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Lessons from three UK cities

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The impact of smart city technologies on the urban process: lessons learned from three UK cities

The concept of smart city has been discussed widely in the academia and policy terms, mainly referring to the ways in which cities can be managed more efficiently. Nevertheless, the real implications of smart technologies in urban practice often remain unexplored. Today, especially, not much is known about the challenges of smart city implementation in the context of the built environment. In order to demystify the concept of the smart city, this article uses 3 UK cities, namely Bristol, Manchester and Milton Keynes, to report on how smart city ideas are designed in practice. The result of this paper gives some ideas towards the challenges of integrating technological and social innovation by providing real-life processes on the ground.

Introduction

The academic literature on smart city discussions predominantly focus on how smart city ideas can benefit our cities and our everyday life. The concept of the smart city goes back to earlier discussions when multinational technology companies attempted to design digital infrastructure to solve some of the technical problems cities are facing even today. The main research attention has focused on smart cities planned "from scratch", and revolved around three paradigmatic case studies: Masdar City in the UAE, Songdo in Korea, and PlanIT Valley in Portugal (Greenfield, 2013; Carvalho, 2015).

Later on, there have been several attempts to define the smart city (see Albino et al, 2015). Caragliu et al. (2011: 70) state that "[a] city is smart when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance". The dimensions of the smart city correspond to: smart people, smart economy, smart environment, smart government, smart mobility and smart living (Batty et al., 2012).

In addition to a breadth and diversity of smart city definitions, stakeholders' motivations for pursuing smart city solutions differ significantly (Luque et al., 2014). Recently, smart city discussions focused on the ways cities have been instrumented and governed based on experimentation (Glasmeier and Christopherson, 2015). On the one hand, the focus has been on the widespread implantation of sensors into the built environment. This has brought forward the importance of new governance models where the relationship between a series of actors matters (see Ersoy, 2017). The discussions have also open up new sites of experimentation and interactions through data infrastructures in cities.

However, the practical dimension of the smart city concept and the influence on actors, links, networks, strategies and programmes needs more attention. Currently, there has been some efforts both in research and policy fields for the integration of social and technical aspects of the smart city concept. Some examples include projects funded by European Research funding programmes and actions (e.g., Horizon 2020, FP7 and COST). Nevertheless, seeing the actual results of such programmes is not straightforward. One of the main reasons for this is that the impact or the outcome of the smart city strategies or programmes are 'slow burners'. In other words, they take a long time to show actual results, and whether they provide lasting solutions to urban problems. Another reason is that there is a limited number of papers that explore 'smart cities' in a systematic and empirical way, beyond its being just a series of physical assets in the city (Ersoy, 2017).

This article discusses some of the technical changes as well as what can be learned from UK experiences so far. The findings will be based on desk-based research and 30 interviews across three UK cities, namely Bristol, Manchester and Milton Keynes, conducted with policy makers, academics

and non-governmental organisations in the UK in 2016. These cities are chosen due to their pioneer roles in the smart city discussions nationally and internationally[1]. The interviews are transcribed and coded thematically.

Smart city discussions in the UK

As much as the breath and diversity of smart city definitions change, the actors involved in the implementation of smart city projects vary as well. Three examples of UK cities where very different combinations of stakeholders involve themselves with the smart city concept are found to be very illustrative of this point.

Manchester

In Manchester, smart city discussions refer to a mixture of digital and sustainability agendas, led by the City Policy team within Manchester City Council (MCC) and to a lesser extent, the two Universities in the city, i.e. University of Manchester and Manchester Metropolitan University. While MCC takes the policy lead, the Universities take more practical implementation lead. Even though there is no 'Smart City Strategy' set up by the city authorities, Manchester has been keen on referring to the concept via incorporating a variety of partners in Manchester and beyond (Figure 1).

At a higher level, the smart city discussions are referred within the Greater Manchester Combined Authority (GMCA), which represents ten local authorities within the Greater Manchester (GM) city-region) via growth coalitions such as GM Low Carbon Hub, Transport for Greater Manchester (TfGM) and Manchester Growth Company. The Low Carbon Hub is GM's partnership-led body charged with retrofitting and renewable energy. Within the Hub, smart energy projects explore reducing anti-consumption particularly of buildings, generation of low carbon energy, increasing utilisation of electric vehicles (EVs) and integrating intelligent energy management technologies such as covering local energy demand and new energy provision, integrating building energy use and alternative fuels. In particular, the Smart Systems and Heat Programme[2], which is funded by the Department of Energy and Climate Change (DECC) in the UK, seeks to explore new domestic energy services via smart monitoring. TfGM has been set up to coordinate transport networks across the city region. The tram network is at the core of an integrated policy that aims to reduce car access to the city centre. With the "Bus Services Bill[3]" is on its way, GM will be undertaking a bus franchising model which will enable a fully integrated and effective transport system. At the moment, smart ticketing is used that integrates bus, train and tram services. Through the Triangulum[4] and City Verve[5] projects that Manchester has recently been awarded, there will be further opportunities.

Manchester Growth Company (MGC) is in charge of driving GM's economic development. It's an arm's length economic development agency that engages with the business community in Manchester. They provide support for SMEs and the business community around e-commerce, connectivity and digital economy. Furthermore, Greater Manchester Connect (GM-Connect) has

[1] Bristol has a number of major EU projects such as Horizon 2020 REPLICA and the city is ranked as the leading UK smart city in 2017. Manchester has flagship projects such as Triangulum and City Verve. Milton Keynes carried out the first automatic vehicles demonstration project in Europe in 2016.

[2] http://www.eti.co.uk/catapult-to-deliver-the-etis-smart-systems-and-heat-programme-as-its-first-major-project-for-the-energy-industry/ also https://networks.online/gphsn/technology-focus/1000128/heat-smart-systems-heat-programme/page/2

[3] https://www.gov.uk/government/news/bus-services-bill-to-help-deliver-more-regular-services-for-passengers

[4] http://triangulum-project.eu/

[5] https://www.gov.uk/government/news/manchester-wins-10m-prize-to-become-world-leader-in-smart-city-technology

been set up by GMCA as a data-sharing authority to help break down the barriers around public services sharing information. In 2016, there has been ongoing discussion in terms of how to reduce costs and make processes more efficient for health and social care. Nevertheless, the city has not particularly framed itself as a smart city locally yet. MCC has a Smarter City Programme[6] that aims to explore better use of technologies. The Programme offers a future city framework for Manchester to achieve better outcomes for the city and its citizens.

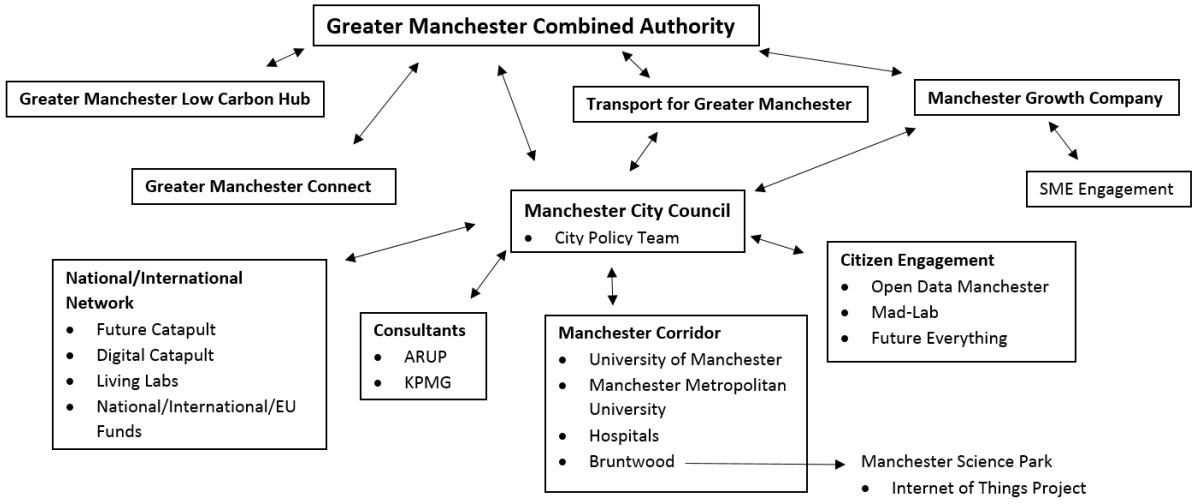

Figure 1: A group of actors who are involved in smart city discussions in Manchester (Source: Author's own illustration)

Within MCC, the smart city discussions also align with 'The Manchester Strategy[7]' set up to work toward 2025. Five themes have been identified; a thriving and sustainable city, a highly skilled city, a progressive and equitable city, a liveable and low carbon city, and a connected city. Smart city has been refereed to access funding in relation to these five strategic themes. 'Manchester Corridor' has been designated as a test bed for the implementation of most of the smart city projects. The term represents a combined group of Universities and hospitals on Oxford Road. The current Internet of Things demonstrator project[8] is located around this corridor. Bruntwood, the largest property development and Lettings Company, is also located within this corridor. The company also owns and operates Manchester Science Park.

In terms of citizen engagement, MCC has been engaging with a group of organisations across the city. Some of them include Open Data Manchester, Mad-Lab and Future Everything. The primary interests of these grassroots innovation organisations focus on science, technology, arts and culture. Although the most of the smart city conversations are project based, external networks (such as the EU-China Smart Cities Forum and the UK Core cities) and funding opportunities have also been quite influential in terms of shaping smart city discussions. There have been some key individuals who have provided important contribution to smart city discussions in Manchester. Most of them have actively engaged with consultancy companies in Manchester.

Bristol

[6] http://www.manchester.gov.uk/site/custom_scripts/smarter_city/case_studies.php
[7] http://www.manchester.gov.uk/mcrstrategy
[8] http://www.manchester.gov.uk/news/article/7343/manchester_announced_as_uk_s_internet_of_things_iot_city_demonstrator_and_awarded_10m_investment

In Bristol, smart city discussions have been referred to as a public-private-people partnership (PPPP) with an emphasis on citizens working through Connecting Bristol[9], the city's digital partnership. Building on digital inclusion programmes within Bristol City Council (BCC), smart came up as a potential concept to develop within the city. After the Smart City Report[10] was commissioned by BCC in 2011, Bristol's Smart City Programme was published in March that year. The Programme aimed at understanding how smart city technologies could contribute to Bristol's carbon reduction targets by 2020. The programme was broadcasted by the Covenant of Mayors within the same year. As a result of this work, a number of themes emerged around data, mobility and energy. Even though BCC built a portfolio of projects and programmes in the following years, environmental and sustainability has remained at the core of Bristol's approach. BCC's approach has been supported at a higher level by its directly elected mayor at that time and the West of England Local Enterprise Partnership (WELEP) which covers Bristol, Bath and Weston-super-Mare and the surrounding countryside. After he was elected as a mayor of Bristol, George Ferguson aimed to make Bristol as a "laboratory for change". The WELEP funded research projects such as 'Terabit West[11]' to initiate a research and development testbed infrastructure for projects relating to Smart Cities, Software Defined Networks, Internet of Things (IoTs) and Big Data.

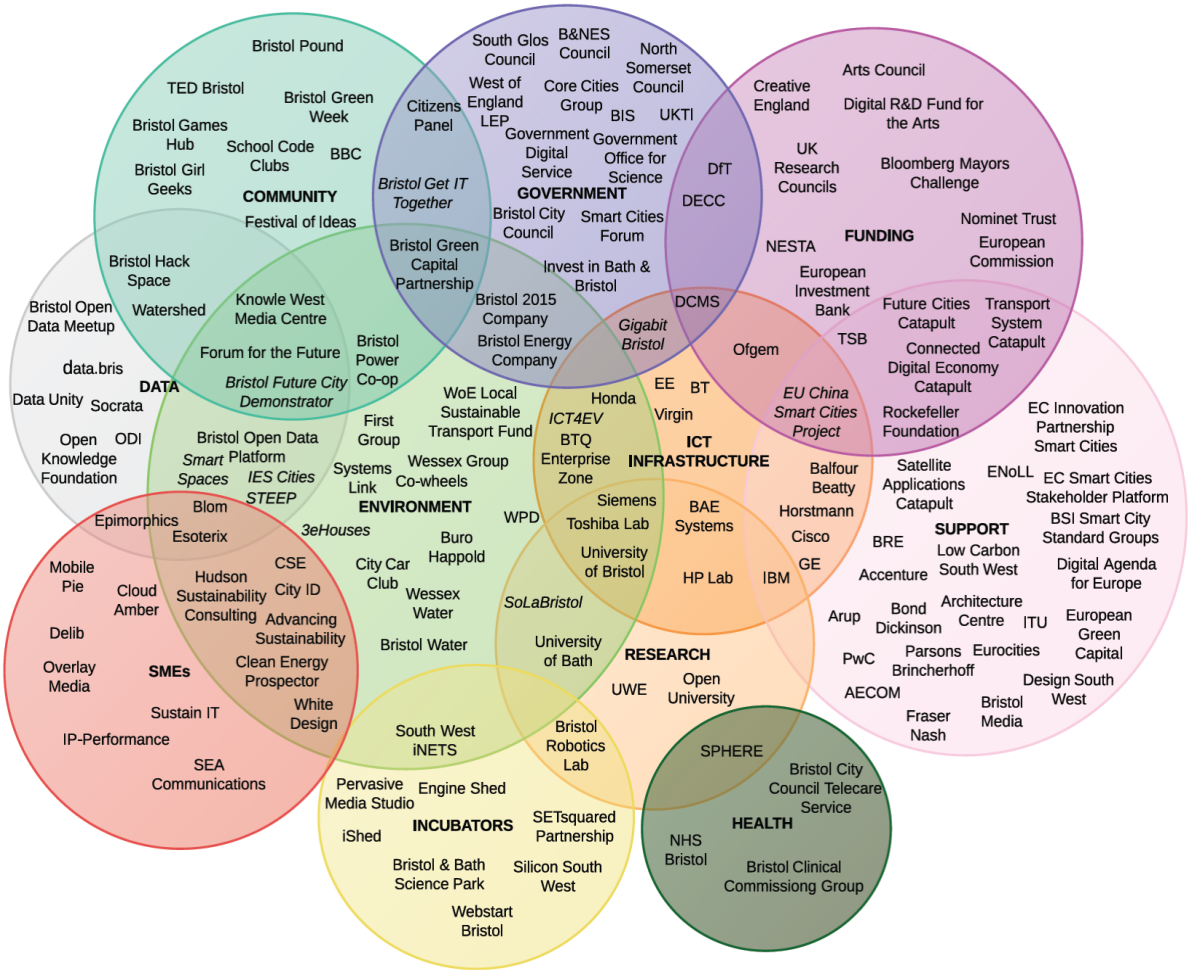

Figure 2: The Smart City Ecosystem in Bristol (Source: 'Bristol is Open' presentation[12])

[9] http://www.connectingbristol.org/

[10] http://www.slideshare.net/Bristolcc/bristol-smart-city-report-7579696

[11] http://techspark.co/spotlight-on-86-2-million-growth-deal-awarded-to-the-west-of-england/

[12] https://www.youtube.com/watch?v=RYBPZRIC0KY

At a more practical engagement, BCC works with a number of collaborators such as universities, businesses, voluntary and community sector organisations (see Figure 2). University of Bristol (UoB), University of West of England (UWE) and University of Bath are the main research bodies within the city-region. Bristol Is Open (BIO) is a city-wide experiment and a joint venture between BCC and UoB. It uses a calibration of a series of datasets to solve problems such as air pollution, traffic congestion and assisted living in Bristol. It has been set up via the connection of three local host partners: At-Bristol, Watershed and Engine Shed. At-Bristol is an educational charity and one of the UK's leading science and discovery centres using a series of multimedia techniques. Watershed is a cross-artform venue and producer which specialises in producing, sharing, developing and showcasing exemplary cultural ideas and talent. Engine Shed is a collaboration between Bristol City Council, University of Bristol and the West of England Local Enterprise Partnership and it has been created to generate innovation through collaboration and networking.

In term of community engagement, Knowle West Media Centre (KWMC), an arts organisations and charity, remains as the key organisation in Bristol. They run Bristol's Living Lab as a part of EnoLL's network and use this network to further understand the role of citizens. They bring in neighbourhoods and diverse communities and engage with members of VOSCUR (the main voluntary organisations in Bristol), Bristol Green Capital Partnership (an independent organisation in the city) and businesses. There is also the Bristol Future City Demonstrator[13] which supports the development of digital infrastructure and the city as a living lab funded by Innovate UK. Big high-tech companies such as Toshiba, IBM and Siemens as well as creative companies such as Aardman and Craig Computing are also located in Bristol and a part of smart city conversations. There are also a number of international collaborations. The city has a sister city in China (Guangzhou) and is a partner with Chicago around a programme called the 'Array of Things'. So, although BCC and University of Bristol are some of the key players, there is a whole variety of other government arrangements in Bristol which creates a complex innovation ecosystem for smart city discussions.

Milton Keynes

In Milton Keynes, the smart city discussions fall under a future city programme. This has been defined deliberately to provide more flexibility in the future. The programme is designed around collaborations between business, universities and government partners such as the national Catapult[14] innovation centres. Within this, the smart city idea has primarily been translated into one particular project called MK:Smart. MK:Smart is a collaborative smart city initiative in Milton Keynes (MK), led by the Open University. A data hub, namely MK Data Hub, has been created to support the collection of data across a variety of different sources. This includes local and national open data, infrastructure networks (energy, transport, and water), sensor networks and social media. The Hub is being run by the Open University and British Telecom (BT). Milton Keynes Council (MCC) and the Knowledge Media Institute (which is a research arm of the Open University) are the key partners that facilitate smart city discussions in the city. Within those discussions, MK Data Hub remains at the core of MK:Smart (Figure 3).

Above the Hub, there are three different domain areas where the city of MK has focused on: energy, water and transport. While energy related research has been allocated to the Open University, University of Cambridge has an important contribution to the transport domain. Also, the geographical proximity between MK and University of Cambridge remain an important element within this relationship. The water domain is split between Anglian Water and HR Wallingford. A level

[13] https://connect.innovateuk.org/documents/3130726/6091879/Feasibility+Study+Bristol+City+Council.pdf/4269233f-cd8b-47da-9f0b-58a27294a684

[14] https://www.catapult.org.uk/

out of these three domains, there are three organisational centric work packages that are citizen innovation, education and enterprise. Community Action MK is the key player that is in charge of the citizen engagement within MK:Smart. While at one level, Community Action MK informs citizens, at another level, they explore how citizens can use the smart infrastructure in place. Via an online platform called ourmk.org, citizens can submit ideas and propose projects in MK. Graymatter has been used as a digital marketing company within this process. While the Open University takes the lead with the education section, the enterprise and in particular SMEs' engagement is done via a part of the University of Bedfordshire that is University Campus MK. Also Fronesys, a consultancy company, has been involved in MK:Smart from its earliest days helping MKC develop the business case for the project. Even though a framework was defined as such, the relationship between different actors varies. For instance, the Open University and Community Action MK work very closely together and their relationship has grown organically. However, sometimes the relationships are defined on a need basis.

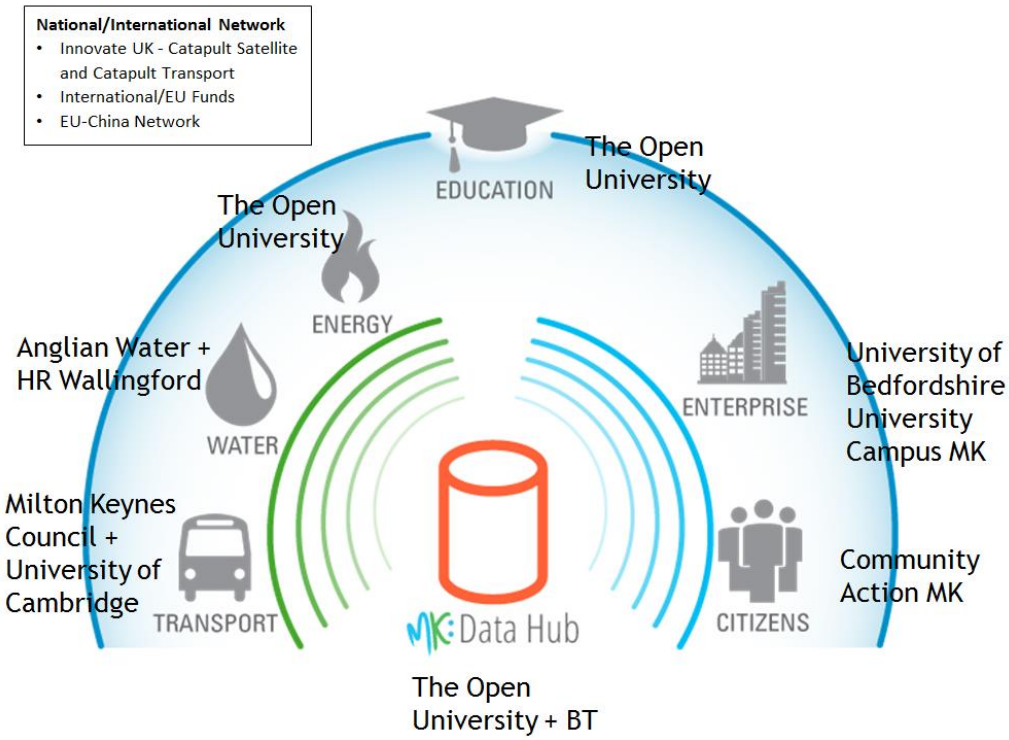

Figure 3: MK: Smart project components (Source: Author's own illustration based on interview notes)

Even though MK:Smart is the main project about smart cities in MK, there is a city level strategy[15] adopted by MKC to transform MK as a city of the future. As the fastest growing city in the UK, smart city has been used as a strategic element adopting new technologies and improve the quality of life to make the city more sustainable. MK:Smart sits as a corner stone project for the city bringing together different sectors. A city-wide IoTs network demonstrator, the Low Urban Transport Zone (LUTZ) Pathfinder project are some of them. MKC has also developed partnerships with corporates in industry. Amongst them, BT's research and development unit has been an important partner. It has invested in MK as a 'flagship city' and as their testbed. Some of the big manufacturers such as Jaguar, Land Rover, Tata and Ford are engaged with MCC due to their interests in driverless cars and EVs. There is also an international interest within the city. MK has involved itself in the EU-China network and builds strong links with Taiwan and Singapore.

[15] http://www.mkfutures2050.com/read-our-report

The challenges of integrating smart systems in the built environment

While there are different approaches towards implementing the smart city approach in practice, the integration of smart systems remains one of the major problems for cities. To start with, all of the smart city discussions across three cases are facilitated by advanced computer technologies which assume that the system integration across institutions are straightforward. However, when it comes to working in partnership, the integration of physical assets and how we use those in a smarter way across organisational boundaries becomes a major challenge. An example might be something like smart street lighting. The smarter element of it is: it uses a different kind of light bulb that's more cost effective so it's energy saving. For an organisation running street lighting, it also gives more functionality and reduces costs around it. However, the multi functionality of such systems comes with a series of other challenges. As has been stated by one of the interviews, there is a need to think holistically how one system is related to other systems such as policing or community safety rather than taking it partially: "We've invested in smart street lighting but we haven't thought about sovereignty or management of that. Could you hand over some control of street lighting to the police in effect so that the police themselves suddenly increase the lighting in an area because they were aware of anti-social behaviour, or is it all done through us and our CCTV operation? How will that affect us in terms of using some of the physical assets that we collectively own?"

Another example is traffic lights. In theory, traffic lights can be changed or fixed because there's a police chase going on or because of an accident. But then the question is who does that and who has the sovereignty of this situation. Or is there potentially a shared ownership model here? In what circumstances could those physical assets be used and how would they be managed? Traffic and mobility is another case in point. They can be the source of great problems in the city, as traffic and mobility are associated with other issues such as air quality and health. But they can also be seen as great opportunities for cities by using the analytics and to stimulate intelligent mobility responses, e.g. changing traffic flows or changing where and how people choose to meet each other. Enabling different sorts of traffic monitoring might also allow people to think about taking another route in case of a congestion or collision on a street. Hence, the technology has potential to employ a range of different solutions as long its embeddedness in the built environment is interconnected.

Lessons from the UK

Today, the concept of smart city is widely and interchangeably used within academia and government. Anything in the context of city operations that is associated with higher technology, information processing, computational systems can fall under the remits of a smart city. The concept can be related to smart meeting, traffic interventions or video data. Lately, there have been some attempts to adopt technologies from Array of Things[16]. This includes projects such as city sensing in which city-wide urban information technology would allow cities to open data to design interventions in traffic, air quality and health. Data and infrastructure remain important elements of these discussions.

Overall, based on the three case studies described earlier, practice in the UK shows that the idea of a 'smart city' is more of a process than an actual product or output. This makes the systemic comparison of the three case studies rather challenging as the actors that are involved in the smart city discussions as well as their activities rather arbitrary, hence making it difficult to relate to one another. Instead of being a full-fledged and functioning system, the concept of smart city has been adopted as an ambition policy makers can aspire to. Hence, it is more about deploying technologies in the built environment to do various experiments. It encapsulates an approach to develop an existing city using technology in order to do things more efficiently. In summary, it necessitates a so-

[16] https://arrayofthings.github.io/

called 'triple bottom-line' approach for cities in which sustainable development incorporates development that is economically, environmentally and socially acceptable (Elkington, 1994). In economic terms, it has to contribute to the effectiveness of service delivery especially in the age of austerity. Local authorities or municipalities have to reconsider new ways to deliver public services while their budgets have been reduced significantly. In environmental terms, the idea contributes to the development of future cities via monitoring CO2 emissions, other greenhouse gas emissions, traffic flows or delivery on meeting the carbon targets of cities. Last but not least, in social terms, the concept needs to engage with communities and aims to be more inclusive and participatory.

Nevertheless, many local authorities have started to move away from Smart City-branding because of the connotations around technology and the top-down views associated with it. 'Future cities', 'Big Data' and 'Internet of Things' have become more recognizable concepts as they refer more to utilising technology and harnessing the existing assets in cities such as citizens and businesses. However, there are still various technical challenges when it comes to adopting smart city technologies in the built environment. Systematic thinking and comprehensive approaches are needed to better manage the challenges of truly implementing smart city technologies in cities. Thinking about smart city as a part of a wider ecosystem, as illustrated in the case of Bristol, would be good way to start off. Nevertheless, local infrastructure and ownership are some of the main challenges in the implementation phase. The UK experience with the smart city discussions has shown that the smart city projects are still in their early stages of development. Yet, they raise some important challenges to current urban policy through Europe in relation to the integration of the socio-technical and socio-political dimensions towards successful transition.

References

Albino, V, Berardi, U and Dangelico, RM (2015) Smart cities: definitions, dimensions, performance, and initiatives. Journal of Urban Technology, **22(1):** 3-21.

Batty, M, Axhausen, KW, Giannotti, F et al. (2012) Smart cities of the future. The European Physical Journal Special Topics, **214**: 481-518.

Caragliu, A, Bo, CD and Nijkamp, P (2011) Smart cities in Europe. Journal of Urban Technology **18(2)**: 65-82.

Carvalho, L (2015) Smart cities from scratch? A socio-technical perspective. Cambridge Journal of Regions, Economy and Society, **8(1)**: 43-60.

Elkington, J (1994) Towards the sustainable corporation: Win-win-win business strategies for sustainable development. California Management Review **36 (2)**: 90-100

Ersoy, A (2017) Smart cities as a mechanism towards a broader understanding of infrastructure interdependencies. Regional Studies, Regional Science **4(1)**: 26-31

Glasmeier, A, and Christopherson, S (2015) Thinking about smart cities. Cambridge Journal of Regions, Economy and Society, **8(1):** 3-12.

Greenfield, A (2013) *Against the Smart City (The City is Here for You to Use),* New York: Do Projects.

Luque, A, McFarlane, C, Marvin, S (2014) Smart urbanism – Cities, grids and alternative? In: Hodson, M.; Marvin, S. (Eds) *After sustainable cities?,* Routledge: London, pp. 75-90.

Figure 2

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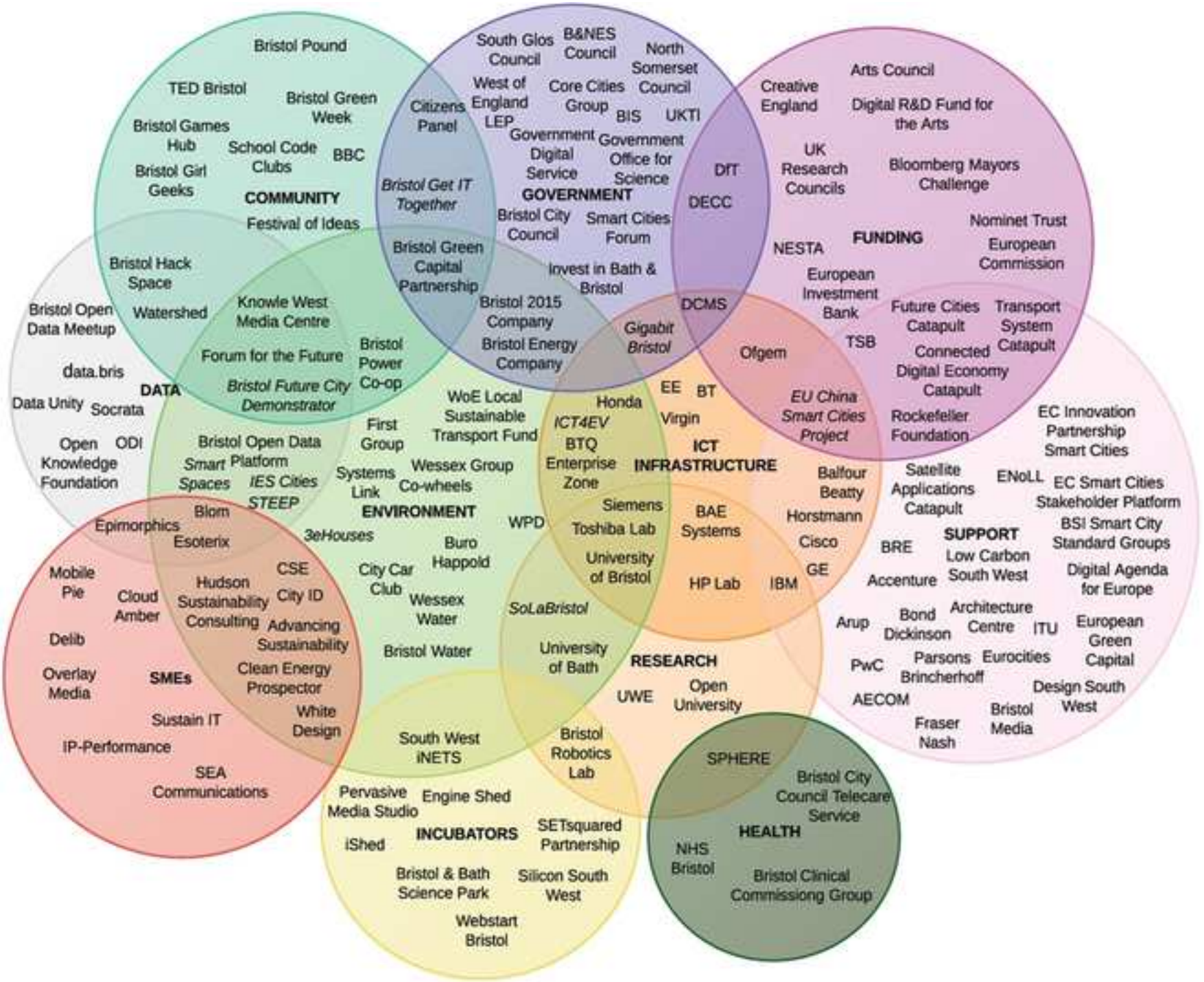

Figure 3