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Maps as participatory platforms: Towards open data and transport service

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Abstract

This paper develops a new perspective on maps and mapmaking moving interacting with Open Data and transport service. It outlines the implications of a design case study in which maps become democratized and start to function as a participatory platform.
This leads to the argument that maps enabled by technology means that the nature of maps has changed and should be considered as a complex value co-creation system with users' experience and knowledge at their centre. Based on the proposition that user experience and the complexity of the value co-creation system are at the core of service design practice, this leads to the conclusion that map development has become a service design practice. This paper contributes to the growing interest in map-based services, the latter leading to redefining the nature of the map and service design's role in relation to the value co-creation system in complex city systems.

KEYWORDS: cartography, map, digital platform, transport service, service design

Introduction

Traditionally mapmaking is an exclusive domain of cartography. Since the rapid growth of digital technologies and smart devices enhanced by ICT, maps and map services faced one of the radical changes in our urban life (Maps and Mapmaking, 2012), thereby we are now experiencing a complete shift in maps/mapping and emerging agenda available in this subject. Maps and mapping have been significantly influenced by digital technology and have come to function as participatory platforms with the capacity to collect, create, store and process data through people's interaction with others, their environment and the cities they live in or visit. These dynamics have significantly changed the way that key stakeholders interact with each other through maps, while further altering the way that design and designers are involved in map development. This shift has transformed the traditional mechanisms of maps and mapping.

A two-stage study is presented in this paper. The first stage identifies the nature of maps in the literature related to cartography, digital platforms, and service systems. At this stage has

developed a proposition, which suggests that the nature of a map goes beyond its physical existence while becoming relevant to services and complex service platforms. The second stage contextualises this proposition through a design case study in relation to these shifting parameters.

The findings reveal that the complexity of maps has dramatically increased driven by the growing usage of advanced technology while user experience has become a central part of map-based service development. The nature of maps as services and service systems has become more evident in this context, particularly when maps are more closely associated with various complex service systems and stakeholders, which suggests that maps become systems of co-creation through the integration of resources. This leads to a further discussion of a designer's role as a facilitator of value co-creation through map services. In this role, service designers consider maps as service and adopt a human-centred approach to facilitating the engagement of key stakeholders in complex systems. Finally, the paper suggests the need for further study to contextualise the involvement of service design in this new area alongside investigating its implications and limitations.

The nature of maps in the digital era

Principles of mapmaking

Understanding the nature of maps and mapmaking has been debated for centuries. Maps are defined in various terms and from a range of. For example, in geography, "the set of graphic representations that facilitate a spatial understanding of things, concepts, condition, processes or events in the human world" (Harley & Woodward, 1987. xvi), while the Oxford Online Dictionary (2014) defines maps as "visual diagrams and representations or collections of data showing spatial arrangement or distribution over an area." Furthermore, we often understand that the world can be objectively mapped using scientific techniques to capture and display spatial information.

As famous allegories from Borges (1946) and Carroll's (1893) maps in their fictions illustrate, a 1:1 scale map is impossible and valueless. A map does not simply mirror the world, not merely an image or drawing, rather it is a process of decision-making (Tufte, 2001). Maps capture something of the world while simultaneously producing the idea of the physical place they represent (Wood & Fels, 2008). Cartographers or designers negotiate information from both physical objects and graphical representations shaped by scientific principles, implying a systemic proposition; symbolically categorised data satisfies according to its accuracy, readability, and interpretability in terms of the best way to deliver geospatial information and communicate with maps users, a process that leads to map readers' action rather than an essentially aesthetic reaction (Robinson, 1952; Pickles, 2004; Wood & Fels, 2008).

Each map is a massive reduction of the reality derived from an extensive set of facts, then uncountable information is abstracted through graphic symbolisation and is accentuated from a number of possible design outcomes (Monmonier, 1996). All maps are created by a selection of truths, suppressing certain information. Central to mapmaking is not simply the representation of the world, instead it produces space so that the user perceives information by interplaying the data underlying the graphic elements of maps and constructing knowledge of space in a systemic way that serves a singular agenda (Turnbull, 1989; Pickles, 2004; Wood & Fels, 2008).

Digital technology and users as co-creators of maps

The digitalisation of cartographic information processes, production and map design showed how the cartographic efforts could be reduced for the creation of high-quality products and new ways of cartographic distribution that make accessing and participating in geospatial information much easier. These emergent mapping practices have been facilitated by a new array of Web 2.0 platforms (O'Reilly, 2005) such as such read and write media, Google Maps[3], OpenStreetMap[4], while social media sites are all around us and a wide range of people consume and simultaneously create maps as never before. The key characteristic of Web 2.0 is that it understands the web as a Read+Write platform with cost-effective scalability, collective intelligence through user participation, dynamic connections, openness and freedom (Haklay et al., 2008). This technological shift has been particularly evident in applied maps/mapping, which has opened the process of mapmaking to everyone by weaving in the perspectives of users as collaborative mapmakers.

Mapping practices or the distribution of spatial knowledge is not only centrally managed by professionals but also by individual users' contributions. Users produce spatial knowledge in the same way that they consume spatial information, for example how they navigate, search and review locations of choice and whether they intentionally and voluntarily contribute spatial knowledge through this space. Thousands of people collectively act as geographically-distributed sensors (see the 'citizen as a sensor' as detailed by Goodchild, 2007); they voluntarily collect, clean and upload geospatial information and contribute data while also connecting to platforms socially, communicating meaningfully and contributing collectively (i.e. explicit user contribution, OpenStreetMap, The Missing Maps Project[5]).

The availability of vast of user's contribution in maps fundamentally altered the way spatial data are generated, utilised and manipulated (Leszczynski, 2012; Leszczynski & Wilson, 2013). Gartner (2009) has termed this movement as 'Web Mapping 2.0,' suggesting that it provides a suitable platform for dynamic and interactive maps that allow everyone to produce and change his or her own individual maps, constituting a democratic approach to mapmaking and mapping. This approach is a central concept of 'Neogeography' or 'Neocartography,' consisting of a set of techniques and tools that fall outside traditional mapmaking and mapping, but which is also concerned with people using and creating their own maps in their own terms (Turner, 2006). The user's spatial information contribution has shifted from professional agencies to amateurs or hackers (e.g. free open-mapping tools, OpenStreetMap), and from governments to individual citizens. Such digital mapping software and a mixture of 'open data' (Powell, 2012) collaborative tools, as well as the geo-tagging embedded in mobile mapping applications, have become the systems that represent the physical evidence of our experiences.

Given this turn in mapmaking, the experience of mapping has become participatory and social. Maps begin to function as participatory platforms and more democratised than ever before. Online cartographic services enable the user to become a source of cartographic information or a knowledge creator, an innovator with a new product or service on an open platform, which is changing the nature and character of the mapping experience. This indicates a series of new relationships alongside changes in the practice of map production and consumption (Wilson & Graham, 2013). The boundaries between producers and consumers have become blurred through users acting as both consumer as well as producers of cartographic products in the so-called 'prosumption/prosumer' process (Ritzer, 2010). Instead of relying on the completed cartographic product users can now create customised maps on demand (Dodge & Kitchin, 2013). The shift from being a map user to mapmaker (Zook & Graham, 2007) is not only about blurring boundaries by letting users control

[1] Jorge Luis Borges (1946) collected fiction "On Exactitude in Science"
[2] Lewis Carroll (1893) "Sylvie and Bruno Concluded"
[3] Google maps is a desktop and mobile mapping service developed by Google. It offers satellite imagery, street maps, 360-degree panoramic views of streets and real-time traffic information with a route-planning function.
[4] OpenStreetMap (OSM) is a collaborative project attempting to create a free editable map of the world. OSM is considered a prominent example of volunteered geographic information.
[5] Missing Maps project was born out of a realisation by the American Red Cross, British Red Cross, Humanitarian OpenStreetMap Team, and Médecins Sans Frontières that maps are pivotal to delivering humanitarian aid. See more https://www.missingmaps.org/

geographical information but is also concerned with counter-mapping and counter-knowledge activities (Harris & Hazen, 2006).

Figure 1. Example of multiple layers of information in maps

Data and the expanded usage of maps as participatory platforms

Geospatial data is now ubiquitous, fluid and has dramatically increased the complexity of the type and amount of data available for mapping. Nowadays most digital information contains geographical references about location. Massive volumes of data are harvested from smartphones, geo-tagging social media contents or posts and sensors embedded in the built environment (fixed and wireless networks, digitally-controlled services and transport infrastructure, sensor and camera networks, management systems and so on) that are invisible to user experience while generated passively and unconsciously as an implicit user contribution in some sense (Graham et al., 2013, p. 332).

Various data from sensors and maps may be combined together with an automated form of data production that provide an even better understanding of geographical data and patterns. For example, head-based wearable devices that track in real-time how a user's ride, movement, and location engage with his/her mind, offering new insights into the ride experience without a user's direct participation, which can be considered as an implicit contribution while explicit volunteering report particular interests that users deliberately want to address and share with a specific purpose in mind (i.e. the OSM community mapping project, Earthquake Maps, Waze). Put together, both implicit and explicit users' contribution in the form of big data has increased the complexity of the types and amounts of data available for mapping.

The visual representation of geospatial data does not simply describe places of space but reveals the system of networks and flows (Batty, 2013). The representation of data on map platforms can be understood as collective knowledge and another facet of urban life, therefore the city planner or policy maker can find this information useful for their decision making, potentially as acting as new ways of knowing (Batty, 2013; Graham & Shelton, 2013). Furthermore, it provides a better understanding of geographical data and patterns, thereby creating value for governments and corporate entities by allowing them bottom-up insights to arrive fundamental truths (Graham & Shelton, 2013; Powell, 2014; Zook & Graham, 2007).

Figure 2. Most Stressful Place,[6] MindRider Map[7]

Given the availability of open data, more data is streamed via map-based interface aggregation and is freely available to the public and businesses, allowing them to access, manipulate and represent information in order to display useful insights into how cities perform such as providing environmental data (e.g., air quality, water levels, temperature and weather), which can be supplemented by objective analysis of urban changes and insights, while identifying facts and establishing connections between various urban stakeholders. These attempts make cities cleaner and healthier places to live by providing quick snapshots for both individual users and local authorities, thereby supporting governing bodies' meaningful decisions in order to improve environmental conditions, which can facilitate better collaboration across exiting applications and services systems accordingly.

In this light, depicting geo-referenced location data can offer new perspectives on the ways in which city services' processes and strategies are designed and implemented (Ciuccarelli, 2014; Graham & Shelton, 2013). Describing the dynamics of a city using data is a crucial step to both understanding people's activities in urban environments and assisting planning and designing. Location data from different systems can be visualised through various cartographic representations and forms of cartographic expression, leading to a system that represents our physical experience of the physical place. This means maps can now transmute the role of maps from the end-product to a situation, wherein the maps display evidence and function as an expression of space (Wood, 1992; Elwood & Leszczynski, 2013).

In this respect, the nature of maps as platforms that facilitate engagement between different urban stakeholders becomes more evident when maps are more closely associated with various complex systems and the available data. This further suggests that maps become a participatory platform through the integration of resources and systems.

[6] Most Stressful Places (MIT Startup, 2015) offers users the opportunity to see patterns in daily lives through wearable devices and to learn about controlling stress better while helping to design environments that are less stressful for everyone.
[7] The MindRider bike helmet and map (MIT, 2015) is a helmet that tracks, in real time, how a user's ride, movement, and their location engages with their mind. The MindRider app maps user's engagement, offering new insights into the riding experience, thereby providing a unique resource for riding communities and street advocacy (www.mindriderhelmet).

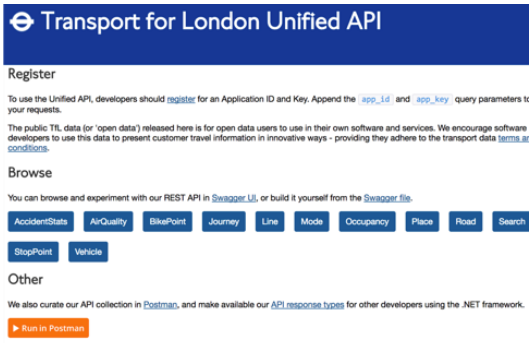


Figure 3. TfL's Open API[8]

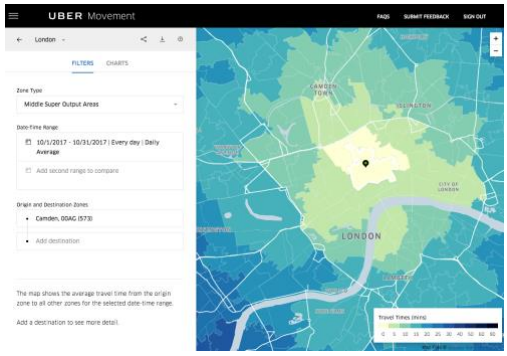


Figure 4. Uber movement[9]

Use of maps as a vehicle to design a service

Based on the previous section that suggests the nature of maps goes beyond physical existence while participatory platforms facilitate engagement, this segment contextualises the proposition through a design case study relating to a new perspective on maps.

Design approaches and propositions

The approaches applied in the case study use action research as a model of both design research for analysis and the design of project outcomes (Checkland, 1981). It has employed three different data collection techniques: observation, semi-structured interviews, and content analysis of existing services. The researcher plays the role of designer, actively and reflexively interacting with both the object of research and design outputs. The development of the case study was a response to a challenge run by TfL (Transport for London). The aim of the challenge was to "tackle London's air quality through a service design approach" and, in this case, uses maps as a vehicle enabling people to be an active agent of change, developing awareness, changing habits and choosing sustainable transport choices, which can have a positive impact on reducing air pollution in London.

The growing population and number of vehicles on the roads and consequent rise in pollution levels in London is responsible for nearly ten thousand deaths each year and is considered a major health crisis, costing our economy around £3.7 billion every year. Overall, 90% of transport-related nitrogen dioxide emissions in central London come from diesel vehicles. In total, 80% of PM10 in London is due to ground-based transport of which taxis are responsible for 25% of PM10 and 10% of NO2, while also spending up to half of their time looking for passengers according to research (Vaughan, 2016).

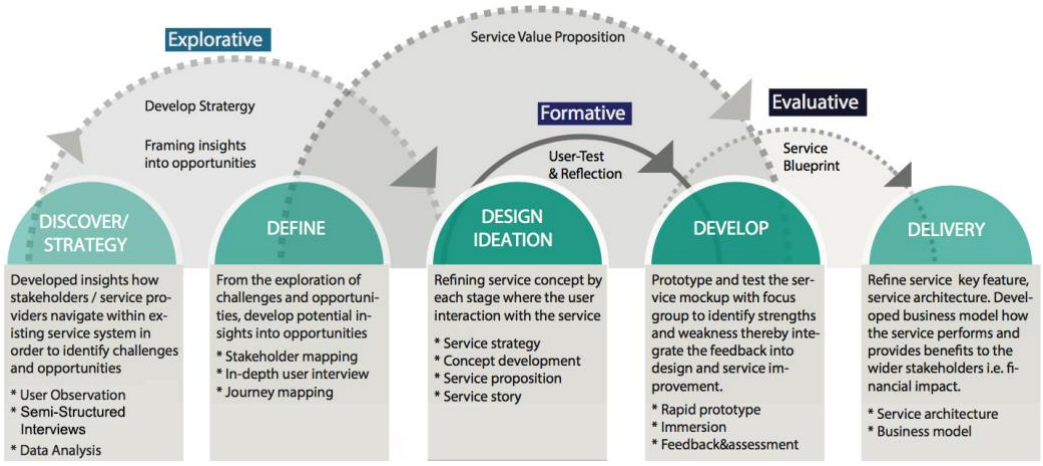
From a design perspective, the design strategy seeks to reduce pollutant behaviour. Central to the design proposition to this challenge is to provide a service using tailored open data with drivers' peer-to-peer information using black cab drivers' knowledge, thereby allowing them to make informed decisions as to where to find fares so they can reduce drifting time in central London. The information provided by designed service consists of three parts: traffic and unplanned roadwork data; event-ending times; and taxi rank moving speed. Instead of giving city-wide information which is largely irrelevant to the drivers, this service provides hyper-local information based on a given driver's current location.

[8] TfL's API: The unified API presents all the data that is semantically similar for each mode of transport in the same format and consistent structures. The complexity of mapping between multiple identification systems used within TfL has been hidden from consumers of the API.

[9] The map shows the average travel time from the origin zone to all other zones for the selected date-time range.

The second design proposition underlines how the platform differs by putting the decision back into the hands of the black cab drivers, who are the most reliable navigators of complex London roads, by allowing them to input or confirm automated data, thereby enhancing its data accuracy while correcting unpredictable road information. By slightly nudging a driver's drifting behaviour using hyper-local data, the driver can reduce the amount of drifting time without carrying a passenger, thus saving fuel costs while increasing the chance of finding fares. Meanwhile, customers are more likely to be picked up when they need a black cab and the city also benefits by reduced air pollution.

This design process adopted broadly accepted iterative cycles of enquiry common to the design process as illustrated in the diagram below.



Figures 5. Design process

The design team developed a deep understanding of the problem following comprehensive desktop research and information gathered from initial user research. This included analysing air quality data from London Air Quality Network, taxi-hailing market trends, alongside map service research to identify current challenges and problematic areas. During first-hand desk research, the design team identified which area in London is the most polluted and which road consumer causes such pollution, for example, taxi, bus, private car or private hire vehicle such as Uber. Following desk research, the design team conducted road observations to identify the 'as-is' situation, namely which type of cars are occupying the road space in peak time, off-peak time, and how their driving behaviour is performed. In the discovery stage, the design team found out that a large proportion of black cabs are empty in certain problematic areas in London.

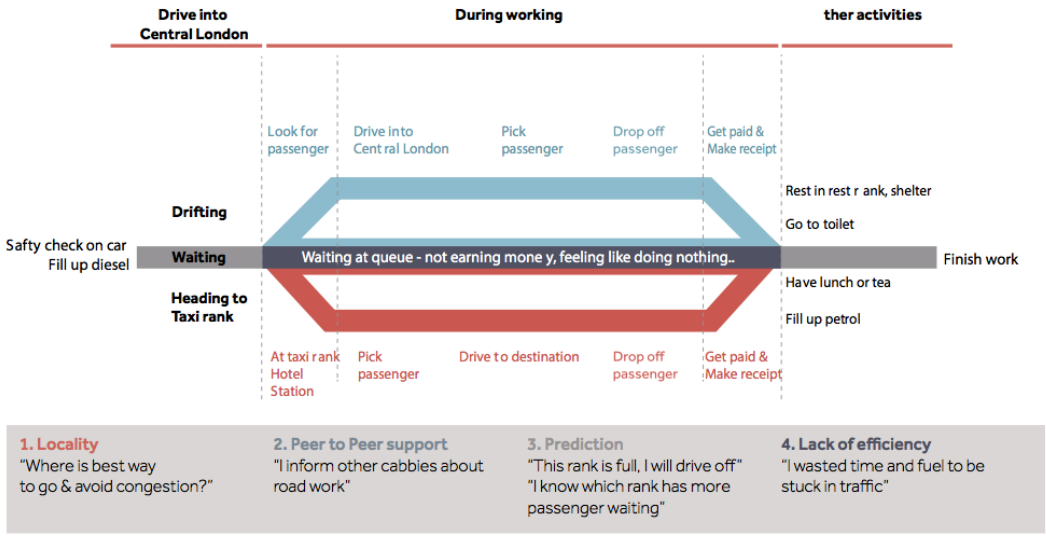


Figure 6. A driver's Journey mapping

Data collection

During the data collection, qualitative data were collected through three types of interview: focus group, in-depth interview, and electronic interview as semi-structured interview using four categories of participants to develop a deep understanding of the problem in relation to driving and pollutant behaviour. In total, the participants were drawn from 70 black cab drivers, two taxi marshals, 15 passengers, 27 Uber drivers, the Head of Finance at TaxiApp UK, a London Air Quality expert from King's College London, and the Sustainability travel manager Royal Borough of Kensington and Chelsea.

Ethics

Before the interview, the scope of participation and a consent form was presented to participants. The latter was carefully explained, and a stress environment was assured. The interview was recorded, and participants would withdraw if they wished to do so.

Data analysis and responses

The qualitative data gathered was analysed and, consequently, coding analysis were adopted into this analytical process. Key problems and insights were defined, which in turn resulted in the generation of a series of opportunities.

First, compared to Uber drivers, black cabs are faced with an unpredictable situation in terms of picking up passengers on the road:

> *"These times when we don't get work really, that's when we head for train stations or ranks…. where we will obviously get guaranteed job but then you have to wait and queue up…otherwise you are driving around and its costing you money such fuel" (T1)*

> *"….2-3 years ago, on my way, five, ten minutes… now sometimes one hour looking for passenger on the road" (T12)*

Second, the black cab drivers are disconnected from each other as individual business owners and experience a lack of information that are necessary in advance of driving decision:

> *"…because we work for ourselves, we only work individually… we are not connected in any way we are all on our own… there is no real group to share useful information" (T57)*

Third, black cab drivers receive identical notifications from a maps-like services regardless of their location, which adds to the noise they experience while they are driving:

> *"… I use some maps and apps… if its busy on the street, there's no point using maps like apps… there's only a limited amount of work on the apps" (T7)*

> *"I use waze, hailo sometimes googlemap but it is not relevant to me. You never imagine road conditions" (T43)*

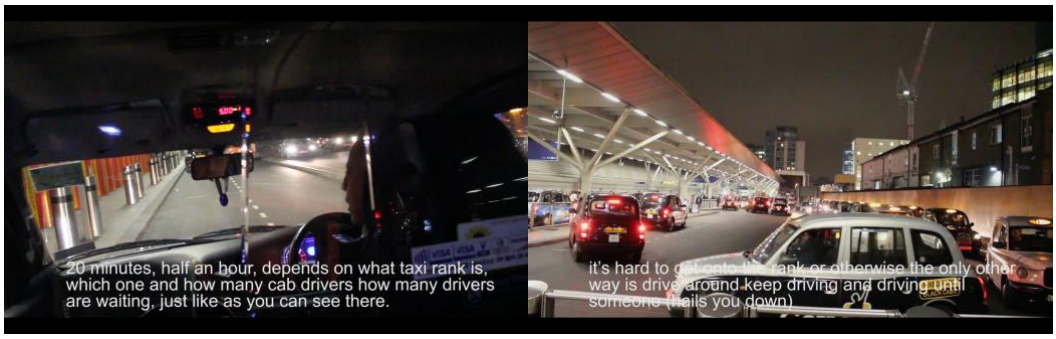


Figure 7. Observation and conversation

Different views of the required design service

Based on the problem areas defined, the design team moved to the ideation stage by framing the key opportunity areas with service propositions that differentiates the service from what already exists in the market. The opportunities are: PREDICTABLE compared to unpredictable: Make the unpredictable 'job' of finding passengers that rely on luck to become more predictable and organised for black cab drivers to know where to go. Second, CONNECTED compared to disconnected: Integrate data generated by black cab drivers that is currently not being utilised. Empowering black taxi drivers by using their own datasets and connecting individual drivers to build a sense of community is necessary. Third, there is a need for TAILORED DELIVERY based in a simple map-like app notification: To make the black cab driver's job more efficient, deliver tailored information based on their location and time by considering hyper-locality as well as relevance and an individual driver's preference.

The data is collected from the peer-to-peer group based on black cab drivers' input regarding the designed map-based service which utilises the knowledge of drivers and real-time data about traffic, road events and taxi rank speed to help them make informed decisions. Through iteration of testing, the service was designed based on the final user interface and as an urban 'Flo' strategy. Following this stage, the design team developed a business model detailing how this service could perform and offer benefits to the wider stakeholders. Importantly, in this stage, a potential financial benefit model measured and estimated costs using the services offered to the black taxi drivers. Furthermore, this suggested the benefit of wider urban stakeholders' having this service live by placing transport data onto one platform for the better understanding of urban flow.

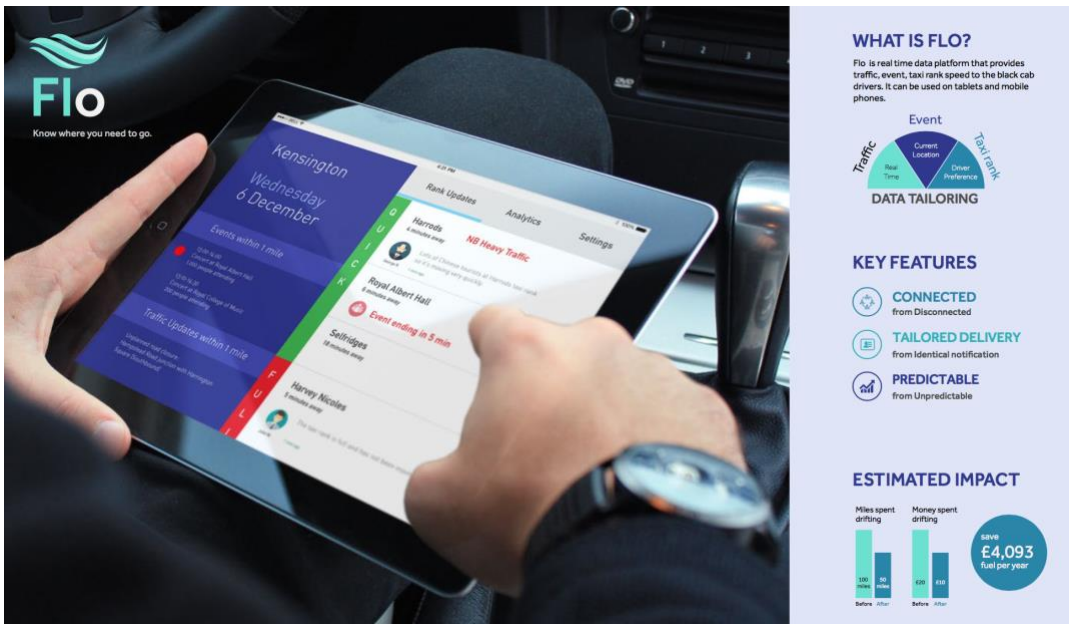


Figure 8. Case design, Smart Black Taxi Service

Discussion

Service Design as a way of viewing human interaction and reframing problems uses designed solutions, and user-centred service system fulfils users' desired experiences by engaging with wider stakeholders (Brass & Bowden, 2009; Ostrom, 2010; Segelström, 2010). Service design can act as a "collaborative, cross-disciplinary activity involving the orchestration of clues, places, processes, and interactions that together create holistic service experience for customers, client, employee, business partner or citizen" (Ostrom, 2010, p.17). In addition, service design deploys holistic approaches to the design of experiences and systems, which in turn requires the integration of multiple design disciplines in a systemic solution. In this respect, service design's contribution in two crucial aspects in the development of map-based service are relevant here.

First, user experience becomes central to map development

As identified in previous section, the expansion of freely available information and accessible tools by individual users allows them to increase their level of participation, thus reshaping our experience in urban spaces (Lessig, 2006). The shifting relationship between maps and users since the emergence of IoT technology has played a key role in allowing the user to involve map services in the creation of bottom-up information while the grouping of individuals' collaborative data embedded in maps reveal patterns and insights that do not simply appear in particular locations and at a particular time.

This platform can be used to gather collective feedback from individual users and a potentially useful tool for city planners, authorities and policymakers to garner insights efficiently and effectively. The individual user has played a significant role in transferring their knowledge and skills into this space in both direct and indirect ways. They are not just simply users, rather their behavioural data input generates and changes interaction dynamics in map services. They are co-producers and deliver the value-in-use of service (Lusch et al., 2008; Vargo et al., 2008).

In this perspective, the role of map service providers and users are not distinct, which means the value is always co-created in the interactions between entities – map service providers,

users, governance and other related entities – emerge through the integration of resources. The nature of maps has nowadays become a value co-creation system that places a user's experience and knowledge at the centre of a complex value system. Users have the power to decide what can go into maps and their experience is one of drivers of map service development.

Second, mapping as a facilitation of user knowledge and collaborative activities

Service design is concern with the complexity of the system where individual and service interaction take place, including in companies, cities and many contexts. Cities are complex systems involving various stakeholders such as citizens, visitors, city planners, policy makers and service providers. The city is also known as the location where people come together to interact with one another, which is affected by complex and reactive information generated by people (Batty, 2013). As we have reviewed, depicting urban data in map platforms can be a way to tease out issues in this complex system, hence the design role in map development have been extensively expanded, moving away from acting as a tool to becoming the catalyst of system.

In a complex system, a service designer can help to unveil opportunities, solve problems and create strategies. They find ways to explain, share insights about complex structures, and to process implementation of the solutions identified (Moritz, 2005). Service designers address and provide evidence of environmental or social issues by engaging with different entities ranging from local authorities, geographical information, technology and people. This illustrates that the design role is not staying in the realm of visual representation but as acts as a connector of various resources from the multiple levels of information that can be implemented, embedded, measured and scale-upped in response to the problems rooted in physical locations.

Viewing mapping as an act of co-creation, service design facilitates collaborative activities because of its unique way of adapting a range of multidisciplinary tools and methods such as stakeholder mapping, user journey mapping, co-creation and blueprints. In comparison with more conventional design methods (e.g. task analysis, sketching and modelling), this set of methods facilitates user participation, interdisciplinary teamwork and creative collaboration. Through the service design discipline, map service developments can facilitate different levels of information and engagement by representing the complexity of city systems that are key issues for better user experience and are therefore a subject for the designer's interpretation.

Lastly, the role of designers in map service development

Design is concerned with people and solving problems. The design discipline works to develop thought and action that can solve problems while developing solutions to our daily problems currently unmet by existing systems (Manzini, 2015). Although the role of design has been raised recently, designers have been critiqued for their weakness in terms of their systemic approaches, including that their focus on overly discrete product or service ideas results in them concentrating on interfaces and interactions aimed at touch-point innovation (Clatworthy, 2011). Service designers' skill are more communicable and accessible. When service designers are involved with map development, this involves a collaborative process involving all stakeholders including citizens, city planners, technology and cities.

Furthermore, they offer a link between stakeholders and resources rather than focussing on visualising information or designing a single touch-point. In doing so, service designers visualise, formulate and choreograph. They interpret people's needs and transform these into possible future services. In this new space, designers' expertise is based on their ability to empathise with people in relation to the system while applying thought to action (Fayard, Stigliani, & Bechky, 2017). The participatory experience is considered as "not simply a

method or set of methodologies" but as "a mindset and an attitude about people" (Sanders & Rim, 2002, p. 1). In this shift, the concept of "design for people" is replaced by "design with people."

As the nature of the map has changed, the designer's role in map development has also transformed. They are no longer mainly responsible for the visual aspects of communication in relation to the creation of goods, rather they expected to develop mutual benefits through applying systemic thought to issues and connecting stakeholder engagement and holistic approaches to many systems such as families, cities, and companies (Maglio et al., 2009). The involvement of designers can function in a more strategic manner when applied on a wider systemic, service and infrastructure scale (Brass & Bowden, 2009).

Conclusion and Future Work

Using mapping as a vehicle of the service design discipline, the development of map services should not be viewed in isolation, instead it should involve the entire environment in a holistic and interdisciplinary fashion by evidencing problems in a user-centred and co-creative way in the context of service development, management, operations and marketing (Edvardsson et al., 2005). Maps and mapping services, from their traditional origins to recent innovations, have shown how the role of the designer has changed from the representation of information to acting as a catalyst of value system design. In the wake of this transformation, this paper argues that map developments nowadays contribute to service design, whereby traditional map design has changed to becoming a subject of service design.

This paper has tried to redefine the nature of maps, identify new perspectives on maps' development, a context in which service design plays a crucial role, while highlighting the role of designers in map development in relation to the service design discipline. The purpose of map services and their role has expanded dramatically, and its usage is on a far grander scale than what went before. Map service appears to function as a service system in the creation of novel and dynamic indicators of urban life and issues, and therefore facilitates value for various urban stakeholders.

In summary, the paper has outlined the new role of service design in a complex value system and concludes that maps' development contributes to the of service design practice, thus helping to redefine the nature of maps and service design's role in value co-creation systems in complex city systems. Thereby when a designer designs a map service, s/he engages with a system that reveals a complex value system. In this role, service designers consider maps as services and adopt a human-centred approach to facilitate the engagement of key stakeholders in complex systems. Future studies might contextualize the involvement of service design in this new territory further and investigate its implications and limitations.

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