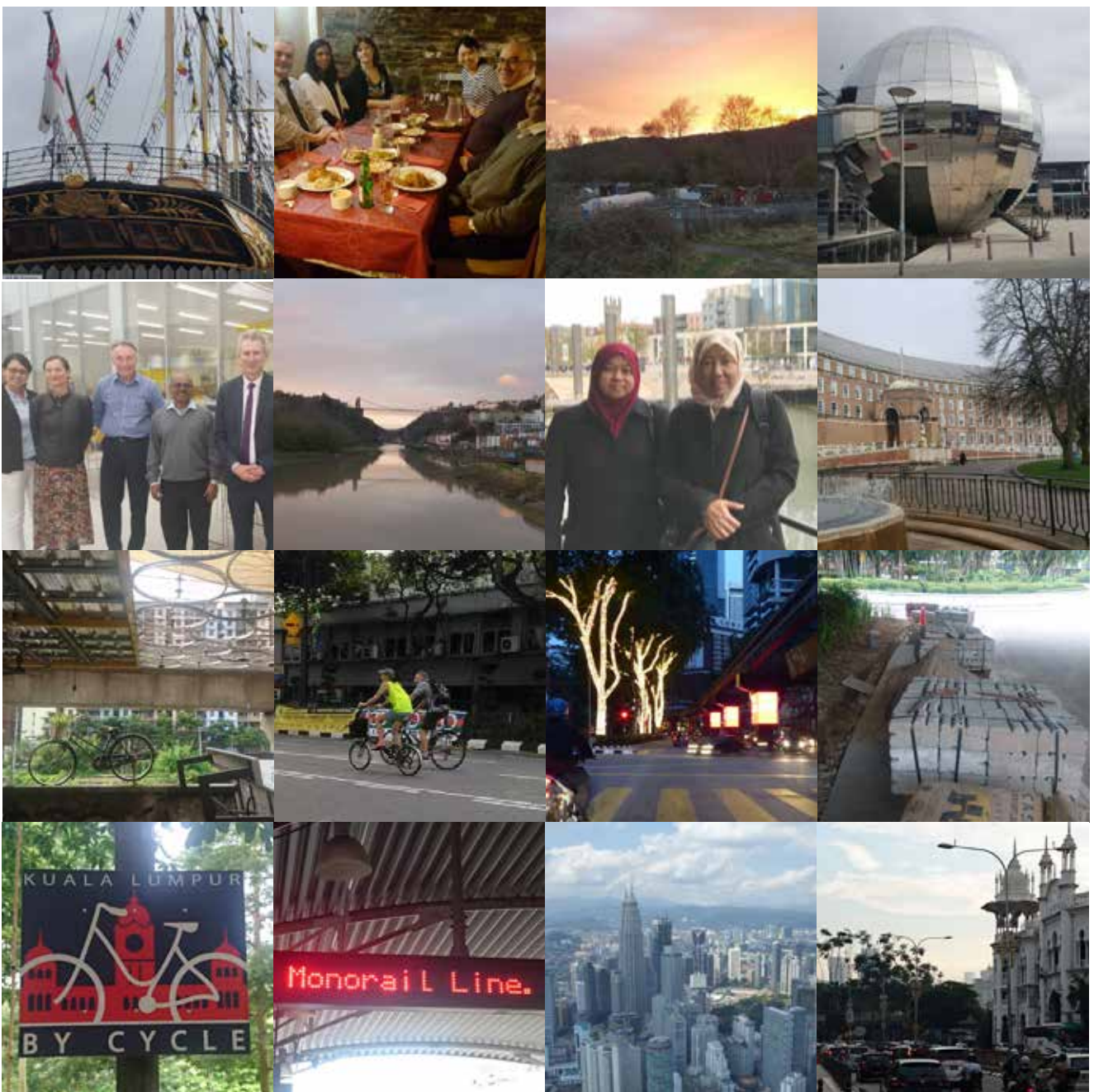# Smart Mobility Cities: connecting Bristol and Kuala Lumpur Project Report

Preface

Financed by the British Council Institutional Links program this Smart Mobility Cities project has opened a fascinating window on a journey of discovery linking Bristol and Kuala Lumpur. This journey was in part directed towards the realisation of Smart Mobility solutions to the socio-economic and environmental challenges of global urbanisation. Beyond this, the journey was also concerned to strengthen research and innovation partnerships between the UK and the emerging knowledge economy of Malaysia, enabling UK social scientists to collaborate on challenging global issues with international researchers and vice versa.

This Smart Mobility Cities project report presents innovative, creative and yet fully practical solutions for these societal challenges. Solutions that explore a range of opportunities, which include those arising from new urban governance requirements, and which are in-line with visions for sustainable urban mobility.

These Smart Mobility solutions have arisen from intensive co-design and co-creation engagement with a diversity of stakeholders. Research co-production has linked the principal university partners of the University of the West of England (UWE), Bristol, and Taylor's University, Kuala Lumpur, together with the Malaysia Institute of Transport (MITRANS), Universiti Teknologi Mara, and the University Sains Malaysia (USM) in intensive engagement with stakeholder interests in both UK and Malaysia over a two-year period.

Foundations of a long-term global research partnership have also been established through the process of active research and innovation – linking research institutes, planners and social partners in addressing the challenges of urban transformation. The dynamics of social and technological innovation has driven and defined this emerging partnership, aiding the specification of transition pathways according to an architectural frame of integrated and participatory urban governance.

Indeed, common purpose binds this Bristol-Kuala Lumpur partnership, as global problems are drivers of change to invest cities with common solutions designed and delivered by cities. Cities are the developers and implementers of innovative solutions to these common problems, and in doing so explore the potentials for common solutions that ensure the realisation of global policy objectives towards the United Nations Sustainable Development Goals. Kuala Lumpur, Malaysian and ASEAN experience and expertise offers insights and understandings for Smart Mobility cities that resonate in Bristol and Europe, and vice versa.

Global transformations in urban economies, the opportunities arising from emerging new technologies allied with social innovation, and the requirements for governance delivering resilient and sustainable urban development represent some of the "grand challenges" of our time. This Smart Mobility Cities project report offers some innovative potential solutions for Kuala Lumpur as a contribution to drive, define and deliver the necessary transformational change agenda for sustainable global cities. The Smart Mobility Cities project team hope these suggested solutions will be of interest to policymakers and practitioners in the field. The emerging global partnership of universities that bridges Bristol and Kuala Lumpur aims to continue this work.

David Ludlow
1st March 2018

Acknowledgements

The Bristol and Kuala Lumpur Smart Mobility Cities project team would like to express their heartfelt thanks to everyone who has made the Smart Mobility Cities project, and its research, possible. On reflection, the research undertaken was a small part of our collaborative work together over the past two years. Both work-based and friendship relations have developed. We very much look forward to collaborating on future research projects.

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01. Cities and urban mobility: trends and challenges

1.1 Global Urban Mobility Challenges

In this report, we define mobility as the movement of people (and things) all over the world and at all scales (Cresswell, 2006: 4). Mobility has many dimensions, such as intellectual, social, professional or spatial. It also brings countless opportunities, constraints, and freedoms that shape modern society "over time and across space" (Shaw and Hesse, 2010: 306).
 In the global context, drivers such as rapid urbanisation, changes in production and increase in energy use, changing social preferences and rapidly advancing technology are playing a key role influencing the scale of mobility (Frost and Sullivan, 2012).

1.1.1 Rapid Urbanisation

Globally, over 50% of todays population lives in urban areas. This trend is expected to continue, in which by 2045, the number will increase by 1.5 times leading to 6 billion urban residents (World Bank, 2018). Rapid urbanisation and greater population density may offer many promising prospects. Regarding the economy, a larger population means greater access to both large supplies of labour and a consumer market. Having good access to large markets allows higher product and service efficiency as well as lower costs of production. The McKinsey report, *Urban World: Cities and The Rise of Consuming Classes* (Dobbs et al. 2012), highlights that it is expected that more than one billion people in cities worldwide will be mainly consumers with enough income to buy necessities, who will drive the rapid demand for many goods and services.

On the other hand, as the world's urban population is expected to increase, most urban areas in the world will face numerous challenges in meeting the needs of this population including meeting accelerated urban development, responding to transport needs, seeking a mechanism to protect the environment as well as ensuring social interaction and wellbeing. The largest urban growth takes place in countries of developing regions (United Nations, 2017). As a result, the increased level of urbanisation has resulted in a number of urban mobility challenges. The growing proportion of the world's population, who are located in the urban areas been projected to reach nearly 66% by 2050 (UN, 2014). This scenario imposes several challenges regarding a growing concentration of people and the associated flows of resource required to support economic prosperity and social well-being, as well as addressing the resultant waste. An important component of the 'urban metabolism' (Clift et al., 2015) is mobility, in particular, the movement of people, driving major energy and emissions implications. Such mobility has also been a long-term challenge for urban authorities faced with limited capacity (and capacity to invest) and substantial demand, with increasing pressure from urban population growth. Thus, making urban mobility sustainable has been a longstanding pursuit (Lyons, 2016).

1.1.2 Increased use of Private Transport

Urban growth has led to an increase in the use of private cars as cars have always been the preferred choice due to their speed, cost and convenience. In our neo-liberal and individualist societies, cars have also been identified with people's achievements and identities (symbolic value). Buying and driving cars can stimulate feelings of thrill, excitement, stress and embarrassment (effective value). Thus, the car has been the 'iron cage' of modernity, motorised, moving and privatised. Automobility, thus produces desires for flexibility that only the car system seems to be able to satisfy (Urry, 2008). In Malaysia, for example, about 83% or 6 million trips were made using single occupancy private vehicles and the car is the main transport mode in Kuala Lumpur (Onn et al., 2014). Although travel by car is sometimes necessary, the increase in the number of cars on the road and its popularity has contributed to severe environmental problems to both human and non-human. An apparent consequence of urbanisation is rapid motorisation in all cities around the globe. The rapidly increasing motorisation leads to heavy traffic congestion in urban districts, especially in super cities. Sprawling cities, in particular, together with relocations of workplaces, schools and other urban amenities, lead to more people making more trips and travelling longer distance by car. The excessive use of private transport harms the urban mobility, resulting in damage to the population and the environment (Costa et al., 2017).

1.1.3 Environmental Degradation

Private car transport planning approaches have failed to cope with the externalities of the transport system, such as traffic congestion, air pollution, transport noise and degradation of the environment (EU, 2001). They have not responded to the challenges of energy scarcity and climate change, as for over two centuries people depend on abundant and cheap energy. Additionally, use of energy is not equal amongst various nations or population groups: 20% of humanity is responsible for 80% of the world's consumption, energy use and greenhouse gas emissions (Wegener, 2013). In urban areas in Malaysia, emissions of carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), sulphur dioxide (SO_2), lead (Pb) and particulate matters (PM10) are the most common pollutants associated to car traffic (Mohamad et al., 2015). These pollutants, produced by vehicle emissions, have been linked to numerous health hazards, such as lung damage, mental health and asthmatic condition. Beyond localised air pollution problems, car traffic has also caused large-scale environmental problems, including climate change as a result of carbon dioxide (CO_2) emissions, acidification of nature, agriculture and the landscape (Van Wee, 2007).

1.2 Sustainable Urban Mobility Issues

Mobility is one of today's major technological challenges. From the beginning of the 20th century, the automotive industry has risen to the top, by providing mobility for public transportation. The dependency of urban mobility on non-renewable resources has affected the environment, deteriorating the air quality in various urban areas. Although vehicle emission

standards and regulations are enforced, and manufacturers' compliance is already established, greenhouse gas (GHG) emissions, stemming from urban transportation, are still often above the levels that can be compensated in the social and environmental sustainability (Cagri Kose et al., 2016). Sustainable urban mobility is about the ease, convenience, affordability and accessibility of travelling to one's destination with minimal impact on the environment and others. Lam and Head (2012: 259) suggest that "accessibility and convenience can be increased with good urban design, behaviour change, advance technology, supportive policies, economic incentives, and city engagement and leadership".

1.2.1 Road Safety

Rapid motorisation has also increased deaths and injuries from road accidents. The risk of injury or death increases when urban areas are designed for motor vehicles and not human scale or speed (human speed = 3 mph vs avg car speed of 30 mph). The risk of accidents also (i.e. the ratio of accidents/population) increases with the size of the towns and population. Thus, the level of safety may, therefore, deteriorate with urbanisation. Based on the OECD *Road Safety Annual Report 2017*, road crashes kill about 1.3 million people worldwide every year and severely injure an estimated of 50 million people; with nine out of ten lives lost in traffic being in low and middle-income countries (ITF 2017).

1.2.2 Evolving Societal Changes

Besides the economic benefits, denser population growth may create opportunities for social change to emerge. Many posit that rapid urbanisation and greater population density provide spaces for "social innovations" to take place. The *World Urbanization Prospects* by the United Nations (2014), highlights that increasing urbanisation has been accompanied by many innovations to deliver life-changing outcomes for both society and individual such as longer life expectancy and a reduction in poverty. However, easy and cheap travel opportunities may also facilitate wide networks of friendship and social relations. For example, spatial mobility facilitates social and job mobility, but also often enforces separation of partners and fragmented families. The idea of "automobiles for all" is ficticious, as large parts of the population (the elderly, the poor and the disabled) remain excluded (Wegener, 2013).

1.2.3 Government Commitment and Policies

For the last two centuries, people have enjoyed travel without having to pay more. However, depleting resources and higher cost may limit travelling, unless technological innovation is created and adopted. The global warming phenomenon has also triggered, as in most countries, greenhouse gas emissions which have continued to grow, with transport being the major contributor. As a result, many governments have established ambitious greenhouse gas reduction targets, which require both technological innovation and price incentives to induce changes in mobility and location behaviours.

Unfortunately, many urban models are not prepared to model policies, such as the promotion of more energy efficient vehicles or alternative fuels and the necessary refuelling infrastructure, redirection of transport investment to public transport, transport demand management, anti-sprawl legislation, and the resulting distributive effects and social conflicts. Many do not consider travel costs in trip generation, trip destination and mode choice, or household travel and housing budgets. Many use price elasticity estimated in times of cheap energy. Leading, as a result, to an underestimation of rising transport costs (Wegener, 2013).

For example, the effort and commitment of advanced countries to reduce greenhouse emission by 80% by 2050, have led to what can be said to be a sad demonstration of the "tragedy of the commons" due to the unwillingness to give up the over-use of free common resources. Fuel consumption by transport, after some stabilisation during the economic crisis in 2009, has started to grow again. Technological progress in alternative fuels, electric cars or fuel cells has been slower than expected. If current trends continue, it is likely that without higher fuel prices, either by market developments or political intervention, the targets will not be achieved (Wegener, 2013).

The policy challenges, of energy scarcity and climate protection, for cities are closely related. New policies and policy packages in urban transport and land-use planning are needed to secure a reduction in fossil fuel use, increase in energy-efficient vehicles and alternative fuels, as well as changes in mobility and location behaviour such as:

- Promotion of more energy-efficient vehicles or alternative fuels

- Investing in refuelling or charging infrastructure

- Redirecting transport investment into public transport

- Managing transport demand to promote public transport

- Increasing tax and other incentives to promote cycling and walking: higher fuel taxes, road pricing, speed limits and other restrictions of car driving

- Introducing anti-sprawl legislation as well as minimum standards for access to basic services, such as retail, healthcare and education, for all population groups and in urban, in suburban and rural areas

These policies may take time to be developed and implemented. They might also generate significant financial and distributive problems as well as social conflicts. Planners will, therefore, have to identify groups or communities affected by energy scarcity and greenhouse gas reduction policies and to design and test compensation policies to assist the most affected groups (Wegener, 2013).

2. Defining smart Mobility City

2.1 Smart city concept and definition

The needs to improve quality of life and security, to manage resources and better mobility and connectivity, and to facilitate community living led to the rise of cities (Zubizarreta et al., 2016). The rapid growth of urbanisation and need for sustainability has led to the development of thinking around the concept of Smart Cities, an urban strategy using technology to increase the quality of life in urban space, both improving the environmental quality and delivering better services to the citizens (Hall, 2000).

But what does the concept entail? Despite considerable attempts by governments, industry practitioners and academicians to define the vision and ideal images of the Smart City (i.e. Smart Economy, Smart Governance, Smart Environment, Smart Mobility, Smart People, and Smart Living), there is no universally accepted definition, concept, components and frameworks for a Smart City. It will depend on human needs at a specific time but can develop and evolve. Empirical evidence suggests that the evolution patterns of a Smart City depend on the area or country-specific factors such as economy, regulation and culture. Obviously Smart Cities initiatives have been at the forefront in developed countries while cities in developing countries are still at the infancy stage of Smart City development.

Some equate Smart Cities to digital technology, others to the response needed for transport-related challenges, including pollution, congestion, accidents, public transport decline, environmental degradation, climate change, energy depletion, visual intrusion, and lack of accessibility for the urban poor. Many agree that cities have become too car-dominated and less sustainable (Arena et al., 2013). An overarching definition of a Smart City could be transformation and learning processes, which promote digital technology for cities to be more competitive, innovative, responsive, inclusive, resilient and sustainable.

Giffinger (2007) defines Smart Cities along six axes: (1) Smart Economy (2) Smart Environment, (3) Smart People, (4) Smart Living, (5) Smart Governance and (6) Smart Mobility.
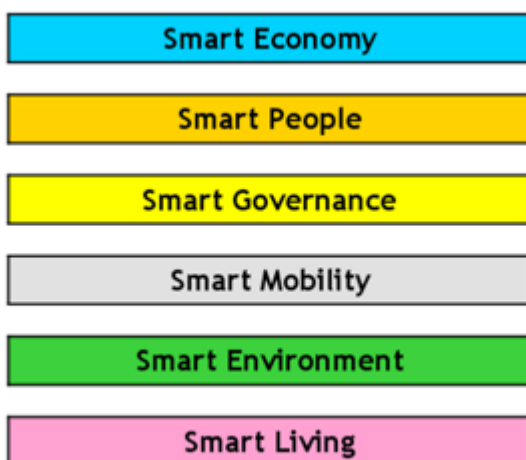

Figure 1: Characteristics of a Smart City.
Source: Final Report Smart cities – Ranking of medium-sized European cities, Giffinger (2007).

For McFedries (2014), the Smart City concept is not just an application; it is an infrastructure of information and an application system for the city. Hence, the Smart City concept can be streamlined into:

- Digital City
- Green City
- Knowledge City (Benovolo et al. 2016)

The Smart City consists of various fields, with key tools being technology and urban development, as Figure 2 highlights.

No	Definition	Concept/tools
1	A high tech-tech intensive and advanced city that connects people, information and city elements using new technologies to create sustainable greener city, competitive and innovative commerce and an increase life quality (Barcelona City Hall).	People Governance Environment Quality of life Mobility
2	The smart city specifically uses innovative technology and is willing to change behaviour related to energy consumption in order to tackle climate goals for a more sustainable city in which people's quality of life is higher, their environment more liveable and their economic prospects stronger (Amsterdam City Hall).	Technology Environment Quality of life Economy
3	The use of smart computing technologies to make the critical infrastructure components and services of a city which include city administration, education, healthcare, public safety, real estate, transportation and utilities-more intelligent, interconnected and efficient (Washburn et al., 2010).	Governance People Infrastructure Mobility

Figure 2: Smart City Definition and concept.

Cities have always been smart, however, just infusing intelligence into each subsystem of a city (e.g. transportation, energy, education, healthcare, buildings, physical infrastructure, food, water, or public safety) might not be enough to increase city smartness.

2.2 Smart City Dimensions

To build up a Smart City, urban planners need to take into account the needs of the city, as there are no prescriptive ways on how a Smart City should be developed.

The Smart City dimensions identified by Giffinger et al. (2007) will often be referred to in this report. The *European Smart City Classification Standard* (Zubizarreta et al., 2015) also uses this model:

a)   Economy
b)   Mobility
c)   Environment
d)   People
e)   Living
f)   Governance

Economy
Smart economy focuses on the ability the city to be innovative, entrepreneurial and productive.

Mobility
Smart Mobility emphasises the accessibility, connectivity and sustainable transport system. Cities across the world strive to meet urban sustainability standards by improving public transport, encouraging non-motorised modes, creating pedestrian zones, limiting the use of private cars, and trying to undo the transformation of cities caused by automobile dominance.

Environment
Reducing pollution and having sustainable resource management assists in having a smart urban environment.

People
Smart Cities are also concerned with ensuring people are educated and have skills allowing them to be creative and innovative. Education needs to be enhanced in accordance with the needs of Smart City development.

Living
Better quality of life is one of the attributes of a Smart City. City residents should be stress-free and able to enjoy life.

Governance
Smart governance requires transparent city governance to enhance the quality of public and social services in the city.

2.3 Smart Mobility City

Smart Mobility is a crucial element of a Smart City. As the population of cities has grown exponentially, one of the biggest problems is accessibility (Nadeem, 2011). This has implications for numerous aspects of citizens' quality of life and for delivering a quality environment for economic, social and environmental stakeholders. Smart Mobility is a key component of the smart transformation of the city (Aleta et al., 2017). It is one of the most complex issues to face metropolitan areas, requiring a clever balance between all the elements of sustainability, as well as advanced technology. It requires virtuous people behaviour, while taking into consideration existing conditions of the transport system and the built environment (Benevolo et al., 2016). Ultimately, Smart Mobility can influence other smart city axes such as the economy, environment, people and governance. Smart Mobility, when part of a shared mobility strategy based on renewable energy, can enable public access to real-time information, and help improve transport services by saving time, enhancing the journey, saving cost and reducing CO_2 emissions.

For Chun and Lee (2015), Smart Mobility offers comprehensive and smarter future traffic service, in combination with smart technology.

For Lyons (2016), Smart Urban Mobility is using technology to generate shared data, information and knowledge, that in turn influences decisions: it uses technology to enhance vehicles, infrastructure and services; it derives improvements for transport system operators and users and for shareholders; it also ensures sustainability by using technology. Garau et al. (2016), suggest three principal aspects of Smart Mobility for Italian cities, namely public transport, alternative mobility options and technological mobility services.

 The objectives of Smart Mobility (Lawrence et al., 2006 & Bencardino et al., 2014) can be split into six categories:

- reducing pollution
- reducing traffic congestion
- increasing people safety
- reducing noise pollution
- improving travel speed
- reducing transfer costs

Smart Mobility is largely affected by information and communication technology (ICT) used through accessible applications, to support the optimisation of traffic instability, but also to collect citizens' opinions about livability in cities or quality of local public transport services (Aleta et al., 2016). The following are key factors comprising mobility classification: 1. local and international accessibility; 2. availability of ICT infrastructure; 3. sustainable, innovative and safe transport systems.

Three strategic requirements for Smart City mobility include:

- Network the system: An integrated public transport system should be in place to increase use and convenience of public transport, to support the value chain of integrated public transport service. It requires implementation of an advanced traffic management system and policy to reduce the use of a private vehicle in the city.

- Rethink the system: Cities with high private vehicle usage need to redesign the mobility system, so it promotes active travel and is more sustainability oriented.

- Establish a sustainable system: A Smart City needs to establish a sustainable mobility system to fulfil the demand without having to redesign the system in the near future. For a new Smart City, the technology embedded in the transport system should be equipped to meet the demands of future urban mobility (Lerner et al., 2011).

To achieve an innovative and effective mobility strategy, these shortcomings need to be addressed:

- Lack of a collaborative platform
- Absence of vision
- Lack of focus on customer needs
- Inadequate competition (Lerner et al., 2011).

3. Methodology

3.1 Collaborative and Comparative Research

The Smart Mobility Cities project methodology was placed firmly within the Newton funding spirit to build innovative collaboration promoting economic development and social welfare of partner countries through knowledge sharing.

The purpose of the Smart Mobility Cities project was to explore Smart Mobility in Bristol and Kuala Lumpur and exchange experience, in particular identifying smart mobility challenges in Kuala Lumpur and exploring with Bristol academics and practitioners how to resolve these challenges by sharing good practice.

The hypothesis for knowledge sharing was that Smart Mobility challenges might be similar for both the Bristol region/West of England area and Kuala Lumpur and therefore that the exchange of ideas and solutions would be valuable to explore, despite the difference in scale between the two city regions.

The Kuala Lumpur team identified the challenges. These were organised into three themes:

- Governance and Collaboration
- Infrastructure and Physical environment
- Behavioural and Informational

Two workshops took place in Bristol (November 2017) and in Kuala Lumpur (January 2018) aimed to develop a Smart Mobility dialogue between Bristol and Kuala Lumpur's experts, practitioners and academics. Both workshops were participatory, with participants chosen on the basis of their role and expertise in the fields of transport, urban planning, public health and local government.

3.2 The Bristol Workshop

The Bristol workshop took place on the 21 November 2017 and was held at Watershed, a culture and digital arts venue in Bristol city centre. There were twenty expert practitioners in attendance, from the fields of public health, environmental health and transport, and from around the Bristol city region. The morning session began with a presentation on Smart Mobility, which was then followed by presentations on the governance and planning contexts of Kuala Lumpur and the city region's smart mobility challenges, and lastly a presentation on the Bristol governance and planning context. There was also the opportunity for questions and answers after the Kuala Lumpur and Bristol presentations.

Figure 3: Malaysia Context presentation at the Bristol Workshop.
Source: Bristol SMC Project Team.

During the afternoon session, participants were asked to discuss solutions for the Smart Mobility challenges identified by Kuala Lumpur colleagues. How would these challenges be addressed in the Bristol context? Can good practice be identified in Bristol? (See Annex 1 for Bristol workshop participating organisations, workshop agenda and challenges questions).

Figure 4: Bristol Workshop 'expert' discussions.
Source: Bristol SMC Project Team.

3.3 The Kuala Lumpur Workshop

The Kuala Lumpur workshop was held at Taylor's University, Lakeside Campus, Subang Jaya on 9 January 2018. Twenty-five participants attended the workshop, from seventeen different organisations, in fields relating to Smart Mobility. The workshop was aimed at reviewing the Bristol workshop findings and gathering input, advice and experience from local stakeholders on the challenges, as well as considering the adoption of a Smart Mobility agenda for Kuala Lumpur. (See Annex 2 for Kuala Lumpur workshop participating organisations and workshop agenda).

Figure 5: Kuala Lumpur SMC Workshop Flow.
Source: Kuala Lumpur SMC Workshop, 9 January 2018.

Figure 6: SMC Project Team Presentation.
Source: Kuala Lumpur SMC Project Team.

Kuala Lumpur **workshop agenda:**
Workshop participants were divided into three groups to:

1. validate the Kuala Lumpur challenges in the implementation of strategies and projects
2. highlight additional challenges
3. propose innovative solutions to address those challenges

Figure 7: Round Table Dialogue at Kuala Lumpur SMC Workshop.
Source: Kuala Lumpur SMC Project Team.

Each group had a mixture of representatives from various ministries, agencies, user bodies, transport consultants and mobility activists.

Using a prepared feedback template, participants elaborated on the challenges, identified new challenges and constraints for consideration in their spheres of responsibilities and functions. From these open-table talks, interfaces and concrete ideas for a concerted effort were identified and mooted. The identification of challenges is a sensitive and delicate process as these challenges are tied to government policies and the political willingness of the government to initiate a paradigm shift in policy making, planning and implementation structures.

The insights of the discussion, which took place at the break-out sessions, were then summarised to represent a general consensus amongst the participants.

Both workshop findings are detailed in later chapters.

Figure 8: Round Table Dialogue at Kuala Lumpur SMC Workshop.
Source: Kuala Lumpur SMC Project Team.

4. Kuala Lumpur Smart Mobility: City Drivers and Trends

This chapter describes Kuala Lumpur city features and its mobility plans. It also contextualises general mobility challenges and the evolution of Smart Mobility in Kuala Lumpur, the capital city of Malaysia. Finally, it presents some operational challenges in translating Kuala Lumpur into a Smart Mobility city.

Figure 9: Kuala Lumpur in Malaysia Map.
Source: www.vacationtogo.com.

4.1 Kuala Lumpur: City Features and Mobility Plans

4.1.1: Kuala Lumpur: City and City Governance

Kuala Lumpur is the national capital of Malaysia. It is considered the country's economic, tourist and cultural centre. The city covers an area of 243 km2 (94 sq metre) with an estimated population of 1.73 million in 2016 and has a population density of 17,310 people per square mile or 6,890 per square kilometre.

Figure 10: KLCC Twin Towers.
Source: Kuala Lumpur SMC Project Team.

The Kuala Lumpur City Hall (KLCH) is the council that administers the city of Kuala Lumpur. Endowed with the power given by the Malaysian Local Government Act 1976, a Mayor presides over KLCH, who has executive powers over general administration (tax and revenue collection), education, social welfare, public health, town planning, transport, environment, culture, leisure and sports, utilities and economic.

Figure 11: Kuala Lumpur City Hall Building, Jalan Raja Laut.
Source: Kuala Lumpur SMC Project Team.

4.1.2 Kuala Lumpur

Kuala Lumpur is also one of the largest cities in a large urban agglomeration called Greater Kuala Lumpur; which, along with the ten other municipalities surrounding it, creates a metropolitan area of 2,793.27 square km. Greater Kuala Lumpur has been supported by the Malaysian government, through its objectives within its Economic Transformation Plan (ETP), to become one of the top 20 most livable cities in the world and to increase the country's Gross National Income (GNI) per capita by 2020, to a become a high-income nation. Kuala Lumpur it is currently considered to be a high middle-income country.
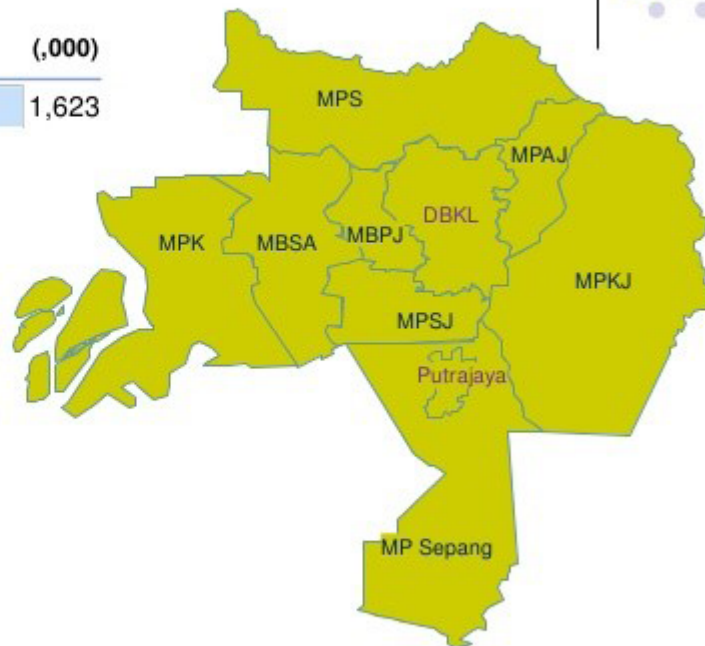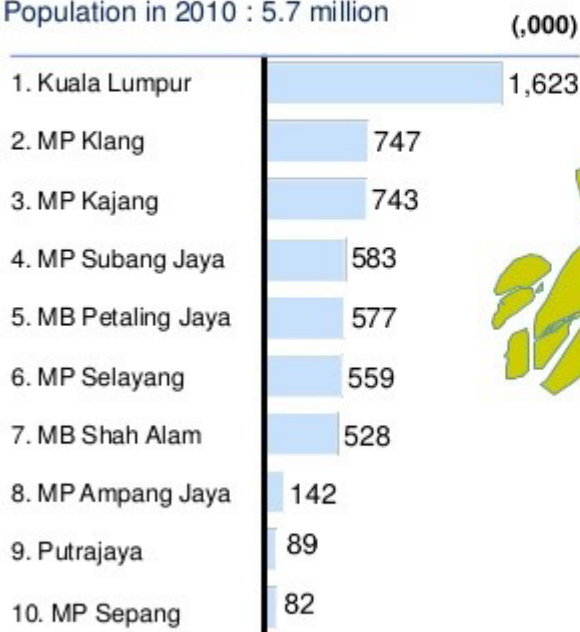
Figure 12: Kuala Lumpur (DBKL) on Greater Kuala Lumpur Map.
Source: Kuala Lumpur Smart Cities Conference 2014 by CHKL.

Intense urbanisation has posed significant challenges to government and city administrators. Cities globally face issues such as inadequate affordable housing, over-burdened public amenities, urban poor, declining health condition and well-being, traffic congestion, environmental pollution, shrinking green areas and public safety (Rosly D, 2015). Consequently, planning and development approaches have been adopted by governments and city administrators with the aim to address these issues and their impacts on the local, national and international environment.

4.1.3 Kuala Lumpur City Structure Plan: Integrating Urban and Transport Planning

Figure 13: Kuala Lumpur Structure Plan.
Source: Kuala Lumpur SMC Project Team.

The main urban planning tool for the Kuala Lumpur area is the *Kuala Lumpur Structure Plan 2020*. The *Structure Plan* guides and coordinates the mobility planning and urban development, so it becomes more efficient and systematic. In particular, the *Structure Plan* has to manage social, economic and physical development within the context of an increased number of urban residents in 2020. This *Structure Plan* guides the territorial development of a wide area in a manner consistent with the new form of local governance promoted by international and national standards. This *Structure Plan* also contains two overarching policy frameworks namely, the *National Physical Plan* (NPP) and the *National Urbanisation Policy* (NUP). The *Structure Plan* emphasises achieving the following objectives:

- Provide comprehensive and integrated transport system that caters to the need of inter and intra-city travel.

- Reverse the decline in public transport usage and to achieve a targeted public-private transport modal split of 60:40 by the year 2020.

- Optimise the road and rail transportation infrastructure so that it operates at its full capacity and maximum efficiency.

- Ensure that the overall configuration of land use is integrated with road and public transportation networks to optimise the development of land.

- Ensure that all areas of the city enjoy the same high quality and standard of provision of public transport services.

- Create a city that is highly accessible for all its occupants and users, in particular, one that is pedestrian and disabled-people friendly.

4.1.4 Kuala Lumpur Low Carbon Society Blueprint: Action Plan for Smarter Mobility

Figure 14: Kuala Lumpur Low Carbon Society Blueprint 2030.
Source: Kuala Lumpur SMC Project Team.

The *Kuala Lumpur Low Carbon Society Blueprint 2030* (KL LCSB 2030) is another milestone and innovative plan that guides the development of the entire city of Kuala Lumpur in a manner consistent with the new carbon emission targets of the United Nations Climate Change Conference in Copenhagen (UNCCC). As such, the *KL LCSB 2030* includes the commitment to reduce the country's carbon emission intensity of GDP by 45% by 2030. This blueprint outlines five Mobility Action Plans which aim to reduce Kuala Lumpur's carbon emission by inducing a voluntary modal shift from motorised vehicles to walking and cycling for short and medium distance trips, while at the same time promoting public transport use. These Mobility Action Plans are: (1) active walking; (2) integrated public transportation; (3) development of low carbon vehicles; (4) enhancing traffic flow, and (5) green freight transportation. It is expected that the new dimensions of mobility actions by city administrators will create and promote a new culture of sustainable mobility in Kuala Lumpur city.

Similar to other cities around the world, Kuala Lumpur has launched broad, ambitious plans to promote Smart Mobility initiatives. Smart Mobility is seen as an emerging solution to address the city's mobility challenges.

4.2 Kuala Lumpur Mobility Issues and Smart City Initiatives

The *Economic Transformation Plan* (ETP) under the *11th Malaysia Plan* (11th MP) paves the way for transforming cities in Malaysia. The *ETP* specifies the role of Kuala Lumpur as the engine of Malaysia's economic growth. This means that Kuala Lumpur needs to lead the agenda for green and sustainable growth, world-class public transport infrastructure and inclusive development. The *11th MP* prioritises technology as the emerging solution/tool for propelling the sustainable green mobility agenda in Kuala Lumpur. Consequently, technological solutions should help the development of a new Smart City model for the city.

The Malaysian government is seen to be proactive and increasingly invests in Smart City initiatives. A number of positive steps have been taken, including the preparation of a Smart Cities Framework in relation to ICT Aspects. Additionally, several cities in Malaysia have been declared Smart Cities (Cyber Jaya, Petaling Jaya, Shah Alam and Malacca).

The next section will discuss the state of development of Smart Mobility in Kuala Lumpur, in particular, the city's mobility challenges and the growing number of Smart Mobility initiatives.

4.2.1 Mobility Challenges in Kuala Lumpur

Figure 15: Traffic Congestion in Kuala Lumpur.
Source: Kuala Lumpur SMC Project Team.

Kuala Lumpur is facing many transport sector challenges. Transport challenges in Kuala Lumpur are mostly derived from inadequate solutions for the local transport system. Mobility in Kuala Lumpur is predominantly characterised by heavy car dependency leading to traffic congestions and delays. Having ranked as number 95 out of 100 cities in a recent study on sustainable urban mobility, Kuala Lumpur has a lot to catch up on when it comes to the efficiency and reliability of the city's public transport system (Sustainable Cities Mobility Index, 2017). This low ranking indicates that an integrated transport system is still patchy. Hence, many residents still opt to use private cars instead. The same study also indicates that like most Asian cities, Kuala Lumpur did not do so well regarding the level of greenhouse gas emissions and pollution, as well as in its efforts to lower emissions and the level of road congestion or incentives for increasing green space covering the city. Kuala Lumpur is also ranked low regarding average commuting time to work and by public transport, particularly by bus.

KL can further tap mobility area

KUALA Lumpur ranks 94th among the world's most sustainable cities for transport, according to the 2017 Sustainable Cities Mobility Index.

The index was compiled for design and consultancy firm Arcadis by the Centre for Economic and Business Research. It explores mobility through three pillars of sustainability — social (people), environmental (planet) and economic (profit) — to develop an indicative ranking of 100 of the world's cities.

Kuala Lumpur scored an overall 31 per cent, an indication that the city should explore its mobility issues to benefit from an even greater economic future.

Source: Malaysia New Straits Times. November 9. 2017

New Straits Times 2017

4.2.2 Smart Mobility in Kuala Lumpur: Example Initiatives

Kuala Lumpur recognises the urgency for smart sustainable mobility. Clearly, the city authority must keep working on effective and smarter solutions, addressing dynamic and complex urban mobility problems with technological solutions. Smart Mobility is seen as one crucial element of a sustainable Kuala Lumpur. Smart Mobility and transport systems in Kuala Lumpur can be divided into the following areas: (1) Mass & Light Transit (2) Individual Mobility and (3) Intelligent Transport Systems. These are discussed below.

Figure 16: MRT Station.
Source: Kuala Lumpur SMC Project Team.

The Klang Valley Mass Rapid Transit (MRT) that is already in operation is one of the innovative mobility solutions for Kuala Lumpur. This project was listed as an Entry Point Project (EPP) under the Malaysian Economic Transformation Program. The MRT Line 1 runs through the city centre of Kuala Lumpur. This service is expected to carry about 400,000 people, taking around 160,000 cars off the road, easing the city's considerable congestion problem.

Monorail

Commercial District Travel for Kuala Lumpur's Commuters

The KL Monorail is an intracity public transit system that links many key destinations within Kuala Lumpur's busiest areas and is operated by Prasarana Sdn. Bhd. The KL Monorail offers a hassle-free way to travel through the city as it serves central commercial, employment and shopping districts. The 8.6km long KL Monorail system runs across 11 stations from KL Sentral in Brickfields that passes through the Central Business District (CBD) of Kuala Lumpur and ends at Titiwangsa Station on Jalan Tun Razak.

Source: Malaysia Public Transport Commission, 2017

Figure 17: LRT on Track in Kuala Lumpur City Centre.
Source: Kuala Lumpur SMC Project Team.

Making Buses a More Attractive Option

At present, bus services play an important role in the overall transport system for Kuala Lumpur. They are important because they provide first and last mile connectivity for intracity and intercity travel. Several improvement measures have been planned and implemented since 2010, to make buses a more attractive option for Kuala Lumpur commuters. These measures include the Bus Network Revamp initiative in 2015, new fleets, upgrading of bus terminals and bus stops around Kuala Lumpur, provision of MRT Feeder Bus Routes and providing the free bus service Go KL. The new facelifts for bus services are aiming to help Kuala Lumpur commuters get around the city area.

Figure 18: Go KL Free Bus to improve public mobility in Kuala Lumpur Central Business District (CBD).
Source: Kuala Lumpur SMC Project Team.

Personal Mobility

The creation of pedestrian-friendly infrastructure and cycling lanes add additional Smart Mobility measures for Kuala Lumpur. In recent years improvement in the provision of pedestrian linkages has increased pedestrian's mobility and accessibility to public transport services, hence achieving mixed modal access and prioritising clean and non-motorised options of Smart Mobility.

Figure 19: Tactile Pedestrian Walkway – Jalan Bukit Bintang, Kuala Lumpur.
Source: Kuala Lumpur SMC Project Team.

Active Travel Provision

The provision of dedicated cycling and walking facilities in the middle of the busy city is another remarkable effort made to promote active travel in Kuala Lumpur, thus reducing carbon footprint. This includes dedicated cycle lanes, shared bike schemes, shared cycle, and pedestrian footpaths.

Figure 20: Bicycle lane in Kuala Lumpur.
Source: Kuala Lumpur SMC Project Team.

Figure 21: Shared bicycle scheme in Kuala Lumpur.
Source: Kuala Lumpur SMC Project Team.

Shared Footpaths

Figure 22: Shared Space Concept Along Jalan Ampang, Kuala Lumpur.
Source: Kuala Lumpur SMC Project Team.

Other Smart Mobility solutions adopted by Kuala Lumpur include vehicle technology (electric car and fuel technology), an intelligent transport system (ITS) for traffic management, collecting public transport real-time data about city buses, providing passengers of public transport about routes and arrival time and new mobility services (ride sharing).

Figure 23: Smart Mobility Solutions.
Source: www.nst.com.my.

Mobility challenges have been identified and will be described in Chapter 6.

5. *Bristol Smart Mobility: Drivers and Trends*

This chapter provides an overarching context for Smart Mobility in Bristol, through looking at the city region's governance structures, mobility challenges and transport strategy. This chapter also provides a contextual comparison to the Kuala Lumpur city features, mobility plans and Smart Mobility operational challenges detailed in Chapter 4.

.5.1 Bristol Governance

5.1.1 Bristol City

Bristol City Council, a local unitary authority, is headed by the city Mayor who has powers over spending in Bristol and setting the corporate strategy. Local unitary authorities in England have responsibilities over fields of policy with links to Smart Mobility, including planning, transport, public health and environmental health. The current local plan is to be refreshed in 2018; a transport plan is in production with various strategies and guidance documents supporting the spatial and transport strategies (see Transport: https://www.bristol.gov.uk/streets-travel/transport-plans-and-projects; Local plan: https://www.bristol.gov.uk/planning-and-building-regulations/local-plan) influencing the scale of mobility (Frost and Sullivan, 2012).

5.1.2 Bristol Metro-region: West of England

Bristol's prosperity depends very much on the economic achievement of the West of England (WE) (Figure 24), the wider Bristol metro-region. However, administrative boundaries have, over the years, limited shared functions or policy cooperation between the four WE local authorities. The need for joint infrastructure, transport and skilled policy responses to a growing economy and population, in 2017 led to the creation of a WE metro authority, called the West of England Combined Authority (WECA). WECA is comprised of Bristol City Council, and the three neighbouring local unitary authorities of Bath and North East Somerset, South Gloucestershire and North Somerset (see Figure 24). WECA is presided over by the West of England Mayor who has power over sub-regional spending on transport, housing, adult education and skills. Additionally, a Local Economic Partnership in Bristol plays an advisory role to WECA and supports business growth and the creation of new jobs (see New WECA structure: https://www.westofengland-ca.gov.uk/). It is too early to evaluate the achievements of this new metro structure. The political leadership at Bristol and WE levels will be explored later.
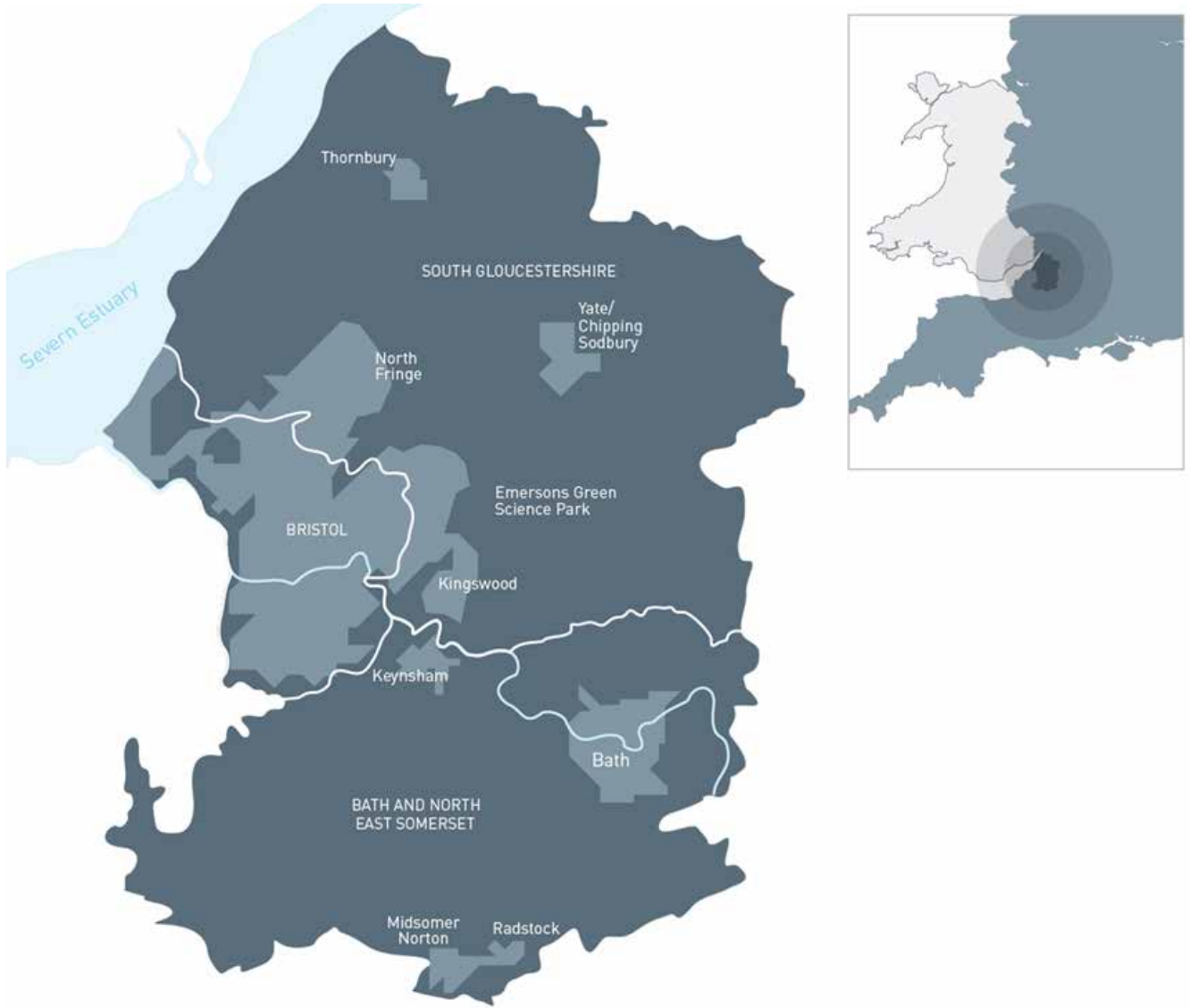
Figure 24: The West of England's Combined Authority.
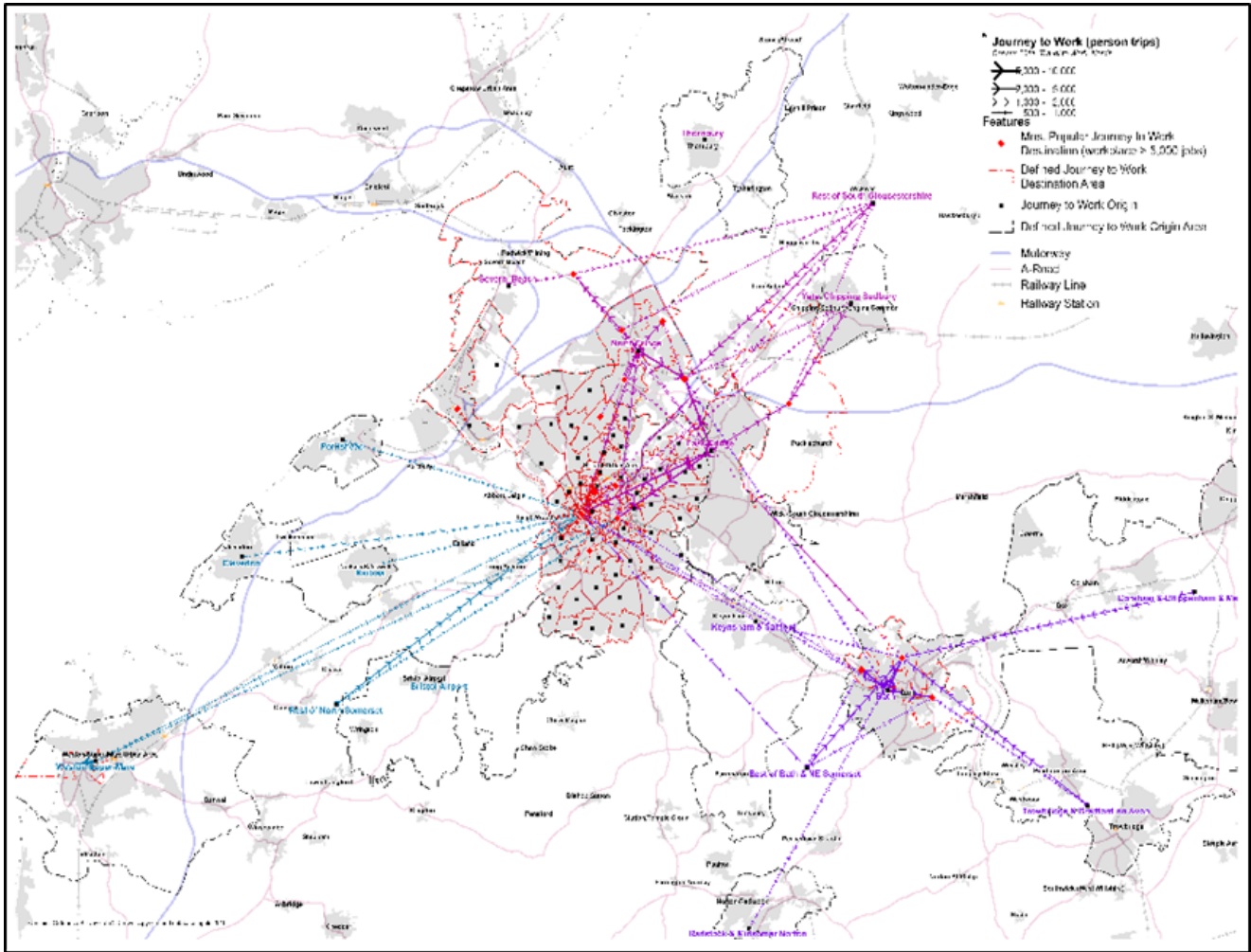Source: West of England Combined Authority.

Figure 25: Travel to work area in the WE sub-region.
Source: ONS (2011).

The WE strategic location (crossroad of M5 and M4 motorways) brings social and environmental challenges, in addition to significant pressures on local public finances for a population that has grown over the last decade, faster than the UK average, to more than 1.1 million people (see http://westofenglandlep.co.uk/about-us/the-west-of-england/).

The WE transport system is subject to a high level of travel demand by the local population and by daily commuters. Traffic pressures are evidenced by daily traffic congestion on the road network (M4/M5/M32, A38 for instance), as well as capacity problems on local rail services (Figure 26).

Use of bus services has grown in Bristol in recent years. However, bus usage from WE locations is still extremely low, and car trips dominate. This is a particular issue on road corridors, such as the M32 and A370, where vehicle journey times are low, and bus priority measures are limited, meaning there is little reason to use the bus other than due to low car parking availability. For BCC transport strategy, improving express bus routes to areas, such as Yate, Winterbourne, East Fringe, Nailsea etc., are critical to getting people to switch from car to public transport. These need to be provided with comprehensive bus priority measures (BCC 2018).
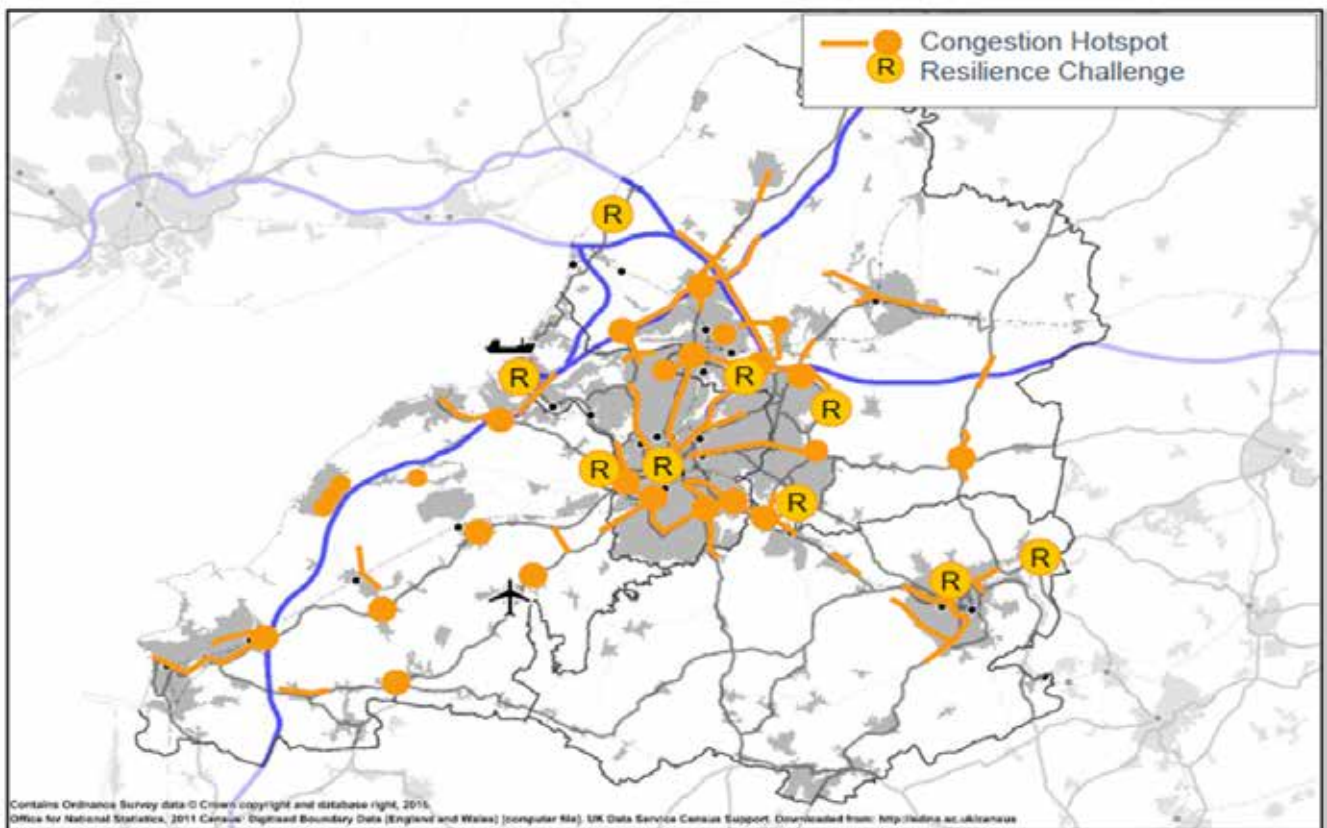

Figure 26: Congestion hotspots and resilience challenges in the WE.
Source: ONS (2011).

As an urban hub, transport pressures on Bristol city are particularly high (see Figure 27), with a majority of travel journeys still using cars.
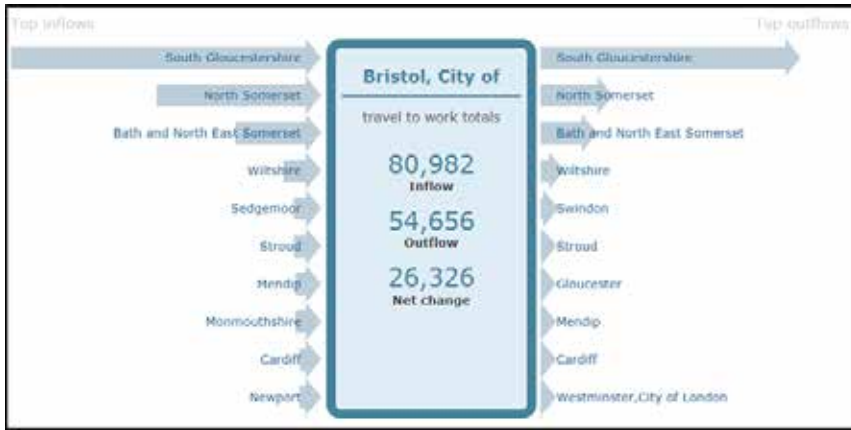
Figure 27: Transport flows in Bristol City.
Source: Bristol City Council (2017).

5.2.2 Answering Transport Challenges

5.2.2.1 Bristol City Priorities

For BCC experts, Bristol needs to prioritise a reduction in car use (see Figure 28). With transport pressures comes an impact on the state of the environment and on the health of the local population. In Bristol, the concern is around NO2 emissions, as no substantial improvement has happened over the past 20 years. Diesel is responsible for this problem. A national plan is now in place with cities mandated to produce plans for compliance in the shortest possible time. That is likely to mean a charging Clean Air Zone (CAZ) in Bristol.

Figure 28: Prioritising City Centre traffic volume.
Source: BCC context presentation (2017).

Bristol itself is also developing a cycling culture through consistently successful rounds of funding (see Box 6). As a result, cycling doubled between 2001 and 2011 (8,8108–16,211) and is still rising (see Figure 29 below). In 2005 only 4.5% of women cycled to work, by 2013 this had risen to 11%. Almost a fifth of people are choosing to walk or cycle to get to work. More people cycle to work in Bristol than Sheffield, Nottingham and Newcastle combined.

Change in transport use by mode
Percentage growth since 2008/09
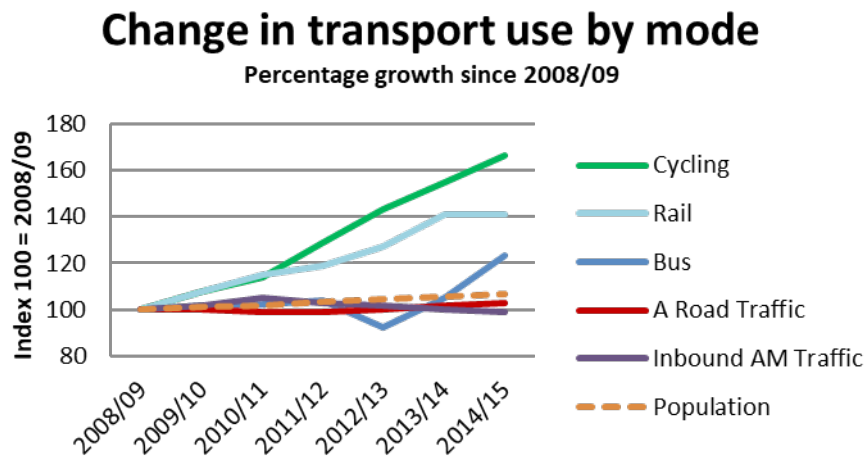
Figure 29: Change in transport use by mode in Bristol 2008 to 2015.
Source: Bristol City Council (2016).

5.2.2.2 WE Transport Strategy

Local authorities in the WE have also joined forces to develop a joint spatial plan (WEJSP) and a transport study to feed into a joint local transport plan (JTP): these aim at addressing the delivery of over 100,000 homes and identifying needs in transport investment for the next 20 years. The map below highlights the key economic and infrastructure priorities set in the JSP and JTP.
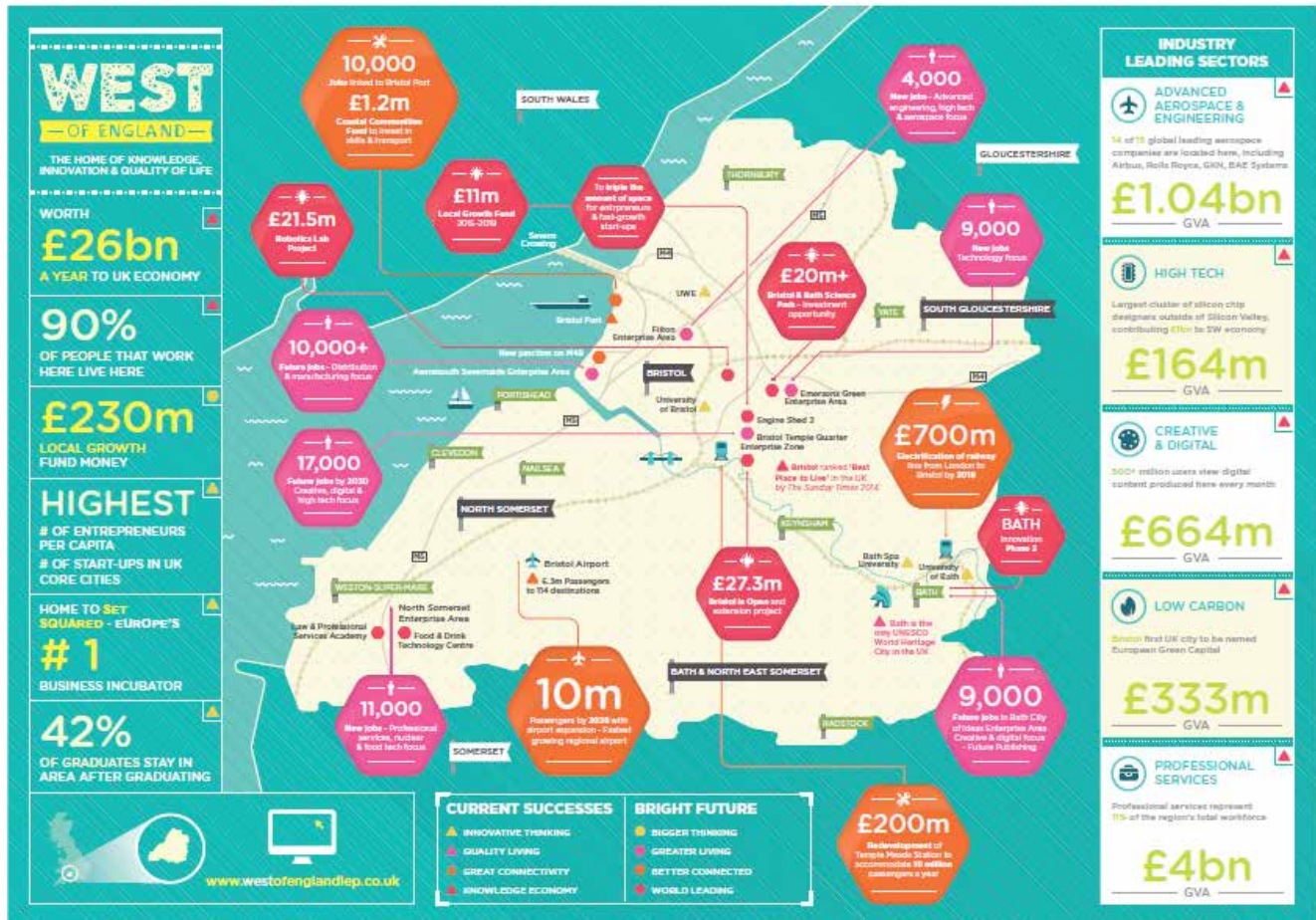
Figure 30: Map to show The WE spatial and transport priorities.
Source: http://westofenglandlep.co.uk/about-us/strategicplan.

6. Kuala Lumpur Smart Mobility Challenges

Kuala Lumpur is currently transforming into a Smart Mobility City. This chapter presents the challenges that need to be addressed for Smart Mobility to develop in Kuala Lumpur. Three themes have been identified:

- Governance Challenges
- Infrastructure and Physical Challenges
- Behavioural Challenges

6.1 Governance Challenges

The role of government, as the implementing organisation in collaboration with stakeholders (e.g. infrastructure providers, city administrators and transport modes operators) is crucial to delivering Smart Mobility initiatives. Several challenges affecting governance are outlined below:

6.1.1 Private Sector Driven Approach

Many Smart Mobility initiatives are undertaken by big enterprises such as Cisco, Ericsson, IBM or Siemens. The advantages of this private sector led approach is that these companies have the strong economic capacity to implement and deliver solutions in a faster and efficient way. However, there is a risk associated with this kind of approach whereby large corporations monopolise Smart Mobility development to the extent that it kills creativity. Yet, due to limited public funding, the current arrangement offers the best solution to optimise resource and ensure interoperability of these initiatives. Another salient feature of the private sector-led approach is that it promotes too many fragmented and small-scale solutions, making it difficult to monitor. Smart collaboration and cooperation between governments and IT companies is a way forward to address this challenge.

6.1.2 Lack of City-level Development Strategy on Smart Mobility

Lack of clear development strategy on Smart Mobility at the national level leads to unclear direction and desired outcomes. Differing perspectives and priorities affect policy interpretations and motivations for implementation. Implementation is very focused on immediate fiscal and operational gains, rather than directing at overarching strategic priorities.

6.1.3 Inadequate Regulatory Framework

Technology offers opportunities to improve institutional functionality. However, integration of infrastructure, product and services for Smart Mobility faces implementation constraints due to the lack of legal powers and the legal responsibilities which are split between agencies. The limits of administrative control can lead to the weak enforceability of the policy. In general, the regulative mechanism for Smart Mobility implementation is largely incomplete and reactive to the problem.

6.1.3 Shared Mobility Services Incentives

The provision of incentives and taxes are key means through which city administrators can enable actions by private sectors organisation. One of the key issues is about finding the right, innovative business model for the partnership to take place.

6.1.4 Managing City-level Change

Competency in managing change is a pressing issue in Smart Mobility initiatives. Very often the competency to drive the agenda is so much higher among companies than among city government. This issue results in an inability to specify the needs and to properly evaluate the offer that city government receives from companies.

6.2 Infrastructure and Physical Challenges

6.2.1 ICT & Infrastructure

ICT is rapidly changing the mobility in Kuala Lumpur. Infrastructure for Smart Mobility, such as vehicle technology, an intelligent transport system for traffic management, data on travel information and new mobility services (ride-sharing, connecting transport modes, integrated urban mass transit system and new pedestrian and cycling system) offer solutions to urban mobility issues in Kuala Lumpur.

6.2.2 Planning for an Enabling Environment

It is observed that the implementation of technological solutions and products varies greatly. Some solutions are rather easy to be implemented, such as real-time data on travel information for users; while some are difficult because of the inherent complexity of the current rules, regulations, policies and their enabling eco-system.

The creation of an enabling eco-system is another challenge: well-functioning infrastructure is necessary as a platform to accelerate adoption, but it is not the only prerequisite for Kuala Lumpur to become a Smart Mobility city. Without real engagement and willingness from the users to start adapting and experimenting, there is no smartness in this infrastructure. Infrastructure must emphasize how to move people physically. Thus, the element of accessibility and connectivity is of paramount importance to help people make intelligent decisions. The overall infrastructure for Smart Mobility is still a work in progress in Kuala Lumpur. Gaps exist between the theory of what Smart Mobility infrastructure can offer and their actual contribution to societal needs. Creation of more shared space, rather than road space, density with connectivity, walkable and cyclable streets and inclusive public environments all have an important role to play to promote Smart Mobility.

Figure 31 & Figure 32: Current public transport infrastructure in Kuala Lumpur.
Source: Kuala Lumpur SMC Project Team.

6.3 Behavioural and Information Challenges

While the previous two sections have highlighted the "hard aspects" of Governance challenges and Infrastructure and Physical challenges for the development of Smart Mobility initiatives in Kuala Lumpur, this section will discuss the "soft aspect" of Behavioural and Information challenges.

Several major trends include the changes of land use patterns, lifestyles and demographic patterns of Kuala Lumpur residents over the last decades, thus making behavioural changes a real challenge. The discussion on behavioural change must concentrate on the linkage between city form and design, mobility practices and the well-being of urban residents.

A smart city focuses on the role of human and social capital in improving economic, social and environmental sustainability (Neirotti et al., 2014). Hence, changing human behaviour is crucial for securing the status of Smart Mobility for Kuala Lumpur. According to the *Megacities on the Move* report by Forum for the Future (Gazibara et al. 2010: 47) "cities need to think about ways in which mass behaviour and social norms can be influenced to get people to think about their current patterns of travel and ways of living."

The discussion is now focused on two critical questions:

- How to change the current state of unsustainable mobility behaviour of the people in Kuala Lumpur?

- What kind of information is needed to mobilise behavioural change towards a smart mobility city?

Kuala Lumpur acknowledges the effective way to promote behavioural change by designing good transport solutions focused on people, not cars. Since 2010, many development efforts have been geared towards public transport improvement, in particular rail transport and the promotion of active travel. After nearly one decade of gradual, but massive improvement in the public transport system, 80% of Kuala Lumpur's residents still depend on their own transport, i.e. personal cars to travel around the city, while only about 20% of people use public transport. This shows that public transport is still not a preferred mode choice among Kuala Lumpur city residents.

Car culture is a prime factor to be blamed for low usage of public transport in Kuala Lumpur. Pro-car policies and private sector strategies such as affordable car prices, subsidies for petrol, extensive car parks and highway projects to ease car travel have, over the years, encouraged car use. Besides, public transport planning was largely negligible in the past years. Obviously, in this context, breaking car culture requires time and an integrated regime. Kuala Lumpur needs smarter, more creative and coercive solutions to complement public transport (rail) with convenient and reliable buses, biking and walking, because only then will get people to think beyond the car and opt for other modes of transportation. Soft measures to encourage public transport use and alternative modes evolve around creating awareness. Creating awareness is about feeding the correct and useful practical information to trigger behavioural change. Technological solutions, with the help of instrumentation and interconnection of mobile devices, sensors and actuators allowing real-world urban data, must be made a key priority to create awareness. Thus mobilising behavioural change for Kuala Lumpur.

50% anticipated reducing car use by 40% or more

14.1% have the intention to reduce car use by 30%,

while 28.7% anticipated reducing car use by only 10%-20%
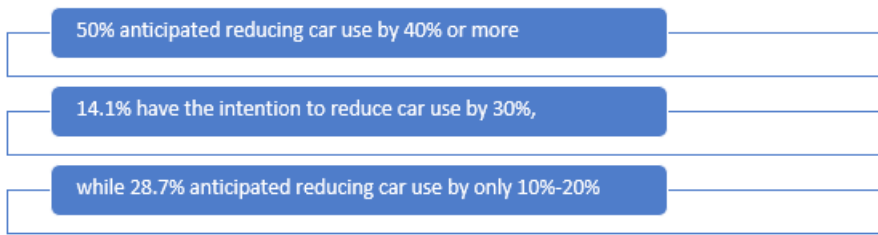
Figure 33: Willingness to switch to sustainable modes of transport for a work trip.
Source: Daud (2015) (Doctoral Thesis).

7. Findings from the Bristol and Kuala Lumpur Workshops: Institutional and Governance Challenges

This chapter presents the Institutional and Governance findings from the Bristol and Kuala Lumpur workshops. Firstly it details the proposed Smart Mobility solutions made by the Bristol workshop participants to address Kuala Lumpur's Institutional and Governance challenges in relation to enabling Smart Mobility in Kuala Lumpur. Secondly, it presents the learning and reflections on Governance from the Kuala Lumpur workshop.

Findings from the Bristol Workshop: Institutional and Governance Interventions for Smart Mobility

The Bristol workshop explored a number of aspects of the governance and collaboration required for promoting Smart Mobility: Kuala Lumpur colleagues had identified challenges in developing collaboration between stakeholders from private, public sector and communities (see Chapter 6). Bristol stakeholders explored, in particular, the following questions, within the context of their own experience in Bristol and the West of England (WE):

1. What are the characteristics of leadership, community engagement and partnerships for Smart Mobility?
2. What resources and policy mechanisms can facilitate collaboration in the field?
3. What strategies can be deployed for partnership and good governance for Smart Mobility?

7.1. Characteristics of Leadership, Community Engagement and Partnership for Smart Mobility

7.1.1. Leadership

How has Bristol leadership made changes or can leverage change?

In recent years in the WE, political leadership has been given more power over spatial and transport policies through improved institutional and financial resources with the introduction of a Bristol 'directly elected', or 'City Mayor', and a devolution deal with a new WE Mayor. The Localism Act 2011 allowed the citizens of English cities, following local referenda, to directly elect Mayors with political functions (traditionally in England, Mayors are not elected by citizens and have only representative functions and no political power). Bristol city has had a City Mayor since 2012. In the field of Smart Mobility, change requires 'policy entrepreneurs' - individuals or institutions to create and lead change. Political leadership has allowed Bristol City Mayors' to develop Smart Mobility projects. George Ferguson, the first City Mayor of the city of Bristol (2012-2016), was an entrepreneur in architecture and built environment and led on major ongoing changes in transport (e.g. neighbourhood parking enforcement and Metrobus). Initially unpopular - post-implementation, these policies may be seen more favourably, as has happened in other UK cities. For instance, London congestion charging was initially unpopular but offered environmental and traffic benefits and is now accepted. The Edinburgh tram was initially controversial but is now viewed favourably across the city.

Additionally, from 2017-2018 an agreement between the government, the Bristol City Mayor and the three other Council Leaders of the WE have devolved a range of powers and responsibilities to a West of England Combined Authority (WECA) and a new Mayor for the city region. The devolution agreement builds on a process of devolution of funding, building on the City Deal (agreed in 2012) and the Growth Deals (agreed in July 2014 and January 2015). The Devolution Deal gives more power to make decisions locally about transport, housing and business support and to secure more funding to improve transport infrastructure. It also allows the WECA to tackle key common issues such as of air quality, creating clean air zones to achieve air quality objectives.

The new WE Devolution Deal might mean that collaboration between the four local authorities in the west of England area may lead to more strategic plans for mobility in the region. Devolution occurred in 2017-18, and hence it is too soon to say if the new WE structure will make any difference.

Within this context, the relationship between policy-makers and the public needs to be addressed. Policies which are unpalatable to the public are often withdrawn, but is it a good thing? Undertaking projects that will not fit within one political cycle might be difficult. Political fashions may mean that schemes' palatability swings back and forth. Additionally, making long-term Plans remains difficult. Bristol City Council's 20-year Plan constantly need to adjust to new priorities (for example, with regards to Brexit); such activity takes over from the long-term Plans. As such, it was commented that there could be too many long-term Plans, Strategies and Visions. Long-term Plans can be particularly difficult in the case of transport, where a 20 or 25-year vision can be difficult because what will be needed in 25 years may not be buildable or palatable to the public, in the present. Building in adaptability can be important in Plans.

Participants in the workshop, with experience of new leadership models in Bristol and the WE, identified a number of strategies for City Mayors to develop their policies.

- Advantageous to pick projects that can be completed during a political tenure.

- Local Authorities must have business acumen: means of developing projects that provide incremental benefits during the course of the project.

Box 1: City Leadership in Bristol

On 3 May 2012, the citizens of Bristol voted to have an elected City Mayor. The first mayoral candidate to take up this position was George Ferguson, an architect - renown in Bristol for his south Bristol neighbourhood regeneration projects and cycling promotion - when he was voted in on 15 November 2012 (Hambleton et al. 2013). Ferguson held this position until May 2016 when he was superseded by the present elected Mayor, Marvin Rees (BBC 2016).

During Ferguson's tenure, he aimed to tackle Bristol's road congestion and resulting poor air quality through pursuing a number of sustainability-focused transport initiatives in the form of an optimal public transport system, encouragement of walking and cycling and car-use behaviour change.

- **Projects that he implemented included:**

  o   The increasing the city's Park and Ride capacity

  o   Introduction of 20mph limits across the city

  o   Introduction of Residents Parking Schemes within central Bristol. Neighbourhoods

  o   Investment in walking and cycling infrastructure

- **Other smart transport initiatives Ferguson supported included:**

  o   Joint Travel Plans with neighbouring unitary authorities

  o   Taster bus tickets

  o   Smart ticketing

  o   Travel planning advice to encourage use of other forms of transport

- **Ferguson's tenure can also be credited with specific Smart =Mobility projects, such as:**

  o   Winning £3m UK government funding which enabled public access to datasets of real-time air quality readings and traffic speeds

  o   Bidding to pilot autonomous vehicles (Polis Network 2015)

However, not all Fergusons initiatives or proposals were welcomed; there was some opposition to the introduction of the 20mph limits (ITV 2014), and the RPZ proved highly unpopular by many car-drivers across the city (BBC 2013).

7.1.2 Community Engagement

Community engagement is important at various stages of policy-making; it ensures co-production and provides the opportunity for deprived areas to address local issues, whether as bottom-up or top-down processes. Stakeholder/community engagement is undertaken on most planned urban developments, helping the right scheme to go ahead more easily with local support.
But how to get wide representation and not just the usual suspects?

The workshop identified that the following activities could help support community engagement:

- Importance of setting a local presence within the community, e.g. community centres such as Knowle West Media Centre

- Getting communities involved in bidding for funding as this can benefit the dynamics and perceptions of a project

- Developing Living Labs

- Getting the 'right person' to convene in a neutral space

Knowle West Media Centre has developed the B*ristol Approach to Citizen Sensing* framework. This framework can be applied to any issue identified by a community, including application to Smart Mobility issues and barriers (see Box 2).

Box 2: Knowle West Media Centre

Knowle West Media Centre (KWMC), is a Bristol-based charity whose work centres around helping people to make positive life and neighbourhood change (Sustrans 2017).

KWMC has devised 'The Bristol Approach', which seeks to understand the issues that are important to people and provides support to enable their solutions. When 'The Bristol Approach' is specifically applied to Smart City or technology projects, it is referred to as 'The Bristol Approach to Citizen Sensing' as people are 'sensing' or gathering knowledge, resources and ideas for ways of using existing or bespoke technologies for societal benefit. Figure 35 below shows the six phases within 'The Bristol Approach' framework, also used within 'Citizen Sensing' projects.

Figure 35: The Bristol Approach Framework
Source: KWMC (2016).

Identification: work with people to identify their issues. Framing: gather data, technology and resources to achieve aims. Address any knowledge gaps.
Design: create tech tools. Deployment: test the tech tools in situ.
Orchestration: share the tech tools and findings with others.
Outcome: assess the findings against the original aims. Reward participants and share learnings. Make any changes.
More detailed information can be found within the Bristol Approach booklet (KWMC 2016).

'The Bristol Approach to Citizen Sensing' is currently being used in the EU funded H2020 project 'Replicate' to engage with Bristol citizens and gather their ideas for using technology for smarter new travel options, as well as asking them to identify other challenges and smart solutions.
Suggestions include: E-bikes, taxis on demand and apps to aid parking (Connecting Bristol 2018).

Please access the following website for further information on Knowle West Media Centre: http://kwmc.org.uk/.

It is important for people active in the community to help generate bottom-up momentum, raise issues and funding to place Smart Mobility strongly on the political agenda. SUSTRANS has done so for the last 40 years (Box 3).

Box 3: The Sustrans Story

Figure 36: Sustrans.
Source: Sustrans (2018).

The Bristol-based active travel charity, Sustrans, began in 1977 as a pressure group, campaigning against the oil crisis and the dominance of traffic in the United Kingdom's towns and cities. From these beginnings, Sustrans has become the UK charity that promotes cycling and walking - which is done in a number of ways.

National Cycle Network (NCN)
From 1984 to 2013, Sustrans established the NCN through funding by the UK government and the national lottery (Sustrans 2017). The NCN consists of 14,000 miles of off-and-on-road routes - created from refurbished disused railway lines, new off-road paths and existing quiet roads. Sustrans owns and maintains 348 miles of the NCN, but the majority of the NCN is owned by local authorities and land-owning bodies such as the Highways Agency, Network Rail and the National Trust. The NCN now reduces car journeys of 30 million annually, resulting in improved public health, reduced traffic congestion and climate change impacts which have saved the UK economy around £7 billion (Sustrans 2017). Donations fund much of Sustrans work. UK Government also commissions specific projects and initiatives, as do local authorities and other organisations throughout the UK (Sustrans 2018a).

Main streams of work for Sustrans include:

- Contributions to policy development for cycling, walking, and public transport.

- The development of active travel strategies for local authorities and other stakeholders.

- Community Engagement: involving local people in the design and development of user-friendly active travel routes and attractive, safe places to live.

- Sustrans also provides an online resource of links to academic literature relating to active travel and its health and economic benefits (Sustrans 2018b).

London Quietways

London Quietways is a new network of routes using quiet streets, parks and waterways in London. These are for all cyclists but are also encouraging non-cyclists to make journeys by bike. London Quietways also create safer and nicer neighbourhoods and improve public health, traffic congestion and air quality. During the development of London Quietway Number 1, Sustrans ensured that complex route issues were overcome through the use of urban planning and legal expertise and that it was designed for disabled cyclists by working with disability support charity 'Wheels for Wellbeing'.

See the Sustrans website for more information: https://www.sustrans.org.uk.

7.1.3 Partnerships

In addition to leadership and community engagement, the workshop participants also identified a number of multi-sector partnerships which have helped develop the sustainable transport agenda, e.g. Bristol Health Partnership, Bristol Green Capital Partnership (see Box 4).

Box 4: Bristol – Partnership City

Bristol Health Partners: strategic collaboration between the city region's major health institutions, covering the Bristol, North Somerset and South Gloucestershire areas. These include its three NHS trusts, three clinical commissioning groups, two universities and Bristol City Council.
The partnership addresses lifelong health and how to prevent illness in the first place, promoting, for instance, active travel and physical activity.
(see http://www.bristolhealthpartners.org.uk/)

Bristol Green Capital Partnership: founded in 2007, Bristol Green Capital Partnership is a partnership of over 800 member organisations who have committed to working towards Bristol becoming a sustainable city with a high-quality of life for all http://bristolgreencapital.org/. It has developed in collaboration with Sustrans, a vision of a sustainable and resilient transport system" A Good Transport Plan for Bristol"
(see http://bristolgreencapital.org/wp-content/uploads/2016/01/A-Good-Transport-Plan-for-Bristol-2016-PDF.pdf)

7.2. Resources and Policy Mechanisms to Facilitate Collaboration

Resources are important for developing policy processes and strategies. Cost-benefit evaluation of new infrastructure and bidding for national or European funding can support the political buy-in, support planning and delivery of smart mobility solutions, building collaborations and resourcing research and development activities. While the creation of new knowledge is important, the ability to use existing data can also support the delivery of Smart Mobility ambitions.

7.2.1 The Cost of Smart Mobility

The Bristol workshop participants highlighted the Health Economic Assessment Tool (HEAT) for cycling and walking, developed by the World Health Organisation (WHO) in collaboration with experts to estimate the value of reduced mortality that results from regular walking or cycling. The HEAT provided rigorous evidence to support Bristol cycling policy (Box 5).

Box 5: The Health Economic Assessment Tool (HEAT) for cycling and walking

The HEAT answers the question: if 'x' people cycle or walk 'y' distance on most days, what is the economic value of mortality rate improvements? Bristol used the HEAT to develop its cycling policy to increase the number of people cycling, using vital baseline data prior to providing infrastructure, such as bike lanes.

The HEAT is an online tool to estimate the value of reduced mortality that results from regular walking or cycling. It complements tools for economic valuation of transport interventions.

The HEAT can support the development of cycling or walking infrastructure by modelling the impact of different levels of cycling or walking. The tool facilitates the monetising of carbon improvement and health benefits (for reduced respiratory problems) of improved air quality. It attaches a value to the estimated level when the new infrastructure is in place. It can also value the mortality benefits from current levels of cycling or walking, such as benefits from cycling or walking to a specific workplace, across a city or in a country. It can be used for a prospective Health Impact Assessment (HIA) to estimate the mortality benefits from achieving national targets to increase cycling or walking, or to illustrate the potential cost consequences of a decline in current levels of cycling or walking.

For further information, see http://www.heatwalkingcycling.org/#homepage

Funding then can directly support local R&D collaboration, exploring scientific solutions to societal problems, including mobility in cities. Of course, decisions on making funding applications is political for cities as bidding is a time-consuming activity aimed at the delivery of identified priorities. Bristol was successful in securing funding to deliver its cycling ambitions (see Box 6 below).

Box 6: Funding Bristol Cycling Culture

Bristol has been successful in securing funding to develop its cycling culture. This funding includes for instance:

- European Funding (multiple years)
- Cycle City 2007-2011
- Local Sustainable Transport Fund 2011-2015
- Sustainable Travel Transition Year 2015-2016
- Cycle City Ambition Fund 2016-2020
- Access Fund 2016-2020
- Go Ultra Low Fund 2016-2020
- Clean Bus Technology Fund (multiple years)
- New Stations Fund 2017-2021
- Local Growth Fund 2015 onwards

Finally, Bristol workshop participants also identified the UK government's Innovate UK programme to promote innovation and productivity of the economy through funding research & development, knowledge transfer, small business initiatives. As part of this programme, The Catapult Centres are a network of world-leading centres designed to transform the UK's capability for innovation in specific areas and help drive future economic growth, including Smart Mobility (see Box 7).

Box 7: The Catapult Centres

The UK's seven Catapult Centres were established in by Innovate UK, the UK's innovation agency. This is a public body sponsored by the UK Government's Department for Business, Energy & Industrial Strategy (Innovate UK 2018) to enhance the UK's innovation abilities by commercialising research, thus resulting in future economic growth (Catapult 2018). The Catapult Centre whose work most directly relates to that of Smart Mobility Cities is the 'Future Cities' Catapult.
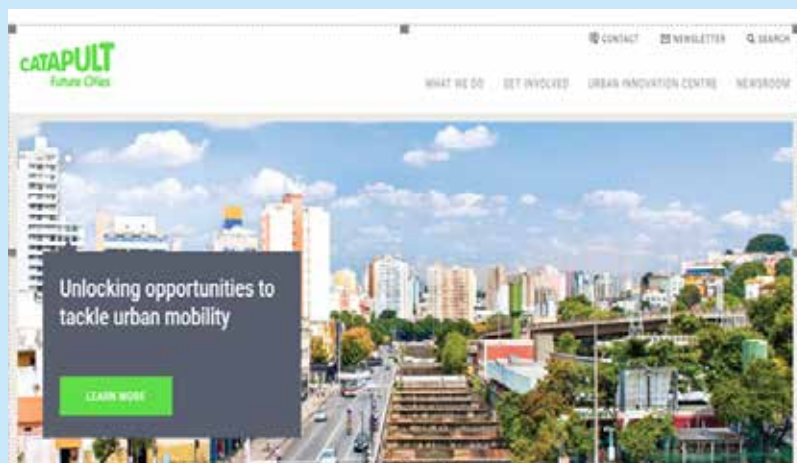
Figure 37: Future Cities Catapult.
Source: Catapult (2018a).

Futures Cities Catapult aims to tackle urban problems by facilitating collaborations between businesses, universities and city leaders to make better cities. Results of these associations can include new ideas, products, services and business models. Futures Cities Catapult has been involved with projects on healthy cities, urban mobility and using technology for integrated urban infrastructure - which were delivered by working with project partners, as well as other Catapult Centres across the Catapult Centre network (Catapult 2018a).

Figure 38: The Future Cities Catapult Innovation Centre, Clerkenwell, London.
Source: Catapult (2018a).

More information on all the Catapult Centres can be accessed here: https://catapult.org.uk

7.2.2 Resilient, Smart Mobility City Data: Transport Policy Formulation, Development, Implementation and Evaluation

The Bristol Workshop participants advised that data is an important resource for Smart Mobility policies. Data can serve as evidence to support the development of a specific policy. It can also provide evidence as to the effectiveness of a specific policy and can be captured to encourage smarter travel behaviours (see Box 8 below). It remains that in the field, lack of data, or lack of rigorous data collection methodologies, as well as limited ability to access existing data, can be problematic.

Open data is used in the UK, allowing for more data sources to be available to researchers, experts and policy-makers. Apps around transport are being developed and used, e.g. the Strava cycling app. These apps can create data based on GPS and can measure road quality for instance. The Bristol Workshop participants also suggested that decision-makers can also use data from other contexts to develop their Smart Mobility policies. Evidence-base/data of the economic benefits of Smart Mobility initiatives in other cities could provide a convincing case. The caveat here is that initiatives can have different impacts in different cities. Thus, solutions may differ from place to place.

Travel West (Box 8) is using traffic data to encourage healthier and sustainable travel behaviour in the WE. cycling policy (Box 5).

Box 8:   Travel West

Figure 39: Travelwest website homepage, showing modes of transport and resources.
Source: Travelwest (2018).

Travelwest is a travel website for the Bristol region that provides travel information as simply as possible - to make life easier, healthier and cheaper - by encouraging cycling, walking and bus use. Travelwest also provides news on transport projects and sustainable travel initiatives across the region (Travelwest 2018a).
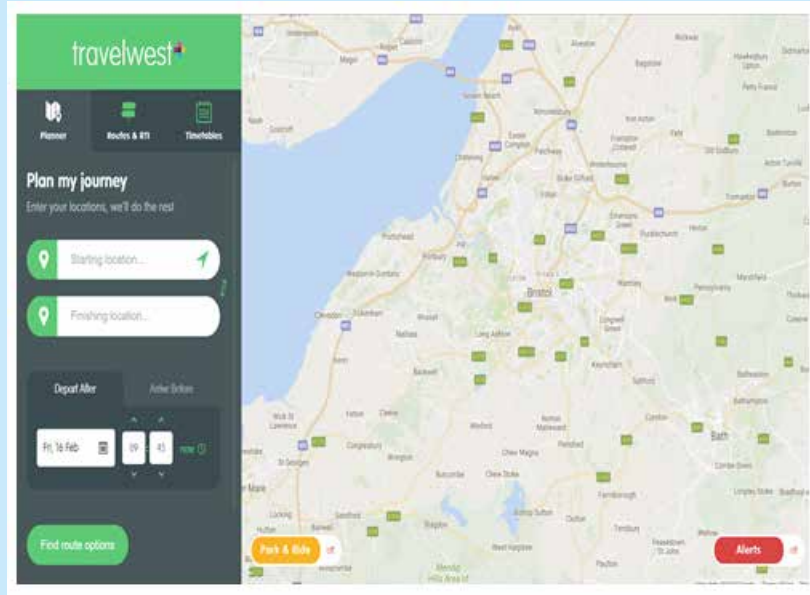
Figure 40: Travelwest Journey Planner.
Source: Travelwest (2018b).

There is currently not a smartphone app that replicates the Travelwest web app. However, there are two smartphone apps for Bristol region bus operator 'FirstBus' - one for journey planning and another for purchasing tickets. Travelwest was initially funded via the Local Sustainable Transport Fund from the UK government's Department of Transport. Since April 2016 it has been jointly funded by the Bristol, South Gloucestershire, Bath & North East Somerset and North Somerset local authorities (Travelwest 2018a).

7.3 Strategies for Partnership and Good Governance for Smart Mobility

The Bristol Workshop participants highlighted how local governance and local leadership are restrained by the scope and limits of their powers vis a vis other economic actors. If the Paris Accord on emission reduction has led to a change in the law, the problem remains however that many changes are business led. Governments are still promoting car manufacturing/industry, and it is difficult to shift policy away from using cars. A shift towards electric and hybrid vehicles is good, but policy-makers should look at how to move away from using cars altogether.

In the planning field, in the UK, the lack of economic and statutory powers of planning officials reduce their ability to impose sustainable development on private developers. Hence, within this context, a number key recommendations to deliver a Smart Mobility agenda, through leadership and public engagement, included the following:

7.3.1 Make the Economic Case to Economic Stakeholders and Fund the Smart Mobility Agenda

Stakeholders must understand that sustainable solutions can enhance growth rather than just restrict it: e.g. economic growth can come from other fuel sources, and there is potential for promoting the green economy vis a vis other economies.

7.3.2 Promote Cross-sector Working and Networking

A broad-based partnership model can support policy at all stages: formulation, development and delivery. It can help economies of scale, with investments in one agency allowing saving in another, e.g. invest in air quality leads to health/National Health Service (NHS) saving. It can allow access to a broader range of data by using indices from different sectors/sources, e.g. in UK: Big Society, Wellbeing - with data from the Office of National Statistics, the Healthy City Index - from the BRE Trust, the Healthy Streets approach - by Transport for London. It also helps raise awareness across sectors and development of a broader range of solutions. Bristol has multiple policy actors promoting the green economy, sourcing a solution or including health and environmental considerations in other sectors of the economy.

7.3.3 Integrate Policies: Spatial Planning and Transport

Several guiding Strategies, the Public Transport Masterplan and Local Governments Plans, have to align. The requirement in the WE Joint Spatial Plan, for mixed-use within development areas where people live, work, and spend their leisure time, must be complemented by sustainable transport initiatives; liveable developments must be situated around transport routes. The UK has adopted a hard line between city and green belt, which means that strategic routes have remained the same for 100 years and Planning is constrained by this divide.

7.3.4 Avoid Fragmentation and Duplication of Agencies' Roles and Functions

There was a feeling amongst the Bristol Workshop participants that government departments will focus to solve issues, e.g. the 100% government owned Highways Agency will offer road-based solutions. But is it so and does it work with local authorities to develop Smart Mobility solutions?

Participants emphasised the Importance of a common vision between different agencies to frame societal challenges and questions more broadly. Citizens must also be engaged in the process to decide the priorities.

Box 9: Highways England

Figure 41: Highways England.
Source: Highways England (2018).

Highways England is the UK Government's company that operates, maintains and improves England motorways and major 'A' roads. Highways England has key relationships with local authorities, technology and innovation partners, sustainability and environmental bodies, motorway service operators and freight organisations; and works closely with emergency services and roadside assistance organisations. Highways England's current priories are to: make jour neys safer for everyone; to improve the road network to minimise delays and give the best possible experience, and to work in a way that ensures value for money and minimal disruption to communities (Ordinance Survey 2017).

Smart Mobility

Smart Motorways

Highways England have implemented 'smart motorways' to some sections of the UK motorway network, which use new technologies to control traffic flows and improve journey times actively, e.g. variable speed limits and use of hard shoulder as an extra lane.

Figure 42: Smart Motorway.
Source: Ordinance Survey (2017).

Smart Safety

Highways England has access to improved accident data from a new road incident recording system, Collision Recording and Sharing (CRASH), which records accidents and classifies injuries. This has potential to be used to reduce incidents (Ordinance Survey 2017).

Smart Communications

Highways England is developing technology to ensure that Variable Message Signs (VMS) on roads display accurate information, which includes incident locations and likely lengths of delays. More detailed information is being provided on social media to help journey planning, and real-time updates to satellite navigation devices to outline alternative routes (Ordinance Survey 2017).

Smart Innovation

Highways England is working on a number of smart technology projects which include: trialling autonomous vehicles on roads; participating in the UK Connected Intelligent Transport Environment project (UKCITE) to support the development of fully technology connected roads; the installation of rapid charging points to support the uptake of ultra-low emission vehicles (ULEVs).

Highways England is also involved with annual Innovation Challenge competitions to support the development of innovative approaches (OS 2017). The current Highways England Innovation Challenge is about harnessing innovative technology to improve road safety. Bristol City Council also has an Innovation Challenge - asking industry for better ways to manage the city of Bristol's road network to improve congestion (Highways UK 2018).

See here for more information on Highways England:
http://highwaysengland.co.uk/

7.3.5 Include the International Agenda

The Bristol Workshop participants advised that external influences may be important to create change. For instance, an example given was that a carbon-neutral economy must raise awareness of products' sites of production. The global north must move away from non-sustainable palm oil sources.

7.3.6 Use Existing Data

Once again, the Bristol Workshop participants suggested that policy development should not depend on big data or a large amount of data. Small-scale evidence-base samples and small amounts of data already available might be sufficient to develop policies if other sectoral knowledge is incorporated, e.g. health, environment.

7.4 Findings from the Kuala Lumpur Workshop: Learning and reflections on Governance for Kuala Lumpur

With the birth of Greater Kuala Lumpur in the not too distant future, the 'smart way' to plan for its vitality and livability is undoubtedly through Smart Mobility Planning. Kuala Lumpur aims to be in the top 20 most livable cities in the world. With this grand objective, a more aggressive and concerted effort by all responsible parties to make Kuala Lumpur what it has been envisioned to be.

There are many intersecting issues in governance when it comes to planning for Smart Mobility. There are various ministries, department and agencies which have been entrusted to work on the realisation of Smart Mobility. The missing jigsaw is an open communication channel in which all these planning issues and solutions are tabled to create a comprehensive and visible picture for all to see. Implementing Smart Mobility requires a structured public and private sector engagement. Participants in the Kuala Lumpur workshop concluded that a high level of citizen engagement is imperative to produce a working mechanism which supports Smart Mobility and its adoption by users. A bottom-up planning method is recommended to fully comprehend users' needs, wants and preferences. Educating and creating awareness of the benefits of Smart Mobility would ensure a smooth transition from an auto-dependent city to a more livable and sustainable Kuala Lumpur.

Overcoming the Institutional and Governance challenges requires all relevant institutions, departments and organisations to come together, to develop an integrated master plan incorporating Smart Mobility in Kuala Lumpur city Planning.

The recommended actions by Kuala Lumpur stakeholders are:

• Identifying a 'champion' for Kuala Lumpur Smart Mobility Planning

• Creating a framework for sustainable cities. The local government must be tasked to spearhead this task

• Creating a common sharing platform for all stakeholders to view plans, strategies of each authority

• Paying attention to first mile and last mile issues

• The collaboration of agencies

• Smart partnership and networking among related governing bodies, operators and society

• Harmonisation of work plans

However, funding remains a central challenge to most initiatives and solutions. Amongst possible solutions suggested were to create a business model with a win-win approach where all parties benefit. This requires an open communication channel between authorities, operators and public. A concerted effort which results in a winning formula for all is fundamental to the implementation and success Kuala Lumpur Smart City aspiration.

The Smart Mobility funding issue has to be addressed by all agencies from local to state and federal level. Smart Mobility is proposed to be funded in partnership with all parties concerned. Additionally, policymakers for Kuala Lumpur must be willing to maintain and contribute to Smart Mobility Planning to support the *Greater Kuala Lumpur Plan*.

•   A new business model/approach is vital to realise the birth of Smart Mobility in Kuala Lumpur. Engagement with all relevant stakeholders is critical.
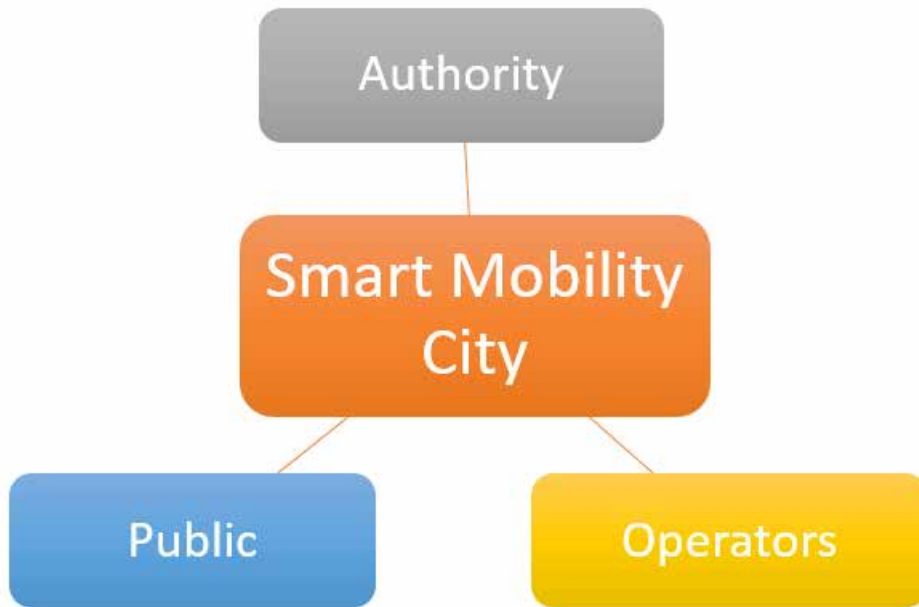
Figure 43: Shaping Smart Mobility City.
Source: Suggestion from the Kuala Lumpur Workshop, 9 Jan 2018.

•   Tax incentives must be introduced to lure the adoption and subsequent championing of Smart Mobility.

All participants were in unison in the acknowledgement that funding needs to be secured and committed towards the realisation of Smart Mobility.

Increasing patronage of public transport would not only allow an increase in revenue of the operators, but also increase the authorities' ability to support public transport infrastructure development. This will ensure smoother traffic on the road with a modal shift from the usage of private car to public transport.

8. Findings from the Bristol and Kuala Lumpur Workshops: Infrastructure and Physical Challenges

This chapter presents the findings on Kuala Lumpur's Infrastructure and Physical challenges from the Bristol and Kuala Lumpur workshops. Firstly it details the proposed Smart Mobility solutions made by the Bristol workshop participants to address these challenges in relation to enabling Smart Mobility in Kuala Lumpur. Secondly, it presents the learning and reflections on Infrastructure from the Kuala Lumpur workshop.

Findings from the Bristol Workshop: Infrastructure and Physical Interventions for Smart Mobility

8.1 Transport Pollution

A strong theme that emerged in the workshop was the challenge of air quality measurement. Big gaps in methodology, policy and practice linked to air pollution exist given a number of factors:

- Causation: difficulties in differentiating between transport or industry as a source.

- Economic priorities: Cabot Circus has increased pollutants due to its design creating 'canyons'. It has been identified as a problem in the design phase but the economic benefits outweighed the environmental/health costs at that time (the mid-2000s).

- Conflict from focusing on incentivising air pollution reduction (public health) vs CO2 reduction (environmental health).

- Lack of cooperation from the car industry, e.g. cheating the MOT system.

Solutions were put forward for modelling air quality. They included:

- Use of diffusion tubes: these can be placed on streetlights or in buildings adjacent to main roads and are relatively low cost.

- Use local knowledge on air pollution:

  o   In Bristol, people are fairly engaged with climate change.
       Local groups are active – such as Friends of the Earth and Greenpeace.

  o   Citizen Sensing – not accurate but useful as an awareness-raising activity – leading to policy-making.

- Look at international solutions: e.g. air quality data is shown on car dashboards in Beijing. The primary benefit is for the driver on knowing when car windows can be opened, but the data is also fed back to a central authority, which then has substantial air quality data to analyse and disseminate.

8.2 Strategies for the Smart Mobility Agenda

A number of aspects of the Smart Mobility agenda were discussed by the Bristol Workshop participants, including the necessary spatial infrastructure for Smart Mobility, type of travel modes to encourage Smart Mobility and associated issues of behaviour change, and renewable energy. Many of these bring together the co-benefits of climate action with health benefits, through a reduction in pollutants and more active lifestyles.

8.2.1 Sustainable Drainage Systems (SUDs)

A number of aspects of a Sustainable Drainage System (SUDs) strategy were put forward that could support Smart Mobility:

- Publishing live information about rain could be important, but difficult in case of flash floods.

- Travel modelling can help build the economic case for flood mitigation.

- SUDs offer a substantial approach to flood mitigation, e.g. reed beds, swales and rain gardens, the latter needing engagement with residents.

8.2.2 Financial Instruments/Financial Incentives

A Clean Air Zone for Bristol was discussed: it would be designed to phase out older cars by charging them to enter the city.

8.2.3 Renewable Energy Technology

The Bristol Workshop participants identified the following technologies relating to Smart Mobility:

- Geofencing (where cars switch from petrol to electric mode in areas of high air pollution) and clean air valency.

- Photovoltaic footways which generate energy. These could be developed for walking and cycling routes. Existing walkways need the available space for retrofitting. Often there will be breaks in connectivity for active travel.

8.2.4 Urban/Transport Infrastructure

Urban design can promote multi-modal transport, to include walking and cycling to suit different user groups.

Footpaths

The UK has experimented with footpath design over the years. Highrise walkways were developed in the1960s, but largely failed in the UK due to perceptions of safety, real safety concerns (e.g. mugging), design and aesthetics. EA number of these walkways in Bristol have been torn down in the last five years, as the concrete 'brutalist' architecture was not aesthetically pleasing or built to last. Also, high-rise walkways are inconvenient for cyclists, disabled and people with young children. Underground walkways or underground paths suffered the same perceptions and real problems. For instance, the 'Bearpit' in Bristol had been updated to include shops and make the area feel nice to walk through but safety remains an issue. Altogether the high maintenance cost of walkways can limit their roll out.

Cycle Paths

Bristol has been successful, as detailed previously, in developing its cycling strategy. The city benefits from the Bristol to Bath Raiway path, a disused railway converted to provide an alternative traffic-free route and safe space to cycle (Box 10).

Box 8:   The Bristol & Bath Railway Path

Figure 44: The Bristol & Bath Railway Path.
Source: BBRP (2018).

In 1978 the UK's active travel charity, Sustrans, bought the disused railway path between Bristol and Bath for £1 and through fund-raising and volunteer work over six years established the UK's first-off road path dedicated to walking and cycling (Sustrans 2017).

The Bristol & Bath Railway Path is a 13 mile off road route between Bristol and Bath. It is an important commuter route, an attractive leisure path and an abundant wildlife corridor. The Path is currently owned by Bath & North East Somerset Council, Bristol City Council and South Gloucestershire Council, with some small sections being owned by Sustrans. The work of maintaining and developing the Path is supported by dedicated volunteers and is coordinated through the Avon Frome Partnership. The Path now carries at least one million trips a year (BBRP 2018).

Figure 45: The Bristol & Bath Railway Path route.
Source: BBRP (2018).

For more information on the Bristol to Bath Cyclepath, please see here:
http://www.bristolbathrailwaypath.org.uk/home.shtml

Maintenance/Policing of Space/Shared Space

Bristol has established 20 mph zones to increase safety, and reduce pollution (but caution about the success of the latter). 20mph zones are also politically sensitive, as politicians are afraid of public perception around the implementation of the limit (see Box 11).

Box 11: Bristol 20mph Limit Policy

Evidence shows that those hit by a car at 20mph are far more likely to walk away with bruises and minor injuries than those hit at 30mph. Additionally, the single major avoidable cause of death for children over five is unintentional injury on the roads and indisputable inequality. Children in the 10% most deprived wards in England are 4 times more likely to be involved in a road accident than children in the 10% least deprived wards (Marmot review *Fair Society, Healthy Lives*').

In 2010, Bristol City Council and NHS Bristol piloted two large 20mph speed limit zones in parts Bristol with higher health needs. The objectives were to reduce injuries and deaths, but also to promote more physical activity, less traffic noise and better air quality which in turn lead to reductions in obesity, diabetes, heart disease and mental health conditions. By 2015, the lower speed limit had been introduced to many areas of the city.

Other measures to improve road safety and promote active travel in Bristol include:

- bus improvements

- cycle infrastructure improvements

- local safety schemes

- major transport schemes such as Metrobus

- rail improvements

See https://www.bristol20mph.co.uk/ for further information.

Electric Bikes & Hybrid Vehicles

Electric bikes and hybrid vehicles can offer a solution, but need to be adapted for the local context and integrate with existing transport modes. In hilly Bristol, electric bikes could contribute to behaviour change away from mopeds and motorcycles and be the gateway to cycling. Electric vehicles require investments in power charging points (see Box 12 below).

Box 12: Vehicle Sharing Schemes: Bikes and E-bikes, Cars and E-cars

Figure 46: Co-wheels
Source: Co-wheels (2016)

Co-Wheels: E-Car Clubs and E-Bike Schemes
Co-wheels provides low emission, hybrid and electric cars for organisations and individuals. Co-wheels is a Community Interest Company, with profit reinvested into the organisation to improve and extend its operations (Co-wheels 2016).

Co-wheels: E-Cars, Bristol
Co-wheels has a car club in Bristol, supported by Bristol City Council and TravelWest, with numerous vehicle pick-up locations for individuals in the city. The cars are mainly based in the city centre, but are also located around large public sector organisations, (Figure 47) (Co-wheels 2016c). UWE has partnered with Co-wheels to introduce a car club scheme for all staff and has three E-cars at its Frenchay campus which are available for business and private use (UWE Bristol 2018).

Figure 47: Map to show locations of Co-wheel cars in Bristol.
Source: Co-wheels (2016)

Co-Wheels: E-Bikes, Bristol

Co-wheels E-bikes schemes in Bristol are available to Bristol organisations and businesses and are currently being delivered through partnering with Avon Fire & Rescue Service, Bristol City Council's Early Help teams, Bristol Community Health, Bristol Dementia Wellbeing Service and UWE (Co-wheels 2016a). UWE hires four E-bikes through Co-wheels, available on weekdays for business travel only (UWE Bristol 2018).

Please see here for further information on Co-wheels and its vehicles: http://www.co-wheels.org.uk/

Figure 48: Yo Bike.
Source: Yo Bike (2018).

Yo Bike is an app based bike hire programme which arrived in Bristol in 2017. The bikes are located, released and paid for via the downloaded Yo Bike app. They are also easy to identify as they are bright yellow. Yo Bikes have no docking stations so Yo Bike hire can finish anywhere. There are also no 30-minute maximum cycling penalties. Yo Bikes has three different payment options: Pay G – 1 hours riding time for £1; The £5 Day Pass – 24 hours of cycling; and the £39 Annual Commuter Pass – two, one-hour rides each day, every day for one year, which works out to be 5p per ride (Yo Bikes 2018).

Further information on Yo Bikes can be found here: https://yobike.co.uk/

8.3 Findings from the Kuala Lumpur Workshop: Learning and Reflections on Infrastructure for the Kuala Lumpur Context

the adoption of sustainable forms of mobility in Kuala Lumpur, like public transport and non-motorised transport, require a paradigm shift in infrastructure Planning. This is to ensure a decarbonised fuel supply to create cleaner, economically and financially viable cities, based on intermixing of land use to promote sustainable forms of mobility.

Participants in the Kuala Lumpur workshop were united in the opinion that incentives and subsidies which promote private mobility have to be reduced, if not completely removed, to initiate proper Smart Mobility transport infrastructure. The challenges identified include:

- The availability of abundant parking spaces.

- The lack of connectivity of non-motorised transport (walking and cycling) with residential and work areas.

- Uncomprehensive public transport operating infrastructure, such as common ticketing systems, which frustrates users.

- The absence of incentives and punitive policies to shift from personal transport to public transport and non-motorised transport.

- Barriers for citizens to access free transport services.

The ultimate objective of smart transport infrastructure planning is to create an infrastructure network which appeals to the users, to give up their personal vehicles and choose smart transport solutions to carry out their daily activities.

Overcoming infrastructure and physical challenges requires an integration of physical infrastructure, operational technologies, communication technologies and information technologies.

Possible solutions recommended by participants are:

- The need for a common ticketing systems platform.

- Integration of technology (web & mobile application) – use of the Internet of Things.

- Integration of public transport scheduling (transport operator networks).

- Integrated infrastructure policymaking for optimal investment in Smart Mobility infrastructure.

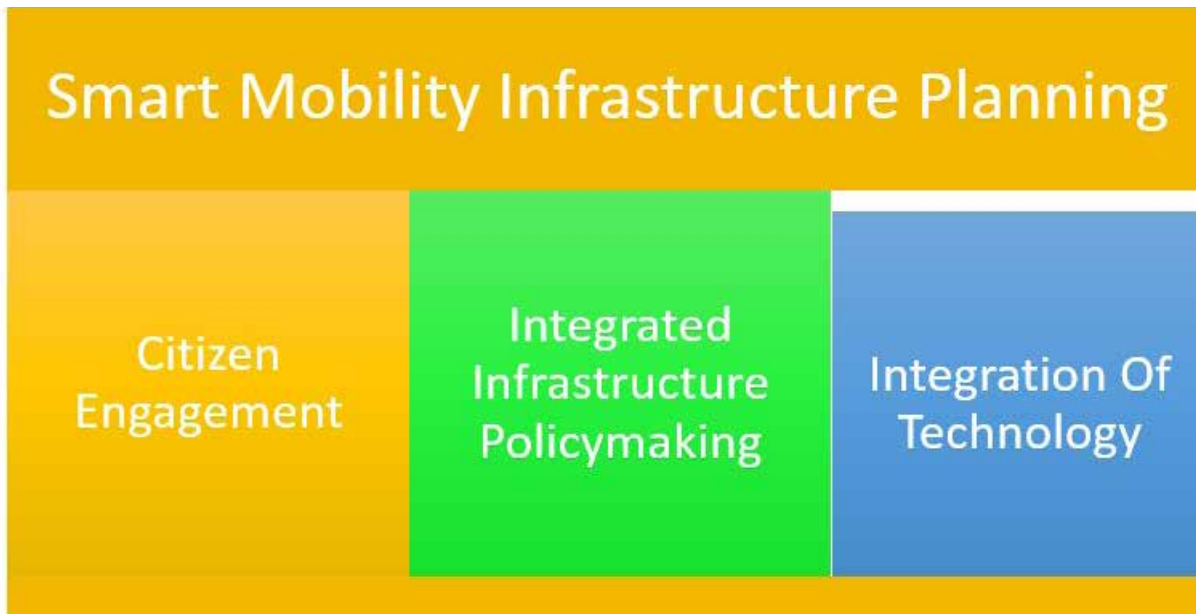- High level of citizen engagement and bottom-up planning and development.

Figure 49: Smart Mobility Infrastructure Planning.
Source: Suggestion from Kuala Lumpur SMC Workshop, 9 Jan 2018.

Smart Mobility infrastructure has to be an encompassing infrastructure system, which supports public transport and non-motorised transport, as well as private car users. Policy makers and transport planners have to be realistic in their infrastructure planning and provision to support these three cohorts of users.

Smart Mobility infrastructure can be an enabler to livability, sustainability and innovative cities. ICT can be used as a tool to achieve the objectives of Smart Cities.

9 Findings from the Bristol and Kuala Lumpur Workshops: Behavioural Change Challenges

This chapter presents the findings on Kuala Lumpur's Behavioural Change challenges from the Bristol and Kuala Lumpur Workshops. Firstly, it details the proposed Smart Mobility solutions made by the Bristol Workshop participants to address these challenges in relation to enabling Smart Mobility in Kuala Lumpur. Secondly, it presents the learning and reflections on Infrastructure from the Kuala Lumpur Workshop.

Figure 50: Kuala Lumpur public transport users.
Source: CEphoto, Uwe Aranas.

Findings from the Bristol Workshop: Behavioural Change Interventions for Smart Mobility

The Bristol workshop considered policies and approaches for promoting behaviour changes towards a more sustainable, and less car orientated, economy and forms of mobility.

9.1 Towards a More Sustainable, Less Car Orientated Economy

9.1.1. Promoting the Health Benefits of Active Travel

First, any strategy needs to put forward the health and wellbeing benefits of walking and cycling, or the equity dimension of public transport. Walking contributes less to the economy than buying cars/taxation on fuel but provides long-term financial benefits, e.g. health and wellbeing.

At the national level, mobility and active travel is a major priority for Public Health England. Latest research from UWE, Bristol, synthesised the latest evidence linking transport behaviour to health outcomes and recommended planning principles, including the promotion of active travel infrastructure, public transport and prioritisation of travel and road safety (PHE, 2017).

Active travel and accessibility of transport are particularly important as we grow old. Remaining mobile throughout our lives is key to physical and mental health. However, ageing is associated with reduced journeys and change in types of journeys, increased risks of social isolation and loneliness and barriers to accessing community activities. This issue is particularly critical, as life expectancy is increasing throughout the world, with the EU life expectancy at birth projected to increase to 84.6 years and 89.1 years in 2060 for males and females respectively (from 76.7 years and 82.5 years in 2010).

The Bristol Ageing Better partnership develops community infrastructure to promote social connectivity (Box 13). Smart Mobility choices can happen when the services are designed in a way that accommodates the requirements of users. This will, in turn, attract potential users.

Box 13: Bristol Ageing Better (BAB)

BAB is a partnership funded by the Big Lottery Fund, which works to reduce social isolation and loneliness among older people, and helps them live fulfilling lives. The BAB has four main themes:

1. **Creating the Conditions** to reduce and prevent loneliness
2. **Identifying and Informing** older people at risk of loneliness
3. **Working with Communities** to increase services & activities available
4. **Supporting Individuals** to live fulfilling lives

Activities have included:

- City-wide community development workers contacting older people in their neighbourhoods.

- Small grants to groups to kick-start activities.

- Volunteers who connect older people to activities.

- Community navigators that advise on transport solutions to access activities.

- Bristol-wide 'Well Aware' website which matches transport solutions to activities.

One of the initiatives funded is the 'Well Aware' website, providing information on a wide range of organisations, support groups, community groups, events and activities that can help improve health and wellbeing in Bristol and South Gloucestershire. The community transport section helps people, who find getting out and about challenging, providing information about local options for community transport, door-to-door transport, and transport with disabled access.

See http://bristolageingbetter.org.uk for further information.

9.1.2 Developing a Multi-layered Approach to Changing Behaviour

Secondly, Bristol Workshop participants stated that developing a multi-layered approach is necessary with a "national philosophy" of discouraging people from driving while the "local approach" includes developing local green transport infrastructure: e.g.

- Removing roads from the city centre – for example, Queen's Square in Bristol.

- Considering the type of journeys and integrating modes of transport.

- Using factors to encourage public transport use:

    o Smart technology: wifi access, mobile phone ticketing and integration of such ticketing on bus and rail, to incldule contactless payment, and apps that cover the entire journey.

- But also to bear in mind the connotations of public transport:

    o For example, in London - public transport is used by all socio-economic groups; whereas in Bristol - wealthy people may choose other transport modes.

9.1.3 Incentivise the Public: the Polluter Pays Principle

Third, the Bristol Workshop participants explained how the 'Polluter Pays' principle can support a change in travel behaviour, for instance: Road Fund taxis charged on vehicles. Low emission vehicles have a lower Road Fund tax and less tax relating to fuel, so therefore pay less road tax overall.

9.2 Case Study: How to Encourage Cycling

Social Practice Theory (Shove 2012) identifies three elements required to change behaviour away from cars and towards cycling:

- **Physical Infrastructure** (cycle paths & links).

- **Cycling Skills** (Bikeability, see Box 14).

- **Associated Meanings** (freedom, health, low-cost vs unsafe, inconvenient).

Participants in the Bristol Workshop also identified that the pathway to a successful cycling policy needs the following three key elements.

9.2.1 Adapting Infrastructure for Cycling

First, infrastructure must be adapted, with alternatives to main roads, to ensure that cycling becomes faster than other transport modes and operates on cycleways closed to cars. Thus, offering a quicker, safer environment for cycling.

9.2.2 Building Cycling Skills

Second, th Bristol Workshop participants felt that cities need to capture people when they are young - promote cycling to children who can encourage their families to cycle. The UK Bikeability scheme is a UK scheme delivering safe cycle training for 10-year-old children (see Box 14). Other UK adult cycling schemes also exist to offer new or refresher skills.

Box 14: Bikeability

Figure 51: Bikeabilty.
Source: Bikeability (2018).

Bikeability is the United Kingdom's cycle official training scheme. It is administered by the Department for Transport and is based upon national standards. The training is delivered by qualified Bikeability Instructors to children and adults within participating schools, clubs and workplaces, or to individuals. The Bikeability scheme, therefore, provides quality assurance that training is delivered to the highest level (Bikeability 2018). There are three levels of Bikeabilty training.

Bikeability and cycling in Bristol
By the end of the financial year 2018, approximately 4814 young people in Bristol will have taken part in the 2018 Bikeability programme (BCC 2018).

Figure 52: Bikeability for Bristol Schools and Communities to 2015
Source: BCC (2015).

Bikeability cycle training is offered within all Bristol schools, Bristol City Council also provides Bikeability training to adults, as well as all-abilities cycling sessions for children and adults, and the training is promoted to communities to support new people into cycling as a way to get around. Bristol City Council has delivered specific cycling campaigns to encourage responsible cycling and driving behaviours and has worked closely with key partners, such as the police and community groups, to ensure safe cycling is promoted throughout Bristol (see Figure 52) (BCC 2015). From 2018 onwards, Bristol City Council is aiming to deliver a joint cycling strategy with the West of England Authority, to include Bikeability (BCC 2018).

See here: https://bikeability.org.uk/ for further information.

9.2.3 Changing Mentalities

Third, Bristol Workshop participants advised that cycling uptake can also benefit from role models and aspirations, e.g. success of Team GB and Team Sky male and female cycling teams in the UK in the Olympics. Cities can also learn from other urban cycling countercultures, e.g. Amsterdam style. Advocacy is needed to encourage people who are taking up cycling and moving away from car use. In Bristol, Sustrans promotes the switch in travel behaviour (see Box 15).

Box 15: Big Commuting Challenge 2017

Between 5th June and 14th July 2017, Sustrans, in partnership with other local active travel advocates (Travel West, Business West, North Bristol SusCom and SeverNet), ran the Big Commuting Challenge - to promote a switch in travel behaviour. The competition required workplace teams to log walking, cycling, public car-sharing and other active and sustainable journeys on the Big Commuting Challenge website or via a downloadable app. 3,329 people took part in the challenge. More than 15,000 single occupancy vehicle journeys were replaced by more active, or sustainable, modes of transportation.

9.3 Findings from the Kuala Lumpur Workshop: Learning and Reflections on Behavioural Change for the Kuala Lumpur Context

Changing mindsets is central and critical for a behavioural change of the population of Kuala Lumpur in adopting smart city mobility solutions. A value-laden proposition is vital to change behaviour. Pain points must be addressed, and prohibitive actions, limiting private car use, must be undertaken simultaneously to shift private car usage to public transport and smart transport usage.

Participants at the Kuala Lumpur Workshop identified the following obstacles which pose challenges to the authorities and urban planners in creating the behaviour change required for a modal shift for transport use in Kuala Lumpur.

Amongst factors identified as obstacles to the required behavioiur change for a transport modal shift in Kuala Lumpur are:

•   Lack of first mile and last mile connectivity.

•   No incentives for choosing public transport.

•   Safety and security issues.

•   Weather condition.

•   Longer journey time.

•   Private car affordability and ease of purchase.

Suggestions to improve and change behaviour include:

*   To educate/ give awareness to the public on Smart Mobility through:

    o   Community engagement.

    o   Intensive use of social media platforms.

    o   To introduce the concept of Smart Mobility introduced in the syllabus of driving schools'. This would ensure that 'would-be' drivers are introduced and made aware of the Smart Mobility concept. 'Would-be' drivers are categorised as 'post-millennials' or 'generation Z' whose preferences can be shaped with correct and precise information with regards to Smart Mobility.

*   To enhance the usage of information technology, including social media platforms, to provide and access information.

*   Behavioural change initiatives, such as free buses (Go KL, Smart Selangor). Route planning of these services has to be comprehensive and accessible to users for behaviour change to occur.

Behavioural change can be greatly increased by taking into consideration the social-psychological dimensions of humans, through understanding their motivations to change.

Additionally, a thorough analysis is required, with regards to data analytics of citizens habits, demands and preferences. Real-time information has to be collected, analysed and leveraged to effectively plan and operate integrated Smart Mobility. The need for segmentation, taking into account travel attitudes and behaviours, is paramount to change habits and preferences in practice.

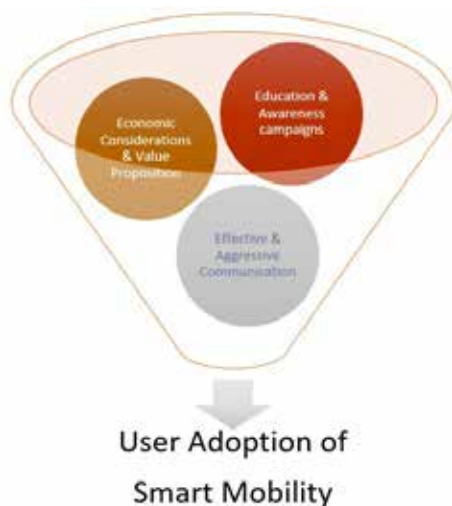***Figure 53: Proposed User Adoption Strategy for Smart Mobility.***
Source: Kuala Lumpur SMC Workshop, 9 Jan 2018.

Policies should be aimed at the market segments which are most motivated to change and willing to reduce the frequency of personal car use. Embarking upon these would create cross-cutting dimensions of environmental preservation, addressing health issues and enhancing city livability and sustainability.

10. Vision 2030

Cities around the world have begun to recognise the multiple challenges facing rapidly urbanised areas, such as changing climates, degradation of environmental conditions, and increasing population growth, as well as increasing congestion and rising safety fatalities concerns. Visions drafted in the last decades have been influenced by a growing trend of sustainable mobility and increasing walking and bicycling as main modes of transport. A growing number of cities are framing mobility and accessibility in new formats to achieve global goals on a local scale. A Vision may become the toolbox that informs the long-term solutions addressing the challenges the region has identified.

The *Kuala Lumpur Structural Plan* 2020 goals provide a benchmark for the decade to follow along with Kuala Lumpur Low carbon Society Blueprint 2030 (KL LCSB 2030). A smart mobility Vision emphasises accessibility, connectivity, and sustainable transport systems taking into account technological innovations in autonomous, electric, shared and active mobility.

10.1 The challenges of Vision 2030

The Kuala Lumpur team identified the challenges facing Kuala Lumpur, organised into three themes: governance and collaboration, infrastructure and physical environment, and behavioural and informational. A long-term Vision should be based on a comprehensive perspective of existing conditions, desired conditions and visioning in scales. The Vision must be conceived collaboratively, between both government agencies and with community engagement to focus on citizens needs.

Autonomous mobility is viewed worldwide as one of the most significant evolving revolutions that can transform current mobility practices towards a more sustainable mobility future. Supplemented by full electrification of the system and a shared car-use model replacing private ownership, these three transformations, led by autonomous technology, could have far-reaching consequences for the built urban environment. Autonomous mobility is viewed as having the potential to increase safety, reduce traffic, and alter mobility ownership patterns towards increased levels of energy efficiency.

1. Provide comprehensive and integrated transport system that caters for the need of inter and intra city travel; reverse the decline in public transport usage and to achieve a targeted public: private transport modal split of 60:40 by the year 2020; optimize the road and rail transportation infrastructure so that it operates at its full capacity and maximum efficiency; ensure that the overall configuration of land use is integrated with road and public transportation networks to optimize the development of land; ensure that all areas within the City enjoy the same high quality and standard of provision of public transport services; create a city that is highly accessible for all its occupants and users, in particular, one that is pedestrian and handicapped friendly.

2. A commitment to reduce the country carbon emission intensity of GDP by 45% by 2030. The blueprint introduced a voluntary model for short and medium length trips and promotion of public transportation use. Five action plans were drafted: active walking, integrated public transportation, diffusion of low

Autonomous vehicles have the potential of increasing mobility access for everyone, which in turn increases social inclusion to those who do not have a drivers license or access to other modes of travel. Time taken to spend driving or standing in traffic can be used more efficiently doing other activities in a much smaller setting from that of large public transport systems. A shared autonomous vehicle system will reduce, if not completely remove, car-ownership related expenses, such as insurance, purchasing of the vehicle, day to day maintenance, for parking. The autonomous technology and the new nature of the system reduces the need of parking, opening up urban public space for other uses such as parks, small-scale developments, and expansion of the infrastructure systems for cyclists and pedestrians. Electrification of the system will have a significant impact on air pollution levels.

Autonomous vehicle technology is progressing rapidly. However, its multiple potential benefits can also turn sour. If allowed to develop a personal ownership model, autonomous vehicles will increase road congestion. Parking will no longer be an issue when one can instruct a vehicle to drive around the block until the work day is over, or until the errand is completed. On the one hand, autonomous vehicles will provide an opportunity for mobility to historically disadvantaged groups, such as young children, ageing adults, and people with disabilities. Yet on the other, increasing vehicles on the road, with no share riding schemes, will result in increased noise pollution, increased air pollution, increased congestion and increase safety risks. To make a significant reduction in air pollution, autonomous vehicles must be fully supported by renewable energy. Gaps also remain in the technological development of autonomous technology; the relationship between the vehicles and the other users of the streets, pedestrians and cyclists, as well as other vehicles. But is not limited to the ability of the system to respond to the complex conditions of the built urban conditions both static (turns, intersections, lanes, the width of the road) and active (users).

The challenge of planning for a changing technology that is rapidly developing is, as identified by the Kuala Lumpur project team, creating flexible policy, with the ability to be updated rapidly, providing a flexible infrastructure to transform current physical environment conditions. Flexible policy needs to accommodate the new technology while informing and educating the public on smart mobility practices (Hannon et al. 2016).

10.2 International goals

The desired conditions of a long-term Vision or a vision goal, in many international cases, have been focused on reaching measurable changes. The Paris Agreement's essential elements focus on greenhouse gas emission mitigations. With the Agreement's main goal of "holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change" (United Nations Climate Change 2018).

The United Nations Development Programme (UNDP) Sustainable Development Goals (SDGs) (UNDP 2018) provide overarching long-term goals focusing on sustainability. Yet, no specific SDG was endorsed as transport or mobility. Out of the sixteen SDG's, two are related to sustainable mobility. Goal 9: 'Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation', and Goal 11: 'Make cities and human settlements inclusive, safe, resilient and sustainable' (UNDP 2018). The long-term perspective of the SDG's provides a solid framework in which to vision local goals. A growing number of instances have municipal governments and local authorities acting with a variety of tools, such as appropriating public space from exclusive use by personal vehicles, and newly allocating these civic resources to non-motorised users and public transport systems, resulting in an improvement in congestion, safety, and environmental conditions. Underlining these efforts are the global benchmarks going beyond a 2030 Vision.

10.3 Smart Mobility Goals

Six categories have been identified as the Smart Mobility objectives (Lawrence et al. 2006 & Bencardino et all 2014): reducing pollution, reducing traffic congestion, increasing people safety, reducing noise pollution, improving transfer speed, reducing transfer costs.

The UC Davis 'Sustainable Transportation Energy Pathway' within the Institute of Transportation Studies, California, USA, identifies three revolutions in urban transportation to "achieve the full potential of vehicles electrification, automation and shared mobility in urban transport systems around the world by 2050" (UC Davis, 2017).

10.3.1 Electrification

The 19th century saw the rapid decline of electrical vehicles (EV) only to re-emerge as a viable technology, hybridised or running on batteries this new/old technology has put more than 2 million electric and plug-in hybrid vehicles on the world's roads. Supported by renewable energy, the technology can have a direct effect on pollution levels.

3. SDG 1 no poverty, SDG 2 zero hunger, SDG 3 good health and wellbeing, SDG 4 quality education, SDG 5 gender equality, SDG 6 clean water and sanitation, SDG 7 affordable and clean energy, SDG 8 decent work and economic growth, SDG 9 industry, innovation and infrastructure, SDG 10 reduced inequalities, SDG 11 sustainable cities and communities, SDG 12 responsible consumption and production, SDG 13 climate action, SDG 14 life beyond water, SDG 15 life on land, SDG 16 peace, justice and strong institutions.

10.3.2 Automation

Technologies to automate vehicles have been employed in certain transport applications such as in track-based transport (trains, light rail, and so on) and planes. Current innovations are seeing the automation of on-road vehicles moving rapidly, from driver assistance automation, to full automation. Level 4 and 5 are already being tested in commercial fleets capacities around the world.

10.3.3 Shared

Public transport, taxis and carpooling have been around for centuries, allowing shared trips to occur for decades. New technologies have created new potential in ride-sharing services both as a private service or a public one. Ride-sharing can cut costs in ride-hailing (service mobility) schemes and reduce the number of vehicles on the roads, by reducing the number of trips taken. Taxi services or transportation network companies (TNC) that are not shared do not reduce trips but exasperate traffic conditions.

10.3.3.1 Shared Mobility Principles for Liveable Cities

Launched at the 2017 Ecomobility World Festival in Kaohsiung, Taiwan, and initiated by transport entrepreneur Robin Chase, a working group on International NGOs, created ten principles to guide urban decision-makers and stakeholders to prepare for the fast pace of innovation in transportation. The principles are as follows:

Principle 1:   Plan cities and their mobility together.

Principle 2:   Prioritise people over vehicles.

Principle 3:   Shared and efficient use of vehicles, lanes curbs, and land.

Principle 4:   Engage stakeholders (residents, workers, business, and others who may feel direct impacts on their lives).

Principle 5:   Equity, physical digital and financial.

Principle 6:   Lead a transition towards a zero-emission future and renewable energy.

Principle 7:   Support fair use fees across all modes.

Principle 8:   Public benefits via open data.

Principle 9:   Integration and seamless connectivity.

Principal 10:   Autonomous vehicles in dense urban areas operated as shared fleets only.

10.4 2030 Vision Toolbox

10.4.1 Active Travel and Human Scale Design

Active travel and human scale design refer to resources to transform the built environment to encourage physical activity and non-motorized modes of transit. The experience of the built environment user (pedestrian or cyclists) is shaped by its physical spaces which are regulated by policies.

10.4.1.1 Retrofitting Urban Roadway (Physical Space)

Motorised spaces that are temporarily or permanently pedestrianised can be repurposed as green public spaces, especially in consumption oriented areas. Small-scale projects include introducing plazas, adding benches, traffic calming, wayfinding infrastructure, and Art projects.

1.   There are three scales in which projects are implemented:

    1.   **The neighbourhood context**: provide people with walkable destinations in a safe, continuous, and interesting pathway.

    2.   **The street typology**: the scale of presence in the street of the built environment. A distinction is developed that should be made based on the street typology (downtown commercial, main neighbourhood street, residential street).

    3.   T**he sidewalk "room"**: made out of the ground plane, the roadside, the building wall and a canopy, the sidewalk "room" interchanges with a variety of other realms of development (Active Design, City of New York, 2013).

        1.   **The ground plane**: width and clearance, planters, tree pits, curb cuts, transit stations, service access, lighting and signage poles, pavement material (texture, patterns), street furniture, waste collections, newsstands, and fire hydrants.

        2.   **The roadside plane**: planters, tree pits, lighting and signage poles, parked cars, bike lanes, bike racks, street futures, waste collection, newsstands, fire hydrants, and parklets.

        3.   **The canopy**: balconies, fire escapes, shading devices (canopies, awnings), trees, signage, building height, building setbacks, lighting poles, electrical poles, other lines, and landmarks.

        4.   **Building wall plane**: land use, ground floor set back, building height, plantings, parking entrance, transparency, security gates, shading devices, balconies, outdoor uses, lighting, public, and private.

Box 16: Retrofitting urban roadway: New York City Plaza program

Figure 54: New York City Plaza program
Source: New York City Department of Transportation, 2018

The New York city Department of Transportation (DOT) works with selected community organisations to create neighbourhood plazas. The New York City (NYC) Plaza program is part of the city's effort to provide a quality open space within a 10-minute walk. Community organisations send DOT an application that demonstrates local support for a proposed plaza. The design and construction of the plaza are completed by DOT once the site is selected. Selected sites go to a public Vision workshop with a DOT assistant to develop a conceptual design appropriate for the specific neighbourhood. Once developed, a professional team of designers within DOT uses the conceptual design and produces formal plans. Possible amenities in the public spaces may include tables and seating, trees and plants, lighting, bike racks, public art, and drinking fountains. The community organisation is expected to develop a funding plan to show how the organisation will fund and manage the plaza in the long term, with continued progress reports to DOT. The community organisation is the one responsible for ensuring the is plaza clean and in a good state of repair. Programming and events are encouraged and include holiday events, food or craft markets, temporary public art installations or exhibits, music, and dancing.

10.4.1.1 Retrofitting Urban Roads (Policy)

Spatial planning policy has a significant role in promoting healthy living and active design. Zoning planning policy, in particular, offers a strong way to influence the outcome of the built environment changes.

1. **Policy that ALLOWS**: elements in local zoning laws may set a template to allow the appropriate retail use of ground floor with a sidewalk cafe. Regulations should contain certain minimum and maximum requirements, as well as allow for flexibility and diversity by typologies.

2. **Policy that INCENTIVIZES**: form and size of the incentive should be associated with the costs and benefits of the feature. Used to encourage desired practices, for example, incentivise residential development which installs bike parking facilities, or shower facilities for business.

3. **Policy that MANDATE**: requirements that must be followed and complied. Minimum standards should be established.

4. **Policy for RELIVE**: removing penalties based on outdated policies or conditions that have yet to be updated.

5. **Policy to GUIDE**: most policies do not include guiding documentation. A guideline can have a vital role in supporting all scales of developers and community organisations.

10.4.2 Governance

Smart governance calls for a transparent governance process to enhance the quality of public and social services in a city. Models of mobility have historically divided, to either consider mobility as 'market' or mobility as 'well-being'.

With advances in autonomous venicles increasing, mobility governance faces a challenge of becoming a faster, more flexible entity that can keep up with innovations. The role of governance in this evolving transition sees possibilities ranging from becoming a service aggregator (contractural authority), regulator, and educator (see the Disruption Project: www. distruption.net).

There needs to be a clear policy goal produced by those bodies governing mobility to direct the decisions made during the transition. Small incremental decisions can be a valuable step toward a Smart Mobility future and should not be taken lightly.

As identified in Chapter 7, the characteristics of leadership, community engagement, and partnership in Smart Mobility are based on a relationship between the policymakers and the public. These partnership need to be evolved within the local context and can be stakeholders from a variety of fields. Bristol City Council's 20-year plan is constantly changed and adjusted to new priorities. Although the frame is different, the process is the same with Smart Mobility development. The three recommendations identified in this Chapter create a framework in which governance of Smart Mobility can evolve:

- Short-term projects to avoid political conflicts over tenure. See NYC Plaza project as a sample typology.

- Projects that provide incremental benefits to the community it serves. This also requires the involvement of the community with the development process itself to identify the benefits that interest the public within the Smart Mobility framework (See section 7.1.2 Community engagement).

- All projects need to be completed. Without completion, it cannot be truly determined if a project has failed or suceeded.

10.4.3 Behaviour Change

Behaviour change is driven by people and projects supporting the issues facing those people. Proposed are several policies and development projects to respond to common challenges facing communities and which encourage Smart Mobility.

Car-free Zoning

Designating a car-free zone within urban areas, either temporary (daily or seasonal) or permanently, introduce communities to an alternative use of public throughways. It is encouraged to programme activities and events within the newly designated spaces, especially if implemented in non-commercial areas. Most successful pedestrianisation projects to date are often in retail based areas. Car-free days provide highly visible opportunities to test larger scale pedestrianisation of entire main roadways or entire city regions (for example, Paris Plage, Paris; Times Square, New York; and car-free days in Bogota, Colombia).

Parking Policies

Policies which limit free parking (supplemented by improvement in other modes of transport) have had success in reducing private vehicle usage under certain conditions. Limiting parking encourages smart use of vehicles (toward carpooling). Removal of on-street parking to improve the streetscape, safety, provide cycling infrastructure, or increase pedestrian infrastructure can increase non-motorised used.

Vehicle Ban Legislation

Limiting access of specific types of vehicles, in specific locations, at certain times of the day. Bans can be implemented temporarily and lifted according to local pollution levels.

Tax Reductions/Expeditions

Tax incentives implemented to encourage certain market behaviours, such as exemptions for electrical vehicles to encourage purchasing of specific types of vehicles, a program providing financial incentives to ride bicycles to work, or subsiding public transit rides.

Congestion Charge

A pre-determined geographical location, in which a fee is imposed on vehicles entering a specific zone. Can be limited to specific times of days, or specific times during the day. Congestion pricing must increase steadily, with each adopted year, to remain an incentive.

Bike Infrastructure Expansions

Expanding alternative travel modes of infrastructure provides individuals with the opportunity of choice. Investment should be made in both hard infrastructure and legislation, with interaction of sharing schemes, protected bike lanes and electric bike legislation, as well as parking amenities. Business opportunities around bicycle infrastructure expansion can be found in delivery, logistics, and transit-oriented development (TOD) centred around bicycles.

Education Programes

Awareness programs to familiarise cyclists of all age groups with traffic rules for bicycles, pedestrians, and drivers, including rules that each pathway or road user should be aware of the rights and obligation of the other users. This includes driving speeds education, bicycle safety education, and pedestrian safety education. There is the requirement for good educational content, including using stuntmen to replicate traffic accidents, holding participative, hands-on practical classes, and so on.

Walk to School Programes

Supported by communities, education institutes and public finance these programmes reduce congestion around schools and provide children with education as pedestrians, cyclists, and public transport users. The programmes can extend to either mode, based on the childrens' school location and living location, and are coordinated and supported by schools through grants.

10.4.4 Technological Innovations

As indicated in Section 10.3 Smart Mobility Goals, there are three main innovations for the future of sustainable mobility: electrical, automation and shared. As such, several mobility apps have the potential of making public transport more attractive to use and more competitive.

10.4.2.1 Information

Access to real-time online transport data-sharing platforms can be gained via both privately and publicly owned devices (smartphones, tablets, computers), in public transport stations, residential buildings, office buildings and other public institutes. These platforms provide tools for trip planning, online ticketing services, ease of knowing when the next vehicle/mode of transit is arriving at your station, the frequency of travel to better plan ahead, availability, or specific infrastructure. Together with other real-time useful information such as weather, time, and other news. See Box 17 for a sample interactive display multimedia product.

Box 17: Transit Display: Interactive multimedia

Figure 55: Example of a transit display option.
Source: Redmon Group, 2018.

10.4.2.2. Automation

Automated technology is developing rapidly and requires policy and infrastructure to catch up at a fast pace. Significant technological, legal and cultural hurdles must be addressed by cities before Level 5 fully automated vehicles begin to roam and be used on public roads. These include: optimising the existing system, improving infrastructure - both hard and soft,;using techniques and technology - with the likes of intelligent transportation system (ITS) technology; and limiting usage of vehicles and trucks - by encouraging behaviour change through policy and design.

Vehicle automation is expected to reduce vehicles on the roads and reduce parking needs (if adopted as a shared autonomous system). Reduction of vehicle roadways provides an opportunity to improve pedestrian and cyclist infrastructure, as well as the development of station infrastructure for autonomous shared mobility and other general improvements to the built environment. Alternative street designations can be enabled to limit speeds of motor vehicles and encourage a more shared usage of the roads. See Section 10.4.1.1 on Retrofitting Urban Roadway Physical Spaces. Design also needs to support the electrification of an autonomous vehicle fleet with investment in EV infrastructure, both policy and physical: charging stations, storage, way-finding, wait-stations, pick-up locations, digital interface and data collection.

10.4.2.3 Shared mobility

Technological innovations provide an opportunity to share multiple mobility modes, as well as sharing information for better facilitation of existing modes of transport and new data availability. The shared use of a bicycle, vehicle or any other mode enables short-term access on an 'as-needed' basis. The term, 'shared mobility', refers to alternative transport services, such as micro-transit (see Dynamic shuttle service below) that can supplement fixed-route services. It does
not refer to ride-hailing (or e-hailing), in which an app-based system secures a ride from a taxi or an on-demand riding service (for example, Uber and Grab).

Car sharing (carpooling)
Car sharing can have a business model of either a public or private (or public-private) finance scheme, which includes free-floating, peer-to-peer, or co-ownership. Journey's may be round-trips or one-way, with charges being at an hourly or per-mile rate. Infrastructure improvements (parking facilities) and policy (incentives, mandate, and guide) need to be implemented to support and encourage the development of car sharing schemes.

Bike sharing
Bike sharing can have a similar business model to those of car sharing. Technologies for shared bicycles are currently available in two systems: station-based and "dockless". Both allow for one-way trips, while dockless bikes provide advantages in flexibility and less need for new hard infrastructure (no need for stations). Electrical bikes (e-bikes) can offer increased utilitarian transportation options beyond the private sector and into logistics and deliveries. Different types of bikes can also extend cycling trips and adoptions. All types of bikes must be supported by infrastructure improvements (bike parking facilities, protected bike lanes, bike repair shops) and relevant policy (allow, incentives, mandate, guide).

Dynamic shuttle service (micro-transit)
Micro-transit vehicles are small shuttles buses, that can serve more individuals than a regular taxi. Micro-transit also provides a more flexible transport solution than fixed-route public transport. Trips are shorter with micro-transit and can be based on road conditions and passenger requests, while concentrated within a certain area. With this approach, on-demand microbus services can optimise and lower travel costs, especially for public transport agencies, by providing on-demand services in un-supported or low-supported areas.

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Annex 1

BRISTOL WORKSHOP: PARTICIPATING ORGANISATIONS

ARCADIS
BEDMINSTER TOWN TEAM
BRISTOL CITY COUNCIL
BURO HAPPOLD, CONSULTANCY
CHARTERED INSTITUTE LOGISTICS & TRANSPORT, UK
DAVID LOCK ASSOCIATES
ESOTERIX
HIGHWAYS ENGLAND
KNOWLE WEST MEDIA CENTRE
PETER BRETT PLANNING CONSULTANCY
PHIL JONES ASSOCIATES
SOUTH GLOUCESTERSHIRE LOCAL AUTHORITY
STREETS REIMAGINED
UNIVERSITY OF BRISTOL
UNIVERSITY OF THE WEST OF ENGLAND

KUALA LUMPUR-BRISTOL SMART MOBILITY CITIES STAKEHOLDER ENGAGEMENT WORKSHOP

21 November 2017

Watershed, Bristol: Watershed 1 & 2

Time	Item	Presenters
9.00-9.30	Arrival tea & coffee	
9.30-9.40	Welcome and purpose of workshop	David Ludlow (UWE)
9.40-9.45	Welcome to Kuala Lumpur Smart Mobility Cities project colleagues	David Ludlow (UWE)
9.45-10.00	Introductions from Kuala Lumpur Smart Mobility Cities project colleagues	Dr David (TU) Dr Harlina & Dr Azimah (MiTRANs)
10.00-10.15	Smart Mobility City context presentation	Graham Parkhurst (UWE)
10.15-10.35	Kuala Lumpur context presentation	Dr David (TU)
10.35-10.45	Kuala Lumpur context presentation Q&A	All
10.45-11.15	Tea & coffee break	
11.15-12.00	Kuala Lumpur Challenges presentation - Presentation by challenge theme to highlight the transport challenges faced in Kuala Lumpur to the Bristol expert audience. - Infrastructural and Physical challenges - Governance and Collaboration challenges - Behavioral & Informational challenges	Dr Harlina & Dr Azimah (MiTRANs)
12.00-12.15	Kuala Lumpur Challenges presentation Q&A	All
12.15-12.35	Bristol context presentation	Jodi Savickas & Chris Mason (Bristol City Council)
12.35-12.45	Bristol context presentation Q&A	All
12.45-13.30	Lunch	
13.30-14.00	Session 1: roundtable group discussion - Infrastructural and Physical challenges To receive input from the Bristol experts on potential solutions to the KL transport challenges, with references to best practice evaluated case studies, as well as examples of what does not work from Bristol and Europe.	Group discussion at tables
14.00-14.30	Session 1: roundtable reporting back to the room	Each roundtable in turn
14.30-15.15	Session 2: roundtable group discussion - Governance and Collaboration challenges Expert input as per previous roundtable	Group discussion at tables
15.15-15.30	Tea break	
15.30-16.00	Session 2: roundtable reporting back to the room	Each roundtable in turn
16.00-16.30	Session 3: roundtable group discussion - Behavioural & Informational challenges Expert input as per previous roundtable	Group discussion at tables
16.30-16.45	Session 3: roundtable reporting back to the room	Each roundtable in turn
16.45	HUGE thank you and goodbye	David Ludlow (UWE)

KUALA LUMPUR CHALLENGE QUESTIONS FOR BRISTOL WORKSHOP

Infrastructural and Physical challenges

1. How does Bristol measure exposure to transport pollutants? Is this method effective at identifying the extent of problem?
2. What smart mobility strategies would you suggest to deal with environmental issues in Kuala Lumpur (e.g. haze, ultra violet radiation from sunlight, traffic flow, dust fall-out, suspended particulate matter and lead, atmospheric circulations, location of Klang Valley problems)? Please suggest ideas you have come across in your practice or highlight the Bristol practice: if the latter, is it successful in reducing emissions?
3. In Malaysia, road infrastructure normally equates with economic success: the view amongst politicians and key stakeholders is that expensive transport infrastructure projects will always deliver solutions. How do we rebalance the agenda towards more sustainable, less car orientated economy? What arguments and policies can we put forward?
4. Do you think that the development and implementation of public transport like Mass Rapid Transit (MRT) in Kuala Lumpur can solve the above environmental issues?

Governance challenges

1. Malaysia is a developing country, and, as such, often regards environmental and social measures as jeopardising economic growth or economic stability. How can stakeholders increase awareness amongst policy-makers of smart mobility solutions?
2. What is the Bristol governance model for a Smart Mobility City? With regards to:
    a. leadership
    b. public engagement (in particular to capture a wide range of users experience)
    c. partnership strategies between local authorities and the private sector
    d. funding and resources for smart city solutions, including 'start-ups'
3. What kind of business/governance models can we implement to:
    a. avoid the fragmentation and duplication of roles and functions of the responsible agencies?
    b. ensure the policy is actually implemented and monitored by executive functions rather than interfered with by politicians and business interests and priorities
    c. What sort of data is necessary for a "resilient smart mobility city", in relation to transport policy formulation, development, implementation and evaluation (e.g. measurement/indicators - pollution levels, population needs assessment, behaviour modelling)?
4. What sort of data is necessary for transport incident response and crisis management?
5. What government regulations or other factors might hinder all the above?

User Behaviour & Communication challenges

1. How do you encourage mobility behaviour change in your city?
2. What "smart mobility practices" in Bristol improve user experiences?
3. How can we ensure that SMC is accessible to all, not just the digitally aware or those with access to digital connections and equipment (the elderly, unemployed, those with English as a foreign language etc.)?
4. How do service providers communicate with the public before and during smart mobility initiatives?

Annex 2

"SMART SUSTAINABLE CITIES: LINKING BRISTOL WITH KUALA LUMPUR WORKSHOP"
TUESDAY 9 JANUARY 2018

PARTICIPATING ORGANISATIONS

Arcadis Consultancy Sdn. Bhd.
Centre for Environment, Technology & Development, Malaysia (CETDEM)
CHKL
Department of Environment of Kuala Lumpur
Disabled People Association (POCAM)
Economic Planning Unit of Malaysia
Kementerian Tenaga, Teknologi Hijau dan Air (KeTTHA)
KPX Sdn Bhd
Land Public Transport Forum
MAHB
Malaysia GreenTech Corporation
Malaysian Industry-Government Group for High Technology (MIGHT)
Mobility Association for Selangor and Kuala Lumpur
Public Transport Assocations for Malaysia (4PAM)
Rapi Mobility Sdn Bhd
Rapid Bus Sdn Bhd
SPAD

"SMART SUSTAINABLE CITIES: LINKING BRISTOL WITH KUALA LUMPUR WORKSHOP"

AGENDA

Date   :   9th January 2018 (Tuesday)
Time   :   08:30 am - 2.00 pm
Venue   :   CODA Gallery
                          Taylor's University Lakeside Campus
                          No 1 Jalan Taylor's
                          47500 Subang Jaya, Selangor

Parking Information:
BLOCK B   :   7 bays
ZONE H2   :   23 bays

Contact Person :   Dr Thulasy   (019-4149567)
                       Dr Sarfraz   (011-36575720)

Time	Item	Presenters
8.30-9.00am	Arrival tea & coffee	
9.00-9.15am	Welcome and Introduction to Smart Mobility Cities project	1. Assoc. Prof Dr David Asirvatham (TU) 2. Assoc. Prof David Ludlow (UWE)
9.15-10.15am	Smart Mobility City Presentation • Governance and Collaboration, • Infrastructure and the Physical Environment • Behaviour and Information	1. Assoc. Prof Dr David Asirvatham (TU) 2. Research Associate Jo Bushell (UWE)
10.15-10.30am	Q & A	
10.30 – 11.00am	Coffee break	
11.00 – 12.15pm	Concurrent Roundtable Discussion	Dr Shahrin Nasir (MITRANS)
12.15 – 1.00pm	Feedback	ALL
1.00-1.30pm	Wrap-up Session	Assoc. Prof David Ludlow (UWE)
1.30-2.00pm	Thank you and Goodbye	Assoc. Prof Dr David Asirvatham (TU)
2.00pm	Lunch & Adjourn	