Smart Transport for Smarter Cities in the UK

Full paper

Kawaljeet Kapoor
Brunel University London
Kawaljeet.Kapoor@brunel.ac.uk

Vishanth Weerakkody
Brunel University London
Vishanth.Weerakkody@brunel.ac.uk

Jeremy Millard
Brunel University London
Jeremy.Millard@brunel.ac.uk

Abstract

Products and services offered under the smart city umbrella cut across numerous city operations and systems that benefit a range of stakeholders. Increasing urban populations raise the needs for innovative systems that are capable of regulating the use of resources within cities. City inhabitants are first-hand victims of the potential problems accompanying urban living. Much often, the inputs from these inhabitants are ignored in the process of developing intelligent cities. With traffic congestion being one of the predominant problems of city life, this paper investigates smart transport trends in the UK. The paper reviews publicly available evidences to gather an overview of the current state of smart transport in the UK. In conclusion, this research proposes increased citizen involvement for developing smarter and sustainable transport options across the country. To effectively understand the challenges of urban living, the responsible bodies should facilitate resident engagement for addressing concerns affecting everyday living.

Keywords

Smart City, Smart Transport, Social Innovation, Urban Traffic Management

Introduction

In the present times of mass urbanization, ICT (Information Communication and Technology) has become a ubiquitous aspect of everyday living. The old industrial metropolises built of steel and concrete are now undergoing massive transformations to spread out as megacities that are encompassed within a realm of computers and software applications (Townsend, 2013). In aspiration of jobs, better lifestyles, and cultural exposure, huge numbers of people are moving to the cities. This rise in population is making city life suffer in terms of depleting resources and climate changes. One of the predominant problems of such mass urbanization is traffic congestion and the carbon emissions that follow it. This congestion costs the UK economy around €24.5 billion, every year (ARUP, 2013).

Smart technological innovations are being pitched in to combat these challenges of urbanization to develop smarter cities. The use of technology and computers for monitoring numerous operations across the city is the underlying concept of a smart city. Smart governance and economy, alongside smart people and environment give shape to a smart city (Caragilu et al., 2011). The UK Department of Business, Innovation, and Skills have invested efforts in developing standards for smarter cities in the UK. The role
of these standards is concentrated in supporting the adoption of common approaches for implementing smart city oriented products and services, which are expected to foster quicker development of a smart city market (bsi, 2014).

As identified in the literature, there is no commonly agreed definition for smart cities as yet (Hollands, 2008; Caragilu et al., 2011; Neirotti et al., 2014). This evolving concept of a smart city is being used in different contexts with varied terminologies (Sivarajah et al., 2014). Different authors have expressed similar views on the defining dimensions of a smart city. As Kitchin (2014) suggests, there are two sides to the smart functioning of a city, one is defined by its technical composition, and the other is dictated by its social activity. A smart city is typically comprised of and controlled by pervasive computing. Furthermore, the economy and governance in a smart city will be primarily driven by the innovativeness, creativity, and entrepreneurship exhibited by its smart citizens (Kitchin, 2014). The incorporation of technology and creation of a network for managing city operations is generally expected to optimize the use of available resources. Nam and Pardo (2011) visualize the realization of smart cities along three dimensions – integrating the technologically mediated services with the city infrastructure, social learning for improvising human infrastructure, followed by the role of governance in engaging citizens to facilitate institutional improvement.

The governments worldwide, in the interest of developing smarter cities, are making massive investments. Despite their best intentions to develop cities capable of catering to citizens’ needs, the sustainability of such cities has often been questioned. Subject experts are thus shifting interest towards the citizen side of smart cities. The developers of such smart cities are particularly insistent on fine-tuning a city to be responsive to citizen needs, but they tend to leave the same citizens out of its development process (Townsend, 2013; Wakefield, 2013). This technological invasion in creating a smart city clearly overlooks citizen involvement. A common misinterpretation of smart cities is that they are wholly technologically driven. Developing a smart city does not suffice unless such a city is sustainable. Social innovations across different sectors are capable of increasing the sustainability of these smart cities. ICT alone is incapable of transforming cities into smarter bodies without the inclusion of citizen-led initiatives. Empowering people to devise and design targeted solutions to their localized problems will realize the total potential of a smart city (Haque, 2012).

Neirotti et al (2014) suggest that it is the investment in human capital that fosters a city’s potential for innovations by encouraging and supporting the citizens in improving the quality of their lives. As Giffinger et al (2007) point out, smart city is a term often associated with smarter logistics and transport systems that are directed at improving urban traffic and citizen mobility. This paper is interested in understanding the importance of citizen involvement in making cities across UK smarter and sustainable. Given the rising congestion and traffic related problems in the UK, the focus in this paper will be restricted to socially innovative smart transport solutions that have been implemented across the country. In the interest of achieving a thorough understanding, the paper will primarily look into the transport related statistics and implications of smart transport systems in the UK. As a nation, UK has already been investing in innovatively tackling issues related to transport; some of these smart solutions have been gathered and presented in the later parts of this paper. This is expected to help assess the current trends governing the concept of smart transport in the UK.

Smart cities and smart transport: a contextual background

Literature on smart cities touches varied aspects of smart initiatives from across the globe. Some of the existing literature has evidences of proposed frameworks for smart city initiatives; for instance, the smart city initiative design framework by Ojo et al (2014) is based on their understanding of ten of the biggest...
smart city programs across different countries. They identify seven success factors as the conditions that foster smart initiatives. Other studies like that of Caragliu et al. (2011) focus on offering operational definitions of smarter cities. A thorough understanding of intricate complexities involved in the socio technical factors of the targeted city is essential whilst developing smart city initiatives; Nam and Pardo (2011) undertake a conceptual study to pinpoint at technology, institutions, and people as the three defining dimensions of a smart city.

Some examples out of the numerous smart transport initiatives in operation across the globe have been briefly mentioned here. Southampton was recognized for its successful multi application smartcard, following which, it came to be known as UK’s first smart city (Hollands, 2008). Barcelona runs an orthogonal bus network that allows getting to any location within the city in a single transfer, 95% of the time (bcnecologia, 2015). In South East Asia, it was Singapore, where the development of an intelligent island under their IT2000 plan used information technology to bring significant transformations in their everyday work and life, in general (Hollands, 2008). Daegu city of South Korea operates a 24km long monorail system, which is a light rail system connecting to 30 stations. It is appreciated as a great alternative to the extant rail systems, given its low construction costs and minimalistic carbon footprint (Hitachi, 2015). Copenhagen, Barcelona, and Amsterdam have been majorly recognized for their smart bike sharing initiatives and low carbon emission levels (Cohen, 2014).

Methodology

To obtain an overview of the present scene for smart transport in the UK, this paper reviews publicly available evidences of smart transport in the UK. In doing so, horizon scanning was carried out using grey literature, white papers, and other evidences openly available in the public domain. Essentially, a web search was undertaken to capture the cases reported and improvements suggested by the local municipalities, government ministries, community agencies, local councils, research communities and their blogs. Given that the concept of smart city, and particularly, smart transport, is still emerging, the aim of this paper is not to typically develop any conceptual framework or model for supporting sustainable transport in the UK. The paper is rather more inclined towards scanning and learning about the potential spread of smart transport across the UK cities.

Implications for transport in the UK

The population in Great Britain is forecasted to rise by 10 million by the year 2037 (Cangiano, 2014). Good transport links contribute to stronger economy and better living in contrast to congested transport networks that bring unreliability and constrained travel opportunities, restricting overall growth. The government is planning to invest more than £70 billion across all transport modes by 2021 (DFT, 2013). High Speed 2 is an active undertaking addressing this issue, which is being held accountable for £16 billion of this investment (DFT, 2013). There has been a notable increase in the number of vehicles on UK roads. The quality of the road network needs specific attention and the critical need to reduce congestion and disruptions to road journeys needs to be addressed (DFT Policy, 2014).

Statistics show that 55% car journeys are less than 5 miles and many of these trips could be walked or biked/cycled, or public transport could be used to fulfil these journeys (Department of Transport, 2014). This will reduce the resulting carbon footprint and will help UK reach its climate change goals. About one quarter of domestic carbon dioxide and other greenhouse emissions in the UK are coming from transport, worsening the air quality within the UK (DFT Climate Change, 2012). Reducing greenhouse gases from transport by 2050 has been actively established as a long-term goal in the UK (Carbon Plan, 2013). The
use of ultra low emission vehicles and sustainable biofuels is expected to reach a new high in the coming years. The use of buses, taxis, private hire vehicles, cycles, door-to-door journeys, and smart ticketing is being heavily encouraged. The government is giving away funding to local transport authorities in England to assist them in developing local transport services. Funds for the local councils are being made available via grants that are paid to successful bidders in a competition (Department of Transport, 2014).

A UK government report on smart transport quotes that by year 2018, the global market for smart transport will rise to $4.5 billion. These smart transport solutions will involve investments in the digital and physical infrastructures for managed and guided parking systems, traffic management, and smart ticketing facilities. Big data analytics and road design will also be a huge part of this smart transport management system (ARUP, 2013). Great Britain has a strategic framework for road safety that is aiming at giving the local councils a free hand in deciding ways to make their roads safer. The transport and mobility oriented policies by the Department For Transport (DFT) in the UK are majorly directed at: making roads safer for public use, investing in managing and improving road networks, minimizing transport-induced emissions and greenhouse gases, ensuring more accessible transport for all, and improvising local transport (DFT, 2015).

Social Innovations for Transport in the UK

In the context of smart cities and solutions for transport, several countries have promoted the idea of social innovations that are aimed at making the cities smarter in dealing with the day-to-day traffic challenges. A social innovation can be a product, a model, or even a service that is implemented to meet a pressing social need/issue that is aimed at improving human wellbeing (Landabaso et al., 2013). Some of the transport oriented social innovations in operation across the UK have been compiled within this section.

Smart parking solutions are being offered via installed parking bay sensors in the Westminster parking zones that intimate the motorists beforehand of parking availability across different locations (Westminster Council, 2015). There are 3000 sensors already in operation that feed real time parking availability data onto the ParkRight application that the drivers can access via their smartphone navigation (Curtis, 2014). Motorists can check the availability of parking spaces on this free mobile application even before leaving their homes. All motorists, even those without smartphones, can utilize this facility, as parking marshals on location will soon be able to access the live feed of parking spaces with these sensors to manually direct drivers to available parking spaces. This initiative is a shift from the conventional parking that avoids unnecessarily arriving at an already full parking facility causing unwelcome congestion.

Pedestrian SCOOT (Split Cycle Offset Optimization Technique) is a Transport for London (TFL) initiative enhancing road safety for pedestrians and cyclists. Smart pedestrian crossings will be introduced on London streets under this scheme, and it is being called the world’s first initiative of its kind. Pedestrian SCOOT will be running on a cutting edge camera and smart sensor technology to monitor pedestrian traffic at busy junctions to re-phase the lights to go red, allowing the pedestrians to cross and clear quickly without long waits (Crawford, 2011). The purpose of this scheme is to combat accidents caused due to pedestrians’ impatience on busy roads. This intelligent system will also be capable of detecting if all pedestrians have cleared, and will then turn the lights green for the motorists by automatically cancelling pedestrians’ cross request. This system is a shift from the pushbutton wait system to automated smart detection of pedestrian volumes for halting the motor traffic as and when required.
Car clubs offer short period car rental service for a small fee by the hour or distance (TFL, 2015). They allow commuters to reserve a car for personal use either by the hour, or for a day, or for even longer periods. These cars come insured with parking permits. These clubs are extremely popular in London, with statistics revealing that about 80% of car club users are based in London. This social innovation is also widely accepted in Scotland. Car club members enjoy dedicated parking spaces in some of the cities. Evidence suggests that UK aims to achieve a target of one million car club users by the year 2020. With such car clubs in the offering, car ownerships can be avoided, which omits car maintenance, insurance, and other associated ownership costs. It brings an evident shift from buying a car and helps improve traffic conditions by eliminating unnecessary parking congestion.

Car sharing or carpooling is widely spread in the UK. It is an initiative actively supported by the British government, whereby TFL is supporting a national UK charity named Carplus for relieving the financial, environmental, and social costs of motoring in London. People from the same neighbourhood, friends, and peers sharing the same workplace or travel destination mutually agree to use one car to get to their desired locations. In this case, all travelling passengers contribute equally, or as agreed, towards the journey costs. There are numerous websites (GoCarShare, Liftshare.com, etc.) that offer information on car owners who are ready to share a ride on given dates, and passengers who are looking for a spare seat on certain dates. Sharing cars on a regular basis helps combat traffic and parking congestion. Unavailability of car sharers at certain times across various locations is a potential problem with this type of transport system.

Public bike share, or public bicycle system, or bicycle sharing system is a socially innovative scheme that encourages people to opt for shared bikes over car journeys. This scheme allows people to pick a bike from one point to get to another location within the city at very affordable prices (Barclays Cycle Hire, 2015). For instance, the Belfast city council is launching a public bike share scheme in the spring of 2015 (Belfast City Council, 2015). To begin with, 300 bikes will be made available across 30 pre-designated docking stations in their city centre. These bikes will be available for public use as a cheap alternative for the residents, tourists, students, and commuters to get around the city. These bikes can be registered for use on an annual subscription or a three-day casual use period basis. Public bike share helps avoid driving small distances (say between train station and workplace). It effectively reduces traffic congestion and comes with zero carbon emission.

Cycle to Work scheme is a tax exemption scheme initiated by the UK government in the interest of promoting healthier environment and living. Only employees of public, private, and voluntary sectors being paid under the PAYE (Pay-as-you-earn tax) system can avail this scheme. All cycles (bicycle, tricycle, or a four or more wheeled non-motor cycle) and cycling safety equipment can be bought tax-free by the employer that can then be loaned to the entitled employee for journeying to work. Employers may recover the incurred costs under a hire agreement, and since the hire payments are made from employee’s gross salary, they become non-taxable (Cyclescheme, 2015). The Republic of Ireland and Wales (Cardiff) also run a cycle/bike to work scheme with the employee salary sacrifice option, similar to that followed in England. This initiative is still in its infancy.

Numerous transport services under varied names of demand responsive transport/DRT, demand responsive transit, demand responsive service, dial-a-ride-transit/DART, and flexible transport, operate on a shared basis to assist people in getting to different places. This service encourages opting for shared rides at low prices in comparison to travelling individually. England and Wales have flexible DRT services that are available only upon pre-booking. Hampshire, Wiltshire, Tyne and Wear, Lincolnshire, Strathclyde, Somerset, Aberfoyle, North Yorkshire, Surrey, and Kent are some of the participating counties in this DRT scheme. DRT avoids traffic congestion and reduces overall fuel usage.
X-crossing is a new pedestrian crossing mechanism in the Oxford circus of London city, which is being exemplified as one of Europe’s busiest diagonal crossing. Recorded numbers from 2009-2010 show that at the busiest hours, around 40,000 pedestrians pass through the Oxford Circus junction in London (Greenwood, 2010). Shaped as an ‘X’, this junction is capable of handling double the number of pedestrians at once, easing out overcrowding at an extremely busy intersection. Controlled by traffic lights, the unique design of this crossing has helped in doubling the amount of pavement and created extra space around the exits to the nearest tube station. X-crossing helps avoid long pedestrian wait times and overcrowding at junctions without having to always halt the traffic.

Fare Car is another innovative transport scheme under which a safe and friendly shared-taxi service is offered to people in secluded areas (Bathnes, 2015). This service runs at set times, only twice a day, from rural areas to the city at very low prices, that need not necessarily be pre-booked. The Bath and North East Somerset council offers combined financial support to Bath taxis for running this fare car service. Available to all residents of Langridge and Northend, and Combe Hay, Shoscombe, South Stoke, and Wellow regions, this service takes the residents to, and brings them back from the Bath city centre. Initiatives like Fare Car help avoid the risks of travelling alone from secluded rural areas to the city.

Chew Valley Community Transport is a unique smart transport solution that assists people with medical requirements in the valley to get to the medical centres outside the valley (Bath and NE Somerset Council, 2015). This community transport service is exclusive to all residents of Bath and Somerset villages of Chew Valley. This transport service is strictly reserved for residents requiring vital medical treatments; such people are driven to their appointments either within or outside of the valley, and also brought back. The residents availing this service are asked to give prior time estimates of their appointments and treatments to match their times with the availability of the car volunteers. These residents are also requested to make a donation towards the car volunteer’s fuel and insurance. Chew Valley Community Transport service prevents people from neglecting their health issues, given the location of Chew Valley and its accessibility difficulties to the appropriate medical centres, by offering people transport aid. Since this initiative runs on the availability of the citizens willing to volunteer their services, one drawback of such a service tends to be the possible shortage of volunteers at given times.

While some of the socially innovative solutions have already been implemented across different parts of the UK, there are many cities with increasing potential still aspiring to incorporate smart solutions across their standard city operations. For instance, the Birmingham City Council has the Birmingham Smart City Commission dedicated to developing smart city solutions to particularly target a low carbon economy adaptable to the fluctuating climatic changes. They are encouraging city residents to be involved in proposing sustainable re-inventive strategies for better organizing their city operations (Birmingham City Council, 2015).

Discussions and Reflections

Of the different socially innovative transport solutions discussed in the previous section, car clubs, car sharing/carpooling, public bike share, and community transport are straightforward examples of social innovations relying on resident involvement in tackling transport related problems on hand. All these transport initiatives are simple and driven by the residents themselves. Since these solutions are not pre-programmed or remotely controlled by a computer generated code under predefined regulations, they are increasingly flexible and can be contextually modified to suit the local requirements at the given hour. A December 2013 press release has the UK department of business, innovation, and skills reporting that the government, businesses, cities, and even universities are coming together to fixate UK’s position as a
global leader in the run to develop smarter cities (DBIS, 2013). As Haque (2012) suggests, people create and recreate cities with their dialogues and undertaken transactions, and also with the spaces that they inhabit; a smart city should be capable of enhancing these interactions by taking inputs from these people instead of treating them as mere consumers of the developed smart solutions (Haque, 2012).

An intelligent model for a sustainable smart city must be based on and acquire from the smartness of its residents. Cities are largely perceived as structures of diversity, and hence restricting focus on functions encompassing transport, utilities, non-evident governmental processes, and construction can become unproductive. One example of such unproductive output can be dated back to the 1960s, where the social housing tower block led to economic inefficiency and overall social unsustainability (Millard, 2014). Mere incorporation of information technology that remotely derives statistics based on the demographic and location aspects is not sufficient in highlighting the smart factor in smart cities. It is rather the smartness showcased by the residents in their newer and efficient ways to understand, interlink, and implement the data on hand to defeat the contextual problems that will create smarter cities.

The city corporations and local government bodies play a crucial part in creating and maintaining a smart city. These bodies are essentially required to make the data open to facilitate coding of the information to build applications and services in line with the available data. However, making the data public does not suffice. Public should be capable of generating their own data, and this possibility can only be realized if the public is allowed to be actively involved in creating and contributing their own data. For instance, Millard (2014) exemplifies the case of systems for monitoring air quality; according to them, numerous systems across the globe offer updated insights on the pollution levels across localities. If such data are freely opened to the public, it could help them make neighbourhood related decisions when planning to move houses. If a resident-assisted air monitoring system is put in use, the system could be used for measuring air quality at different levels, say, the average height of children found in parks. This way the children could be guided to play in a much safer zone dwelling in good quality air. The residents can also use such systems to measure the environmental impact that their private cars have in terms of emissions. Such systems will instantaneously make the residents environmentally conscious encouraging them to adopt greener ways of living. Making such systems accessible allows the residents to experiment more in their habitat, facilitating self-learning and encouraging instinctive solutions to tackle existing challenges.

**Conclusion and Recommendations**

It is evident that the concept of smart transport systems is still in its embryonic phases. Given the emerging nature of this concept, it is too early to make any defining conclusions on the impact it has in managing urban traffic. However, it is clear that social innovations have great potential in dealing with the transport related challenges, and they have an important role to play in sustaining smart cities. The problem being addressed here is particularly of traffic congestion in UK cities, and the solutions involve innovative urban traffic management systems. This paper collates some of successful socially innovative smart solutions that are making transport more accessible and easy for all commuters in the UK. Each of these social innovations have been briefly explained in this paper, and attention is also focussed on identifying the aspects that remain constant with these innovations alongside the changes, shift, and improvisations that they bring to the existing systems for bettering the transport options across the cities. From the identified smart transport initiatives and the undertaken discussions, governance, citizens, communities, economic resources, policies, and different organizational players emerge as the facilitators of smart solutions.

The transport related cases captured in this paper are clear evidences of successful smart initiatives that have contributed in controlling and easing out the city congestion to a considerable extent. The findings
reported in this paper are expected to highlight the fact that the increasing potential for smart transport is not fully captured yet, and citizen involvement in formulating these smart solutions will have a positive influence on their sustainability in the future. Smart cities are expected to better manage the supply and demand cycles, and offer improved services to the citizens, in effect, capable of enhancing the overall quality of life that will boost national competitiveness (Holland, 2008) of those cities. As cities expand, planners invest in developing intricate systems to deal with problems accompanying such expansions.

Smart cities are not solely about authorities generating programs, or designing applications that control and set limits for different operations. Smarter cities are greatly oriented towards the residents who are enthusiastic about collaborating with one another to devise products and applications capable of targeting and fixing localized problems. Smart cities foster an environment that nurtures the creativity of its residents in a way that they actively contribute in developing ideas that offer solutions and services, instead of being mere recipients of some statistically generated solution brought to them via an appointed body. Smart cities essentially need to be efficient and flexible. While the efficiency of these cities is reflected in their smarter/lesser usage of the available resources, their flexibility becomes extensively visible in their dynamic ability to adapt to changes in response to the unplanned occurrences. The creative side of the residents is harnessed through their abilities to adjust and rewire the city to address the contextual problems hindering the smooth functioning of their lives in the city.

City conditions are subject to constant change, and a smart city will not remain smart for long with a simple installation of pre-programmed system designed to tackle a pre-defined issue in a particular manner. Smart cities demand reconfiguration on a daily basis. The governments are required to pay specific attention to compliances concerning common frameworks, open standards, and structured data formats (Millard, 2014). Communities will then have a freehand in developing programs based on the available data. However, aspects such as those concerning infrastructure-oriented investments are required to be purely entrusted with the governments and other regulatory organizations.

The British government is encouraging social investments and innovations to address the transport and mobility related policies for making extant public services more economically viable. The transport and mobility sectors have witnessed successful social innovations with initiatives being taken up by a range of actor networks. Green motoring is being extensively offered by myriads of services. Community transport is being hugely supported and operated by volunteers and voluntary organizations. Numerous councils are partnering with potential charity services in their areas to offer mobility related support to those with restrictive movement. Transport for London is actively lending support to national charities to facilitate motoring initiatives in the UK. Groups and forums are coming together to offer mobility support for the elderly. Universities are also offering innovative solutions to address issues concerning elderly mobility. The UK government is also supporting socially responsible transport via employer-based schemes. In summary, government and other community-based organizations are heavily contributing funds to promote social innovations in the UK. Social partners such as the NGOs, charities, and entrepreneurs are playing an important role in communicating their local level concerns regarding transport and congestion to the central government through their local government representatives. While this helps in shaping local level transport needs, it also contributes towards national level policy formulations. Governments should foster an environment for policy implementations that encourage smart initiatives.

The inclusion of pervasive computing to manage city operations cannot be perceived as a foolproof solution to all challenges ranging from air pollution to urban traffic. The local governments and corporations are creating and linking responsive systems with available data, but this will not fully target or solve the extant challenges of urban living. These systems will undeniably offer increased visibility and broader perspectives concerning these challenges, but will not necessarily be effective in providing long-
term solutions. Therefore, for the full potential of a smarter city to be realized, it is imperative to empower residents so they can acknowledge, address, and attack the localized challenges to devise dynamic responsive solutions.

REFERENCES


DFT Policy. 2014. “Managing, Improving, and Investing in the Road Network,”


