SMART SHEFFIELD

A report into the ‘Smart City’ or ‘Future City’ concept and how it should be adopted in Sheffield.

Commissioned by Sheffield First Partnership under the auspices of the Sheffield Executive Board and the SmartSheffield Advisory Group.

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EXECUTIVE SUMMARY

This report represents the first iteration of a Smart City Strategy for Sheffield.

It is the culmination of an engagement exercise undertaken between September 2014 and January 2015, which sought to understand and define what the 'Smart City' (or sometimes 'Future City') agenda means in Sheffield, and set a direction of travel for related activity and decision making.

The Smart City agenda is a powerful concept that reflects the increasing prominence of cities, and broader metropolitan areas, as economic, demographic and cultural engines; and it has emerged as a key driver of investment, innovation, academic research and public policy globally.

The Smart City agenda spans many domains and is difficult to pin down conceptually, however the most important message is that **it presents a rare opportunity for Sheffield to make innovation, and the adoption of new methods and technology, systematic across the city's principal functions**. It represents more than a way of conceiving, funding and initiating new technology projects, but can be used to transform the way the city uses its resources - human, material and cognitive - to accelerate development and build a future that conforms to the aspirations of its citizens.

A systematic approach to smart city innovation means **creating strands of technology, innovation and collaborative practice that cut across traditional 'silos'**, and that connect resources together, carry common understandings and methods, and increase accessibility at all levels. These concepts are discussed in more depth in the *Themes* and *Framework* sections of this report.

Furthermore, while the direction of travel needs to take the city rapidly along a progressive path, it also needs to gain widespread support within the city and amongst its citizens; and be attractive to people and organisations on the outside who might decide to apply their talents and resources here. This means that **the strategy must understand what is distinctive about the city of Sheffield, and support its aspirations and vision**.

Finally, **the strategy makes recommendations for specific action** - it provides a Roadmap to show the potential route that needs to be travelled.

This report is the first step towards describing a holistic framework to achieve these things, and begins to lay out the tools necessary to efficiently drive innovation into the city's systems.

EXECUTIVE SUMMARY

The development of this report involved conversations with more than 40 city leaders, from the public, private and voluntary sectors, as well as from both our universities and the college.

The purpose of these conversations was to begin to map the landscape of activity and opinion around the Smart City agenda in Sheffield, and through this process gain an insight into the organisations, projects, opinions, desires and challenges that currently exist.

This map is necessarily incomplete, and it will change quickly over time, but it provides sufficient information to make the first step towards defining a Smart City strategy for Sheffield.

At the heart of the strategy is a *Definition* of what the Smart City agenda means in Sheffield, and the most important concepts that should drive decision-making.

To develop this, we compared external *Conceptions* of what a Smart City means, local *Opinions* and attitudes, and existing documented ambitions and *Visions* of Sheffield's future.

We distilled the cross-cutting *Themes* that were repeatedly raised by our interviewees, and that apply across multiple domains of Smart City activity.
This resulted in the following "Thumbnail Description":

> ***"Sheffield has a long tradition of civic and commercial innovation, and its Smart City approach is a continuation of this, bringing resources together creatively and collaboratively to drive innovation across a broad framework of city domains. Sheffield has a deeply human focus, both in its desire to engage and inspire, and to deliver outcomes that increase inclusiveness, cohesion, resilience and prosperity for all."***
>
> *Key themes are:* ***Inclusion; Leadership; Innovation; Data; Collaboration; Resilience***

Each of the themes is further broken down into specific concepts and practices later in this report.

To complement the Definition and Themes, we produced a *Framework* which maps Smart City activity in the city against a broad set of city functions, or 'domains', and which is presented in its initial draft form in this report.

We also recorded existing and proposed Smart initiatives, and divided them into those that represent infrastructure or ground-work that should be in place in order to enable other innovation and improvements; and often in specific domains, some of which represent opportunities for flagship projects that will define Sheffield's smart credentials. These are presented in a *Roadmap*.

Preceding all of this, there is a section on how this document can be *Used* by people and organisations defining new projects. We want the strategy to be a living resource. It represents a way of 'getting on top' of the civic innovation and inventiveness that is bubbling away across the city, and provides a way of linking people and initiatives together, connecting them to local skills and expertise, and providing a compliment to each others ambitions. When this kind of connectivity is the norm there will no longer be a need for a 'Smart City' strategy.

Sheffield has a great history of innovation, and there are significant assets here that must be tapped into. It is especially important to listen to the smaller, quieter voices that have a deep understanding of what communities need, and what works. There is much grass-roots activity that deserves recognition and the oxygen of attention.

Above all, our desire is for the city's leaders, across all domains, to be more knowledgeable and confident in the story they tell about Sheffield's 'smartness', and to actively embrace technology and new ideas as the city has done so many times in the past.

HOW TO USE THIS REPORT

This report intends to provide an overview and introduction to the Smart City agenda and activity in Sheffield, but has also been designed to provide specific usefulness to policy-makers and people who are engaged in new city innovations and smart city projects.

1. Firstly, you can look at the Roadmap and see whether anyone else is already doing or intending to do, a similar thing to you - perhaps you can combine forces?

2. Secondly, if you are intending to create a new initiative in a certain smart domain, you can see from the Framework what other projects and organisations are active in that area, or who might have attempted something similar in the past and have useful resources and insight to offer.

3. Thirdly, you can look across the framework to see whether your project or organisation has anything to contribute to, or gain from, any of the other domains. And you can see who you might talk to in order to find out.

4. Fourthly, you can assess your initiative against the Themes to see how your project aligns with those underpinning concepts and whether there are opportunities to increase that alignment - and by aligning gain greater support, publicity and collaborative benefits.

5. Finally, you can consider your project in terms of Sheffield's Distinctiveness, and in what way you are contributing to this story.

PROCESS

In order to investigate what a Smart City strategy for Sheffield might look like, we set up a 'lab' at Integreat Plus on Brittain Street and invited leaders and stakeholders from across the city's sectors to come and talk to us about Sheffield, their work, customers, challenges, ambitions, hopes, technology and new ideas.

Starting in September 2014, we established an engagement space at Integreat Plus, in the Cultural Industries Quarter - the SmartSheffield Lab - where we could engage with city stakeholders on the subject of the 'Smart City'.

In all we invited approximately 70 individuals to the lab, and 44 were able to spare the time to talk to us (a full list of interviewees can be found in the appendices). The project was never intended to be comprehensive across such a wide scope, and we knew there would be omissions. The most notable gaps are in the broad areas of public transport, education and health, which should be the first areas to be addressed in the next iteration.

The aim of this engagement was:

- To map Smart City-related activity that is currently going on in the city, and work that is planned.
- To discover who the people and organisations are who are driving this agenda and contributing to it.
- To listen to opinions around this agenda and the way Sheffield, as a city, is pursuing the opportunities.
- To give us all an idea of the scope and scale of the agenda locally, nationally and globally.
- To connect people and organisations with others who are working in similar or related areas and to foster integration and interconnectedness.

35 Interviews

44 Interviewees

3000+ Minutes of Recordings

September

- Set up SmartSheffield Lab
- Identify Stakeholders
- Design Engagement

October/November

- Arrange & Conduct Interviews
- Organise Knowledge on Walls
- Report on Progress

December

- Complete Interviews
- Convert Knowledge to Infographics
- Decommission Lab

January/Febuary

- Complete Analysis & Infographics
- Present Outcomes
- Publish Outputs

The necessary starting place for a discussion about the Smart City is to define what we believe the concept to mean.

We started by looking at some formal definitions of the Smart City. Here are a few representative ones..

"A Smart City is a city seeking to address public issues via ICT-based solutions on the basis of a multi-stakeholder, municipally based partnership."

EU Smart Cities Index (2014)

"Smart cities are places where information technology is combined with infrastructure, architecture, everyday objects and even our bodies to address social, economic and environmental problems."

Andrew Townsend (Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia)

"The effective integration of physical, digital and human systems in the built environment to deliver a sustainable, prosperous and inclusive future for its citizens."

BSI Smart City Framework (2014)

Please see the bibliography at the end of this report to see the full list of documents we consulted in the course of this work.

OTHER CITIES

According to the formal definitions, Smart Cities apply technology, especially digital technology, to solve city challenges. But is that it or is there more to the term 'smart'?

Here's what some other cities say...

Helsinki

For Helsinki, a Smart City means more than advanced infrastructure and state-of-the art technological solutions. For Helsinki, Smart City signifies advancing open engagement of the citizens and the rest of the city community, pioneering in open data and transparency of city governance, as well as promoting agile service development.

#Engagement
#Transparency
#OpenData
#Governance
#Agility

Vienna

Smart City Wien uses a holistic approach focusing on Energy, Mobility, Buildings and Infrastructure resulting in: radical protection of resources; a high, socially fair quality of life; and productive use of innovation/new technology.

#Sustainability
#Innovation
#SocialEquality

Amsterdam

Amsterdam Smart City is about the testing of innovative products and services, understanding the behaviour of residents and users of the Amsterdam Metropolitan Area, and sustainable economic investments. The acquired knowledge and experience is shared via the ASC platform to help accelerate climate and energy programmes.

#Innovation
#Behaviour
#Economics
#Knowledge Sharing

Barcelona

Barcelona is working to merge urban planning, ecology, and information technology to ensure the benefits of technology reach every neighbourhood and improve the lives of citizens. Barcelona's transformational approach follows a long-term vision based on building productive, human-scale neighbourhoods within a hyper-connected, high-speed and zero-emission metropolis.

#Collaboration
#Neighbourhoods
#Mobility

Copenhagen

Copenhagen has the ambition of becoming the first carbon neutral capital by 2025. The goal is supported by a municipal strategic climate action plan in which 50 initiatives are described. Each initiative meets the 2015 midterm goal of a 20% reduction in CO_2.

#Sustainabilty
#Liveability

Birmingham

The aim is to embed a capability for smart and sustainable re-invention into the way the city is organised and in the way new business is created to deliver a step-change in Birmingham's economic growth, well-being and prosperity.

#Agility
#Innovation
#Economic Development

Bristol

Bristol's Smart City Programme emphasises the need to be green and therefore its aim is to help deliver a cleaner environment, a higher quality of life and a vibrant economy. The aim is to use smart technologies to meet a target to reduce CO2 emissions by 40% by 2020.

#Environment
#Living
#Economic Development

London

If it is to adapt to significant growth challenges, London must harness new technologies, its creative strengths and the vast amount of data that the capital generates each second of every day. This effort will require new forms of collaboration between Londoners, Government, businesses and academia to approach London's challenges in an ever more integrated way.

#Collaboration
#Data
#Creative&Digital

Glasgow

This large-scale, city-wide demonstrator will show what can be achieved by innovative use of today's technology. At its simplest, the project will allow Glasgow to develop a one-stop shop City Dashboard which will help monitor city systems from traffic lights and CCTV to air quality monitoring and street lighting faults and services like hospital waiting times and journey planning.

#Monitoring
#CityDashboard

Liverpool

The vision is for Liverpool to use a bottom-up approach to create ongoing monitoring of resource deployment, insightful visualisations and constant feedback loops to develop a highly efficient, interactive and engaging city, stimulating behaviour change. This will develop a low carbon, competitive and therefore sustainable Liverpool City Region utilising contemporary technology and design.

#BottomUp
#Visualisation
#FeedbackLoops
#Behaviour

Manchester

Manchester has the desire to implement a Digital Strategy which has the ambition of enabling Manchester to be a leader as one of the world's top 20 digital cities. A "smart city" means "smart citizens" – where citizens have all the information they need to make informed choices about their lifestyle, work and travel options.

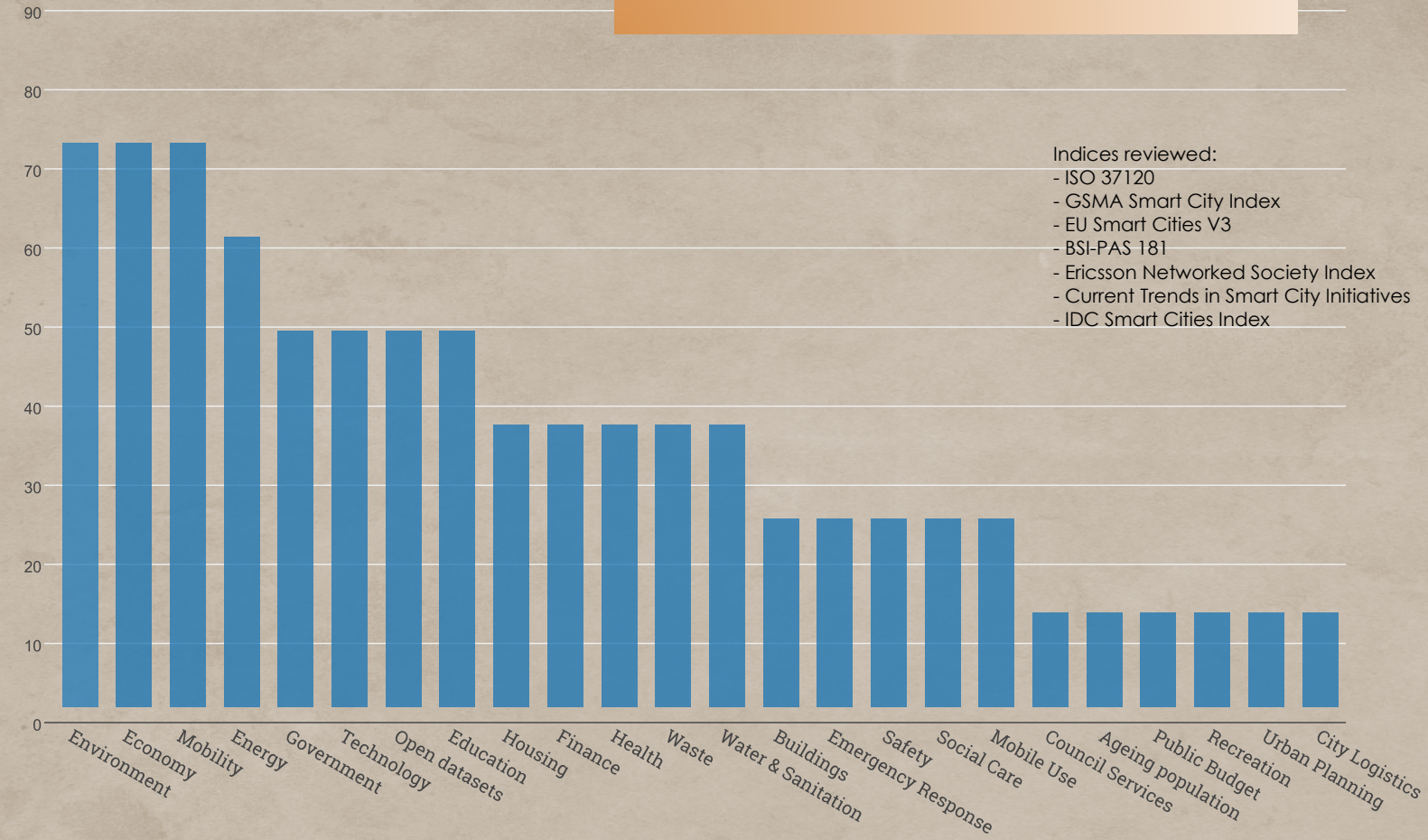
#DigitalStrategy
#SmartCitizens

Sheffield

By the end of this report, Sheffield will have it's own entry and defining concepts.

RANKINGS

We can also try to define the scope of a "smart city" by looking at the areas researchers evaluate when they try to compare smart cities. We conducted a comparison of seven of these ranking systems to determine the most common factors.



Indices reviewed:
- ISO 37120
- GSMA Smart City Index
- EU Smart Cities V3
- BSI-PAS 181
- Ericsson Networked Society Index
- Current Trends in Smart City Initiatives
- IDC Smart Cities Index

OPINIONS

The analysis so far only shows us the areas that are most commonly associated with smart city activity, not what should drive a strategy. Many of our interviewees had strong opinions about what the motivations guiding Sheffield's Smart City strategy should be, here are a few selected highlights:

"A smart city is not 'all about digital' - it is about making better decisions, and more time + more information + more brains = better decisions.

Good decisions need a clear vision to quickly evaluate benefit.
Fewer resources mean that good decision-making is even more important."

- Martin Mayfield
(University of Sheffield)

"Sheffield is an extremely socially minded city. This is a strength! Successful US cities are adopting a more socially-minded, more European model - New York, Portland, Seattle, etc. We should learn from them. How are we extrapolating Smart City learning? Do we have a whole city approach to what works in terms of education, skills, transport, etc.?"

- Simon Green
(Sheffield City Council)

"A smart city understands what value is; is constantly adapting; is self-sufficient; knows where it is and where it is going; measures the right things; has 'common sense'; connects customer needs to provision; is not afraid to get some things wrong; looks outside; creates feedback loops; and has visionary leaders. But: recently we've been struggling to get to 'success', let alone think seriously about the future..."

- Richard Wright
(Sheffield Chamber)

'"A Smart City is a city that asks smart questions."

- Julian Dobson
(Urban Pollinators)

"We need to look far ahead now, because there are known problems facing a world that is increasingly networked, but also increasingly isolated.
This is a crucial issue for Smart Cities."

- Jag Goraya
(Better with Data Society)

"Perhaps the greatest asset we have is the widespread, pent-up desire to do well for this city and to succeed through alternative means. Our way - the Sheffield Way.
We created a great space for this in the 80s and 90s, and some iconic artists and companies emerged from it. Can SmartSheffield create a secret space for amazing things to happen again?"

- David Kay
(Sero Consulting)

"Can the Smart City be a tool for transformation and disruptive innovation?
Can we take Smart City 'hacks' to excluded communities?
Can we bring design into the heart of local government? What would happen?"

- Sharon Squires
(Sheffield First Partnership)

"A Smart City is a city in which everything is interrelated and interconnected, instead of being in a linear chain. An ecosystem.
We all have invested stakes, and contributions to make to the Smart City."

- Graeme Hathaway
(Sheffield College)

"Sheffield needs a 'future city' vision, not just a 'smart city' vision.
It needs to be more ambitious in its aspirations, but not of the 'brash' kind - it needs to bring people with it and avoid 'haves and have-nots'.
It needs to be inclusive and attract people to the place."

- Aline Hayes
(Sheffield City Council)

"I would like to see an integrated plan for Sheffield that accounts for:
- Living
- Education
- Recreation
- Low Carbon, etc.
as well as infrastructure, spatial planning, transport and economic development."

- Edward Murphy
(Mott Macdonald)

"I would love the Smart City to inspire the agenda-setters and the policy makers and give them some hope so that they can be ambitious and be leaders."

- Mel Kanarek
(Tiger Nash)

THEMES

As we spoke to more and more people, we got a better sense of the core concepts that were driving their opinions and hopes for the future.

This led us to define the following cross-cutting themes that should be applied to all Smart City initiatives in Sheffield.

Inclusion

- Fairness
- Digital Inclusion
- Citizen Engagement
- Smarter Civic Dialogue
- Engagement Platforms
- Creativity & Play
- Visibility
- Citizen-led Design

Leadership

- Agility
- Collaborative Leadership
- Decision-making
- Vision
- New Operating Model
- Harnessing Movements

Innovation

- Permissionless Innovation
- Challenge-driven Innovation
- Open Commissioning & Procurement
- Funding & Bid-writing
- Innovation Risk Portfolio
- New Business Models

Collaboration

- Ecosystem Support
- Resource Mapping
- Shared Services
- Cross-sectoral Engagement
- Collaboration Platforms

Data

- Open Data
- Data Sharing
- Modelling City Systems
- Privacy

Resilience

- Sustainability
- Community Resilience
- Financial Resilience
- Resilient Systems

The following section looks at each of these themes in more detail...

Fairness

Sheffield's smart initiatives must account for the city's vision of its future as the fairest city in the UK - "a city that is eventually free from damaging disparities in living conditions and life chances, and free from stigmatising discrimination and prejudice, a place in which every citizen and community knows and feels that they will be treated fairly."

Digital Inclusion

Many smart-city applications involve providing citizens with information and the ability to transact at the point, and in the context, that they need it. It is therefore crucially important that as much of the city's population as possible is able to use digital tools. However, having access to the Internet and knowing generally how to use it is not enough - a truly digitally included person also knows how to apply these technologies to their own social and economic advantage.

Citizen Engagement

When city initiatives fail it is often due to problems that could have been identified if more attention had been paid to people 'on the ground', or could have been better adopted if the intended audience had felt more understanding and ownership. Unless citizens are engaged in decisions, trust is easily lost. We believe that a smart city is an open city in which involving citizens at every stage of a project is standard practice.

Smarter Civic Dialogue

Much public debate about the city occurs on social media, online forums, email and in the comments sections of local media outlets. City leaders cannot simply ignore this debate, but need to recognise that this provides an opportunity to listen, understand, engage and persuade. This means more than just basic social media training - public officials and councillors need to be expertly skilled in order to engage productively with the populations they represent, including the ability to refer people to appropriate information and communicate positively

Engagement Platforms

There are a large number of digital platforms designed specifically for bringing communities together to solve local and city-wide problems, as well as to list and share city resources. But which platforms are well suited for Sheffield, and how might they be used and promoted to improve the city's ability to aggregate around problems and resources? And where there is currently no suitable platform available, should one be created here?

Creativity and Play

In order to be engaging, the city needs to be fun to engage with. Aspects of creativity, play and delight should be considered in all smart city applications, and fostered where there is an opportunity to do so. Innovators should look to collaborate with artists, poets, storytellers, performers, games-makers and creative technologists, as well as appropriate funding opportunities. Rather than just adding this on though, playfulness should be considered integral to the design.

Visibility

Much of the city's smart infrastructure is currently hidden from view, and little information is available online. The more visible these city systems are to the general public, the more informed and included they are in the operation and flows of the city. Making the workings of the city, and the impacts and effects of city initiatives, visible in ways that are designed to be consumed by citizens is important.

Citizen-led Design

This theme covers user-centred design, user-experience design, co-creation and other similar conceptions. Smart city applications will only be successful if they are designed around the people that will engage with them, whether that is citizens at large, or specific groups and individuals. It's important therefore that user-focussed design practices that are well understood in some disciplines are applied in smart city initiatives, and there is much expertise in Sheffield to support this requirement.

Agility

The concept of the 'agile city' appears in several smart city strategies, and so it's useful to form an understanding of what this could mean in practice. One conception is that agility describes the ability of a city to adapt to unknown future challenges. In another it's the ability of civic leaders to make decisions rapidly in response to new challenges and opportunities. And finally, 'agile' is also a project management methodology in web and software development, designed to cope with a highly dynamic environment, and from which practices can be borrowed by other domains.

Collaborative Leadership

The concept of 'Collaborative leadership', or the ability of civic leaders to lead and support ecosystems, rather than 'only' lead their organisations, is a common theme. The basic concept is that individual organisations are no longer able to deal with the complexity and speed of change to develop enough high-quality responses, and therefore new ways of harnessing broader effort are required. These models are variably called 'Collaborative Leadership', 'Systems Leadership' or 'Network Leadership'.

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Decision-making

A crucial aspect of the smart city is that it should make decision-making easier, faster and better informed. The data gathered through sensor networks or social media analysis needs to be put in the hands of decision-makers in the right format to be actionable, and should involve the input of as wide and diverse a range of people as possible. Good decisions are a function of time, information and brain power - good decisions around smart projects should work to improve the use of these resources in Sheffield.

Vision

Decision-making needs to be underpinned by a vision of where the city is going, and what it wants to be in the future. Such a stated vision also enables people and organisations to act autonomously, conscious of the relationship between their plans and the city's direction of travel. The vision has to be a holistic one - not just focused on a particular aspect of the city, such as transport or space or digital connectivity, but a set of visions that are strongly aligned and integrated with each other, well articulated, are authoritative and have wide support.

New Operating Model

The British Standards Institute's smart city framework (PAS 181) recommends transforming the city's 'operating model' in order to better develop approaches that conform to citizens' needs. They state: "*The traditional operating model for a city has been based around functionally-oriented service providers that operate as unconnected vertical silos, which are often not built around user needs. Smart cities need to develop new operating models that drive innovation and collaboration across these vertical silos.*"

Harnessing Movements

With so much of the population now networked together, and talking to each other about things that affect them in their environment (both the good and the bad), the ability to listen to people's concerns; recognise where there are motivated groups; provide insight, information and tools to enable them; and connect them with other city actors who can help them make a positive difference, are crucial leadership skills that should be fostered.

Permissionless Innovation

This means that people and organisations within the city should be able to create new initiatives and projects without needing to seek permission from an authority to do so. On the one hand this means that data should be made open for people to use, application programming interfaces (APIs) should be made available to allow people to build new services that interoperate with existing ones, and information should be made available in areas that enable people to find premises and resources to start new things. Permissionless innovation allows for the most efficient use of resources, and the greatest proliferation of valuable new things.

Challenge-driven Innovation

The idea of public sector stakeholders in the city being able to express the challenges they face on a public platform and invite solutions and proposals to address those challenges was a concept expressed by many. There were several different conceptions of what this challenge platform could look like in practice, and of course there are several existing ones available online, but the desire for this kind of engagement and the innovative solutions it could foster was widely expressed and desired.

Open Commissioning & Procurement

This theme is related to Challenge-driven Innovation, and indeed commissioning and procurement could form part of a single online challenge platform. However this theme extends the idea beyond expressing challenges, to publishing commissioning intentions and opening up the procurement process across the city to make it easier for new organisations to bid to supply public services.

Funding & Bid Writing

Several of the interviewees expressed that they would like to see smarter ways of writing bids and connecting projects with funding. This could, for instance, mean that bid writing expertise would be offered to community groups and social enterprises for free, or that bid writing resources and tools could be made available publicly, or that help with bids could be crowd-sourced by a network of knowledgeable volunteers.

Innovation Risk Portfolio

This theme relates to the need to take a portfolio approach to innovation in the city, meaning that there needs to be a balance between low-risk innovation that seeks evolutionary gains, and higher-risk innovation that seeks revolutionary transformation. The danger is that even in areas in which new things are being progressed, the likely gains will be insufficient. Finding ways to investigate transformative innovation with limited resources, in a risk-averse, cost-conscious climate is the challenge.

New Business Models

In addition to funding opportunities for smart city initiatives, new kinds of business model should be evaluated, especially models that take advantage of networks such as crowd-funding or clever forms of sponsorship and partnering. In addition, this could be creating new investment funds within the city that leverage funding streams that are available either from disposal of assets, or from taking commission for facilitating funding national and European funding applications.

Ecosystem Support

As important as it is for city leaders to create new smart initiatives, it is even more important to nurture the right conditions for initiatives to be created independently. This means ensuring that as many ecosystems of activity in the city as possible are supported, with information, networking, awareness and promotion of their activities.

Resource Mapping

Mapping resources of various kinds across the city is an essential enabler for better collaboration. The diverse kinds of resource that were raised in the conversations included community rooms made available by the Fire and Rescue service and others; council building and land assets; community clubs that cater to people with mental health issues; street furniture; etc. An overarching focus on city resource maps would ensure maps are appropriately available, accessible and discoverable; ensure they are managed and kept up to date; and ensure coverage including areas in which new maps would provide benefit.

Shared Services

Many of the lab discussions involved the potential of sharing services between public sector organisations. There is a clear need to reduce costs, and sharing services is seen as a way of doing this. However sharing services can also provide opportunities for organisations to work together more broadly, and in some areas may lead to expertise being more concentrated and more valuable. Specific areas in which service-sharing was discussed included shared fleet cars, vehicle servicing, public sector procurement services, etc.

Cross-sectoral Engagement

The need for different sectors to work together better is a frequently expressed desire, and should be fostered wherever possible. In relation to the smarter city this is especially true for the local digital industry as their skills and knowledge have a direct bearing on many smart-city initiatives and potential solutions. As expressed in London's smart city strategy, ways should be found to engage Sheffield's digital community in the city's challenges.

Collaboration Platforms

Similarly to encouraging the use of online platforms that allow citizens to collaborate and coordinate, there are benefits to using digital platforms for other kinds of city collaboration. This does not necessarily mean creating and/or promoting certain specific platforms in a top-down way, but it does mean being aware of what platforms are available, and how they can best be used. Issues such as how to build communities, how to manage conversations, how to make it easy for new people to join and get up to speed, what happens to people's data, how to mix online and offline activity, etc. should be well understood by city stakeholders.

Open Data

Making the city's data available publicly in formats suitable for it to be re-used, interrogated, combined, compared and visualised is a crucial component of any smart city strategy. However, the benefits from doing this do not accrue automatically. The data sets, the platforms on which they are hosted, and artefacts that have been made from them all need to be promoted in order to establish the behaviours necessary to turn the data into new value. Having said that, we have a great history of encouraging community engagement with Sheffield's data, as the very first city in the world to run public #hackthecity events. This is an asset that should not be overlooked.

Data Sharing

In addition to making data available openly, there is a great requirement for public sector agencies to share data with each other, especially in areas where personal details are associated with the data and privacy needs to be maintained. Appropriate data sharing can provide better insight and allocation of resources for agencies, and a better experience for citizens. There is currently much work being done in this area around common standards and protocols, however several interviewees felt that faster progress could be made if it was given more strategic importance.

Modelling City Systems

Collecting data from sensors and other sources, and using that data to produce more accurate models of how the city's systems work and inter-operate is a foundational driver of the smart city agenda. Sheffield already has models in a number of areas, including two separate 3D city models which are subject to different licensing terms and costs for use. There are some issues over ownership, maintenance, licensing and availability of the city's models, as well as many areas in which the city is not yet collecting data. There are also large opportunities for collaboration with contractors, universities and local research spin-outs, as well as opportunities for involving citizens through the use of observatories and crowd-sourcing.

Privacy

Of all the issues raised by the city's use of data, privacy is the most important, as it is the one that can most undermine the city's commitment to inclusion and fairness. If citizens feel that their data is being used without their permission, or in ways that do not have their best interests at heart, or that their data is being held in insecure ways, then the city is going to find it incredibly hard to reap the benefits from data openness, sharing and modelling. On the other hand, clearly and tangibly stating the city's commitment to privacy can complement its vision and be a significant differentiator. For instance, the city could commit to pro-actively testing the anonymity of every open data set published (both universities have expertise in this area).

Sustainability

The sustainability (or 'green', or low-carbon) theme is a nearly universal driver of smart city strategies around the world, as the resource use of cities is seen as a crucial point of leverage in the global response to climate change, and it is an area in which much innovation is happening, and still needs to happen. Sheffield has a commitment to becoming more self-sufficient, as outlined in the Green Commission report, and its smart city vision must reflect this. Sustainability is clearly a hugely important requirement for the resilience of Sheffield and its citizens, and is most reflected in the Smart Resources and Smart Mobility domains of this framework.

Community Resilience

The resilience of Sheffield's citizens at community level is one of the city's core priorities, and much work is being undertaken to understand the dynamics of resilience and how it can be enhanced and fostered. By including this aspect in a strategy for Sheffield as a smarter city, and conversely by making smart city practitioners aware of the dynamics of community resilience, it is hoped that new innovations can be brought to bear in this area. For instance by spreading ideas from 'Jugaad' or the 'frugal innovation' being increasingly practiced in parts of the developing world.

Financial Resilience

A key component of the Fairness Commission report is to promote financial resilience in the city, for example by way of ensuring fair rates of pay. In addition, the creation of Sheffield Money as a means of providing more affordable credit to citizens is an important and progressive smart initiative that the city should look to build on and promote.

Resilient Systems

There is an oft-expressed risk inherent in smart city activity that the city, its systems, and especially its citizens, become too heavily reliant on the consistent functioning of technology, and lose the ability to properly sustain themselves when things fail. This issue may manifest itself in applications not working effectively, or costing too much to be maintained properly; or it may be that applications introduce new points of failure or potential targets for terrorism; or that an underlying layer of infrastructure (such as connectivity), carries more responsibility than its resilience warrants. Mitigating these risks must be an important focus of Sheffield's strategy.

FUTURE VISION

Sheffield's smart city strategy needs to reflect the wider ambitions and vision for the future of the city.

Currently the best expression of this future vision is contained in the report: Sheffield 2035

*"Our aspirations for **Sheffield 2035** are for a city with a strong civil society, a great place to live that is globally successful, with a distinct identity underpinned by an environmentally sustainable economic and urban offer. It will be a city full of agile, responsible and forward looking organisations with ambitious, collaborative, accountable and innovative leaders."*

The report uses scenario analysis to examine the ambitions for Sheffield in three broad and related areas: the city's Social Future - how people within the city will relate to each other; it's Urban, Economic and Environmental future - how its infrastructure and systems will provide a sustainable city to live and work in; and finally its Organisational and Leadership future - what the future governance of Sheffield should look and feel like.

There are many overlapping values between this future vision of Sheffield and the Smart City agenda. The aspirations for Sheffield's social future refer to a city that is "*smart and connected*", "*agile and confident*" and "*creative and innovative*". The vision for the city's Urban Future refers to "*sustainability and being at the forefront of the design and use of green technology*", a "*talented and agile business base and workforce*" and "*creative and innovative enterprises*". And there are many connecting values around leadership as well, in regard to taking a holistic approach, embracing technology and innovation.

In a very important sense, the Smart City agenda should be seen as the means by which large portions of Sheffield's vision for itself in 2035 will be delivered.

DISTINCTIVENESS

In addition to complementing the city's vision of its future, a smart city strategy must also seek to enhance the city's distinctiveness. This question was raised and discussed in nearly all of the interviews we undertook

Here follows a distillation of Sheffield's attributes that resonated the most with people…

Understanding the value of things, especially around knowing which things to preserve, which to renew and which to replace. This speaks to our ability to build on our assets - in order to do so we must be able to recognise our assets when we see them. There is an opportunity for Sheffield to become widely known as a city that innovatively repurposes its past and creates new value from it.

Placing citizens and communities at the heart of the city's concerns, emphasising fairness, resilience, quality of life, sustainability and closeness to nature. Sheffield is often described as a city of villages, and this combination of big city culture, amenities and employment opportunity; with small town community, friendliness and engagement; and close access to the great outdoors - especially when combined with a commitment to social and cultural inclusion - is a compelling differentiator.

Sheffield's industrial heritage, its history of innovation, graft and craft, and its future at the cutting edge of technology, digital development, advanced manufacturing, materials, healthcare and the creative industries. There are important connections to be drawn between Sheffield's industrial past, characterised by socially progressive, family- or employee-run firms aggregating the labour of many independent 'little mesters' and distributing their products globally. This fed the city's prosperity and growth over two centuries, and we once again have similar conditions and opportunities, particularly in the creative and digital sectors.

Sheffield is a city of great pioneering successes, many of which are not as widely known as they should be. It has been mentioned on several occasions that it is not in Sheffielders' nature to be vocal about things, but **there is an important story to be told about Sheffield's track record of smart initiatives**, and it is important that we tell it.

Distilling all of these considerations - the Conceptions, Opinions, Themes, Vision and Distinctiveness - into a single, short summary of Sheffield's Smart City approach, while knowingly contentious, produces the definition...

Sheffield

"Sheffield has a long tradition of civic and commercial innovation, and its Smart City approach is a continuation of this, bringing resources together creatively and collaboratively to drive innovation across a broad framework of city domains. Sheffield has a deeply human focus, both in its desire to engage and inspire, and to deliver outcomes that increase inclusiveness, cohesion, resilience and prosperity for all."

#Inclusion
#Leadership
#Innovation
#Data
#Collaboration

FRAMEWORK

In order to begin mapping Smart City activity across Sheffield, we wanted to have a broad scope. We looked at a number of different ways of categorising smart city innovation, and settled on a model that divides the activity into seven major domains.

Smart People | Smart Resources | Smart Mobility | Smart Buildings | Smart Living | Smart Economy | Smart Governance

Each of these domains is further subdivided into a number of sub-domains, as shown in the following pages.

We mapped the framework to the existing EU Smart Cities categories so there is a link back to aid in funding applications.

This is not (yet) a comprehensive study, but it goes a long way towards describing the landscape of smart activity in the city, and shows the potential of a comprehensive, and up-to-date map.

This section of the report shows each of the domains, along with its sub-domains.

In addition, specific organisations, initiatives, projects and resources are shown associated with some of the sub-domains, using the following symbols:

S Items marked with a SmartSheffield 'S' indicate smart-city initiatives that already exist in Sheffield, or that are in the process of being created.

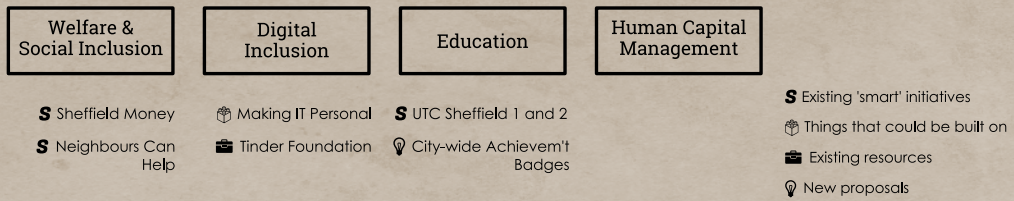
Items marked with a lego brick indicate things that have been tried and could be built on, or that could be developed into smart initiatives.

Items marked with a toolbox indicate city resources that could be useful.

Items marked with a lightbulb indicate ideas or proposals for new smart initiatives.

SMART PEOPLE

People - the citizens of Sheffield - must be the highest priority of all smart city initiatives, and there must be a clear link between a project and the human benefit it provides. Equally, it is of paramount importance that the city's population has the capacity to take advantage of new ideas and technology.



Welfare & Social Inclusion
Improving quality of life by stimulating social learning and participation, with particular reference to specific categories of citizens such as the elderly and disabled.

Digital Inclusion
...or reducing digital exclusion, is about making sure that people have the capability to use the Internet to do things that benefit them day to day - whether they be individuals, SMEs or VCSE organisations.

Education
In this context this means the application of modern learning technology (e.g. tablets, electronic whiteboards, etc.) and methods (e.g. flipped classroom, minimally invasive teaching) in public schools.

Human Capital Management
Policies to improve human capital investments and attract and retain new talents, avoiding human capital flight (brain drain).

SMART RESOURCES

This domain covers the city's consumption of natural resources, as well as initiatives designed to progress Sheffield along the path to a more sustainable future.

Renewable Energy	Smart Grids	Waste Management	Water Management	Food & Agriculture
S Sheffield Renewables	S Smart Meter Deployment	S Energy Recovery Facility	Sheffield Waterways Strategy	S Sheffield Food Network
S Blackburn Meadows Biomass Plant		S District Heating Network	WeSenseIT Citizen Observatory	
S Hydrogen Mini-grid			Lower Don Valley Flood Defenses	
S Social Housing PV Roofs				

S Existing 'smart' initiatives
Things that could be built on
Existing resources
New proposals

Renewable Energy
Exploiting natural resources that are regenerative or inexhaustible, such as heat, water, and wind power.

Smart Grids
Electricity networks able to account for the behaviours of all connected users and deliver sustainable, economic, and secure electricity supplies. Smart grids should be self-healing and resilient.

Waste Management
Collecting, recycling, and disposing of waste in ways that prevent or minimise negative effects on people and on the environment generally.

Water Management
Analysing and managing water throughout all the phases of the hydrological cycle, in particular when water is used for agricultural, municipal, and industrial purposes.

Food & Agriculture
The application of technology and smart thinking to the local food chain, from the use of sensors to improve crop cultivation to visualising local supply and consumption patterns.

SMART MOBILITY

Smart Mobility is all about how people and goods move through the city. Despite dividing this domain in to different kinds of mobility for the sake of this analysis, the most important factor is that all of Sheffield's transport and travel systems are well integrated and accessible.

Public Transport
Integrating and improving the experience of using the city's public transport infrastructure.

Private Transport
Initiatives that improve the experience of using private transport, or other means of moving around that are not part of the city's public transport provision.

City Logistics
Improving logistics flows in cities by effectively integrating business needs with congestion patterns, and environmental issues

Road Network
Improving, monitoring and maintaining the city's road, foot- and cycle-path networks, including signage and traffic signals.

Public Lighting
The application of intelligent public lighting and signage solutions.

SMART BUILDINGS

Smart Buildings covers innovation in Sheffield's buildings, the way they are designed, planned, built, occupied, monitored, maintained and managed.

Facilities Management	Building Services (M&E)	Housing Quality	Assisted Living	Cultural Heritage Management
S Council Asset Mapping		Decent Homes	Lab4Living (SHU)	
"Sheffield Investment Fund"		Incentives for Private Landlords		
Creative Space City Platform				

S Existing 'smart' initiatives
Things that could be built on
Existing resources
New proposals

Facilities Management
Cleaning, maintenance, property leasing, or any technology and/or operating modes associated with facilities in urban areas.

Building Services
Also known as 'Mechanical and Electrical' - the systems in a building such as heating, electric networks, lifts, fire safety, telecoms, data processing, etc. and the computer-based management of them.

Housing Quality
Aspects related to the quality of life in a residential building such as comfort, lighting, heating, insulation and ventilation, especially with regard to social housing provision, but not exclusively.

Assisted Living
The intersection of building design and care services for elderly and disabled citizens to enjoy independence and dignity in their own homes.

Cultural Heritage Management
The use of new technology systems (for instance augmented reality systems) to deliver new customer experiences in enjoying the city's cultural heritage.

SMART LIVING

Smart Living is about how citizens engage with their city and how the city enhances and enables their lifestyles, health and wellbeing.

Healthcare & Wellbeing	Entertainment & Sport	Culture	Retail	Hospitality & Tourism	Pollution Control	Public Spaces Management	Security (Blue Light)
S Adv. Wellbeing Research Cntr	S @SocialSheffield	S Sheffield Creative Guild	New Retail Quarter	S Our Favourite Places	S Air Quality Plus	S Love Square	S SYP Mobile Info Project
S Nat. Cntr f. Sports & Excercise Medicine		S What Next Sheffield?	S Now Then Discounts App		Catalytic Poetry	Public Wifi	CENTRIC
S Move More		C3RI (SHU)				Smart Sensor Areas	
Sheffield Recovery Hub							
S We Love Life							
S Devices4Dignity							

S Existing 'smart' initiatives
Things that could be built on
Existing resources
New proposals

Healthcare & Wellbeing
Prevention, diagnosis, and treatment of disease supported by technology, and assuring efficient facilities and services in the healthcare system.

Entertainment & Sport
Ways of stimulating the entertainment, sporting and night-time economies, providing information about events and enhancing those experiences.

Culture
Facilitating the diffusion of information about cultural activities and motivating people to be involved in them.

Retail
Initiatives to develop new ways of increasing the city's retail experience and city-centre footfall.

Hospitality & Tourism
Ability of the city to attract and accommodate tourists, foreign students and other non-residents by offering solutions appropriate to their needs.

Pollution Control
Controlling emissions and effluents by using sensors and mitigating technology. Improving the quality of air, water, and the environment in general.

Public Spaces Management
Care, maintenance, and active management of public spaces to improve the attractiveness of a city.

Security (Blue Light)
Protecting citizens and their possessions through the active involvement of local public organisations, the police force, fire service and citizens themselves.

SMART ECONOMY

The Smart Economy domain is about the technological readiness and capability of the local economy, as well as high-tech production, advanced manufacturing, the digital industries and initiatives designed to promote economic activity.

Innovation & Entrepren'ship	Digital Skills	eBusiness
S The Growth Hub	S The Skills Bank	S Digital Directions
S AMRC	Sheff. Comm'ty Networks	
S Adv Mfct'g Innovation District	S Better with Data	
S DotForge SV	Sheffield College e-Enabled	
S Sheffield Startup Weekends		
S Venture Funding Hub		
S Hack The City		
Co-working Spaces		
Sheffield Digital		
S Digital Media Exchange		

S Existing 'smart' initiatives
Things that could be built on
Existing resources
New proposals

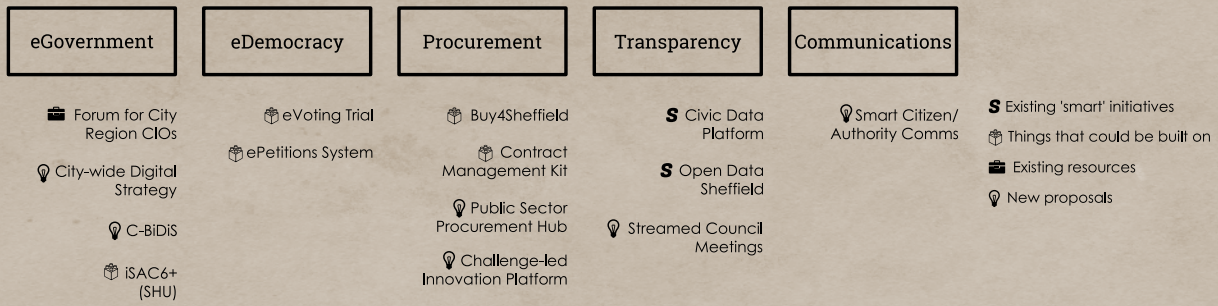
Innovation & Entrepreneurship
Measures to foster the innovation systems and entrepreneurship in the urban ecosystem.

Digital Skills
This is about the development of technical skills such as coding, testing, interface design, etc. as well as broader capabilities such as social media and data literacy.

eBusiness
This relates to the widespread dissemination of digital business knowledge and capability across the city's economy.

SMART GOVERNANCE

Smart Governance describes the use of smart thinking and technology in the performance of governing the city. A key distinction is made between eGovernment (making government operate more efficiently) and eDemocracy (using information technology to increase democratic engagement).



eGovernment
The digitisation of public administration and the application of new technologies, methods and behaviours to optimise and improve services to citizens.

eDemocracy
Enriching democratic engagement both during elections and in regular interactions with elected officials.

Procurement
The use of technology, data and collaborative methods to improve the way public services and and equipment are procured.

Transparency
The application of digital technology to improve transparency of public services and administration, particularly through the use of public open data repositories.

Communications
Improving the way city government and public services communicate with customers and make their work visible to the public in general.

THE ROADMAP

This section presents a potential roadmap of activity that advances Sheffield along the lines outlined in the rest of this report.
The roadmap is divided into two categories: Critical infrastructure, and Current Initiatives that are either in development or that exist as ideas for evaluation.

Critical Infrastructure

Initiatives that enable the Smart City, both technological and human-oriented.

City-wide Digital Inclusion Strategy

Digital Inclusion is an essential enabler, and there needs to be a comprehensive plan. It's also important to do more than simply show citizens how to use the Internet, but how to apply that knowledge to their lives and livelihoods.

City Connectivity

Providing good quality broadband coverage throughout the city is an obvious essential. There should also be a plan for WiFi connectivity, evaluating public provision, private-sector open networks and connected sensor networks.

Data-sharing protocols

Data-sharing is for personal data that is used to support better integrated personal services and/or decision-making. This calls for the establishment and broad adoption of protocols between public sector organisations. These protocols are in the process of being developed but need support.

Establish the SmartSheffield Programme

This would involve making an organisation responsible for maintaining the Smart City framework and providing a space for continued engagement so that innovation can progress in a way that takes full advantage of the city's networks and assets.

Open Data Standards

The requirement here is the adoption of an inclusive data policy; support for a primary civic data platform; and interoperability standards between emerging observatories and existing civic platforms. and/or decision making. The guiding principle for public organisations should be "Open by Default".

Smart Citizen Communications & Engagement

This is about developing the policies, behaviours and skills for public sector bodies and elected officials to be able to engage with citizens online in more positive, effective and fruitful ways. This includes the ability to recognise group motivations and direct them towards positive action.

Transform the City's Operating Model

As mentioned under Themes, this would involve the reconfiguration of the way public services operate to enable agility, data flows and collaboration. This transition is described in the British Standards Institute document "BSI PAS181 - Smart City Framework".

City-Wide Challenge Platform

The desire for an online platform that presents challenges faced by the city and its organisations, and invites ideas and bids to address them, was expressed by a large number of interviewees. This concept should be fully evaluated to decide what kinds of innovation it should cover, and whether the platform should be local or the city should use a global platform such as CityMart, for example.

Critical Infrastructure (continued)

City-wide Digital Strategy

A city-wide digital strategy would make digital infrastructure available to citizens & organisations within the city - not just connectivity but other services such as local search, and data feeds, etc. that application designers can incorporate into their systems. It would also look closely at the experience of people trying to engage with the city digitally and seek to improve their experience.

Data Literacy

Data literacy is the ability to read, create and communicate data as information, and is a crucial skill for citizens of a smart city (and for citizens in the digital age in general). In Sheffield's context this includes knowing where to find city data and making data journalism a common feature of local reporting.

Current Initiatives

Initiatives that are currently in development or that have been suggested as ideas (*not in order of priority or significance!*)

Centre for Big Data in Sheffield (C-BiDiS)

This is an initiative to establish data sharing arrangements between the five major public sector organisations in Sheffield - the two NHS Trusts, the two Universities and Sheffield City Council, to enable advanced modelling, enquiry, targeted decision-making and training.
(Ann Dalton at the Sheffield Children 's Hospital is driving this initiative.)

Digital Trade Association

This would be a trade body for the Digital Industry in Sheffield, which would provide a point of contact for engaging the sector in helping to solve the city's challenges, and potentially simplify the procurement process enabling more local businesses to provide their services locally.
(This initiative is currently being progressed by Mel Kanarek, Chris Dymond and others).

City-wide Skills Badging Standard

There are a number of achievement badging standards in the marketplace. This initiative would establish city-wide best practice to allow educators to offer vocational and skills achievements in a transferable, digital format that young people understand and that is globally supported.
(Sheffield College, Sero Consulting and Better with Data are all interested in developing this concept).

Open Council Property & Land Platform

There is an effort going on to map the council's property assets, and this effort could be extended to provide a self-service platform for social enterprises and communities looking for space, and allow people to engage with the council with a much higher level of prior knowledge and planning
(Martin Wood at Sheffield City Council has described this idea).

Ferrovial/Amey Smart City Centre of Excellence

This initiative is for Amey's parent company Ferrovial to set up their intended UK Smart City centre of excellence here in Sheffield. This would provide a focus for research and development around smart infrastructure and applications.
(Discussions to investigate this possibility are currently underway, led by Simon Williams of Amey).

Professional Bid Writing Team for Social Enterprises

This would be a service that provides help and support to local social enterprises and entrepreneurs to help them write funding applications. It could potentially be funded by taking a commission from successful applications.
(Suggested by Mark Tuckett - Sheffield City Council)

Co-located Public Procurement

This concept is for combining the procurement resources of several local public sector organisations in order to create a centre of excellence for procurement.
(This approach has been suggested by Filip Leonard at Sheffield City Council).

Sensor Areas

Smart Sensor Areas are parts of the city in which sensors are deployed to monitor how people or vehicles behave. A smart sensor area in Sheffield could provide a test bed for smart applications, the use of new streetlight connectivity and connecting sensors to city models.
(This has been suggested by Dr Alex Peng at the University of Sheffield).

Current Initiatives

Sheffield Urban Metabolism Observatory (SUMO)

This facility is being proposed and developed by the University of Sheffield, and will draw together data from disparate existing city systems, technology demonstrators, citizen scientists and environmental data to create a single platform that supports the advancement of the emerging field of the 'science of cities'.
(This initiative is being led by the University of Sheffield's Urban Institute.)

Space, Planning and Skills Platform

The intention of this system is to provide a straightforward, digital way to serve people who are considering moving their business to Sheffield. It would allow them to see what office space is available, what the costs and conditions are, and what the skills provisions are for staffing.
(This project is being developed by Toby Hyam of Creative Space Management).

City-wide Data Commissioner

This role would provide an over-arching authority in the city who would be able to drive agreement on data sharing policies and new initiatives to get the city's data into usable formats and situations.
(The concept of a City Data Commissioner was suggested by John Curtis at Sheffield Council).

River Don Citizen Observatory

This would be an initiative to extend the existing observatory being undertaken in Doncaster, and two other European cities, upstream to Sheffield's waterways. It would involve a combination of observations and passive sensors.
(This method is being pioneered by Fabio Ciravegna of the University of Sheffield and Oak Research.)

APPENDIX I - BIBLIOGRAPHY

We reviewed the following publications in the course of this project:

- BSI Smart City Framework
- BSI Smart City Vocabulary
- BIS The Smart City Market: Opportunities for the UK
- Future Cities Catapult: How Can The UK Innovate for the World's Cities?
- ARUP: Delivering the Smart City
- Cities Journal: Current Trends in Smart City Initiatives
- Mapping Smart Cities in the EU (European Framework 2014)
- EU Smart City Self-Assessment Framework
- RSA City Growth Commission
- Centre for Cities: Smart Cities Briefing (2014)
- New Climate Economy Report (2014)
- Smart Cities: Big Data, Civic Hackers and the Quest for a New Utopia (Andrew Townsend)
- Against the Smart City (Adam Greenfield)
- State of Sheffield 2014
- The Sheffield City Strategy 2010-2020
- Sheffield 2035
- Sheffield City Region LEP Growth Plan (2014)
- Sheffield Community Networks - New Strategies for Digital Inclusion
- Sheffield Community Networks - Digitising the High Street

APPENDIX II - INTERVIEWEES

We'd like to extend a heartfelt thank you to all who came to talk to us, and very much look forward to picking up those conversations soon!

Rob Allen
(Amey)

Danny Antrobus
(Better with Data)

Martin Beer
(Sheffield Hallam University)

John Bower
(Kier)

Andy Buck
(Sheffield Citizen's Advice)

Dave Caulfield
(Sheffield City Council)

Fabio Ciravegna
(The University of Sheffield)

Ben Curran
(Cabinet Member for Finance & Resources)

John Curtis
(Sheffield City Council)

Jag Goraya
(Better with Data)

Simon Green
(Sheffield City Council)

Chris Hardaker
(Kier)

David Hartley
(South Yorkshire Police)

Graeme Hathaway
(Sheffield College)

Aline Hayes
(Sheffield City Council)

Edward Highfield
(Creative Sheffield)

Toby Hyam
(Creative Space Management)

Mel Kanarek
(Tiger Nash)

David Kay
(Sero Consulting)

Terry Keefe
(Sheffield Hallam University)

Heather MacDonald
(Sheffield College)

Debbie Mathews
(Manor & Castle Development Trust)

Martin Mayfield
(The University of Sheffield)

Richard Motley
(Integreat Plus / CIQ Agency)

Edward Murphy
(Mott Macdonald)

Simon Ogden
(Sheffield City Council)

Alex Peng
(The University of Sheffield)

Chris Roast
(Sheffield Hallam University)

Lorena Segura
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Daniel Sheppard
(Sustrans)

Jason Slatcher
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Mark Smith
(SAFE@Last)

Sharon Squires
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Brendan Stone
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Mark Tuckett
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(Creative Sheffield)

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(Sheffield Hallam University)

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BETTER WITH DATA

amey

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PLUS Integreat

Yoo Mee

UNFOLDING INNOVATION

Sheffield City Council

tigernash

ciq Cultural Industries Quarter agency

The University Of Sheffield.

Birchenall Howden