadvantages and uses, as well as perceptions of data usage and collection in public spaces more generally.

In total we conducted 75 short street vox pops with members of the public (30 in Glasgow and 45 in London). The sampling of the vox pops was significantly dependent on people walking by and/or using the smart kiosks and benches when and where we were conducting fieldwork. Through this opportunistic sampling we spoke to professionals, students, families, tourists, gig economy workers, older people and vulnerable groups such as people who were homeless.

Semi-structured interviews and document analysis

The interviews sought to gain insights into the design and implementation of the smart benches and kiosks and their relationship to systems of governance, as well as the providers' and partners' aims and ambitions for the smart street furniture, and expressions of concern in regards to any of these aspects. To understand the discourse about vision, implementation and planning, a document analysis of InLinkUK and Strawberry Energy's publicly-available documents was undertaken. These included documents such as privacy policies, terms of use, device specifications, press kits and blog posts, as well as audio-visual and written material amassed on their websites. The interviews and document analysis focused on the following themes: 1) the vision and strategy behind the adoption and installation of smart street furniture; 2) usage, perceived users, and perceived benefits and disadvantages; 3) transparency about data collection and use; and 4) future applications. Interviews were conducted with representatives from a London-based data privacy activist, a community group in Glasgow, the smart bench company, and city authorities involved in

implementing smart city initiatives. In addition, a pre-fieldwork discussion was held with one representative from the smart kiosk company.

Data analysis

We used qualitative data analysis software (QSR NVivo version 11) to collaboratively code the data in two stages, in a process that enabled us to iteratively develop a coherent coding scheme across all datasets. For the first stage, the coding scheme was based on a discussion of findings from the literature review and driven by the project's aim and research questions. This produced a set of nine top-level themes (Accessibility, Data, Design, Environment, Governance and Planning, Perceptions, Times, Use, and User) as topics for us to explore. To code data in the first stage, we divided all data equally among the team members, ensuring that each analyst coded a range of data types across each of the research sites. Each team member openly coded their allocated data thematically, in line with the nine top-level themes, within a standalone NVivo project. For this, each team member used a matching NVivo project template. As each team member coded their data, they added new codes beneath the nine top-level codes and noted any deviance from them.

The coding itself involved a process of 'dual coding' (Hanchard and Merrington, 2018), which involved coding data both descriptively and analytically. For example, under the top-level 'Use' code, team members added descriptive codes such as 'Use [for charging facility]' and 'Use [for Wi-Fi]'. At the same time, we added analytical codes such as '*Potentially used without knowing*'. Once all the data had been coded in this way, we merged the standalone NVivo projects into a single file and discussed all new codes and deviations from the first stage coding scheme.

In our second stage of coding, we finalised the coding scheme through a team workshop and ongoing collaborative discussion. This involved merging duplicate codes, deleting unused ones, discussing new ones, and revisiting the data to recode it to the updated scheme. Throughout this two-stage process, we developed our coding scheme collaboratively and iteratively, adapting it to emerging patterns in the data. Once the data had been coded, we used various data exploration and visualisation tools within the NVivo environment to develop a conceptual understanding of the coding, to build theory and to open areas of discussion. This latter stage of exploring and discussing the coded data holistically as a team informed our ongoing analysis.



Findings:

Perceptions and use of smart kiosks and benches: visions of recombination and recombination in practice

The study found that the multi-functionality of the kiosks and benches means that to assess their use requires addressing the perceptions that people have about these objects and their usage in relation to the particular combinations of their features and affordances. People combined perceptions about these benches and kiosks with imagined ways to use them and who they might be useful for on the one hand, and through their actual use shaped by perceptions of their function on the other hand. This included their more visible aspects, such as an advertising board or a seat, and their less visible aspects, such as Wi-Fi connection and the use of environmental data. It also included some details that were not immediately evident, such as the phone, charging facilities and public information tablet facility.

From the perspective of users and passers-by

Public discovery and perceptions of smart kiosks and benches

Smart benches and kiosks involve an element of discovery – how people work out what a new kiosk or bench is, what it does and how it might be used. Many people who took part in the vox pops were not aware of the smart kiosks and benches prior to our interviewing them and may not have registered their existence. Neither were people fully aware of the functionalities they offered. In many situations, participants were discovering the kiosks or benches for the first time during the vox pops, as shown below. When this was the case, people were prompted to infer the functionalities and purposes of the type of smart street furniture that they were encountering.

Interviewer: *Have you noticed these InLink points in the city before?*

Respondent: *Er no, I haven't... what's it for? Is it to make free calls [laughs] to anywhere in the UK?... I just thought it was like an advertising board, I guess! [laughs] Um what is it for? Just that I guess?... I would think bus times, it kind of looks like a bus timetable but I don't know! [laughs]*

(Vox pop, Glasgow)

Interviewer: *Have you noticed this bench before, or are you passing by for the first time?*

Respondent: *Not really. I've passed a few times but didn't notice it... It's more interesting than a regular bench, for sure. But it's quite small and looks similar, I think I've seen similar benches trying to do a similar sort of thing... you can charge your phone and it serves Wi-Fi, it looks like.*

(Vox pop, London)

While some functionalities, in particular the devices' charging facilities, were easily identified by passers-by, other facilities and features, such as the kiosks' touchscreen tablet and emergency 999 call button, and the benches' cables interface and solar panel, remained more elusive.

Some vox pop participants in Glasgow and London reported having noticed the smart benches and kiosks and were aware of their functionalities. This awareness had come from observing other people using them, either charging their phones via the benches' USB charging facilities or cables provided, or using the kiosks' phone facility. With the exception of participants who had seen someone using the kiosks or benches or those who had used them – mostly to charge their mobile devices – we encountered a lack of awareness or indifference to this type of street furniture from members of the public. As one participant in Glasgow explained:

I've seen them [smart kiosks] at some other places throughout the city centre but I haven't really paid it much attention. They're not new, you know, they're not new for me, I have seen these... pretty much indifferent, to be honest.

(Vox pop, Glasgow)

Smart kiosks in Glasgow were often passed unnoticed, as highlighted above, and were repeatedly described as 'advertising boards' by the passers-by we interviewed. Some thought that the smart kiosks' design was 'okay' and fitted into the urban landscape, while others characterised them as 'big', 'clunky' and 'austere'.

Yeah it's good, well it looks good from a distance down here, it doesn't look too alien in the street, and I guess this building here's not particularly a planning permission street so it's not really impeaching on any kind of heritage, it's kind of modern against modern against modern, so you're kind of, you're all right there in that kind of sense. That's the only kind of thing I care about with city planning is whether it would ruin a, you know, heritage kind of area.

(Vox pop, Glasgow)

While opinions on the design of the smart kiosks varied, one common element that emerged from the vox pops was the lack of signage about the functionalities on the kiosks' public interface.

I guess the only thing about the design maybe is that, you know, there's no indication at all on it, from what I can see, that it is a Wi-Fi spot or anything like that. So it is not evident, looking at it.

(Vox pop, Glasgow)

Smart benches in London were described by passers-by and users as clean and well-maintained, convenient and comfortable.

...it's nice, it looks nice and clean... I mean, obviously they are new and it's just needing to be maintained well. But yeah, I mean usually you see the public benches, they are not that clean, you know, very old. But it looks nice and fresh, very clean, yeah.

(Vox pop, London)

Overall, the people who answered our questions were positive about the placement of smart kiosks in Glasgow, located in the central shopping and commercial areas of the city which have a high footfall and are close to the main transport hubs.

It's quite good [location for smart kiosks], it's a little bit out of the way from the path, I'm guessing it's mostly for tourists and stuff like that, so um it's quite good, it's in busy places, there's a lot of people going back and forth.

(Vox pop, Glasgow)

People had differing opinions on the design and purpose of the smart benches in London, which were seen by some as places to sit, rest and relax, as well as spaces to access free Wi-Fi and charging facilities. People's views on their locations were more mixed than those on the smart kiosks in Glasgow. Some people thought that this new type of bench should be more of a feature in parks, as shown in this excerpt:

I feel probably in parks and stuff like that it would probably be a better idea. Um but on this other street's good as well, for people who are just passing by and need to charge up, but like parks and stuff like that, they might fit into the environment a bit more because, maybe, this is a really busy road, it's not the nicest of places to sit, to be honest, and wait for your phone to charge.

(Vox pop, London)

The smart benches and kiosks fed into a sense of the public realm and publicness. The fact that they were free to use and accessible to everyone supported a sense that the in-built services were part of a broader public provision, therefore they were perceived as a useful addition to the street landscape. The people we interviewed often mentioned other publics who could benefit from this type of smart street furniture, such as tourists, students and more vulnerable groups who do not have continuous access to the internet or charging facilities.

My first thought was um the individuals who are homeless need to have access to being able to call resources. It's great, I mean it will charge their phones, they don't always have access to power. So just that alone is a huge help.

(Vox pop, Glasgow)

Well it's my first time to sit here. I still didn't get quite close like here but what I can realise here is that it's the free Wi-Fi along with the charger, which is something really perfect. So, you know, I know so many people here who don't have, like Wi-Fi on their phone outside, they only rely on the Wi-Fi inside the home, so it's a really good thing, especially for people who live, like away from their home.

(Vox pop, London)

Some people explained that the smart kiosks generated a sense of feeling safe in relation to the provision of an emergency 999 call button and charging facility. This was also discussed in the context of people running out of battery charge on their mobile phone and experiencing an emergency of some sort, in particular at nighttime.

I would use it, probably for if I ran out of juice or, as I said, if I was feeling vulnerable, if I was walking here maybe on my own at nighttime and I felt um I wasn't quite safe then yeah, I probably would use it. Especially if my mobile phone wasn't charged.

(Vox pop, Glasgow)

While the majority of people we interviewed in our vox pops did not have direct experience of using the kiosks or benches, they said that they had no objections to using them 'in principle'. This was particularly true for people who reported relying quite heavily on their mobile phones for work, such as freelancers and those employed in the gig economy.

I need to have my phone constantly on because of work so if my phone was nearly dead I would use it to quickly get some charge in.

(Vox pop, Glasgow)

If you knew that there were these sort of things in London or in other cities you'd think, oh great, I need to do something quickly um, you know, and I would use it actually because I work freelance.

(Vox pop, London)

In a similar way to the sense of safety that some associated with these services, some people considered using the kiosks and benches as a last resort facility, either to charge their phone or, in the case of the kiosks, to make an urgent phone call.

Interviewer: *Would you consider using one of these devices?*

Respondent: *100 percent, yeah.*

Interviewer: *Yeah? In which situation do you think you would consider using them?*

Respondent: *Maybe if I'd run out of data on my phone and needed to phone somebody.*

(Vox pop, Glasgow)

However, our vox pops also captured a range of perceived barriers to use, including the need to have your own cables:

I don't have the cables, because some of them are missing... to charge your phone and it's impossible to charge it! [laughs] I think somebody is coming out taking the cables to be useless, why are you taking it?

(Vox pop, London)

Some members of the public we interviewed perceived Wi-Fi as being unsafe and/or slow, which they saw as an obstacle to using this type of smart street furniture. For example, one participant in London commented:

I generally just don't have a lot of faith in public Wi-Fi actually working, because most of the time it doesn't work or is really slow, so that would be my first reservation.

(Vox pop, London)

A Wi-Fi user in Glasgow explained that it was best to use protected Wi-Fi, although that was not always available:

I'd go down whichever was the safest route because if it's not a protected Wi-Fi then it's not overly safe. I think which is fine if you're on just generic stuff but if you go on to do banking and stuff like that then it's a no!

(Vox pop, Glasgow)

Furthermore, some passers-by explained that they would not consider using smart benches or kiosks as they did not think they were user-friendly, or because they saw themselves as 'not good with technology'. Thus, some people felt that this type of smart street furniture required technical skills and digital literacies which they lacked, or which they expected would be difficult to acquire.

Interviewer: *Would you be comfortable though, using one?*

Respondent: *No.*

Interviewer: *Why not?*

Respondent: *Because I don't know how to operate it, I don't know what it connects to and if I'm going to get any hidden charges or do I need to give any details, etc so it's not very clear how you can use it.*

(Vox pop, Glasgow)

The vox pops in both cities also captured a few failed attempts where members of the public failed to connect to the Wi-Fi using the kiosks and benches, or charge their phones using the cables provided on the benches.

In summary, most of the individuals we interviewed had positive perceptions of smart kiosks and benches, seeing these objects as convenient and accessible. However, this does not mean that the kiosks and benches were used, or that there was widespread awareness of their multiple functions. While some members of the public (users and non-users) raised some concerns about public Wi-Fi safety (see page 27), the majority seemed to welcome the innovation, and the underlying trade-offs of recombining street furniture with digital services to widen internet access and improve digital connectivity. They were, in the main, seen as adding benefits to the public (especially those perceived to be more vulnerable) and amenities to public spaces.

Public uses of smart kiosks and benches

The research found that people used the smart kiosks and benches in multiple ways and for multiple purposes, including making phone calls, phone charging, looking up directions, and/or resting (sitting on one of the benches, resting a bike against one of the smart kiosks, enjoying a lunch break, smoking, or sheltering themselves from the wind). We captured usage by tourists, professionals, students, families, older people, people experiencing homelessness and workers in the gig economy, for example, a deliveroo rider who explained that he made regular use of the kiosks to charge his phone:

Respondent: *I use them when my phone is dying because I work with my phone sometimes, a lot of times it happens to me my phone dies and I forgot my power point at home, so I can use them to back up my charge, yeah.*

Interviewer: *Which ones are the ones that you are using the most often? Is there a specific location that you use?*

Respondent: *Er no just any of them, there is one there when I cycle past I see oh this, this, eight of them so yeah, it's fine. You can go down there use, up there use and like, I don't know, if you go anywhere you can access because there is one er in every location.*

(Vox pop, Glasgow)

To use the kiosk, he leant his bike on it so as to be able to plug in his USB cable to charge his mobile phone, and then proceeded to call someone from his mobile phone. In this example, the worker was able to use the kiosk because he carried his own USB cable with him and had prior knowledge of the kiosk's charging facilities.

Other people using the kiosks were those who looked as though they were sleeping rough, who were seen using the free calling facility offered by the kiosk. They did not have earphones or any audio equipment and, as the kiosk was open to its surroundings, they were forced to talk loudly so that the people they were calling could hear them. As one middle-aged homeless user highlighted, the inclusion of a phone facility in the smart kiosks was beneficial for him as it was free (whereas using pay phones was expensive and involved an unwieldy number of coins). He explained that it allowed him to phone his friends. However, he noted that the drawback of the kiosks in comparison to the former pay phones was that it was not possible to receive calls on them (which is a requirement of job centres and other social welfare services).

As I said, a lot easier to use than the normal public telephone... Well it still costs you money and, as I say, when you use your normal public telephone you've got lots of money constantly. You are putting a pound in, two pound, to make a phone call and you weren't getting through for your call and you actually lost some money to make a public phone call.

(Vox pop, Glasgow)

Further, he explained that he and his friends often made use of the kiosks to contact each other and stay in touch.

The smart benches in Southwark, South London were used primarily as benches – as spaces to sit down, enjoy a break and have lunch or a smoke, as a place to rest and make a phone call (without connecting to the bench) and to wait for people or taxis to arrive. People did not necessarily engage with the added 'smart' functionalities of the bench, just its prior material affordances and form. The smart benches were used (or were perceived as being used) by several different groups, which could create tensions in the sharing of the public space around them. For example, in Southwark, South London, a vox pop participant said:

If for example I was working and I want a break, to sit on, but you can't sit on them because the homeless people are using it most of the time, so you won't be able to make use of the chair, that they lie on it or they don't want anybody to sit, they occupy the whole space.

(Vox pop, London)

This section has described a range of engagements with smart benches in London and kiosks in Glasgow. Public engagement with this new type of street furniture related to both their materiality (e.g. sitting on the benches, using the kiosks as a shelter against the wind) and to the software and hardware embedded in them (e.g. the charging facility, touchscreen tablet, phone facility, Wi-Fi connection). Overall, the section highlighted that different publics used the devices for different purposes. Further, these were often single uses, such as phone charging or making calls. Usage (or lack thereof) was shaped by people's own practices and interactions with smart street furniture but also, and importantly, by the perceptions they had of them and what they imagined were their purposes, functions and features. This indicates some areas for development with regards to perceived use and usefulness of smart street furniture to widen uptake.

Private and public sector perspectives

Opportunities offered by smart street furniture at the local level

Smart kiosks and benches provide access to a range of free facilities including Wi-Fi connection and phone charging to the local population. This in turn can enhance connectivity and internet access to city dwellers. Smart street furniture is being considered by Glasgow⁵ as it develops its digital strategy further and the London Borough of Southwark's⁶ digital strategy, to improve connectivity.

As a provider, InLinkUK strongly communicates about connectivity, arguing that cities and their inhabitants will benefit from the rolling out of their infrastructures and their high-speed free Wi-Fi. They assert that their infrastructure offers not only enhanced connectivity at a local level but also declutters the public realm (by replacing derelict and cumbersome pay phones). However, the kiosks have sparked some concerns about surveillance and privacy infringements,⁷ as well as misuses, such as their reported use for arranging drug sales over the free public phones.⁸ In response to the latter, InLinkUK has rolled out a new call restriction technology which automatically recognises anti-social calls and blocks them.⁹

Strawberry Energy also prioritises connectivity in its promotional material, but widens its remit by developing 'solar powered smart urban furniture for smart and sustainable cities'¹⁰. Strawberry Energy pledges to improve public spaces by not only enhancing citizens' connectivity (via free access to Wi-Fi and charging facilities), but also by providing individuals and local authorities with insights about their localities (via in-built data sensors and a mobile app). The company also commits to sharing insights from real-time data with local stakeholders via a cloud-based dashboard made up of real-time environmental data and bench usage statistics and graphs.

InLinkUK and Strawberry Energy are responsible for the design, installation and maintenance of their infrastructures, which reduces costs for local authorities to a minimum while providing free services. Indeed, smart kiosks are paid for via advertising while smart benches are funded via advertising and sponsorship partnerships (e.g. with Cancer Research UK and motor company Ford)¹². In a context where austerity has severely impacted local authorities' capacity to invest in new infrastructure (Gray and Barford, 2018), the limited costs for this new type of furniture was compelling. However, it was not the only incentive for local authorities to install this type of furniture at the local level.

By participating in smart urban innovations, cities are able to establish a profile and track record for government-funded initiatives, and can leverage these to speed up the delivery of already existing plans and services. Furthermore, this type of smart street furniture may offer opportunities for future development and implementation in the area of real-time, data-driven decision making, to make cities 'smarter, safer and more sustainable'.¹³ For example, smart benches not only address a potential gap in the provision of charging facilities at the local level but also provide new opportunities with regards to the environment and other real-time data collected via the devices. However, such opportunities need to be weighed carefully against a range of considerations and concerns about their impact on the public realm, digital participation, and public provision with regards to connectivity.

5. <https://www.glasgow.gov.uk/CHttpHandler.ashx?id=43572&p=0>

6. <https://www.southwark.gov.uk/housing/housing-getting-involved/better-broadband-for-southwark>

7. <https://news.sky.com/story/new-phone-boxes-spark-privacy-and-surveillance-concerns-11340071>

8. <https://www.standard.co.uk/news/london/smart-phone-boxes-are-a-honeypot-for-drug-dealers-bt-told-a4116226.html>; <https://www.islington.media/news/islington-council-takes-action-to-tackle-anti-social-abuse-of-free-phone-units>

9. <https://newsroom.bt.com/inlinkuk-and-bt-launch-new-technology-to-block-anti-social-calls/>

10. <https://strawberryenergy.com/theCompany.html>

11. <https://medium.com/strawberry-energy/the-worlds-first-network-of-smart-benches-launch-in-london-66618cca40cf>

12. <http://smartbench.london/>

13. <https://futurecity.glasgow.gov.uk/>

Adopting smart street furniture is a learning process for local authorities at both the city and municipality level. Indeed, by adopting the kiosks and benches, in the first phase of development, local authorities can put themselves in a position to assess the extent to which this type of urban furniture can be utilised more widely, as well as the concrete possibilities the devices offer them. To do so, however, stakeholders from the private and public sectors (i.e. companies, various departments in local authorities) need to ensure communication after the initial approval of the smart street furniture and point of implementation, and establish mechanisms to assess and develop these in partnership with private providers and with input from the public.

Licensing and planning smart street furniture

The smart kiosks we surveyed had been installed by InLinkUK after they had obtained full planning authorisation for each of them. These planning applications focused on a range of strict criteria, including the kiosk's location, public safety, pedestrian obstruction, traffic interaction, visual amenity (i.e. digital displays) and built heritage.¹⁴

By contrast, smart benches fell under different planning requirements depending on where they were located (on public or privately-owned land) and whether they were conceived as temporary or fixed structures. Being able to move or relocate smart

benches is a strength, as it can provide leeway to experiment and assess how smart benches address local needs and suit local contexts. In fact, one of the smart benches installed in Southwark had been removed as a result of complaints by local residents with regards to noise and anti-social behaviours. However, the 'temporary' character of smart benches makes it difficult to license them. In our case study this difficulty had only been overcome by drafting and agreeing upon a *Memorandum of Understanding* between Strawberry Energy and the relevant local authorities. However, in a neighbouring London borough, smart benches had to be removed following a planning dispute,¹⁵ illustrating the difficulties underlying the licencing of this type of smart street furniture.

The data components of smart kiosks and benches come under General Data Protection Regulation (GDPR) legislation, which applies to companies in the European Union. This complex layering of legislation, license and planning applications speaks directly to the difficulty of understanding and legislating holistically urban street furniture comprised of a wide array of material and digital communication components.

14. InLink Product Statement V3.0, May 2019, p.3.

15. <https://www.islingtongazette.co.uk/news/firm-that-installed-ill-fated-smart-benches-without-planning-permission-shifts-blame-back-to-islington-council-1-5144967>

Findings:

Working with new combinations of street furniture, data and communication

The smart kiosks and benches combine and recombine street furniture, data and communication in new and differing ways. The kiosks differ in two main ways from the benches: (1) kiosks are designed for standing and benches are designed for sitting; and (2) commercial advertising is seen as a core function of the kiosks, whereas benches have branding surfaces that are mainly used for signposting their partners. This reflects the ethos and overall narratives that underpinned their development (see Background above). Although there are these two main differences in the design and purpose of kiosks and benches, both involve working with recombinations of materials, technologies and functions that need to be understandable to end users, local authorities and service providers, and will fit into existing public spaces and uses.

Fixing and fitting smart kiosks and benches into public spaces: recombining design and use

The placement and recombination of benches and kiosks in public spaces raises questions at functional, social and aesthetic levels. How do you combine the need for accessibility, and for urban flow and places to rest, with enhancing the overall aesthetics of a particular location? How do you achieve a balance between commercial advertising and public information? These questions become more extensive when you take into account different audiences and users and the multiple ways that functions can be recombined with new technologies such as sensors, digital screens, touchscreen tablets and data analytics.

Combining advertising with public information

From the smart furniture providers' point of view, one of the main attractions of the kiosks was their use for selling advertising on the two-sided digital display screens. Commercial advertising on these screens funded the cost of the free public information from councils, charities and local groups provided in the kiosks. This public information is identified by InLinkUK as one of the kiosks' key community contributions, and came in two forms: as free advertising on the digital screens and as service information in apps on the touchpad tablet known as 'tiles'.¹⁶ This advertising offer comprised 876 hours of free council advertising per InLink, a dedicated amount of screen time for local community content and discounted advertising rates for local business groups¹⁷.



Figure 5

InLink touchpad tablet and interface with service and information 'tiles'.

The public information in Glasgow was provided by the local authority, which was responsible for maintaining that information. The advertising had to adhere to advertising regulations and was mainly commercial, advertising brands and events. The private sector media agency partner in the InLinkUK partnership managed the advertising in line with UK marketing regulations. Local authorities determined the number of kiosks allowed through their planning processes, which involved deciding how to balance the number of kiosks without 'cluttering up' the streets, while maintaining the value of their advertising space and, thus, revenue.

In our vox pops in Glasgow we found that a common perception of the purpose of the kiosks was that they were for commercial advertising. Most of those we interviewed were not aware of the public information available on the touchscreen tablets. We also found that some of the information tiles had no content available. The few people who knew about the public information function said that the map might be useful for tourists and visitors to the city. The public information aspect was best known by those who might have been rough sleepers, but for them it was the free phone service that was identified as most crucial:

Just the phone, because I'm homeless... they've saved my bacon a few times, because I'm sitting with you, and I sat in a drugs bust because they wouldnae, I died [taking] street Valium. I was coming off of them and I was three weeks into come off them... The next morning I was away in an ambulance getting the kiss of life and they had to bring me back, I was dead 15 minutes.

(Vox pop, Glasgow)

Others, who were not rough sleepers, also commented on the value of the information services for those in need:

...mostly homeless people, I must admit, but it's good for them, so at least they have access to contacting people that they need to, Social Security and stuff like that...

(Vox pop, Glasgow)

16. InLink Product Statement V3.0, May 2019, p.5

17. InLink Product Statement V3.0, May 2019, p.5

Concerns were raised and suggestions made about the selection of commercial advertising in terms of the public good. The concerns included the preponderance of adverts for alcohol and fast food, which were seen as being detrimental to health. The suggestions included giving more advertising space to community projects, events and volunteering, to encourage civic engagement:

Use the screen for educational purposes... stop with the commercials and get people into thinking about other stuff like, for example, poverty. The ads about eating hundreds of types of cereal, which really makes me feel sick, to be honest with you while I know there are many, many hungry children in the world...

(Vox pop, Glasgow)

In the case of the smart benches, advertising was not a feature at the time of our study. The benches made their partner information visible with logos of their stakeholders on the branding spaces of the material bench but did not display product advertisements or public information. Data about the environment was accessible via a downloadable mobile app but, as we discuss below, this was not known by the people we spoke to and, furthermore, produced some erroneous readings.

A key challenge, therefore, in combining public information with commercial advertising, as in the case of the kiosks, is achieving a balance between public information and commercial advertising. Another challenge is communicating the availability of information services to the public and making these relevant and easily discoverable, as well as keeping information current and up to date.

In addition to the type of information advertised is the matter of how much advertising in public space is reasonable or desirable. This is a particular issue for people in cities being saturated by advertising, and for the advertising regulators, as well as commercially in maintaining the value of advertising space.

Combining phone, Wi-Fi and charging facilities

People worked out how they want to use the kiosks and benches, selecting which features to use, and in what combination. This was shaped by the social and technological resources and capacities that individuals had access to at the time. For example, to make use of the charging facilities required knowledge of this function, possession of a mobile phone and the foresight to bring a charging cable. To use the Wi-Fi a user must understand how to sign up for the service, and to access the information on the kiosk's built-in tablet or the benches' mobile app, a user must be familiar with a touchscreen or dashboard interface.

Rough sleepers used the kiosk telephone service and charging facilities on the kiosks and the benches. One rough sleeper explained that he needed the free phone to keep in touch with his friends and family, describing how he had found out that the free phone service was accessible through the touchscreen tablet in the InLinks, having first noticed this when he saw people charging their phones. His first impression of the kiosk was *'What the hell is that?'*. However, once he started to use it, he found it easy to use: *'Aye, I have used it, very self-explanatory'*. He explained that: *'It says welcome, touch it and then it comes up with a list of all the things you can, all the apps you know, as well. If you take left it's free codes'*. His discovery not only involved learning how to use it but also how to carve out a space on the street corner within sight of a kiosk and implement a daily routine so that he could phone his brother when the street was empty of daytime shoppers.

Difficulties in using the kiosks included their lack of anywhere to sit or physical privacy whilst making a call, charging devices, accessing the internet or using the touchscreen tablet. To address these shortcomings, people developed a range of practices to work around and improvise in use, such as sitting on their backpacks or the ground, edging in close to the tablet during phone calls, and leaning into the kiosks to create a sense of privacy (Figure 6). These end users carved out a space to sit by combining and recombining resources – pavements, street corners and their bags, with the free calls and charging facilities – to meet their individual essential requirements.



Figure 6
A smart kiosk in use.

One of the challenges in combining phone, Wi-Fi and charging facilities is how these can be provided in ways that allow for both movement through public spaces and places to rest. There is also a need to clearly signpost the various functionalities so that people can easily identify what a kiosk or bench does and how to use it. Despite these limitations, the end users we encountered were very resourceful at adapting the design in practice.

Combining existing and new forms of public urban spaces

Social and political values have informed research and development in the area of design, producing ideas and knowledge about universal design and design for all. The underlying principle of these approaches is that buildings, products or environments should be accessible for everyone, regardless of age, disability or other factors. Although there are a number of schools of thought and approaches, there is broad agreement that design should support equitable and flexible use, that design should be simple and intuitive and that information should be easy to understand, while the physical effort required to use the design should be low. The spaces for use should be appropriate to the size of a design and should be fully accessible. These design principles are used in both digital and material design and, indeed, come together in digitally-enabled devices of all kinds.

The InLink kiosks' design is based on the principles of accessibility and universal design. This is seen in the height of the tablet interface (at 121cm), in the 'easy touch' red panic button and in the overall placing of the kiosks to give sufficient space for wheelchair access. They also have braille-embossed information, TalkBack, hearing induction loops, Next Generation Text Relay, and high-contrast large labels. The combination of a large two-sided screen for advertising with free public phone, information and charging facilities, however, impacts on the ease of use. The terminal services accessed through the touchscreen tablet are fitted into the narrow side of the kiosk, which is easy to miss, less comfortable to access, less intuitive and, as participants reported and we observed, does not offer privacy. Here we see that the design tensions of recombining elements – also noted in terms of the blurring of the advertising and public information functionality – extends to the quality of the experience of using the phone, free Wi-Fi and charger. This is further complicated by the lack of public awareness of some or all of the separate functions and services, as we found that very few people had noticed the Wi-Fi sign until it was pointed out to them.

Interviewer: *You weren't aware of any services on this at all?*

Respondent: *No, I just thought it was advertising.*

Interviewer: *So what are your thoughts on the design of it, and how they look?*

Respondent: *Er yeah, it's fine. I've no, I'm neither up nor down about it, I think it's alright, yeah... I suppose they're in a good busy spot, it doesn't bother me the height or anything like that but I guess the only thing about the design maybe is that, you know, there's no indication at all on it, from what I can see, that it is a Wi-Fi spot or anything like that. So it is not evident, looking at it.*

(Vox pop, Glasgow)

The appropriation of the space around the kiosks and benches suggested that the placement of these objects in public spaces invites a range of interactions and combinatory practices. In the case of the kiosks, children ran around them, playing hide and seek and peek-a-boo with their parents. As previously mentioned, people leant against the kiosks to create privacy, to smoke and rest, or used them as a meeting point. The benches facilitated a more familiar set of practices that have long accompanied the function of a bench – sitting, eating, observing, reading, talking with others, as a meeting place, and the more recent practice of using their mobile phone. Like some other bench designs that discourage long-term use and 'staying in place' (Deslandes and Humphry, 2017), the Strawberry Energy bench is designed for sitting on, rather than lying down. A metal bar divides the bench midway across its length in both generational designs. In terms of added functionality in the smart bench, vox pop respondents used the Wi-Fi and charging functions and the overhead solar panel to shelter from rain or sunshine. These different practices relate to the ways in which public spaces combine the requirements of moving through space, as well as providing places to rest and repose.

The fitting and fixing of benches and kiosks in public spaces has generated questions about how these objects, which take up space and require regular maintenance, combine with local contexts and the look and feel of particular hyper-local spaces – or 'spots'. Some of our interviewees expressed concerns about the ways in which public spaces are being 'cluttered' and taken up by advertising. For instance, the community activist said:

... InLink really, it's that it's based around advertising. That's the funding model; that's the business model – and to make the advertising work you want to put the advertising screens in the most visible position, and unfortunately this conflicts with everything that you want to do in urban design to make a decent street. So you've got issues around aesthetics, issues around safety... you can probably go too far with decluttering [laughs] and have a naked public space. But in terms of, yeah, there is a lot of clutter on the streets and it impedes people's movements and it's unaesthetic and these kind of things.

(Interview with activist)

The local authorities and the private sector providers for the kiosks in Glasgow were aware of these issues, and their response has been to make decisions about their placement through the planning process. The London smart benches, however, were subject to licensing through the Highways Act, hence there was more flexibility with their placement in public spaces.

The kiosks were fitted into public spaces with consideration to the advertising requirements and the revenue this brings to InLinkUK, which covers the cost of installation, the Wi-Fi, free calls and public information services. The kiosks we focused on were placed in fairly wide shopping streets, and two were sited near transport hubs: a subway/underground station and a central railway station. These spaces are main routes through the city, two were in pedestrian areas and the other was in an area used by both pedestrians and traffic. One place had benches and dustbins nearby, so people could also sit in that space, discard their rubbish conveniently, and use the Wi-Fi more comfortably. The kiosks are vertically oriented, narrow and tall, making the advertising highly visible. Cleaning and maintaining the kiosks was factored into the provider's contracts.

From a planning perspective, this configuration enabled pedestrian flow, whilst still allowing advertisements to be seen. However, people on the street, like those who participated in our vox pops, did not notice the kiosks, but simply moved past them. Even those sat on public benches near them did not especially notice them. When we pointed out kiosks to our respondents, they commented that the kiosks were not too intrusive, for instance, describing them as ‘...*reasonably discrete without being obscure*’, but on the whole they were ambivalent about them. In terms of fitting and fixing kiosks into the public space, the majority of end users did not combine and recombine their activities in relation to them, but instead passed by or sat on a nearby bench in their habitual ways.

The benches, which were situated outside transport hubs and on main commuter walking routes, had a different dynamic. They were located in precincts or set back from main roads, being located on tributaries that intersected with them. From a planning point of view, the placement of benches slightly away from main routes, and their lower, horizontal shape meant that these were often overlooked, as a taken-for-granted feature of the urban landscape. Many vox pop participants moved past and around the smart benches, on their way elsewhere. However, the benches were sometimes a destination in themselves, being used as places to sit while eating lunch or to congregate with friends.

Every Wednesday I sit down and have a cigarette, and a drink and, if I need to, I plug in my phone... it's near the bus stop, near where I get off.

(Vox pop, London)

With heavier use the researchers observed that both the kiosks and benches tended to accumulate detritus such as cigarette butts and broken bottles. The kiosks and benches were also fitted and fixed into the public space in less visible ways, such as connecting to the Wi-Fi network and collecting air quality, temperature and environmental data from in-built sensors. Some of the vox pop participants knowingly connected to the Wi-Fi around the kiosks. However, their replies indicated that some users had made connections without being aware of doing so. Here the combining of multiple functions, some of which were not visible to the user, and the lack of clear signage, created ambiguity about when people were connected and what services they were using.

Recombining street furniture and data

The emergence of smart street furniture in UK cities raises questions about the recombining of street furniture in public spaces with technologies that may enable data extraction, sharing and analysis. This section discusses the findings of our research in relation to these issues, in consideration of existing regulatory and governance frameworks, private and public partnerships, the development of new technologies, and public expectations and practices of data uses.

Smart kiosks and benches: data issues and data policies

The service providers and local authorities involved complied with GDPR in their running of the kiosks and benches. Providing Wi-Fi in public spaces entails understanding how end users – people in the street – can be made aware of data and Wi-Fi connectivity when using smart street furniture, and the associated personal and social implications. One area to address here is how data principles interact with end user understandings of public Wi-Fi and the management and use of their device and personal information.

On their former website, prior to the dissolving of the InLinkUK joint venture, the emphasis was on the need for a new infrastructure of ‘connectivity through ultrafast, free public Wi-Fi’. The InLinkUK Privacy Notice explains that the types of data that may be collected, used, stored and transferred includes identity data, contact data, services data, technical data and anonymised information¹⁹. InLinkUK provides an option for accessing BT-encrypted networks, but this is limited to Apple devices running on iOS10 or higher that is enabled with Hotspot 2.0 technology. The InLinks contain other potential services that are not yet being utilised, such as integral cameras and ‘smart city sensors’, as mentioned on page 9.²⁰

On its website, Strawberry Energy focuses on its goal to capitalise on the collection, then access and (re)use of granular, real-time environmental data by citizens and local authorities, to improve cities and make them more sustainable, as outlined on page 5. The reliability of this data is important. Some of the researchers found that the online dashboard for two of the benches showed the local temperature to be 10 degrees centigrade lower than the Meteorological Office reading for the same location, raising questions about the reliability of the data.

The benches also provide users with a 4G Wi-Fi connection. They offer various options for people to login to their network via a mobile app, which entails a basic registration via their email or Facebook account, or as a guest (skip login). The latter does not allow users to rate benches or suggest new bench locations, which the other options do. Strawberry Energy’s privacy policy highlights a limited collection of users’ data, including location data when logged in, and the use of personal data such as email address to communicate new services provided by the company. They commit not to sell or share personal data with any third party.²¹

Public uses and perceptions of data in smart street furniture

The research found evidence that the passers-by and users in this study lacked knowledge about what data was being collected through smart kiosks and benches, or how it would be used and shared. For example, when asked whether he was using the public Wi-Fi, a passer-by in Glasgow answered:

I might be, or I might be on data, it depends because sometimes if I’m passing by and it’s a Wi-Fi thing that I don’t know and hasn’t logged me in, I’ll just have the data instead so that I can get any messages or whatever.

(Vox pop, Glasgow)

19. InLinkUK Privacy Notice, 26 May, 2018, p. 2-3

20. InLink Product Statement V3.0, May 2019, p.5

21. <https://strawberryenergy.com/app/v0/toc/>



Figure 7
Strawberry Energy smart bench visual branding.

Figure 8
InLink kiosk visual branding.



People were not always aware when they were connected with a public Wi-Fi network such as InLinks. This may be compounded because, once registered to use the Wi-Fi service, even if the terms of service have been supplied and read over, data extractions and flows are mostly invisible to users and often continue to operate indefinitely after obtaining one-off consent. In this sense, it was not just the Wi-Fi usage that was imperceptible, but also the recombination of the street furniture

with wireless internet access. As a result, this may have further reinforced people's perception that the kiosks' purpose was to act as a digital screen for advertising. While similar dynamics were at play with the smart benches, their other data services were made more visible through their signage (Figure 7). The Wi-Fi signage of the smart kiosks was not as prominent (Figure 8), which might partly explain the disconnect between the public's usage of the InLinkUK Wi-Fi and the kiosk itself.

When prompted, most of the passers-by and users interviewed by the research team had low levels of concern about data collection and privacy protections in relation to smart kiosks and benches. Often, interviewees expressed a sense of resignation to data extraction via these new types of furniture. For example, one passer-by in Glasgow explained: *'I'm quite cavalier about it, I'll connect to any network that will let me in, and I know that it's taking data from me but I don't think about it too much'*. Similarly, a passer-by in London with no prior experience of using the smart benches expressed no concern about data security or going onto a public Wi-Fi network: *'I assume there's a consent thing and I assume that it tells you what it does and doesn't use your data for and you can make your decision'*. However, some respondents expressed more specific concerns with relation to how their data was being used:

Interviewer: *And finally, do you have any worries or thoughts around data collection when you are using public Wi-Fi or when you're using public Wi-Fi through the kiosk?*

Respondent: *The only concern is how they use the data... What is it being used for? Is it being used for marketing purposes, is it being used for safety, security, what is it being used for? So these are the only concerns I have.*

(Vox pop, Glasgow)

Finally, some respondents were concerned about the use of public Wi-Fi in general. For example, one participant from London explained it as: *'just like all these privacy things you hear about going on. Like I say, I've got the data, I might as well just play it safe'*, while another respondent in Glasgow expressed concerns about whether the kiosks were securely managed more broadly.

Trust that data protection assurances would be adhered to was a prominent feature of people's perceptions and practices around data. Some participants assumed and trusted that the local authorities of the place where smart kiosks and benches were deployed would strictly ensure data security and compliance with the relevant regulation (GDPR). One passer-by pointed out: *'to be honest I don't have time to worry about those kinds of things, you know. If somebody's going to give me free Wi-Fi, and if I need to make a phone call, I'm just going to trust that the powers-that-be that run Glasgow wouldn't allow anything that wasn't safe'*.

Another important finding is that a substantial number of people we talked to in Glasgow and London perceived the free public Wi-Fi offered by smart benches and kiosks as beneficial for other members of the public, including tourists, students and homeless people, but not necessarily for them. The smart street furniture was identified as an important resource and essential provision for those who are heavily reliant on smartphones but who have limited access to, and difficulties affording, sufficient data allowances on their mobile plans.

Emerging governance of combining urban street furniture and data services

For local authorities, streamlined and responsive decision-making based on real-time urban data is one of the key promises of 'smart cities'. Smart street furniture may provide an avenue for realising these aspirations, however their emergence raises critical questions about their governance, including decisions about their appearance, purpose, location and maintenance, what data they collect and use, and their funding and partnership arrangements. Urban planning and licensing procedures focus on the physical object, its location in the district and on the street, its compliance with existing legislation including public safety, pedestrian obstruction, traffic interaction, visual amenity and heritage. Data services and regulation are covered by each partner's GDPR processes, and advertising by national advertising standards and regulation.

In relation to the data in these infrastructures, local authorities strictly followed GDPR legislation. In terms of benches in a partnership approach such as in Southwark, complying required a systematic approach to data use. However, the different partnership arrangements in place and differing data regulations made it difficult to have these issues addressed and realise their full data potential. Similarly, InLinkUK and the companies behind it (see page 5) had clearly set up a strategy to roll out their infrastructures in UK cities and develop and implement 'smart data sensors' (as per their privacy notice) to collect a range of new data. Thus, careful attention needs to be paid to these new kinds of street furniture and the data they collect and provide, which could inform local authorities' policy decisions about their installation. This also raises further questions about how to develop governance in strategic partnerships in these new developments.

This section has highlighted the point that the recombinant aspect of smart street furniture, while materialised at the street level, raises questions at a governance level. Smart street furniture are hybrid systems that fall under a range of legislative and planning frameworks. This makes it more complex for local authorities to regulate them or take up the new opportunities they offer.

Issues in the recombination of material, digital and information services in smart kiosks and benches

The concept of combining and recombining is useful for helping stakeholders to identify areas to address in smart innovations. We use this concept to develop a set of issues for consideration in planning the design, use and governance of smart kiosks and benches. The findings from our project suggest that it is important to address the following questions in further developments:

- **How to combine use:** Is there – or should there be – a primary use? If there is not a primary use, how can the different demands on a kiosk or bench be facilitated to an acceptable standard? What might such a standard be?
- **How to design to meet the requirements of a number of functions in a recombined form:** To what extent can universal design principles support recombined public street furniture? How do people learn about and develop confidence to use the new features? How is its design evaluated and adjusted over time?
- **How to ensure responsible and accountable governance of multi-functioning street furniture:** Who is responsible for the data gathered from benches and kiosks, and who is responsible for its use by others? Do these kinds of benches and kiosks require more than GDPR compliance?
- **Suitability of existing planning regulation for smart kiosks and benches:** In particular, what regulation might be needed for physical structures that combine advertising and information, data provision, and communication services? What new kinds of planning processes and laws might be necessary?
- **Recombinations of types of end users in retail and transport spaces:** Are kiosks and benches in the right places to meet some end users' needs, and do they fully address these needs? What are the combinations of patterns of use in different spaces, and is there any requirement for adaptations to fit specific space-place use?
- **Effects of combining public information and communication services with commercial advertising:** How can these free facilities be made financial viable, especially if there is an aim to limit advertising? How can they be made relevant and current for public consumption and service provision? How does this impact on perceptions of public space and inclusion?

These questions are intended to be used when setting guidelines for developing smart street furniture design, and to support their installation and use at the local level.

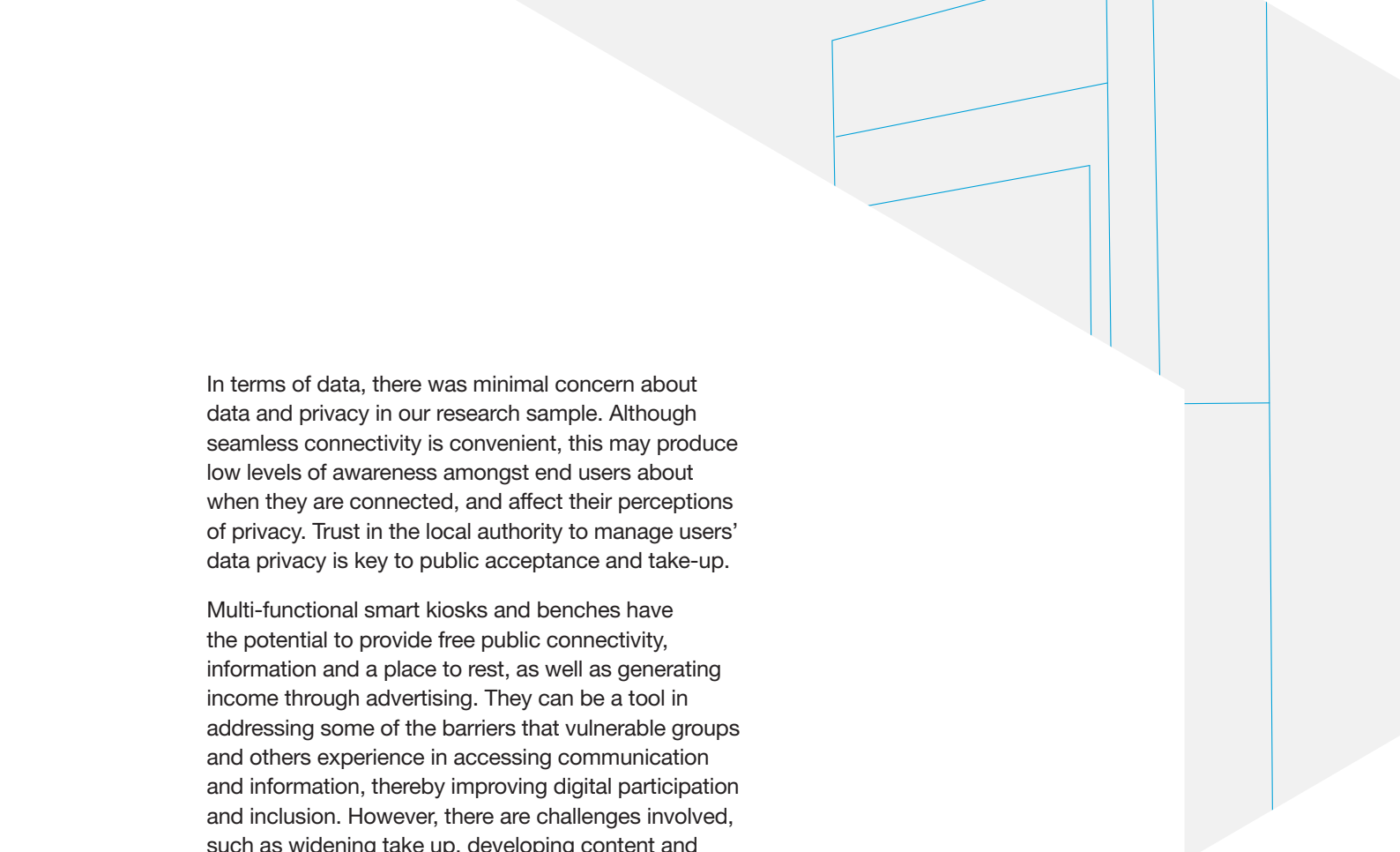
Conclusion

The project sought to ascertain some insights into public perceptions and usage of smart kiosks and benches, and the design and governance issues for these innovations. Smart kiosks and benches provide opportunities for citizens to connect to the internet, make phone calls and charge their mobile phones for free, as well as providing access to advertising and public information. These new kinds of street furniture are innovative and of significance precisely because of their *recombinant* potential – they combine existing urban forms and provisions with new technologies and functions.

In terms of people's perceptions and use, our research found that there was an element of discovery in encountering new types of smart street furniture. However, end users were not always aware of all the functionalities of smart street furniture, so clearer signage and information is needed to enable wider take up. The end users we interviewed liked the overall designs and thought that the kiosks and benches' positions were good: they felt that kiosks were well located in public thoroughfares and there were some suggestions that benches could be located in parks. There was recognition of the public value of free access to Wi-Fi, charging and calling facilities, which was seen as particularly important for members of the public with access limitations including homeless people, gig economy workers, students and tourists. The participants also recognised the safety aspect of the kiosk, in terms of the emergency button and USB charging facility, which was seen as especially important at nighttime.

Most people were not worried about data safety and privacy concerns in using public Wi-Fi, although a few did raise some concern. Some people were put off by not knowing how to use the kiosks and benches. However, individuals created ways to use the functionalities of the kiosks and benches, for instance, gig workers used them to charge their phones when cycling because of convenient access while on the move; office workers used the benches to rest and eat their lunch on whilst charging their phones; children played around both objects; and people leant on the kiosks for a smoke or chat. However, end users needed to bring their own USB cables to use the charging facilities. The free phone calls were a lifeline for some. Some difficulties in sharing the benches were noted, as some people did not want to share them with those they thought were homeless.

In terms of design and use, advertising was seen as the primary function of the kiosks, even though they also provided public information and a directory of social services, which were useful for vulnerable groups. Questions were raised about the type of advertising screened on the kiosks, for instance, the prevalence of adverts for alcohol and fast food was criticised. There were a number of suggestions that the advertising space could be used for educational and community purposes, and questions were raised on how to balance advertising with public information. End users found innovative ways to use the kiosks, creating seats from their backpacks and bags and leaning in close to gain privacy. The universal design of kiosks and benches is a good start, but attention is needed to details such as the digital tablet fitted into the narrow side of the kiosk, which is easy to miss, less comfortable to access, less intuitive, and does not offer privacy. There needs to be continued careful planning to regulate the cluttering of streets and the number of advertisements.



In terms of data, there was minimal concern about data and privacy in our research sample. Although seamless connectivity is convenient, this may produce low levels of awareness amongst end users about when they are connected, and affect their perceptions of privacy. Trust in the local authority to manage users' data privacy is key to public acceptance and take-up.

Multi-functional smart kiosks and benches have the potential to provide free public connectivity, information and a place to rest, as well as generating income through advertising. They can be a tool in addressing some of the barriers that vulnerable groups and others experience in accessing communication and information, thereby improving digital participation and inclusion. However, there are challenges involved, such as widening take up, developing content and services for a wide range of users, as well as creating specific end user information and communication content. There is a need to improve their design to support the discoverability, usability and accessibility of smart kiosks and benches. Attention is also needed to ensure the public's trust in their present use and future application. They also raise important questions with regards to emerging public-private partnerships and their planning regulation and governance.

Recommendations

Based on our research findings, we recommend that:

1. A greater emphasis should be placed on the public and social values of smart street furniture at a local level (e.g. digital inclusion, enhanced connectivity, community-based information announcements) in local authorities' smart street furniture business models. This needs to be combined with an evaluative framework to assess the public and social value of the smart street furniture in the present and future, and modify it if necessary.
2. The smart kiosks' and benches' intended purposes need to be defined, assessed and documented, including how they address local needs and add value to existing cityscapes. This will allow local authorities and commercial providers to ensure appropriate signposting of their functions, taking into account their primary and secondary functions, and determining any added value that can be leveraged.
3. An officer role should be created at the local level, to continuously oversee the risks and opportunities offered by any public service information provision and data collection, sharing and reuse through smart street furniture.
4. A more proactive partnership approach should be taken to explore the possibilities offered by smart street furniture and link them to other service provision (e.g. to local homeless shelters, public libraries and other community services).
5. Local authorities and commercial providers should develop a public awareness and education strategy in order to support the discovery phase of smart street furniture and promote wider understanding of data collection practices and protections.
6. Existing knowledge gained at a local level from the early implementation of similar schemes should be compiled and circulated, in order to inform the fixing and fitting of kiosks and benches into specific suitable local spaces and contexts.
7. An assessment should be made about whether the universal design principles of smart street furniture meet the requirements of end users with specific needs in the context of public places, and to devise a method for public and local council input to be included in future design adjustments.

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