

SMART CITIES

Connected Communities 2025





WHO WE ARE

The world we live in faces ever-changing societal, environmental and economic challenges, which are felt regionally, nationally and also globally. UKBlackTech supports, promotes, represents and encourages the continued growth of diverse innovators and tech innovation across the UK. We work with institutions, industry, local businesses and communities to solve these challenges. To build a great tech eco-system we need to see equity, transparency and representation at the cutting edge of tech.

*Solving the world's biggest problems through **REPRESENTATION**.*

*Greater representation leads to better **INNOVATION***

*which produces global **TRANSFORMATION** for a fast-changing world.*

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UKBlackTech wanted to write a report on innovation within inner cities across the UK. While there are varying definitions and many ways in which cities can be considered ‘smart,’ smart cities are a framework in which technologies, infrastructure and people combine to deliver not just social and economic growth, but sustainability and inclusivity too.

Much of the conversation around smart cities so far has focussed on data, technology, and security, and while these are important topics of discussion smart cities must be accessible, climate friendly and serve the needs of the communities and stakeholders in the local area.

This means we must continually listen to stakeholders, disability groups and communities from all socio-economic backgrounds to ensure they have a voice when it comes to the development of smart cities. This will help to create an environment where people feel they are included and their input matters.

That’s why within this report, we have featured a range of diverse voices, from technologists and academics to residents and equality consultants. Their input provides valuable reading into the varying challenges and opportunities surrounding the development of smart cities, backed with evidence from the many interviews, round tables, meetings, and discussions that have taken place over the last year to inform this report.

We have generated ten key recommendations that will support the development and growth of smart cities across the UK. This report presents a great opportunity to get things right for smart cities to be sustainable and successful, and we are delighted this report is sponsored by Connexin, because they have a real passion for effective digital infrastructure.

Mark Martin MBE

Smart cities are perfectly placed to address the areas that impact communities. But in order for smart cities to thrive, there are some challenges that still need addressing. The recommendations below will help address these.

1. IMPROVE ACCESS TO VENDORS LISTS TO CREATE A MORE DIVERSE AND INNOVATIVE SUPPLY CHAIN.

Developers need to forge longer-term partnerships to foster collaboration, such as making use of government buying power and strengthening partnerships within their supply chain.

2. USE UNIVERSITIES AS MODELING HUBS TO TEST SMART CITIES CAPABILITIES

Universities are ideal environments to review and test the capabilities of smart city technologies before they're released into local areas. Students can also benefit from opportunities to work alongside industries to address knowledge gaps surrounding the development of smart cities.

3. LISTEN TO AND WORK WITH DIVERSE COMMUNITIES AND EXPERTS FOR ALL IMPORTANT FEEDBACK

For Smart cities to thrive, people of all socio-economic statuses should participate in municipal decision making, as built environment, infrastructure, technology and services all need to be designed inclusively.

4. PLEDGE TO GREATER TRUST AND TRANSPARENCY AROUND DATA COLLECTION

Data fueling the development of smart cities must be collected in advance in a diligent and transparent fashion to address privacy and security concerns. Further education amongst policymakers and the general public is vital to help people better understand complex technologies and their impact.

5. SECURITY MUST BE A PRIORITY FOR AUTHORITIES AS MORE SMART CITY TECHNOLOGY IS IMPLEMENTED

Cybercrime is a growing threat and security processes must be considered, tested and put in place in advance of new smart technology being implemented.

6. REPURPOSE EXISTING ASSETS TO REDUCE THE RELIANCE ON NEW SYSTEMS

Energy systems can be re-calibrated with more renewable energy sources while capturing the performance data of existing transport assets can help increase capacity within transportation – a key challenge as populations of smart cities grow.

7. ENSURE ACCESSIBILITY IS IN THE DNA OF SMART CITIES

The success of smart cities needs to be centered around accessibility and literacy. Far too often visible and invisible disabilities are an after thought when it comes to the creation and roll out of smart cities.

8. TRAINING AND SKILLS TRANSFORMATION IN ENGINEERING MUST BECOME A PRIORITY

This is essential if the architecture and infrastructure of smart cities wishes to keep up with the rapid evolution of cultural and design change. There is currently a lack of skills and expertise of digital transformation within engineering, and the growth of the sector is much slower than technology.

9. SMART TECHNOLOGY MODELING SHOULD BE USED TO MEET NET-ZERO TARGETS

Smart cities offer a range of different technologies and practices that can reduce the carbon footprint of local areas. These include traffic management, optimising waste management, monitoring and reducing pollution, managing energy consumption devices and much more.

10. SMART CITY STRATEGIES MUST INCORPORATE MORE GREEN SPACES

Areas of green space are steadily decreasing in UK cities due to growing commercial and residential developments. More green spaces within smart cities will help deliver better air quality and drainage while benefiting the mental health of local residents. A Green Index should be implemented to help organise their creation.

INTRODUCTION

This report has been broken down into three main areas: architecture, technology and communities, and covers everything from infrastructure, inclusivity and transport to data security, privacy and environmental issues.

The purpose of this report is to study the evolution of smart cities and reimagine the model based on the current and probable disruptive issues as well as prospective possibilities. Thanks to contributions from a diverse range of voices, we hope this report provides helpful advice to policymakers, government, education providers and businesses to help deliver more sustainable and inclusive smart cities.

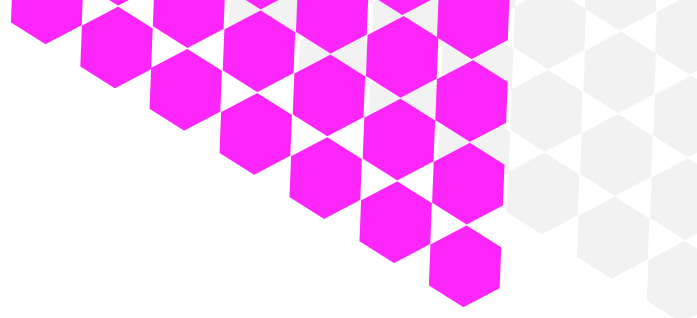
Along with our ten recommendations, we hope this report provides a unique focus and perspective informed by an ethos of diversity and inclusivity, while leaving space for creative thinking.

CURRENT LANDSCAPE WITHIN PANDEMIC

It is impossible to discuss any pressing issue in the current climate without referencing the COVID-19 pandemic, which has been the most transformative global issue since the Second World War. The myriad of costs associated with this virus and its subsequent lock-downs are impossible to cover exhaustively here, but there has been an array of social, economic, political, and even environmental consequences, with COVID-19 devastating local communities and increasing economic vulnerability across the UK. This is succinctly underlined by the government's Universal Credit (UC) which showed claims

grew 10 times in the first two weeks of lockdown in March 2020 [1]. Technology has created an opportunity to more adequately deal with any fallout caused by future pandemics, and this will continue as the world returns to what has inevitably been described as the 'new normal'. One of the most obvious consequences of COVID-19, particularly for the everyday lives of the general population, has been a profound change in the way that people work; employees of many companies have been severed from their workplaces for months at a time, and organisations in both the public and private sectors have been forced to improvise. For example, over one-third of the working population of the UK conducted at least some of their work at home during 2020;[2] a situation that would have been unthinkable in the recent past. As an illustration of this, it was reported by the BBC in October 2020 that over half of the world's workforce was working remotely.[3] Remote work is most likely here to stay; the advantages for both employers and employees are manifold. As the pandemic eases, this figure may diminish, but the indelible impression that this has created will likely never disappear. UKBT will expand on this topic in our next report about the future of work.

“TECHNOLOGY HAS CREATED A POSSIBILITY TO MORE ADEQUATELY DEAL WITH A FALLOUT CAUSED BY PANDEMIC, AND THIS WILL CONTINUE AS THE WORLD RETURNS TO WHAT HAS INEVITABLY BEEN DESCRIBED AS A ‘NEW NORMAL’.”



SETTING A GROUND

As we start to rebuild local communities, technology will be a major driver and innovations such as connected communities will become ever more prominent, especially as 65% of the world's population will be living in cities by 2040.[4] These socio-technical systems utilise sophisticated information technology infrastructure, in order to connect people and organisations, and this sort of connection via technology will become an increasing part of everyday lives, just as the video conferencing app Zoom has become a household name during the COVID pandemic, with downloads increasing 30-fold.[5]

With 5G infrastructure rolling out across the UK and the Internet of Things resulting in vast numbers of connected devices, profound changes to the way we work, navigate, and live our lives will become increasingly apparent, and these changes will take place in an unfamiliar framework. 5G has been described as the fundamental catalyst for the fourth industrial revolution; the automation of traditional manufacturing and industrial practices using modern smart technology. While this is an exciting prospect in many ways and certainly has transformative potential, it's important to remember that, as this revolution unfolds, people matter.

The immediate post-COVID period will be pivotal and epoch-defining, both in the way that we work and interact, and the human aspect of this is critically important. Not just in terms of the great mass of humanity, but at a local level too. This is at the heart of Smart City: Connected Communities. The whole concept of smart cities – using the data created by the information age to run social systems more intelligently – is an intriguing concept with huge potential.

Most importantly, it has to work for everyone. This will mean engaging with a diverse range of stakeholders, and crafting a consensus that gives equal credence to all perspectives. Failure to engage with the diverse needs of groups and communities that are underrepresented and disregarded will diminish the effectiveness of this revolution, ensuring that the traditionally disadvantaged remain marginalised, and that key insights and solutions are sidelined. As an indication of this, NIESR deputy director, Dr Hande Kucuk, told the Financial Reporter that “analysis at sectoral, regional, and household level shows that despite the rhetoric about ‘building back better’ existing inequalities could be exacerbated by the pandemic and an uneven recovery.”[6]



Russ Shaw CBE

Founder of Tech London Advocates and
Global Tech Advocates

Smart Cities Connected Communities

“In the coming years, cities will face increasing challenges around growing populations, climate change, pressure on public transport systems and the management of historic infrastructure. Technology solutions will be the only way to effectively manage these issues - making smart cities an essential part of how cities develop, grow and survive. However, the evolution of smart cities will require multiple skills and technology innovations across different areas such as mobility, health tech, artificial intelligence and data usage, connectivity, sustainability

and tech for good. Successful cities of the future will need to manage the entire innovation pipeline to ensure the talent and breadth of digital capabilities is in place and ready for deployment.

Connectivity is fundamental to facilitate smart city initiatives and enable digital infrastructure. Smart city networks will require a mesh of high speed fiber optic broadband, LTE masts, small cell and IoT technologies to ensure seamless communication between essential services, wherever citizens may be.

There are some positive examples that we can learn from and apply more widely to other regions across the UK and internationally. The London Office of Technology and Innovation (LOTI) is already working to innovate and scale-up digital advancements across London's public services. Within two years, LOTI managed to foster collaboration across the boroughs to improve outcomes for residents and break down the barriers for SMEs with innovative solutions to improve the lives of Londoners. Increasingly connected systems have the potential to create better public services and shared experiences but are also open to being exploited. As these technologies are implemented, they also need to be matched by robust cyber defence capabilities preventing unauthorised access to networks and following a zero-trust approach that constantly assesses levels of risk.

Another risk that needs to be considered is the ethical impact of how we use technologies like AI and machine learning to run smart cities, especially when it comes to monitoring the lives of citizens. Even the most sophisticated algorithms contain biases and it's essential that

these are eliminated as much as possible to serve communities fairly. In the next few years there is some hard work that needs to be done to remove the subjective biases within AI so that people are treated fairly regardless of the colour of their skin, gender, age or any other denomination. Finally, and most importantly, modern cities contribute significantly towards global emissions and the destruction of natural habitats.

There is a unique opportunity for those designing the upcoming wave of cities to put Net Zero commitments at the heart of what they do. City leadership needs to work closely with private sector innovators to find new ways of making cities run cleanly and effectively. Data will be a core part of measuring impact and progress. This won't be achieved overnight and we should all learn from each other in the global community as we start this new chapter of trying to live in harmony with rather than opposition to the natural environment."





Ralph Varcoe

Chief Growth Officer &
Managing Director of IOT, Connexin

What do connected communities look like in a UK region?

When talking about smart cities, it's easy to get dazzled by the technology that enables people, buildings, health care, utilities and cities to become smarter. Much of this report talks about the need for quality connectivity and alludes to the technology that provides a platform for 'Smart'. While it's true that there are fundamental building blocks that are needed to deliver on the smart promise, there are many other things to focus on. The first of which is to define the aim in becoming smart - what are you trying to achieve? At a recent local government event, I met with upwards of 40 representatives from local authorities from across the country where the overwhelming message was "We're behind on the 'smart' journey, we know we need to do something, but we don't know where to start". At the event, we had showcased the magnificent work that

Hull City Council has been doing with their Integrated smart city Platform deployment, so it's understandable that many delegates would think they are behind. But, interestingly, when so many feel like that, you begin to realise that in reality, there are only very few that are way out in front. When Hull City Council set out on its journey, they were clear about the data sets to integrate into the platform and what they were aiming to achieve. This is why our partnership with them is a delight, as it is built on a clear understanding of what the technology can do to support their ambitions. The second differentiator is that of integration. Not of technology integration per se, though that is, of course, something we do for our Connexin OS Platform clients, but it is about the integration of the various departments to come together to make the city, as a whole, smart.

At another recent event, I sat with representatives from DCMS, Transport for London, The Cabinet Office, UK Parliament, and The London Mayors Office, and we all agreed that the largest challenge holding the development of the Smart City agenda back is that local and city authorities still tend to work in team and budget silos. I would propose an Integrated Smart City Platform that gathers data for one department can deliver benefits to another. Taking an example, the Water Utility seeks to have better data on water consumption per capita, more accurate bills, and targets to reduce water leakage/wastage. The data from existing databases (health, police, utilities, social care, and others), with the data from myriad sensor types across the City, and suddenly a world of incredibly Smart opportunities arises.

For Smart Cities to really start making a significant impact to residents and council budget allocation and local tax revenue, it requires a leap to an Integrated City approach first like Hull has done, among others such as Sunderland. From there, it is all about the technology which supports the aims of the city as a whole. One such example is LoRaWAN, a standard for many years which is used across the board with our clients today, from Hull, Sheffield, Leeds and many other locations for every use case under the sun. There's no need to wait for the big dawning of 5G. Those who are leading the field as Smart Cities use what is already the best technology available, and is likely to remain so, even when 5G is ubiquitous, because it has been designed for IoT use cases from the very start.

I've talked about the platform and the network technology so it's fitting to talk about the third element - the sensors that gather the data. While we have experience of many and know which we'd recommend for particular use cases because of reliability and cost/efficiency, we are agnostic. The pace of development in IoT sensor technology is fierce, which is why we have partnered with Barnsley Metropolitan Council's DMC (Digital Media Centre) as well as TEAMSY and Capital Enterprise to launch what's called 'IoT Engine - powered by Connexin and DMC', in Barnsley. This pre-accelerator is attracting tech talent to innovate and create new technologies that support the aims of our Smart City clients, right in the heart of Yorkshire, the county in which Connexin was born and bred, and of which we are immensely proud.

This innovation and development project is our way of helping speed up the development of the technology to support cities becoming smart and to contribute to the leveling up agenda by turning Yorkshire into a tech hub that competes with London, Cambridge and other more southern cities. It goes without saying that everything relating to Smart Cities has to be secure, private, appropriate, transparent and built on trust. Establishing the right frameworks to deliver for the benefit of residents while assuring them that this is not 'big brother' is critical. And, doing this as an Integrated project, across departments and budgets is the Smartest way to deliver on the Smart City agenda.

Connected communities represent social-technical systems that rely on information technology infrastructure to connect individuals and organisations. Their future will rely on the advancement of technology to enhance local spaces, along with the formation of equitable working and residential environments. But nowhere is this more true than in architecture. We are now entering a pivotal and defining period in human society with 1.3 million people globally currently moving into cities every week, [7] it is critically important to manage this transition effectively, and use smart cities to their full potential.

Central to the smart city revolution will be the Internet of Things. This multiverse of connected objects will play a major role in evolving the way that we interact with places and objects. By 2023, there are expected to be 1.1 trillion Internet of Things connected devices,[8] and this will pave the way to an autonomous cityscape that would have been barely imaginable for previous generations, especially when it is coupled with the imminent 5G framework and architecture. Smart cities will ultimately impact everyone. It is because of this fundamental shift that we need to pay close attention to the impact and challenges they will pose, and what solutions can be crafted to address these potential issues. For example, Birmingham's Smart City Commission notes that every smart city initiative should focus "on a set of goals; often they focus on sustainability, inclusivity and the creation of social and economic growth." [9]



Steve Fernandez

Associate Director and lead, Arup

Smart Cities in Architecture

“We can transform the 21st century city via the creative use of technology. The challenges of climate change, population growth, urbanisation, demographic change and resource depletion mean that cities need to adapt to survive and thrive over the coming decades. Information and communications technologies can play a vital role in creating the cities of the future. But, as yet, few cities have fully grasped the possibility of becoming a ‘smart city’. We spend up to 90% of our lives in buildings. These spaces should be efficient, reliable and safe, but these characteristics alone do not

open up the possibilities that a true smart building can. Adaptability is crucial. Smart buildings interact with the people, systems and external elements around them. learning from past experiences and real-time inputs, to adapt to the needs of the people within them by increasing comfort, efficiency, resiliency and safety. For example, a smart building can be used to manage the energy performance to ensure that it meets heating, ventilation, and air conditioning (HVAC) guidelines. In the face of the global COVID-19 pandemic, technology can help ensure the safety and well-being of staff returning back to their workplaces, for example by monitoring occupancy for density and safe distancing, or screen



occupants for elevated skin temperature. So it is essential that we use technology enabling data capture and analysis, monitoring, connectivity and control as the new baseline. In the built environment it has always been important to continually improve buildings for aspects such as their architectural design, structural efficiency, minimising energy consumption and construction materials.

These aspects are still important considerations today, but buildings also need to meet updating standards and expectations. They need to integrate digital infrastructure, with the information and operational technology network embedded in everything that enables the routine functioning of a building. Advancements in the built environment have been made over the past few years using digital technology, ranging from the use of parametric modelling to test multiple design considerations to optimise materials or space, to the use of Building Information Modelling (BIM) to create a 3D model of the entire building, which includes everything from the components and manufacturing specifications to the lights in a room and

the environmental impact of the entire project. These models are used by architects, engineers, and contractors simultaneously during the design and construction process; any change made by one party is instantly reflected to everyone which allows for simultaneous collaboration. The model can however be used beyond just during the design and construction period, with the BIM used for the entirety of a building's lifespan, from conception to demolition. If used correctly, once the building has been constructed using BIM, the owner can use this to schedule maintenance and complete infrastructure updates.

At each life stage, BIM can automatically generate scheduling and logistics which reduces errors, can make cost predictions more accurate, and carry out works faster. For example, consider a sliding door in a building used by the occupants as they flow in and out. BIM would include the design of the door and its dimensions but also each part, the number of door panels, the type of motor to move them, how often it will need to be serviced,

the availability of spare parts, its carbon footprint, its acoustic installation etc. This can all be contained in a single model.

If the door needs to be replaced, all aspects such as the cost, fire protection, soundproofing, energy footprint etc. will all be immediately visible. This can sometimes be referred to as a 'digital twin' or a virtual model of the building that can be used to simulate and test various design options prior to construction.

The digital twin simplifies coordination with multiple design and engineering disciplines, sidestepping possible design conflicts that can be costly to correct during or after construction. Globally, many cities are starting to explore how the principles of smart cities can be

adopted. Some are introducing a top-down approach, with a strategic framework and then deploying this to inform major urban development projects. Others are developing specific, distributed interventions for buildings, open data or mobility, before trying to join up these dots. Either approach is valid and it is more important to act than to stand back and wait to be transformed”.

DESIGN PARAMETERS AND ARCHITECTURAL REQUIREMENTS OF SMART CITIES

Designing the infrastructures and systems inherent within smart cities requires them to be developed in context, with an understanding and awareness of the ethnographic cultures in which they will exist, as well as other elements of the built environment with which they will interact. There are opportunities to create exciting new cityscapes that empower people, but also challenges in terms of making this work fairly, dealing with security and privacy issues, and with existing infrastructure. This last issue can be a major problem, with most smart city projects encompassing smart lighting, intelligent transport systems and smart utility metering for electricity and water. Based on sensor related collection and analysis of big data, these projects unquestionably have huge potential, but there are also logistical

“THE MAJORITY OF RESPONDENTS OPINED THAT DIGITAL TRANSFORMATION ACROSS THE SECTOR IS SLOW, WITH 55% OF RESPONDENTS ATTRIBUTING THIS TO A LACK OF SKILLS AND EXPERTISE”.

challenges associated with putting them in place. Smart cities will undoubtedly be associated with population growth and urban sprawl, and these social trends can impact on quality of life, while adding stress to infrastructure. Smart cities must therefore incorporate energy-efficient systems and resource conservation into their construction, in order to ensure that socio-economic progress can be maintained for all citizens. Technology associated with smart cities can assist with this process, providing governments with an infrastructure buffer that assists with overcoming these issues. Another issue for the construction of smart cities is that development in engineering is traditionally much slower than is with technology. In accordance with this, in September 2019, the Institution of Civil Engineers and Bluebeam conducted an online

survey that examined digital transformation in the engineering and construction industry. The majority of respondents opined that digital transformation across the sector is slow, with 55% of respondents attributing this to a lack of skills and expertise.[10] This suggests that training and development in engineering is essential if architecture and infrastructure in smart cities is to meet the rapid evolution of cultural and technological change.

In the smart cities of the future, placing sensors on buildings will be the norm. This trend will similarly be reflected in everything from street lamps to Wi-Fi hotspots. Smart cities will be ultra-connected; again a source of opportunities and challenges. Intelligent buildings offer the potential to deliver cities that are safer, cleaner, more energy efficient, and ultimately sustainable. But delivering this halcyon vision will also necessitate a joined-up and perceptive approach.

Smart building technology is already assisting in the process of energy efficiency. Integrated building controls systems help reduce energy wastage, overseeing intelligent usage of power and resources. And upgrading buildings to embrace this technology is not prohibitively expensive, thanks to advancements in Internet of Things innovations. Wireless sensors can be connected with relative ease, negating expensive installation costs. This leads to a rapid return on investment, and means that there is a low barrier of entry with regard to initialising

such systems. There are already prominent examples of such technology being implemented, with Chicago having installed 270,000 smart LED street lamps that are estimated to save the city \$10 million annually in reduced energy costs.[11]



This sort of energy saving is critical at a time when the global energy system is rapidly evolving. Developing ecosystems that are connected and interoperable will be a fundamental part of the design of smart cities. Linking all elements of smart buildings together will be a major driver of the energy efficiency that is a major argument for the creation of smart cities in the first place. Everything from door entry to emergency lighting can be linked together, in a system that enhances safety, security, comfort and control.

Harnessing the power of the sun, and utilising other renewables, will also be a vital part of the architectural makeup of smart cities. Global solar power capacity will grow by 9% every year between now and 2050, according to the International Renewable Energy Agency.[12] This can be coupled with smart energy management and more efficient generation plants and methods to massively improve energy efficiency, while achieving carbon neutrality.

Solar panels can also play a role in improving the air quality in urban areas. This is currently a major issue of concern in the UK, with 40 UK cities and towns currently either commensurate with, or exceeding, World Health Organization air pollution limits.[13] Managing this renewable infrastructure will necessitate joined-up smart systems, which will incorporate Internet of Things objects and distributed resources, in a sophisticated two-way communication and analytics network, which constantly monitors and responds to energy demands. Renewable energy will be a fundamental part of smart cities and its architectural design, with rooftop panels being a major design feature. This will contribute to an increasing rise in the proportion of UK energy provided by renewables, and the obvious environmental benefits that accompany this. The extent of this is succinctly illustrated by a recent report from RenewableUK, which suggests that 76% of UK energy could be derived from renewable sources by 2050.[14]



INFRASTRUCTURE

According to Frost & Sullivan, the post-COVID climate will lead to increased expenditure on smart cities and related technology. The business consultancy suggests that spending on smart city technologies will increase by 22.7% by 2025, creating business opportunities with a market value of \$2.46 trillion[15]. And much of this investment will be directed into creating the ideal infrastructure for smart cities. But this is not without its fair share of challenges. One of the most obvious issues that those involved with the design and infrastructure of smart cities will have to tackle is transportation. Smart cities will require highly integrated transport structures in order to work, and this means that several complex technologies will need to be brought together in order to create an intelligent and flexible system. Smart cities promise highly structured transport, based on connected and data-based transportation infrastructure, which improve on the traffic chaos of existing urban areas. Suddenly, it will be possible for traffic signals to optimise the flow of traffic through a city, instead of simply operating randomly. There are already several examples of major urban locations that have implemented smart city technology with the intention of

improving the way that they operate. For example, Singapore introduced the Electronic Road Pricing scheme to manage traffic congestion as early as 1998. Singapore was a pioneer in this department, but other cities have since followed suit. New York has recently deployed a connected vehicle pilot program, in order to collect and analyse data from connected vehicles for a variety of technologies and applications.

The aim is to eventually improve the way that traffic management operates in this bustling metropolis, additionally improving safety as a result. Other examples abound as well. The Smart Mobility Living Lab is providing 5G connectivity for connected and autonomous vehicles in London, Berlin utilises in-ground sensors at roadway intersections, Seoul is the first city to use 5G for public transport, and Barcelona has launched the CLASS program to develop software dedicated to data analysis from smart cities, connected cars, and autonomous vehicles. Such projects are laying the foundation for more intelligent, structured, and safer transportation systems.



Dr Nike Folayan MBE

Co-founder AFBE-UK, Chairperson AFBE-UK

Smart Cities and Transportation

“The subject of ‘smart’ has been the subject of much debate; Csar Gutierrez et al [1a] suggests that a “smart product” should be defined by its intelligence. For example, where a transport environment is concerned this intelligence should, at the very least, account for energy conservation, ticketing, asset management, way finding and passenger experience. Such environments must consider ergonomics in relation to design, environment, operation, and information management. Smart also means capturing the performance data of assets to identify how the customer experience

can be improved and how the asset can be integrated within the context of the operation and maintenance of new assets. Ideally, smart environments should enable existing assets to increase capacity and improve customer experience without the need for new-build solutions. The ‘smart’ that we have come to know as a prefix for cities, highways, railway stations and more, is not a new concept. The Department for Business, Innovation and Skills (BIS) introduced to the UK the world’s first set of standards for smart cities in 2014. Here it defined as essential rather than “effective integration of physical, digital and human systems in the built environment to deliver a sustainable, prosperous and inclusive future for its citizens”.

It suggested that how the technology is integrated to best serve a city is as important, if not more important, than the technology itself. Stations have become more than a means of getting from one location to another; they are becoming destinations in their own right, complete with a variety of multi-modal options for ongoing travel and connectivity. Just look at London Bridge Station one of the stations I have had the privilege to work on, this state-of-the-art destination station is not a million miles from the UIC (International Union of Railway's) [2a] vision of 'living spaces', which can interface between modes of travel within their city environs. In a Post-COVID society it will be even more important to analyse the big data from many interconnected stakeholders and the limiting factors that are now new inputs to create what can be termed as smart.

There is now an even more urgent need to improve passenger safety, and the efficiency of train stations as well as freight operations.

While this data is currently disjointed – owing to different transport operations systems – it could be converged to ensure interconnectivity of information and a robust framework could enable the smart management of stations and policies to incorporate smart solutions based on this data.

To make it effective and applicable, this data will need to account for the different and rapidly changing needs of passengers, commuters, and transit passengers. Better still would be the interpretation of this data in terms of inclusivity, sustainability, IoT, interconnectivity of information, inter-modality, and multi-modality”.

ENVIRONMENTAL ISSUES

One of the most compelling arguments for smart cities is the role that they can play in addressing environmental problems. This takes all manner of shapes and forms, with smart cities cutting across a range of green issues, and almost always playing a constructive role. There are already numerous examples of cities that have massively reduced their carbon footprints by implementing smart city technology, with the shining light being Zürich in Switzerland.

This major urban area has invested in a range of green technology, energy efficiency projects and renewable sources which has resulted in the Swiss city claiming first place in Arcadis' sustainability index, and retaining a place in the top three for several years.[16] As smart cities go online, such results can be further enhanced by the utilisation of superior communication technologies and the efficiency of urban operations. Smart cities make a reorganising of the urban order possible on a scale that would be otherwise impossible.

Another area in which smart city technology can assist with environmental issues is waste management and disposal. Intelligent garbage solutions can redefine and optimise the way that waste management is dealt with, addressing a major issue in the process. The

World Bank estimates that the global cost of managing our landfill collections alone will rise to \$375 billion by 2025 - a figure that is certainly undesirable, and arguably unsustainable.[17] One technology that addresses this is smart rubbish bins, which can be powered with solar technology in order to minimise their carbon footprint. These consumer products have the ability to convey when they are full or approaching this status, preventing both overflows and unnecessary scheduled pickups. This saves resources on numerous levels, and helps ensure that the system is more efficient overall. There are several companies already piloting such schemes, in cities including Singapore, New York and Melbourne. One company involved, BigBelly, pledges that it will eventually reduce the frequency of waste collections by as much as 80%,[18] in the process limiting our dependence on rubbish bins. Computer virtualisation can also be used in order to ensure that systems run efficiently, and this will be a major component of every aspect of smart cities.

Another major issue is the impact of smart cities on green spaces. Plant life in cities serves numerous important purposes, not least that it can improve air quality and drainage, which is vitally important given the poor air quality in many urban areas in the UK.

Unfortunately, in the contemporary climate there is huge competition for city centre space, and green spaces often lose out to commercial projects and residential development. This has meant that areas of green space are steadily disappearing in UK cities. For example, researchers at the University of Leicester discovered that an area in excess of 54,000 acres of green space had been converted to artificial surfaces between 2006 and 2012;[19] an area double the size of the entire city of Liverpool.

Smart cities must therefore make a commitment to incorporating green spaces, plants, and other aspects of nature into their infrastructure and architecture. Projects of this nature are already emerging, with the Bosco Verticale development in Milan having been particularly acclaimed. This residential building included over 20,000 trees and plants, which were integrated within the facade of the development. The plants and trees included would cover an area of almost two acres if planted at ground level. While such developments can play a role in tilting the green balance, there should also be an organisational aspect to the incorporation of green spaces in smart cities. A Green Index, which organises green spaces in smart cities in line with the per capita standards of the World Health Organization, would be highly beneficial.

Another important consideration for smart cities will be the utilisation of sustainable technology. Green IT is a catch-all term for the creation and

implementation of products that consume fewer resources, and this should be at the heart of smart city developments. Recycling computer components, while also ensuring that the lifecycle of existing systems is extended, will be incumbent on all smart urban areas. Cloud technology can play a major role here, by lessening the requirements of hardware, enabling businesses to transfer their on-premise applications to external locations, and in the process massively reducing their energy consumption and carbon emissions.





CARBON FOOTPRINT

Speaking of which, the reduction in carbon footprint that will be achieved by smart cities is another compelling aspect of this innovation. With ambitious targets being set for carbon reduction all over the world, the implementation of smart city technology can play a major role, particularly on an organisational level. Modelling made possible by smart city technology will make a big contribution to environmental targets, while internal systems can be managed far more effectively via smart city systems, for example reducing the environmental impact of traffic and its associated pollution. This should be a priority, considering that the air quality in UK cities is notoriously poor.

“THERE CAN BE NO GREATER CONTRIBUTION TO COMMUNITIES THAT ENSURE THAT CITIES ARE CLEANER AND HEALTHIER PLACES TO LIVE”.

As the urban area is reshaped, energy systems can also be recalibrated, with more solar panels and renewable energy sources implemented in new technology. Smart cities offer a range of different technologies and practices that make a collective contribution to reducing the carbon footprint of the areas in particular, and better environmental outcomes overall. These include, but are not limited to, the following:

- Traffic management
- Taxi sharing
- Remote working
- Optimising rubbish collection
- Managing devices as a energy generation exceeds demand
- Smart energy metering
- Managing parking systems and locating spaces
- Optimising street lighting
- Monitoring and reducing pollution

There can be no greater contribution to communities that ensure that cities are cleaner and healthier places to live. And this can also be a two-way process, with residents both contributing to the smart city environmental agenda, as well as partnering with authorities and providers to improve delivery.



Blessing Dahna

Senior Director at Ankura

Delivering infrastructure's transition to net zero

The UK has set a benchmark by legislating a net zero emissions target by 2050. Following this, major infrastructure owners have begun to publish their net zero plans and strategies, which vary in ambition and detail. However, strategies alone cannot deliver net zero. So, how do we move from plans to delivery?

Where are we today?

We see two main challenges facing organisations. Firstly, there remains a gap between the ambition of infrastructure developers and the pace of change in the development of low carbon materials. Construction is inherently carbon intensive due to the embodied carbon in many of the traditional materials it relies on, such as cement,

concrete and steel. There has been some progress in reducing embodied carbon in construction materials – the use of Ground Granulated Blast-furnace Slag (GGBS) in concrete mix instead of Ordinary Portland Cement (OPC), investment in low energy site compounds, and design optimisation. However, there remains a significant gap to bridge, not just in terms of the supply chain's readiness to supply, but also of regulation, and the readiness of technology.

Secondly, the biggest opportunity is locked in the built asset base - new construction accounts for just a fraction of total infrastructure. In its Paying for Net-Zero paper, Imperial College London reports that the UK is building new houses at an annual rate of less than 1% of the existing stock.



This means the bulk of the carbon challenge for asset owners lies in intervention - converting, or 'retrofitting' existing assets. Central to addressing the challenge of carbon during operation is data. Many asset owners lack high-quality asset information, which hinders their ability to develop effective decarbonisation strategies.

So where should infrastructure developers and operators focus?

We have identified two key areas:

First, forge longer-term partnerships to foster greater collaboration and innovation around carbon. Ankura's 2021 Infrastructure Perspectives survey identified three critical enablers to unlock innovation and allow the sector to take bigger and bolder leaps forwards:

- Making use of Government buying power to stimulate the market. A "category management" approach, focussed on the key carbon culprits and covering our biggest infrastructure programmes could create critical demand mass to enable the supply chain to innovate
- Accelerating industry collaboration to reduce innovation in silos. Collective innovation funds or special interest working groups could provide a platform for sharing prototypes and allowing existing innovations to be continuously optimised.
- Strengthening partnerships with the supply chain. Much closer and more genuine collaboration is needed, with a different attitude taken by clients and suppliers alike to enable conditions for "soft" landing in introducing new technologies and solutions.

Second, as is often said, “what gets measured gets done” - setting stretching targets in the planning and design stages will also be key. Potential examples of this are:

- Within the economic case of the Five Case Model for developing business cases giving more weighting to carbon to ensure that carbon impact of investments on future generations is brought to the fore.
- Reporting against Scope 1, 2, and 3 emissions requires good corporate engagement to support transparency in climate change related disclosures and reporting. External, audited reporting, as seen with the Equality and Human Rights Commission (EHRC) gender pay gap reporting could form part of the solution for the construction industry.

Introducing new incentives: The Institution of Civil Engineers’ State of the Nation 2020 recommended that clients and regulated asset managers prioritise and elevate the value of emissions reduction impacts in procurement criteria, so it is at the same level as value for money and health, and safety outcomes.

The construction sector is often lambasted for a lack of innovation and progress, yet engineers have a fantastic capacity to solve the world’s toughest problems. The Net Zero agenda will require client organisations to develop new policy approaches and embrace partnerships with technology companies, the supply chain, and social entrepreneurs alike to rise to the scale of the challenge.



The Association of BME Engineers (AFBE-UK)

How AFBE is shaping the discourse on architecture and smart cities

The Association of BME Engineers (AFBE-UK) is a registered not-for-profit organisation formed in 2007 to support the growing influence of engineers of BME origin in the field of engineering. As we adapt to the ever-changing demands of the people that make up our societies, AFBE understands that our present actions will affect current and future residents of smart cities and the features, architectural and non-architectural, that make up these cities.

A smart city is only as smart as its designers. This is why we are championing the inclusion of diverse designers in the development of smart cities. By striving for equality in all that we do, we have created an environment that allows for free and open discourse around factors that influence the creation and development of these smart cities. Our members are directly involved in influencing government and public sector policies across multiple industries. We encourage our members to continue to seek improvement in their respective careers and provide support through our mentoring programme.

In addition, we provide the necessary training and support for our members to become thought leaders in different fields. AFBE runs a bespoke knowledge sharing event called Real Projects. Through this event, we foster the sharing of best practices and recent developments within the industry. COVID-19 has highlighted the importance for cities to embrace technology to become more sustainable (SDG 11). As cities around the world work towards achieving SDG 11, there is also a need to build inclusive cities. With one out of three urban residents in the developing world living in slums, we recently held a Real Projects session that addressed

the question around whether we can really build cities that are as inclusive as they are smart. In shaping the discourse, we are very conscious about developing the skills of the current and future smart city designers/architects. As mentioned earlier, designers of smart cities need to be as diverse as the cities that they design. Through our programmes like NextGen and Making Engineering Hot, we ensure that proper support is given to teachers and young people particularly within underrepresented communities to attract the future diverse workforce needed to build and maintain these cities.

TECHNOLOGY

Smart cities are intrinsically associated with technology, as it is only the advancement of technology that has made such a prospect feasible. Technology therefore offers a huge amount of opportunity in smart cities. But it should also be noted that this isn't a one-sided issue, and that there are concerns associated with the implementation of technology in smart cities that also need to be addressed. So how do we address the responsible technology? The technology itself will also revolutionise organisation and infrastructure in cities, ensuring that they can be run in a way that is far more efficient and cohesive. Ultimately, the whole point of the technology associated with smart cities is to capture data and insight that leads to better decision-making and improved organisation. In an era in which there are many issues associated with urban areas, including environmental and pollution concerns, socio-economic inequality, transport problems, and organisational complexity, the technology associated with smart cities can play a major role in creating an urban order that works for all people at all times.

DATA TRAFFIC

One immediate constant across all smart city projects is increased data traffic. Smart cities are connected spaces, and this will create a huge amount of additional information. In many ways, this big data represents a huge opportunity, but it also creates challenges.

For example, when Internet of Things (IoT) technology was initially tested in Las Vegas, the ability of the network to respond adequately was significantly compromised. This sort of bandwidth issue is likely to be replicated across multiple locations, unless infrastructure is developed and improved. In Las Vegas, existing IoT networks were unable to support even the most basic smart

city applications,[20] which obviously means that a significant level of upgrade is needed.

In fact, smart cities not only require outstanding provisions for technology, they also need to be highly scalable. It's hard to put a finite figure on the number of sensors and related devices that will come online, as this number will be continually expanding. And it is only by delivering reliable coverage across a city that smart cities will become a feasible reality.

“SMART CITIES ARE CONNECTED SPACES, AND THIS WILL CREATE A HUGE AMOUNT OF ADDITIONAL INFORMATION. IN MANY WAYS, THIS BIG DATA REPRESENTS A HUGE OPPORTUNITY, BUT IT ALSO CREATES CHALLENGES”.

PRIVACY

Another major issue associated with technology in smart cities is privacy, and this is indeed something that needs to be addressed across broader spaces as well. Technology has infringed on privacy in numerous areas, and this should certainly be considered of concern with regard to smart cities, which will potentially gather vast amounts of data, on a level that has hitherto never been witnessed. Data collection is a major component of smart cities, and this has led to some opposition. There are concerns about privacy in this scenario, as the very collection of data would seem to compromise this. So is there anything that can be done to address this issue?

Fundamentally, authorities must demonstrate that they respect the right to privacy among citizens, defining and implementing firm standards in order to establish this principle. Close collaboration between governments and businesses will be necessary as part of

this process, and security safeguards must be installed to protect the rights of citizens. Companies and services operating in smart cities will need to collect data in a diligent and transparent fashion, ensuring that citizens are kept in the loop at all times regarding data collection and analysis. Providing the option to opt out whenever possible will also be preferable.

There are already examples of legislation that oversees smart city developments. The EU's General Data Protection Regulation (GDPR) has called for the restriction of the use of facial recognition in smart cities[21], while the California Consumer Privacy Act prevents undisclosed sharing and collecting of consumer data[22]. Consumers will also have the option of protecting themselves by utilising virtual private networks and other similar technology.

SECURITY

Security is another important area that must not be neglected. It is already widely acknowledged, even by advocates and supporters of smart cities, that this will be a compelling and challenging issue. The National Cyber Security Centre (NCSC) has already warned that smart cities will almost inevitably be a target for hackers, and that authorities must prepare themselves well before technology is implemented. In accordance with this assertion, the NCSC has already published guidance for local authorities on how connected places should be secured.[23] But there are already examples of hacking issues related to smart cities.

For example, Atlanta and experienced a major problem with Sam-Sam - a ransom wear blog that is affected 30% of mission-critical software applications in the city.[24] Even months after this attack, Atlanta continued to recover from the aftermath of the sustained malware attack, with police and legislative evidence being the most significantly impacted. More than a decade's worth of legal documents and the years of police dashboard camera evidence work completely wiped from computers, and the overall cost of the attack was estimated to be in excess of \$12 million. Clearly there could be even more sinister applications of these hacking attacks, and they could have very serious consequences if cities are not fully prepared.

The extent of cybercrime is well documented, and has become phenomenal in scale. A recent report from McAfee discovered that the world economy is losing over \$1 trillion annually to cybercrime.[25] And Cybersecurity Ventures expects global cybercrime costs to grow by 15% annually over the next five years, more than doubling in the process.[26] This data makes it clear that security must be a priority for the authorities as smart city technology is implemented. Stringent standards and an ongoing review and evolution of the processes will be absolutely essential.



TRUST AND TRANSPARENCY

Another issue for smart cities with regard to technology is trust and transparency. The level of data collection that will be required in order to allow smart cities to run smoothly, and enable the benefits of the technology to flourish, also poses trust issues. While this can be addressed with legislation to a certain extent, it is also important to pay heed to the concerns of the general public. One example of this came when Transport for London recently used more than 260 wifi-enabled stations to collect the unique media access control address of users' smartphone devices, so that the authority could track travel journeys more accurately. The problem is that they

**“INDEED, OFTEN THERE IS NO
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forgot to inform the public that they intended it to do this, and only made the project transparent when the media raised awareness of the issue.[27] This is precisely the sort of negative coverage and unethical practices that smart cities must avoid.

Speaking to The Guardian newspaper on the issue of privacy, Paul Wiles, the UK's biometrics commissioner, noted that the UK had some serious issues to address. “We've almost got as many CCTV cameras as China, not quite, but heading that way. With the rise of things like facial recognition, that is why we need new legislation that decides what is in the public's interest and the legal structure within which they can be used. We shouldn't drift there by accident,” Wiles commented.[28]

Consent will clearly be a major issue for smart cities, and the authorities that govern them, to address. In accordance with this, the Office of the Privacy Commissioner of Canada has acknowledged that the technology associated with smart cities is fundamentally different from the way that online data is collected, as the opportunity to decline service and opt out is considerably less feasible.[29]

Indeed, often there is no awareness that data is being collected in the first place, and this can be problematical from a legal and ethical perspective. One of the solutions to address this problem could be normalisation of the road signs and icons which would inform the public that the data and its type is collected in the public spaces. Such an idea has already been put in place in Toronto by Sidewalk Labs in the project called Digital Transparency [30].

It is therefore extremely important for experts involved with smart city technology and the authorities to enter into extensive preparations immediately. Stringent measures will need to be put in place, and a public dialogue on the subject of smart cities is also necessary. Autonomy, consent and privacy are all critical issues, which are considered sacrosanct in the Western world. Thus, authorities must carefully consider how consent can be preserved, or what should replace traditional approaches to this issue.





Fraser Henderson

Senior associate and advisory board member,
The Consultation Institute

Communicating change matters

“Be it drones, e-scooters or driverless cars, policymakers are consistently behind the curve when it comes to regulating advances in technology. Two significant examples have come to the fore in the last couple of years. Firstly, the whole scale introduction of 5G, which was largely imposed without public consultation. While scientists may find this acceptable, the upshot is that the general public were less accepting of it.

Secondly, the introduction of low orbit satellites which have the ability to spy on us from above and blast us with radio waves. And the future is fraught with similar dilemmas, such as how to deal with

quantum sensors that could read your brain from afar or be used to see through walls. History is littered with examples of how things which were deemed good at the time turned out to be bad– such as asbestos, smoking and the plastic bag. We even had a wobble about the health effects of mobile phones on brain tissue.... well after their introduction. Chances are that it’s fine, but what if WiFi was a cause of cancer?

Believe it or not the government does have a mechanism to inform policymakers about popular concerns and emerging issues in advance of legislation. The initiative is called Sciencewise (Google it) - which aims to develop socially informed policymaking through mini public dialogues.

But that doesn't guarantee that policymakers will listen or that participants will be heard. And for this reason, it's become a bit of a luxury. Today, responsible technology is mostly in the hands of the creator and the user. This causes an imbalance - researchers know about responsible research and innovation but are powerless to safeguard their knowledge. Users blindly trust technologies approved by nanny states and have a habit of using them in unpredictable and irresponsible ways (think laser pen in the eyes of an airline pilot).

Beyond 'responsible by design', what remains of the trust and transparency deficit relating to the introduction of new technologies are three communication challenges. Firstly, we need to help people better understand complex technologies and their impacts. Secondly, we need to articulate any benefits and limitations in equal

proportion to eliminate the corporate comms influencers.

Thirdly, we need to help both politicians and the populous be more accepting of unknowns and uncertainty. The pandemic has demonstrated that people are undereducated about health science. In the absence of a faster policymaking cycle, it's fair to assume that the shine of new technologies will be tarnished by misinformation which stems from the same ignorance. While it seems like a small step, a 'government office of public participation' might actually be the solution we're all looking for".

ETHICAL AND LEGAL FRAMEWORK

A study in 2016 examined the ethical and legal framework around smart cities, and assessed how the general public may react to the technology. The researchers concluded that some of the concerns voiced by the general public have been addressed by EU regulation that was emerging at that time, regarding the processing of per-

sonal data. But the study also acknowledged that as the logistical possibility of constructing individual profiles from impersonal data became more feasible, strategies and regulation in this area would need to expand. In accordance with these concerns, the academics suggested that smart city governments must address the following threefold challenge:

- Identifying which privacy concerns for their citizens may be at stake with specific technologies and data practices;
- Identify if and how these are subject to the EU data protection regulation;
- Developing a specific city policy on new developments that accommodates the concerns of citizens, beyond the bare legal necessities.[31]

An open dialogue with collective citizen groups should be considered important in addressing these issues. And it should also be noted that the UK exit from the European Union could have legislative consequences, which will also need to be taken into consideration.



ONGOING MAINTENANCE

Another obvious issue with technology in smart cities is the importance of ongoing maintenance. This applies on both a hardware and software level, but of primary importance will be the development and maintenance of sufficient database technology. This will be a huge challenge for smart cities, as the scale of information collected could reasonably be described as colossal.

Network challenges are also inevitable. The infrastructure of smart cities will be reliant on 5G connectivity, but the coverage related to

this innovation is nowhere near fully functional currently. There have been issues with expediting 5G rollouts, while it would be naive to believe that this process will go entirely smoothly. For example, the UK has experienced massive problems with broadband deployment in the past, which can reasonably be expected with any major new technology being applied for the first time on a theatre-wide level.

Smart cities will also rely on AI and machine learning in order to tackle the biggest issues and challenges, but the specific solutions required

are still yet to be developed in many cases. There is no doubt that this field is developing rapidly, and by its very nature will continue to evolve, but artificial intelligence is yet to demonstrate that it can reliably solve bigger, more generalised problems at the same level that humans are able to operate. Machine learning is impressive in fields with narrow and precisely defined parameters, but still needs to be developed in order to serve the purposes of smart cities.

“SMART CITIES WILL ALSO BE RELYING ON AI AND MACHINE LEARNING IN ORDER TO TACKLE THE BIGGEST ISSUES AND CHALLENGES, BUT THE SPECIFIC SOLUTIONS REQUIRED ARE STILL YET TO BE DEVELOPED IN MANY CASES”.

COMMUNITIES

Communities must be at the heart of any responsible smart city developments. The whole ethos of smart cities is to improve the way that urban areas operate, and this cannot be achieved without the consideration and approval of communities. One of the most important parts of the design process is involving the actual users. User-centered design should be incorporated and normalised in every smart city design structure.

Detailed studies of different ethnographic backgrounds of people living in our cities will be a key to success. Another factor should include testing and receiving feedback on the current advancements. That will prompt real-life knowledge and will bridge the gap between high tech and people living in the local areas. In the process, the very crucial thing is to not forget about members of the society with different mobility and accessibility issues and to make it possible for private bodies and specialised organisations to be a part of every research and design process.



Global
Disability
Innovation
Hub

Global Disability Innovation Hub

Disability-inclusive smart cities

To achieve connected and inclusive communities by 2030, and meet the targets set out by the UN's SDG Agenda, it is imperative to include disabled people in discussions of urban development and smart cities. There are 1.2 billion disabled people in the world [1b], one in seven people, who have the same human rights as everyone else, but often experience barriers in access, participation and opportunities in their daily lives [2b]. In the UK the figure is higher, over one in five people are disabled and many experience exclusion, higher costs of living and stigma [3b]. This is because the built environment isn't designed to

include everyone, but it should be. The built environment, infrastructure, technology and services all need to be designed inclusively to ensure everyone can participate in society and their communities. Inclusive design is one of the solutions: "inclusive design of the built environment can ensure everyone can experience the world around them in a fair and equal way" [4b]. Inclusive design is both an approach and mindset to design which is supported by technical standards that help design spaces that everyone can access and feel welcome in. During the development of East London for London 2012, inclusive design was prioritised across

Queen Elizabeth Olympic Park through commitment from leadership, a robust delivery framework and standards, co-design with users and more. This part of London now showcases best practice in inclusive design including a park mobility service, accessible toilets and changing rooms and tactile maps to help guide people and it goes beyond specific inclusive design features to think about creating inclusive experiences and choices for everyone who visits the site – leaving a legacy of inclusion from the 2012 Olympic and Paralympic games [5].

The Built Environment Access Panel is still working today to ensure this part of London continues to be inclusive for all. Smart cities aim to leverage technology to improve people's lives, design places that are more interactive and adaptive to people's needs [6] which is a huge opportunity for inclusive design and inclusive innovation but disabled people must be involved in designing the places and services in smart city projects. In 2017, the Smart Cities for All toolkit was launched that aims to empower city leaders to advance inclusive, smart city planning [7].

Currently, the city of Varanasi is piloting projects that bring champion inclusion through India's 100 smart city mission such as creating more accessible heritage sites and more accessible and

welcoming streetscapes, this work is supported by cutting edge research funded by UK Aid on inclusive design and the built environment led by the Global Disability Innovation Hub in partnership with the National Institute of Urban Affairs in India [8].

It is a sign of progress that smart cities, technology and inclusion are being discussed together at the local government scale in cities like Varanasi and applied to live projects that are being implemented. Technology can help deliver inclusive, smart cities but that technology also needs to be inclusive. For disabled people, assistive and accessible technology (AT) can be life changing, but currently 90% of those people who need access to that AT don't have it [9].

People need to be able access AT so they can live, work, learn and play as much as they need an inclusive built environment and infrastructure. Poor quality infrastructure often damages AT, creating further barriers for disabled people [10].

Inclusive design and AT illustrate how technology, architecture, infrastructure, and people need to work together to address global challenges and work towards a more inclusive future.



Sulaiman Khan

Founder and Chief Purpose Officer at
ThisAbility Limited, Co-Founder at Cripjoy

Accessible, regenerative smart cities

“Accessibility is a necessity, not a luxury. We cannot continue living the way we are, and excluding the wisdom and richness of disabled people will be devastating to humanity. This is particularly the case when it comes to smart cities. Since 2020, the global pandemic and social justice movements (including racial, environmental and indigenous justice movements etc.) have caused the world to change dramatically. There’s a lot of talk around smart cities, especially with the UN sustainable development goals. Unfortunately, architecture (that creates smart cities) often isn’t designed for the minds and bodies of disabled people as it is scarce to find a disabled architect. Statistically, 80% of Disability is acquired in someone’s lifetime.

You’re more likely to become disabled the older you get. If disability is a part of the human experience, why aren’t we ensuring that smart cities are fully accessible for disabled people? Why aren’t we creating accessibility within Smart Cities, especially as disabled people are the world’s largest minority (1.3 Billion people and counting) and an \$8 Trillion market?

Disabled people can create worldbuilding, transformative, radical, imaginative, interdependent, and joyful environments that centre people and nature and are accessible for everyone.

To me:

- **World building** is building systems and structures that are equitable and just for everyone.
- **Radical** is not being afraid to ask difficult questions and think radically to create the systems and structures for everyone.
- **Imaginative** is ensuring that disabled people can utilise their infinite imagination within limitations to find solutions for accessible and just systems and structures.
- **Interdependence** understands that everyone and everything (humanity and nature) are dependent on each other, and that's okay. Nothing is done or can be achieved in isolation. Disabled people understand this the most.
- **Joy** is being able to create unfiltered, unconditional and radical love and contentment in harmony above balance.

A great example of someone creating world building, transformative, radical, imaginative, interdependent, and joyful smart cities that include Disabled people is Dr. Victor Pineda. He is the founder and president of world enabled, an international consulting group for the rights of disabled people.

They initiate inclusive urban design through their #Cities4All campaign. Technology can assist in creating inclusive smart cities too, but yet again, disabled people need to be included with solutions since disabled people are native tech users. However, we need to take note of nature and integrate ourselves back to nature and each other in harmony above balance. Accessibility within smart cities is the core DNA to this, and ultimately, smart cities have to be rooted in [Crip Time](#), [Anti-Ableism](#), and [Disability Justice](#). There are no smart cities without disability. Designing with (not for) disability is world building, sustainably regenerative and joyful". N.B.: This article is imagined, created, written, and shared joyfully and interdependently between Tia Denton (Personal Assistant) and Sulaiman R. Khan in Crip Time.

About Sulaiman

You can read all about Sulaiman here. You can follow Sulaiman on Twitter and on Instagram [here](#): @SulaimanRKhan



JOBS

Having discussed many of the pressing issues that need to be addressed with smart cities and technology, it's also important to remember that they bring massive opportunities. The development of smart cities will bring huge labour and economic prospects, and there is certainly an argument for training specifically to work in this area. Indeed, it is generally presumed that the labour market will evolve in order to meet the compelling and growing needs of smart cities in the years to come. At first they will have a disruptive impact on local labour markets. This can work both ways - on the one hand, some jobs may become obsolete due to automation, but new opportunities may also be created in smart city-related industries.

“ONE POSITIVE IS THAT THE NATURE OF EMPLOYMENT CREATED BY SMART CITIES IS LIKELY TO BE MORE SKILLED, INVOLVING AND POTENTIALLY HIGHER PAID THAN THE JOBS THAT ARE DISPLACED”.

It is nonetheless noted by Deloitte that some unemployment will be caused by the initial forays into smart cities, as frictional unemployment occurs due to the disappearance of existing jobs.[32] It will be important for new employment opportunities to be created quickly in order for smart cities to avoid causing an increasing number of long-term unemployed people. However, one positive is that the nature of employment created by smart cities is likely to be more skilled, involving and potentially higher paid than the jobs that are displaced.

INEQUALITY

It should be noted that many of the issues and opportunities associated with smart cities are topics that need to be explored from a cultural perspective, in order to ensure that the appropriate questions are being asked, as we embark on this mission critical journey.

For example, it is easy to envisage scenarios where people who are not tech savvy are excluded from certain aspects of life in smart cities. The solution to this isn't necessarily easy to craft, but businesses, public service providers and governments need to work together closely in order to provide facilities to assist the vulnerable in this environment.

Mitigating inequality issues will also require governments and authorities involved in the organisation of the smart cities to work closely with local communities. Acquiring inputs from a wide variety of voices, particularly those that are typically underrepresented, will

be an important part of the process if the transition is to be handled smoothly. Central to this notion should always be equality of opportunity, meaning that all people living and working within smart cities are afforded access to the same facilities, activities, and experiences.

“THE SOLUTION TO THIS ISN'T NECESSARILY EASY TO CRAFT, BUT BUSINESSES, PUBLIC SERVICE PROVIDERS AND GOVERNMENTS NEED TO WORK TOGETHER CLOSELY IN ORDER TO PROVIDE FACILITIES TO ASSIST THE VULNERABLE IN THIS ENVIRONMENT”.

In fact, smart cities already offer opportunities to address inequality in urban areas. There are frequently chronic economic and social disparities in cities, with this being particularly marked in the developing world and emerging economies. Considerable progress has been made in terms of urban

regeneration, yet often the proceeds of this gentrification have not been fairly divided. If smart cities are to provide a true alternative to the status quo, they must allow people at all levels of socio-economic status to actively participate in municipal decision-making.

With regard to this, a study by the Urban Institute found that cities that are more inclusive have better economic health indicators.[33] Smart city initiatives are already leveraging technology in order to address social deprivation and inequalities. One example of this is the ability of cloud-based systems and data-driven platforms to enable residents to gather information on their society, and contact local government and authorities more readily. This then provides the opportunity for providers to adequately correlate online services with the requirements of residents, and even proactively respond to issues before they arise. An initial example of this has emerged in Kolkata, India, in which a start-up provided postal addresses to hundreds of thousands of slum residents via geocoding technology. [34] And in London, an initiative overseen by Google and the Royal London Society for Blind People has enabled visually impaired people to navigate the transportation network of the capital via beacons that provide audio instructions to smartphone applications.[35]

It is also possible to think about the entire concept of smart cities in an innovative and left-field fashion. Instead of focusing on the, admittedly impressive technological development the emphasis can instead be placed on the preferences of the city residents. In order to achieve this, providers and organisers can use data, digital

technology, and human-centred design to promote decision-making by residents, businesses, and other city stakeholders. Residents can be invited to contribute to solutions to local problems, and, concurrently, be involved with the creation of infrastructure. Smart cities that provide the tools for residents to participate in this process will create more cohesive frameworks, which better serve the needs of residents and communities.





Stephen Hilton

Fellow of the University of Bristol Digital Futures Institute

Founder and Director of City Global Futures LTD.

The future of smart cities is inclusive & local

“The Internet has provided society with a valuable lifeline during the pandemic, keeping us working, talking and connected. The pace of change has been remarkable – the digital world literally ‘Zoomed’ into our homes as the physical world retreated: enabling work; school; leisure; shopping; entertainment; relationships; politics and banking – plus many other aspects of everyday life.

Many of the new patterns that have been established during the pandemic – online shopping, home working and more local ways of living, look as if they are here to stay. Economically, the biggest

winners have been the global tech giants who have seen trillions of pounds added to their bottom line. So what does this mean for the future of the smart city? For me, it is more vital than ever before that inclusion and diversity sit at the heart of what it really means to be a smart city. It is also vital that we find new ways for the smart city to deliver fair local value and not just global profits. Of course, not everyone is currently able to connect with the digital realm. The copper/fiber/wireless networks and sophisticated cloud-based data platforms that power the smart city are not equally distributed or accessible.

In addition, too many people still lack the basic skills, equipment and resources, or simply the confidence, they need to engage effectively online. Governments, public bodies, community organisations and businesses have been slow to prioritise digital exclusion (despite it being talked about for well over a decade) but at least, the pandemic has raised new understanding of “Digital Poverty” as an abhorrent issue, which must now be addressed.

In my view, the future smart city should, however, seek to go much further than simply digitally-enabling excluded citizens and communities so that they can become ‘smart consumers’ –

the real opportunity is to harness the once-in-a-lifetime shift that we have experienced to energise and equip a generation of smart city producers from different parts of the community and walks of life.

Here in Bristol, the University of Bristol’s Digital Futures Institute (BDFI) and a group of community hub partners – the Black South West Network (BSWN), BABBASSA and Knowle West Media Centre (KWMC) – are co-designing use cases for a cutting edge ‘nomadic’ digital network. Each hub has appointed a ‘Fellow’ to lead the work and the ambition is that the nomadic network can become a shared, portable resource to support ongoing Smart City innovation in each of the community locations.

By creating a new, localised networking model, we can also harness edge-computing technologies to bring data into local control, creating space to explore ways in which the real value of the smart city can be held locally, for the benefit of current and future generations.

So in future, let’s aim for a smart city where the power of digital innovation, diversity and inclusion is in creating places and systems that are sustainable and fair because they work better for everyone!”



MENTAL AND PHYSICAL HEALTH

While many people undoubtedly have wonderful experiences living in urban areas, it must also be acknowledged that cities are more readily associated with mental health difficulties. It is widely documented that cities make the human brain more susceptible to certain conditions, notably depression, anxiety, and schizophrenia, and that this has a direct impact on mental health outcomes.

Published research has documented this extensively. For example, a study published in the magazine demonstrated that city inhabitants have a stronger reaction to stress than those living elsewhere.[36] In research from 2010, Peen, Schoevers, Beekman, and Dekker demonstrated a strong correlation between urban life and poor mental health.[37] And John B. Calhoun's studies, which discovered the concept of behavioural sink, suggest that populations can deteriorate when too many residents are compressed into a sufficient space. [38]

This is troubling considering that over two-thirds of the world's population is expected to reside within urban areas by 2050, according to the United Nations.[39] This means that addressing mental health issues should be a major priority for smart cities, if they are indeed to serve the needs of communities.

And the evidence of declining mental health is manifold. Mental illnesses already represent the world's largest health burden after infectious diseases, and the World Health Organization projects that,



by 2030, depression will be the leading cause of disease burden globally.[40] Clearly, smart cities have some work to do in addressing this. One immediate improvement can be made is improved commitment to green spaces in cities. It is known that nature can help reduce stress, and therefore providing more opportunities for people to connect with nature can only have a positive impact on the mental health balance of cities.

On another level, data and intelligence systems can play a role in transforming cities, ensuring that they are more supportive of mental and emotional well-being. Technology can be utilised to help planners understand phenomena relating to mental and emotional discomfort, while solutions can also be designed to help prevent mental illness from arising in the first place. Again, connecting with communities and seeking a two-way feedback loop should be considered a critical aspect of this process. With artificial intelligence and machine learning also set to play a major role in smart cities, this technology can also be of assistance. The insight provided by these innovations can help medical professionals analyse data and

make proactive decisions. All manner of information will be collated by smart cities, and parameters such as temperature, humidity, allergens, pollution and power grid status can all actually make a contribution to better understanding and treating both mental and physical health.

Finally, the Internet of Things (IoT) solutions inherent within smart cities will improve population management, helping healthcare professionals more readily identify individuals and groups that are more at risk of illness. Behavioural analytics will bring new insight to the medical field, while the ability to monitor and influence many facets of the infrastructure of cities can be used to assist with both mental and physical health outcomes. For example, the McKinsey Global Institute reported that Beijing was able to reduce air toxins by 20% in 12 months, purely by identifying pollutant sources and carefully monitoring traffic and construction.[41] This could then aid health outcomes, but there are many other potential areas that can feed into healthcare and population management as well.





Feven Woldu

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Which really comes first: the city or its people ?

On reflection of points made in this report, it's apparent that the design of a smart city can ultimately determine whether it will provide meaningful opportunity that existing residents both want and can attain, or whether it strays, widening gaps and reinforcing existing inequities. One would be remiss to not emphasize the need to ground success indicators heartily between two categories of bottom-line performance: those that measure economic welfare improvement, and those that measure financial gain. The latter, of course, necessary for continued city maintenance and funding additional efforts, among other things.

Too often in smart city discussions, economic welfare, though still championed, is ultimately a byproduct of the city's development rather than a pursued objective. That needs to change. Fortunately, these city developments present us with a unique opportunity to "get it right." Perhaps the most obvious step would be to ensure that existing members of the community are being consulted and heard. In this case, it would make sense to bring into the fold, representatives from the community who are granted meaningful voting power. Diversity amongst workers isn't enough; this, alone, only replicates the power dynamic and societal hierarchy observed everywhere else.

Diversity is celebrated while the legacy of race, sex, class hierarchies remain intact. With smart cities, we have a chance to model, even at a smaller scale, something arguably more profound to the human race—systemic advancement. In my view, even before Smart city strategy development should come a clear plan detailing the approach to engage existing residents first; we would be remiss to not exercise utmost level of care in this diligence. Minding sensible sample size, insights derived from discussions with residents, data collected from surveys and/or other means should shape the strategy. And following that, prioritization of tactical developments.

Smart city development and maintenance framework must mind the needs of the community it is supposed to serve. For instance, sustainability is of course a critical consideration. However, if a community is vulnerable to criminality, there are likely other tactical

priorities to action ahead of standing up better waste management systems, for instance. Perhaps instead, a better-serving initiative could be safe spaces where residents can access tech resources for learning & development. Naturally, measurements should be in place to determine effectiveness. Some agility would be needed to pivot based on that feedback, if needed.

Given the magnitude of change that a smart city would mean for a community, diligence in understanding community concerns and needs isn't just warranted, it's necessary. Otherwise, who, really, is said city being created for? If development of priority KPIs do not consider the feedback of the very residents the city is meant to serve, who is to say they are safe from being forsaken by yet another inherently capitalistic model?



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THANK YOU

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Founded in Hull in 2006, the internet of things (IoT) and digital infrastructure specialist known as Connexin has established itself as a market leader in the provision of end-to-end smart city solutions, such as smart water, smart parking, smart lighting and smart waste. It enabled Hull to become the first city in the UK to benefit from its own purpose-built smart city operating system and gave the city of Sheffield a smart technology overhaul to integrate, view, manage and respond to information to improve highway maintenance services and revolutionise service delivery across the city and surrounding areas. Connexin announced the new broadband network in September 2021, with the aim of disrupting the existing monopoly by offering residents and businesses freedom of choice when selecting a fibre broadband provider. It said that until now, Hull's fibre broadband market had been monopolised by one company, leaving residents and businesses unable to access other providers – the only UK city where this is the case.

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