How smart are Australian cities?

Local approaches to adopting smart city strategies

future cities collaborative | THE UNITED STATES STUDIES CENTRE at the University of Sydney

More than
19 million people
live in urban
Australia

Contents

INTRODUCTION

Australia is highly urbanised and in 2016 our major cities are home to more than three quarters of our population.[1] Producing sustainable and prosperous cities with high amenity for its citizens is essential for Australia.

As Australia becomes increasingly urbanised, our cities face an array of economic, demographic and environmental challenges. We are also at a critical juncture as the nation moves beyond the mining investment boom towards a sustainable and globally productive economy. The Australian government has recognised the need for supporting the growth of the nation as a knowledge-based economy and the critical role that cities will play in this new economy.

As acknowledged in the Australian government's smart city plan, "our cities need to be productive and accessible, but they also need to be liveable with a clear focus on serving their citizens. Great cities attract, retain and develop increasingly mobile talent and organisations, encouraging them to innovate, create jobs and support growth. While the opportunities have never been greater for our cities, congestion, poor access to jobs and services, reduced housing affordability and increasing pollution can challenge the quality of life they offer".[2]

New information and technological initiatives are often positioned as a solution to these urban challenges. There is also considerable debate as to whether these initiatives, which range from traffic management systems to alternative service models, are improving our cities. The challenge for Australian cities and communities is to understand how best to adopt smart approaches to urban development, and how to leverage new technologies and urban data to enable smart decision-making and planning to optimise the quality of life for citizens and therefore productivity of our cities, large and small.

This report aims to provide new insights into the implementation of smart cities in Australia – how these initiatives are being implemented in cities, whether they are fulfilling their promises, the challenges involved and how cities can learn from each other.

The term 'smart cities' is used to describe how the use of information and communication technologies (ICT) can transform the social, cultural and urban development in cities. Multiple definitions and interpretations exist across academia and industry, some of which refer to similar concepts that carry different names, such as ubiquitous city, wired city, intelligent city and digital city. Smart cities have rapidly evolved in numerous ways over the last few years, and with this evolution there has been a shift from a technology focus to a smart city that puts the focus back on the citizen.

KEY OBSERVATIONS & RECOMMENDATIONS

These are key observations from our examination of the smart city case studies and recommendations for how these learnings can be used by local governments, and those working with local governments, when implementing smart initiatives within their own city.

Citizens are at the centre of smart city strategies

Cities are placing the citizen at the centre of their smart city strategies, from the predominantly mobile, young population of the City of Melbourne and City of Boston, where the median age is 28, to the mixed demographic of the Sunshine Coast, the City of Adelaide and City of Newcastle. City governments are using raw data and technology as smart approaches to re-engage with citizens to co-design and build cities that improve the quality of life for all citizens. For many cities this includes reinvigorating economic growth and developing high amenity, inclusive places to retain and attract people to contribute to the thriving economy and place.

The City of Adelaide, the Sunshine Coast and the City of Newcastle looked to citizens to decide what urban issues or 'pain points' were highest priority to solve, varying from parking solutions in the central business district (CBD) to fostering a knowledge-based economy; the City of Melbourne and City of Newcastle engaged the citizens as architects to co-design solutions to urban problems, from how to report graffiti online to creating safe nighttime economies, using raw form data to give citizens greater agency in how the city is designed and how they are serviced.[3] The City of Boston uses this methodology for generating ideas and prototype development. The Sunshine Coast actively uses its Smart Centre and Living Lab to showcase and invite citizens to provide input on solution development. Each city carefully curates citizen or community groups, industry or government resources, or a combination of these, to examine, co-design and develop solutions, depending on the complexity of the issue being addressed.

Adelaide's use of 'Claire's Story', a storyboard that visualises the day-to-day interaction of a young entrepreneur, guides the city administration in re-designing its citizen/government interaction. Solutions vary from way-finding applications to support in property investment decisions and in providing entertainment options.

Moreover, as shown by the City of Melbourne and City of Boston, which have a high proportion of 'digital natives' with a median age of 28, those citizens expect a quicker transition by city government to solutions that allow realtime engagement with the city whether that be by mobile applications for wayfinding and managing traffic congestion to reporting pot holes that need filling.

Recommendations

- Local government should identity and focus on resolving the urban problems that are impacting most on the quality of life of the citizen. In doing so, the city will experience a deeper engagement with all sectors of the community and will garner support of stakeholders, including elected leaders, administrators and industry.
- Local governments should know and understand the changing local demographics to be better positioned to co-create solutions which meet the needs of the community as they change.
- Local governments need an agile and flexible approach to design solutions that best suit the task or problem in focus.

Smart cities start with smart organisations

Well-informed, future-focused and innovative leaders have paved the way for smart approaches to city building to take root in each of the cities examined. All the cities profiled in this report have strong leadership at the elected leader or executive level, which has led to the creation of smart city strategies or designated teams. Examples include Mayor Tom Merino, from Boston, who formed the Mayor's Office of New Urban Mechanics (MONUM) to fast track data driven, interdisciplinary solution development for citizen problems such as traffic congestion, to the 'entrepreneurial spirit' exemplified by the City of Adelaide's elected leaders to endorse the development of the ultra high-speed broadband network for its central business district, and the smart city champions leading change from within each city.

Each city defined a 'smart city' as the organisational approach and implementation of practices that would deliver an improved quality of life for citizens; high quality, inclusive and connected urban spaces; diverse jobs, thriving economy and efficient resource use. The City of Melbourne, City of Adelaide, City of Newcastle and Sunshine Coast saw smart approaches to designing and building places for people as core to its purpose and approached it as a methodology, rather than a 'label'.

Melbourne has its interdisciplinary Smart City Office comprised of five core teams from across the council; Newcastle has a dedicated Smart City Coordinator within the CBD revitalisation team, within Planning and Environment; Adelaide has a core group of representatives from across the organisation who champion and optimise cohesiveness in smart approaches across council; and the Sunshine Coast has a Smart City Lead, positioned within the Property and Infrastructure team, responsible for coordinating whole of council and whole of region implementation of their smart city program. Boston's urban innovation team, MONUM, are the internal consultants, bringing an entrepreneurial, data driven approach to co-designing solutions with internal departments for problems selected by the mayor.

A smart organisation also determines the role that it wants to play in developing and implementing smart city approaches. Innovation involves risk and governments are typically risk averse and fear failure. In the case of Amsterdam, it was decided that the innovation that comes with smart city approaches was better placed in an organisation separate to government. Amsterdam's smart city program was consequently developed to provide a platform for innovation, private industry engagement and solution development. The City of Newcastle and Sunshine Coast is also taking on a facilitator role by bringing together the university, industry, non-government and citizen groups to co-design and build solutions for the city.

Recommendations

- Elected leaders and city executives should develop a deep understanding and commitment to the role of information and technology in developing and delivering government actions. This will build organisational confidence and capability.
- Local governments should have a digital or smart city strategy embedded and endorsed within the strategic plan to underpin smart thinking in all solution and strategy development for the city.
- Local governments should prepare for the use of urban information and technology to become mainstreamed and central to the city's core business.
- Local governments need to explore ways to defray the risk to allow an innovation culture without damage to reputation or political will.

Smart cities have common drivers and components, different starting points

There is no standard 'playbook' for developing a smart city. Each city examined has developed the appropriate strategy depending on its unique current and future demographic and industry composition.

Increasing economic growth by attracting and retaining knowledge-based industries, improving the quality of life of citizens, optimising existing infrastructure, increasing government efficiency and improving environmental performance and sustainability were common drivers of smart city programs.[4,5] Common to each of the cities examined was a focus on the foundational elements of a smart city – communications connectivity for citizens and industry, open-source – interoperable environments and a focus on solutions and process re-engineering to better service the new and existing citizens and industry in a sustainable way.

However, the city's unique context led to each city developing smart approaches from a different starting point. For example, Newcastle experienced a significant shift in industry, moving away from a mining and industrial-based economy to diversified economic foundations. Increasing digital infrastructure and capability of the region offers opportunities to harness the potential of new technology industries and entrepreneurial activity. A smart and digitally-connected public and urban infrastructure provides the city with an ecosystem that drives innovation and creativity, helping them to attract and retain innovative business and leverage the creative capital of their resident population to continue to revitalise the city. For Melbourne and Adelaide, the starting place emerged from the need to attract, retain and grow knowledge industries to grow the local economy. Amsterdam started with improving the quality of life of citizens by reducing greenhouse gas emissions (GHG) and the adoption of renewable energy solutions.

The starting point for smart city approaches emerged from the local setting and context.

Recommendations

- Local governments need to start local.
- Local governments must collaborate across jurisdictions and share solution development to accelerate the adoption of new technologies and applications.

Smart Cities need to embrace disruptive technologies

To ensure that smart city solutions serve citizens well into the future, government needs to evaluate and understand technological change that is on the horizon.

The cities examined recognise the need to be agile and flexible to respond to current and future technological disruption whether that be electric driverless cars and ride sharing or the increasing demand of citizens to have realtime access to city services through personal devices. However, the institutional barriers of a historically slow-moving government organisation, coupled with the scale of current city works programs, limits local government from responding as quickly as it would like. Nevertheless, cities are taking steps to get ahead of the curve. For example, the City of Melbourne is proactively investigating what impacts disruptive mobility practices, such as ride share services like Uber and electric shared autonomous vehicles, may have on future infrastructure, planning, revenue and management challenges to cities. Indeed a recent report by the National Transport Commission outlines a series of reforms and regulatory barriers to autonomous vehicles, indicating the complexity of these future challenges.[6] The city is also a key partner of the National Connected Multimodal Transport Test Bed, which will trial smart transport systems and road networks to the north of the city centre. The City of Adelaide and City of Newcastle are investigating autonomous vehicle trials and the Sunshine Coast is, through the Maroochydore Priority Development Area, creating a smart city from scratch and incorporating new technologies into urban infrastructure such as pneumatic waste treatment and using this as a 'test bed' for how to scale these initiatives to other areas of the region.

Recommendations

- Governments must anticipate and plan for the changes that disruptive technologies and business models will bring to urban life and city infrastructure.
- Create 'test beds' for disruptive technologies such as future transport, by collaborating with government, industry and academia.
- Local government must convene an interdisciplinary team to undertake any investigations in this area to avoid 'siloed' thinking.

Smart cities collaborate

Open collaboration with industry, state and local government, academia and other thought leading organisations is key to supporting Australian cities in accelerating the adoption of smart approaches in a rapidly moving technology environment. Local governments are closest to the demands of the community and are best placed as a facilitator to bring together the appropriate government and industry partners to develop and implement technology solutions to meet the needs of its citizens.

Each of the cities examined recognised the need to share their unique lessons from implementing smart city approaches – both the failures and successes – with other cities, whether that be neighbouring councils, interstate and international cities. For example, the City of Adelaide shares high-speed broadband connection with four neighbouring councils to enable co-design workshops. The City of Melbourne, in partnership with more than thirty councils across Greater Melbourne, is also a member of The Rockefeller Foundation, 100 Resilient Cities program, and has a Chief Resilience Officer in place to manage this partnership.

Each city has developed domestic and international relationships with city networks, including US Ignite, Smart City Protocol, Global Smart City Community Coalition (GSC3), Australian Smart Communities Association, Smart Cities Council Australia and New Zealand, and Future Cities Collaborative, all of which play a role in thought leadership and capacity building across the sector.

Looking to collaboration between levels of government, unsurprisingly collaboration and alignment across local and state government agencies have achieved results such as the 10 Gig City project underpinning the City of Adelaide, and the Hunter Innovation Project in Newcastle. Similarly, both the City of Melbourne and Sunshine Coast are working closely with federal and state agencies on key projects. More recently, the federal government through the Smart Cities Plan and National Innovation and Science Agenda are providing programs that incentivise collaboration across jurisdictions, and between industry, cities and universities. The City of Boston has also leveraged federally supported programs such as the Smart Communities program, Metrolab network, a mutually beneficial partnership, where the university becomes the city's research and development department and the city is the 'test bed', and innovative programs offered by non-government organisation such as the Make Cities Work program by Bloomberg Philanthropies. In addition to program incentives, governments have a key role to play in fostering 'test beds' for smart approaches outside of the regulatory regime.

Recommendations

- Local government should collaborate with neighbouring councils on smart city solutions, especially where councils can benefit from economies of scale with industry partners, this in particular is relevant for rural and regional local government areas.

- Local government leaders at all levels need to actively engage in learning and understanding the digital transformation that is occurring within industry and communities to be better equipped to respond to forthcoming changes.

- Cities and universities should work together to develop and apply new approaches to urban problems in real time.

- State and federal government should implement programs to accelerate the capacity building and knowledge sharing between jurisdictions.

- Local and state government develop programs to support the scaling of smart city approaches to other jurisdictions by identifying centres of excellence.

Smart cities use a mix of approaches to technology infrastructure

Cities implement a mix of digital infrastructure to support the strategic vision of the city and meet the needs of industry and citizens.

Newcastle, for example, recognises the value of high-speed broadband connection to industry and tertiary institutions and by extension to its broader revitalisation strategies and future transport applications, such as autonomous vehicles. Adelaide and the Sunshine Coast are facing similar issues as they compete to attract industries that rely upon reliable high-speed communications infrastructure.

From a policy perspective each city is attempting to meet the need for high-speed broadband by deploying a mix of infrastructure solutions including the national broadband network (nbn™ network), free Wi-Fi and in some cases working with partners to establish their own high-speed broadband network and have a carrier license like the Sunshine Coast. The City of Boston also considers the policy interventions to increase affordability, performance and access across the city when new property developments occur. Each city was taking stock of its ability to deliver a high-speed broadband network in areas which are central to the innovation economy and revitalisation strategies of the city.

Additionally, low power, wide area networks (LP-WAN) to support the growing connection between sensors in urban areas are being explored by all cities examined. The low power, wide area networks support the transfer of small data parcels at low frequency across the sensor network and can be used to transmit environmental data such as noise, pollution, pollen and other data that the citizens and city can use to improve the performance of the city. This is particularly attractive to rural and regional councils who do not have access to ubiquitous broadband networks.

Digital equity and inclusion for citizens is also important. Despite the potential benefits, technology discriminates, with varying degrees of access and competency across citizen groups. Some cities are proactively addressing this issue through policy and infrastructure. The Victorian state government's free Wi Fi service in Melbourne, for example, enables homeless people to access a range of services online via Ask Izzy. This reflects actions in cities internationally, such as Boston, where the city's broadband policy supports infrastructure in underserved neighbourhoods and also has implemented trial charging points for smart phones so that those with less reliable access to charging units, such as the homeless, can access key services via their connected devices. Other cities such as Adelaide are providing education about various technologies through spaces such as public libraries.

The connectivity requirements of each city is dependent on the services they provide and the demands on the network for each city to realise its economic, innovation, social and entrepreneurial potential and, consequently, each city is tailoring its digital infrastructure to meet its needs and future vision.

Recommendations

- Local government should develop an information and communication infrastructure plan that underpins the strategic goals for the city and develop partnerships with industry and government to realise the plan.
- Local governments can develop policy and regulatory levers to enable industry to improve access to broadband for business and residents, including ways to increase broadband competition in developments; incentives for broadband access into underserved and targeted neighborhoods or districts.
- Cities should know their assets and digitise them. Most cities have identified vast amounts of conduits that support telecommunications infrastructure, which can be leveraged to support the city's performance.

Smart cities encourage open data and open sourcing

Consistent with smart cities being citizen-centric, the cities examined encouraged an operating environment where all data generated within the city, from pedestrian movements to urban tree canopy, is open to the public, providing citizens with greater agency to know and live in their city. Similarly, to encourage the sharing of systems and applications, open sourced sourced rather than proprietary solutions, were preferred. This shift in philosophy to one of transparency demonstrates the growing sophistication of cities in using information and technology to understand and make cities work better.

The cities examined are at different stages in opening government data to the public and between governments, however all cities are unanimous in the need to do this to make cities work better. Melbourne sees opening its data as a way to foster transparency and accountability, increase government efficiency and encourage innovation and entrepreneurial activity. City data is collected, stored and provided in machine readable formats enabling it to be used with open licensing. The city recognises that there are privacy issues surrounding open data, and have therefore enacted a series of safeguards to protect privacy.

Similarly, the City of Adelaide is working on providing a greater range of data sets to the public which is in line with its strategy to use technology to deliver increased transparency of council operations. More than 60 data sets are available through the council's data portal ranging from water quality to the council works program. However, the council has put a hold on further data releases so they can improve the accessibility and usability via an integrated data platform and release data in a targeted way so that the most relevant and useful data is being shared.

Cities such as Boston and Amsterdam go further and are encouraging citizens and industry to share and exchange data for the public good. There is much more work to do to unlock the value of the data that goverments hold in Australia. Determining the data sets to be collected in a usable form, analysed and applied to a specific urban problem is the first step for many local governments.

Open vendor and interoperable systems that work together are preferred in all the cities examined. Councils want to remain able to choose multiple vendors on the basis of best fit with the region's values and vision.

Each city recognised its unique context and challenges and did not believe in a 'one size fits all' solution. Preference was for solutions tailored to their specific context and are open to multiple vendors, both increasing competition and choice to ensure the best solution for the city. Furthermore, when it comes to scaling solutions across jurisdictions, the adoption of open data standards and open source systems was seen to assist this transition.

Recommendations

- Local and state government agencies must adopt and implement open data policies to improve government transparency, accountability and leverage the potential of the data.
- Open data policies should be implemented in ways that protect privacy and give the community confidence that it is sufficiently de-identified.
- Open data, all and any data, should be hosted on one platform such as a website with an interface that allows citizens to interact.
- Governments should review and update procurement policies to ensure open source and open vendor solutions are preferred.
- Local governments should continue to collaborate and share learnings to maintain capability in vendor selection.
- For smart solutions to be replicated to other areas of the city, or to different jurisdictions, standards for interoperability of systems and data are essential.

Smart cities have places to connect with citizens

Dedicated, accessible places in the cities examined, which some described as living labs, were central to connecting people, the private sector and government to co-design urban solutions, trial technology and share information about smart solutions with the community. They vary in size and range from a single space where people discuss and exchange ideas or view the city's smart initiatives in action, or they can be entire cities or sections of the city where pilot projects and technologies are trialed in context. Living labs therefore perform multiple roles: facilitating partnerships, trialing technologies, and communicating smart initiatives.[7]

In Amsterdam, for example, the entire city is considered a living lab – a place to trial technologies in context. Australian cities have also adopted this approach. The Sunshine Coast's 'Living Lab' is a designated section of the local government area (LGA) used to trial smart technology in real life context. The heartbeat of their living lab is the 'Smart Centre', a space where council demonstrates the trialed technologies to their public. Adelaide has their own version of the living lab with their Smart City Studio – a co-delivered strategy by the City of Adelaide and the SA Government. Similar to the Sunshine Coast's Smart Centre, Adelaide's Smart City Studio is used to communicate the city's smart city initiatives to the broader public, and is also seen as a space to encourage entrepreneurial activity, exchange and trial ideas, network and facilitate partnerships between industry, the public and government.

Recommendations

- Cities should embrace the concept of living labs to co-create solutions to urban problems in a local context.
- Cities should make living labs accessible to all of the users of the city – citizens, community groups, private sector and government.

CASE STUDY LOCATIONS

Four cities of varying sizes and geography that are embracing digital smart city strategies were selected for this study. Each city demonstrates leadership in developing a smart city strategy and, moreover, grapples with existing urban environments where smart city solutions need to be retrofitted into existing infrastructure.

These cities also share a focus on citizen engagement. They range from:

- City of Adelaide, a capital city which is growing an innovation economy by retaining and attracting people and industry;
- City of Newcastle, which is transforming from an industrial base to a professional services hub;
- Sunshine Coast, a regional community that is becoming a springboard for new advanced technologies;
- City of Melbourne, a capital city that is future proofing the urban environment for its burgeoning population growth and knowledge economy.

A global, rapidly changing environment requires cities to adopt smart city approaches to enhance their organisational capacity; therefore, the study examined the leadership and organisational attributes of the local government. Information about each city was gained from publicly available data and from July to October, 2016, thirteen interviews were conducted on site with city representatives, including elected councillors and mayors, chief information or technology officers, directors of planning and/or environment, and smart city officers or equivalent.

Whilst the study is limited to larger cities, many of the lessons are transferable to cities and communities of all sizes. Nevertheless, stage 2 of the report will provide a snapshot on more regional and rural communities and their unique drivers and challenges faced. To provide a global context, the approaches adopted by the case study cities in Australia were contrasted with our learnings gathered over the last two City Exchanges to the United States led by the Future Cities Collaborative, including interviews with leaders from New York City, the City of Boston, the City of Chicago, San Francisco and our European partner the City of Amsterdam.

There is no standard 'playbook' for developing a smart city. Each city has developed their strategy depending on its unique current and future demographic and industry composition as we learned when visiting:

Boston

A digital pioneer.

Amsterdam

The open city.

Sunshine Coast

Sunshine Coast is a regional community which is becoming a springboard for new advanced technologies.

Newcastle

City of Newcastle, an innovative city as it transforms from an industrial base to a professional services hub.

Adelaide

City of Adelaide is growing an innovation economy by retaining and attracting people and industry.

Melbourne

City of Melbourne, the most livable city, which is future proofing for its burgeoning population growth and knowledge economy.

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CASE STUDY

City of Adelaide

Citizen-centred smart city

The City of Adelaide is the state capital of South Australia and, as part of the Greater Adelaide region, is located between coastal and wine regions, contributing to its ranking as one of the top 5 most liveable cities.[8] By placing people and business at the centre of the city strategy it aims to foster an innovation driven economy.

The city, generating one fifth of South Australia's economic activity, is set to play a significant role in driving the economic growth which will flow on to the remainder of the state, where the unemployment rate is high and economic growth is subdued as it shifts from manufacturing and mining to new knowledge-based industries.[9]

Against this backdrop, the city as a 'smart city' will put people and businesses at the centre of everything the city does, creating "open and citizen-driven innovation".

City profile

The city has experienced significant growth since 2001 which is primarily driven by the City of Adelaide's strong emphasis on growing the resident, worker, visitor and student populations within the city who are attracted to the city lifestyle, high amenity, tertiary education and employment.[10,11]

In addition to its resident population, in 2011 the city attracted a further 111,216 employees and the city is planning for a 50,000 increase in worker numbers within the city to reach 170,000 by 2040.[12] Driving this growth has been a recent increase in employment in the media and telecommunications industry and the professional, scientific and technical services industry that is considered indicative of a move towards a knowledge-based economy.[13]

Creating a vibrant and digitally enabled city centre is a key city strategy to attract and retain residents, industry and workers. The city's 2016-2020 strategic plan prioritises people and businesses and aims to create an open and citizen-driven innovation ecosystem.[14] The city strategy reflects that a diverse resident population is a key driver of city retail markets, job creation and economic growth, and innovation and entrepreneurialism.[15]

The city's smart approach envisions "a smart city with a globally connected and opportunity rich economy".[16] Being 'smart' is key to the city's role in addressing the employment and economic challenges that are also affecting the state more broadly, and central to the economic transition from mining and manufacturing to a knowledge economy.

Smart city drivers

The city's smart approach is citizen-led rather than technology-led. This means that while technology is central to the delivery of programs it is not the primary driver – instead, the catalyst is improving the citizen experience of the city, identifying current pain points, and then using information and technology to deliver an improved experience.

Illustrated by 'Claire's Story', a storyboard that visualises smart possibilities and opportunities through the eyes of a former resident returning to establish a business in the CBD, the council has envisioned a future Adelaide where city functions and experiences are seamlessly integrated through digital technology and smart devices. Whilst, the technological possibilities of 'Claire's story' are not yet fully realised by the city, the storyboard provides a roadmap of the essential groundwork that is needed to realise the vision of a digitally-enabled city. To achieve this, the city is leveraging and value adding to existing infrastructure, trialing new technological solutions and platforms, partnering with both public and private industry and developing and supporting entrepreneurial activity within the city.

As described by Peter Auhl, the city's Associate Director, Information Management, who is accountable for the smart city strategy, four themes emerged as critical to the realisation of the city's vision as an open innovation city; smart, green, liveable and creative. "So instead of just focusing on smart cities per se, we could really talk about smart greening, or smart liveability, or smart creative environments. So it's about technology enabling the city's strategic big issues".

The capabilities of both technology and people are harnessed in the City of Adelaide's vision of a smart city, with the driving force being the improved experience for the customer or city resident, promoting economic growth, and sustainability with the plan integral to achieving the city's carbon neutral goals.

Adopting a smart city approach is also seen as a critical driver of economic development helping Adelaide to transition from an industrial to a digital economy. This includes attracting and retaining new businesses and talent through developing a city that accommodates entrepreneurial activity and which provides digital infrastructure to support this. The government of South Australia has been awarded contracts to build vehicles and vessels for the Australian Defence Force, and the City of Adelaide sees this as an opportunity to leverage further economic growth by having a vibrant, walkable city built on smart foundations that will attract and retain new residents and industries to the city.

The City of Adelaide's carbon neutrality and larger sustainability ambitions are also driving the city's smart approach. The city can map and monitor a range of environmental data collected by sensors throughout the city. City pulse, the data visualization platform, enables the city to visualise the data being collected by these sensors to make planning decisions

" … we believe smart cities start with a smart organisation and they're intrinsically linked, which is where we put the customer at the centre."

Peter Auhl, City of Adelaide

Claire's story

Claire's story is a narrative illustration used to communicate the City of Adelaide's smart city vision.

'Claire' is a hypothetical Adelaide resident, returning to the city after living overseas and planning to open a new business with her husband – a sandwich bar. In this story, the city has made its data accessible so Claire is already able to start making decisions on the feasibility of her business in Adelaide before she has moved back to the city. This means being able to select vacant properties that align with her business requirements – whether there is free Wi-Fi, licensing requirements are met, sensor data is able to provide her with foot traffic data so she can choose locations which have good exposure. Once in Adelaide, she can manage her appointments with council through her MySE portal, which provides her with additional ways to engage with the city. Meeting with council staff in person, Claire's business vision is further developed by a 3D simulation tool, bringing her business idea to life. While Claire is meeting with council staff, she receives a text that her parking is due and she is able to top it up via her phone and avoid a fine. Later, Claire and her husband can make decisions on whether to return home or linger in the city a little longer based on notifications that alert them to expected commute times based on the influence of big events in and around the city. Vouchers for local businesses tailored to their tastes and preferences obtained from their own data footprint are also provided to Claire on her smartphone. The data from Claire's and others' use of the city can be analysed by council staff to gain a better understanding of how the city is used and how they can best manage the city. Claire's Story is all about how the technology can mediate a positive experience of the city and generate data that is useful for city management.

that align with their sustainability goals. For example, by understanding the link between urban forests, the reduction of urban temperatures and carbon emissions, the city can use its data to develop a greening strategy which cools the city and contributes to its carbon neutrality plan. As Daniel Bennett, Associate Director, Design and Strategy, describes, the data collected provides the foundation for a smart urban forest strategy which will help shape greener streets which alleviate heat islands and reduce carbon pollution.

"…we've taken data from traffic patterns and it shows congestion elements and where we're actually emitting most of the carbon, so that we can start to think strategically about how we plant trees. So, do we plant them more closely to places where there's more congestion? Then we can start to look at talking about measurement. Let's go back over the years and see year on year, is it working?"
Peter Auhl, City of Adelaide

Strategic focus

The information management team at the City of Adelaide has described its vision as two intersecting circles – one for a smart city and one for a smart organisation – with customers located at the intersection of these two circles. Importantly, the creation of a digital platform is envisioned to bring the elements together and to support the transformation within the organisation of how to think differently about supporting the city's economy and how best to deliver services. A digitally enabled 'smart' approach is embedded across city strategy and positioned as a way for the council to meet its four key objectives – smart, green, creative and liveable – outlined in its strategic plan:

"… we believe smart cities start with a smart organisation and they're intrinsically linked, which is where we put the customer at the centre. One of the key outcomes of the council's strategic plan is smart. So it's really important to make sure that as an organisation we recognise that."
Peter Auhl, City of Adelaide

Central to this vision is the idea that information and data are a key asset of the city driving changes across city operations and service delivery creating an attractive and efficient place to live, work and invest. This is illustrated in the vision of Claire's story but also intersects current initiatives and practices. City pulse is able to visualise different data sets and translate them into useable information. For example, the city is able to visualise the use of their Wi-Fi network, enabling them to identify the most heavily-used access points, variations in use and broader usage patterns. With over 6.2 million connections in 2016,[17] they can use this information to plan not only for network infrastructure and capacity but also pedestrian congestion during peak times or potential foot traffic for new or existing businesses in the area. Similarly, city pulse enables the city to extract data on economic performance which they can use to plan their own growth strategies but also share with businesses and investors.

In this way, combining smart cities with smart organisations can help improve the city for the citizen who remains central to the city's goals. As Bennett states, the information gathered about the citizen experience in the city," gives [the design team] the data which drives design decisions".
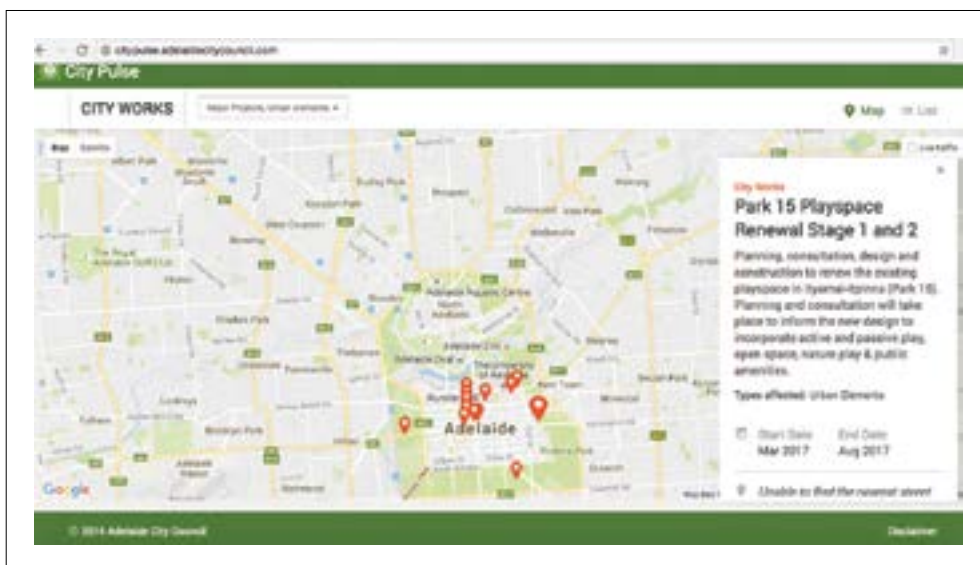
Extract from City Pulse,
City of Adelaide

Leadership and organisational capability

The City of Adelaide is led by a dedicated and savvy team of future-focused elected leaders who have unanimously supported the digital enablement of the city as a foundation for attracting and retaining industry and talented people.

'Smart' is embedded within the city's strategic plan and central to its implementation is a governance framework comprised of representatives across the organisation who meet monthly to optimise cohesiveness in smart approaches across the council. The group is "proactive rather than regulatory" and focused on how to make better investment decisions about technology, information and how to take the organisation forward. The core group is considered a point of difference that has allowed the city to move relatively quickly on its smart initiatives. Claire's story is used as the "artifact", as described by Peter Auhl, which has united the organisation's thinking about what's possible, and provided an illustration of what their role may be in delivering it. This approach has been central to accumulating support for smart initiatives as it brings the city data to life.

However, obstacles to delivering the smart city remain. A key challenge is extending the understanding and value of smart approaches throughout the large organisation and the projects are reliant on smart 'champions' and strong leadership – the core governance group is integral here as is emphasising that this is not so much an extensive change in practice but leveraging existing data and presenting it in ways that makes managing the city more efficient and facilitates improved customer experience.

Key to this is reminding people that although the process is being framed as a smart approach, it is not technology-led but is people-led. As Peter Auhl explains: "we try to capture the best possible way of articulating the outcome through customer journeys and through experiential-type activities to say, 'this is what it would feel like for a citizen', so the approach is more emotive than it is technical. It's more, 'do you want a city that feels like this?' If you're serious about growth you need to create a vibrant city."

It is acknowledged by the city that the change process and business process re-engineering within the council is challenging. The information management team within the City of Adelaide supports the organisational change by facilitating citizen-centred design labs within the organisation, focused on specific service delivery issues using a design thinking process.

To support the change process, the 'insights team' takes a view of the city's business readiness for smart solutions by developing 'heat maps' of organisational skills and impact so that targeted upskilling and communication can occur.

The return on investment of each new initiative is measured and, importantly, must have a benefits realisation framework, customer experience map, data management framework and performance framework – each of which are independently reviewed prior to, during and post implementations.[18]

Collaboration and partnerships

A foundational element to the City of Adelaide's smart approach is an understanding that it can't do this on its own. The city sees its core role is delivering services to the community and within that context has responsibilities to not only resident citizens, but visitors, workers, key stakeholders and the state of South Australia, and will lead, provide service, regulate, advocate, facilitate and own assets to grow the city.[19] The city is developing strong partnerships with state and federal government, fostering collaboration between neighbouring local governments, industry, educational institutions and international organisations.

State and local government work together to prepare Adelaide for future growth. The City of Adelaide's Strategic Plan 2016-2020 aligns with the state government economic targets which aim to increase foreign investment, service exports and skilled migration.[20] Additionally, federal government initiatives and programs align with some of the programs enacted at the local level.

Beth Worrall and Paul Daly from the City of Adelaide meeting in the Smart City Studio

The state government's Smart City Studio illustrates the congruence between the Adelaide City Council's smart city strategy and the smart state strategy. The Smart City Studio embodies the linking of the two levels of government through their smart strategies. Beth Worrall, Manager of the studio, describes the studio as ".. a physical space that embodies a commitment that both the state government and the Adelaide City Council have to create Adelaide as a smart city... Adelaide City Council are providing the physical space and providing the cost for the fitout of this environment, and the state government provided the person to manage that."[21]

The studio also receives support from Cisco as part of Adelaide's Lighthouse City status, which itself was partially influenced by the high degree of communication and alignment between state and local government. Alliances such as this work to promote the city as an attractive destination for international businesses and investment attraction.

The Smart City Studio is also strategically positioned to raise public awareness of the city's smart city strategies. The space itself reflects how the different levels of government are aiming to harness the potential of smart cities to drive growth yet recognises that they need a conduit between layers of government and individuals to identify the shared pathways and agendas necessary for collaboration. The Smart City Roadmap is one such example.

Peter Auhl explains the storyboard underpinning the digital city experience for new resident, Claire.

The roadmap identifies the existing entrepreneurial and smart city activities already happening in Adelaide, which helps to identify areas where the city can develop greater expertise and become a leading city in those areas. Already this level of communication and alignment has led to the city identifying greater connectivity as an area in which they can excel, such as medical science and research.

Digital infrastructure

The City of Adelaide recognises the need to continue liaising with industry partners to improve connectivity within the city with a specific focus on improving business-to-business connectivity and business-to-cloud service connectivity. This includes working with nbn™ co to facilitate the roll out of the national broadband network (nbn™ network) and further expansion of the Adelaide free Wi-Fi network; and working with key partners to implement its 10 Gig City vision which will facilitate a broadband network across the city and North Adelaide capable of 10 gigabits per second. Improved connectivity is enabled through leveraging existing infrastructure such as the council's own fibre network - and partnering with private industry to deliver the project. As described by Peter Auhl, "Imagine the possibilities of an entire city's business community connected to each other and then interconnected to the world through cloud exchanges without the congestion of Internet traffic."

In addition, the state government and local government have developed plans that will increase internet connectivity, central to the renewed growth of the economy within the Adelaide region. The South Australian state government's 'Gig City' initiative, based on the US city Chattanooga - the world's first 'Gig City', is a $4.7 million program that will deliver gigabit broadband to innovation sites across Adelaide including the Tonsley Innovation District, Technology Park, Techport Maritime Precinct, St Paul's Creative Centre, the Thebarton Bioscience Precinct, the Majoran Co-working Space, Hub Adelaide and the Stretton Centre (Adelaide Gig City). This will increase the connectivity of the region and attract industries that are hungry for ultra high data speeds. On the back of this development, recently a global data centre firm has decided to locate in the city.

The Smart City Studio is also working with people with innovative ideas to help them access Adelaide City Council infrastructure or to streamline access into the state government to prove their concepts, support the delivery of their projects, essentially encouraging the citizen-led and grassroots projects that are characteristic of entrepreneurial smart urbanism. Creating a climate that can encourage entrepreneurial business and start-up activity is acknowledged in the city's strategic plan and seen as central to driving growth.

When it comes to selecting service providers, choosing the best solution for the city that supports the vision of an open innovation environment is most paramount.

Rather than vendors bringing a developed service package to the city, a shift has occurred where cities now consider their problems and the ways in which they would like to address them, with the city seeking more customised solutions that they can integrate in the digital platform of the city. As Auhl describes, "we'll be searching for capabilities. We won't be searching for a single solution. We'll integrate, and we'll bring data and information together in one platform that is highly useable".

Cities want solutions that recognise their unique positions. Relying on one system that could supposedly address all problems was unrealistic.

City management is increasingly asking for solutions to urban issues within the context of their own city. No one package can address their needs and vendors need to be able to offer a range of capabilities which can be integrated into existing and future city systems.

Summary

The City of Adelaide has embarked on a bold journey to transform the city to a tech-savvy, tech-enabled smart city which is a thriving and accessible place to attract and retain people and industry.

Smart city initiatives

Outlined below are four key initiatives of the City of Adelaide that provide part of the foundation work for it to be a smart organisation and smart city which drives growth.

Initiatives	
Develop "game changing" Infrastructure to attract and retain knowledge based industry.	Digital infrastructure will significantly influence the City of Adelaide's goals to deliver an open, transparent and efficient government, connect and empower communities and drive growth as part of its positioning as a smart city.
	Central to the city's smart initiatives is the provision of high speed broadband accommodated by the implementation of the nbn™ network and expansion of the Adelaide free Wi-Fi network, the state government's Gig City Initiative, and the city's own digital strategy and 10 Gig City innovation.
	This is supplemented by 305 free Wi-Fi access points throughout the city. The city is also supporting low power, wide area networks (LP WAN) to expand the capacity for the connection of sensors within the city.
Make urban data useable for city planning and innovation - Data Information Platform and Open Data.	The city has over 60 datasets available on its council portal and an open data policy.
	The city is now focused on ensuring these and future datasets are delivered in an accessible and integrated data platform which will become the information engine room for the city and the delivery of its services. Secondly, the data sets to be released will be informed by the priority 'pain points' that the city and citizens would like to solve.
Attract businesses, visitors and citzens to the CBD through smart parking solutions.	The number one issue for people interacting with the city was parking.
	The city's smart parking strategy is an example of the application of technology to improve the experience of the city. As part of the city's attempts to make travel to and from the CBD a seamless experience, they are trialing and implementing ways to make parking 'smart'. City drivers will be able to locate car spaces more easily, pay and top-up parking via a mobile application. Smart parking keeps the customer experience at the centre but also provides data that council can use to monitor parking, usage and improve management of street parking. In this way smart city technology assists people and council – to manage the city in a way that values the people who use the city, and to facilitate a seamless citizen-city interaction.
Enhance citizens' engagement with the city through City Pulse.	The City Pulse is a publicly accessible portal and mobile application of all council activities within the city, where 'real time' data is drawn from the city's project management and system graphically represented. The work program categories include major projects, lighting and electrical, environmental, street works and so on. This tool not only informs the public but is also illuminating the work that the council is doing within the organisation.
Smart LED Lighting	'Follow-me', light harvesting and sensor lighting for pedestrian walkways which saves up to 10 per cent in energy use, are being trialed. Up to 64 lights have been installed along Pirie Street and Hindmarsh Square. The objective of the trial is to optimise the amount of light required to create a safe environment for citizens.[22]

2
CASE STUDY

City of Newcastle

Smart and innovative Newy

Newcastle, Australia's seventh largest city, is 180 kilometers north of Sydney and is in the heart of the Hunter Region. Once a thriving steel and coal port, it is transforming into a vibrant and creative post-industrial city.

The City of Newcastle is currently the focus of a state government revitalisation agenda and is experiencing major urban renewal, including light rail, growth in city residential population, and the development of a University City campus. Within this framework of revitalisation, renewal, and renewed investment, the smart city initiative has come into focus as a key contributor to the future vision of Newcastle.

City profile

The Newcastle local government area (LGA) has a population of 160,021. The median age of 36.9 years is slightly lower than the national average of 37.3.[23]

Newcastle's economy has traditionally been industrial-based, however, downturns in these areas has forced the city to diversify its economy, an issue being addressed in its smart city strategy. In 2011, the top employers by industry were retail trade, education and training and manufacturing.[24] Recognising the need to diversify its economy, the city's smart city strategy is aimed at promoting technology, advanced manufacturing, digital economy and creative industry as areas for development.

Smart city drivers

Smart cities come in many shapes and sizes and there is not one single definition of what a smart city involves. Newcastle's definition focuses on three interconnected elements. A smart city is one that puts the community at the centre. It also enjoys smart and digitally-connected public and urban infrastructure, and works to develop a thriving ecosystem to drive innovation and creativity. The intersection of these three elements point the way forward for Newcastle as a smart city.

" **The council took a very conscious decision that we wanted [smart city approaches] to be all encompassing... whether it was our own infrastructure, whether it was conversations with start-ups, whether it was about the way that we engaged with broader community or through our economic development. It was going to be about being a smarter city** "

Lord Mayor, Clr Nuatali Nelmes

As described by the Lord Mayor, Clr Nuatali Nelmes,[25] developing Newcastle as a smart and innovative city is one of seven core strategic directions within Newcastle 2030, the city's overarching strategic plan, with the following objectives:

- A vibrant, diverse and resilient green economy built on educational excellence and research;
- A culture that supports and encourages innovation and creativity at all levels;
- A thriving city that attracts people to live, work, invest and visit.

The vision for Newcastle as a smart and innovative city requires all three levels of government, the community, educational and research providers and business and industry sectors to work together to achieve it. The overarching aim relates to improving the amenity of its urban core, sustainability and economic diversity of the city.

Newcastle City Council established the Newcastle Smart City Initiative in 2015. The Smart City Initiative is the realisation of Newcastle's smart city agenda and aims to harness the potentials of technology, innovation, collaboration and creativity to support the revitalisation of the city.

Realising that a transition to a revitalised city is not something they could do alone – the city undertook an extensive community consultation process in 2010 that highlighted the opportunities for the city and the needs of the community. This process unearthed seven core themes, one of which was the community's ambition to create Newcastle as a smart and innovative city. The Newcastle 2030 Strategic Plan was first adopted in 2011/2012 and then updated in 2013/2014. The process targeted demographic groups and used various forms of engagement including breakfast and nighttime meetings, roundtables, World Café workshops and submissions, reaching thousands of people.[26] The significance of this consultation is that the smart city agenda, now being fully realised through the Newcastle Smart City initiative and forthcoming Smart City Strategy, has longstanding community support and is established on deep and ongoing engagement.

"The council took a very conscious decision that we wanted [smart city approaches] to be all encompassing... whether it was our own infrastructure, whether it was conversations with start-ups, whether it was about the way that we engaged with broader community or through our economic development. It was going to be about being a smarter city." Lord Mayor, Clr Nuatali Nelmes.

Newcastle has a growing creative and entrepreneurial economy – it has the highest number of artists per capita in Australia – and the potential for a digital economy was identified in the community consultation, as was the broader social, economic and cultural benefits of a smart city approach. Newcastle's economy has traditionally been associated with mining and industry. However, the decline of this industry meant the city and broader community has been looking for new economic foundations and the shift to a knowledge-based economy inherently tied to the smart and innovative city approach is increasingly seen as a path to revitalisation:

"…our smart city strategy is entwined with our revitalisation strategy and that's about jobs creation, talent attraction, talent retention, those economic development actions." Dr Nathaniel Bavinton, Smart City Co-ordinator

An additional economic driver was the opportunity for increased efficiency of resources that could be achieved using smart city applications and analytics, meaning that the city could manage its resources more effectively.

Strategic focus

The Smart and Innovative City Strategy grew out of the need for regional economic renewal and revitalisation, as well as a broader community expectation of a smart and innovative place to live and work. Within this context Newcastle began to develop its strategic focus from being a 'safe city' to being a 'smart city' with the city's comprehensive smart city strategy originating in a 'smart surveillance' and a nighttime economy project which was underpinned by technology. The Headphones Project on Darby St used sensor technology to create public space activation around music representing the congruence of the smart and creative capacities of Newcastle.

Newcastle's approach transitioned from a focus on using technology to create a safe city to one that saw the value of technology in a holistic context of a smart city. An initial pilot study had focused on creating a safe city. The police had discussed the opportunities of CCTV with the council but rather than a traditional surveillance approach, the council recognised the opportunity to trial smart surveillance options. This resulted in the Smart Crime Prevention Platform and included the application of 'new frontier technologies', such as various sensors and analytics, which could provide a smarter approach to community safety. From there, realising the broader potential of smart applications, the scope

for technology was widened, including its application in developing the creative and nighttime economy of the city. The Smart Crime Prevention Platform is currently being re-scoped for deployment in 2016-17-18, in a partnership with NSW Police Newcastle Command.

The Darby Street Project was driven by the need to develop a safe and vibrant nighttime economy. In association with technology company VIMOC, local business improvement organisation Newcastle Now developed an Internet of Things-inspired project which encouraged a dynamic interaction between people and the built environment within the precinct through the use of sensors aimed at improving the understanding of the urban environment. The project placed in the top six of 812 entries globally of a global innovation challenge organised by Cisco, with the finals held at the Internet of Things World Forum 2014, in Chicago. The Darby Street pilot's success created the opportunity for the city to be showcased in Silicon Valley and Chicago. This success story helped to reinforce the opportunity of the smart city program to the city's elected leaders.

Combined with an increasing awareness of the opportunities the smart approach could offer, these projects help to increase momentum in integrating smart approaches across the council more broadly. Grouping existing practices that could be considered 'smart' into the development of a smart and innovative city strategy additionally enhanced the broader integration of smart technology into the city, which also correlated with strategies outlined in the council's Community Strategic Plan Newcastle 2030. For example, the renewable energy program and the digitisation of the city library were examples of 'smart' approaches that already existed in the council, as was the anchoring of community development activities around digital inclusion.
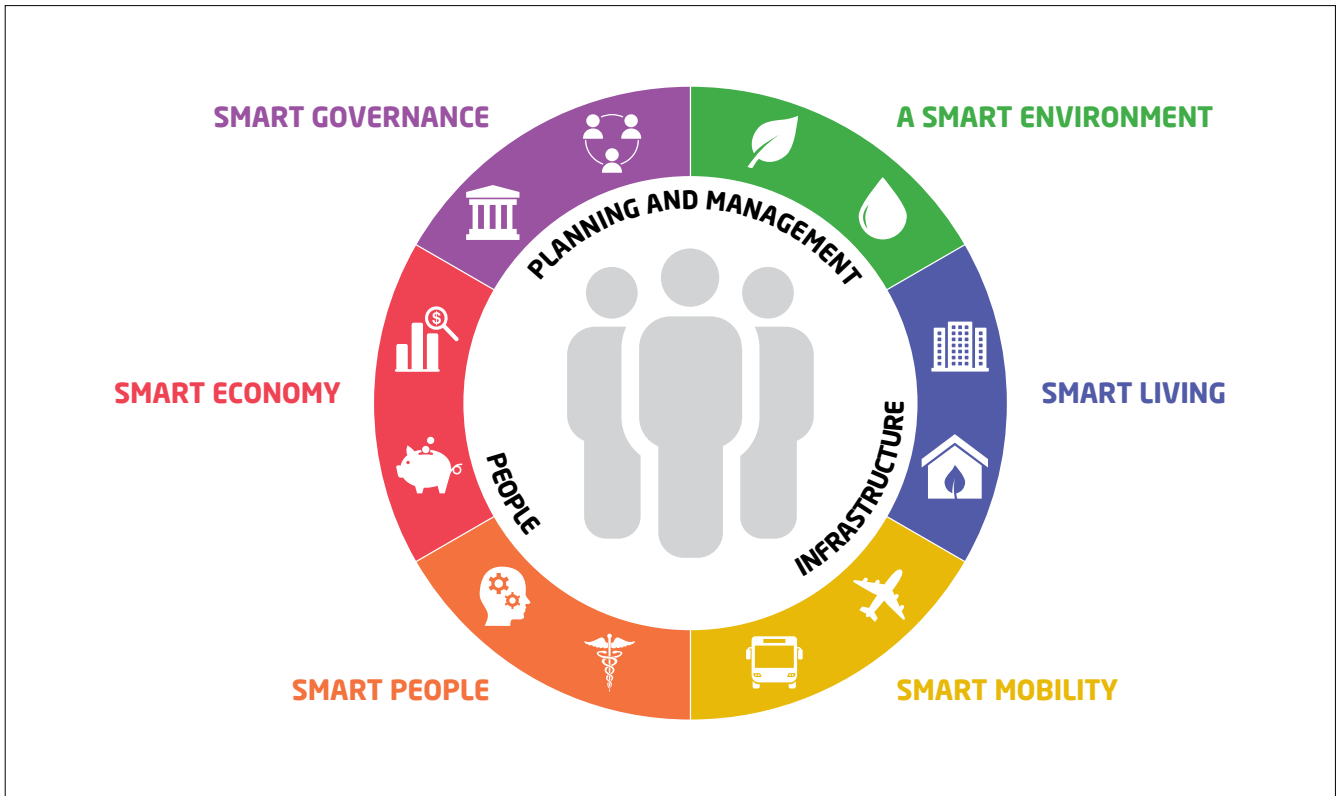
Fig 1: Smart City Themes

> **" The Hunter Innovation Project will provide smart city infrastructure like Wi-Fi, smart parking and lighting, and an innovation hub where sharp thinkers can put their minds together to make our city and region a better place to live, work, visit and invest."**

Lord Mayor, Clr Nuatali Nelmes.

Newcastle therefore had substantial 'smart' activity before the city decided to formalise a smart strategy. Accordingly, the city is currently formalising, rather than developing, their Smart City Strategy around several key themes as depicted in Fig 1: Smart City Themes.

Concurrent with formalising the smart city strategy, the city is focusing on bringing together the many key elements of its smart city plan that delivers smart infrastructure that will support the growing innovation ecosystem and regional incubators, supported by the living lab to develop prototypes and trial solutions and innovations.

Leadership and organisational capability

The city demonstrates commitment and strong support at the elected leader level and has established an organisation-wide internal advisory group tasked with developing ideas for how smart technology and digital applications might contribute to the local economy or meet citizen needs better. The group encompasses the majority of the business unit managers within Newcastle City Council and became the initial mechanism for understanding the opportunity and capability of the city to take a smart approach. A key aim of the advisory

group is to embed 'smart' thinking into all the council business and consider how technology and data can improve service delivery. Ideas for pilot or demonstration projects are required to be match funded by the business unit in question with 50 per cent met by the smart city budget. These ideas progress from concept to implementation via normal established council approval processes. In addition to the core advisory group, there are ad hoc project groups that include key roles such as the digital projects officer and those working with GIS data, and the digital libraries staff, and more recently there has been a Mayoral Minute[27] to establish a sub-committee of the council to oversee the smart and innovative city agenda.

The council established one position dedicated to the Smart and Innovative City Strategy situated within the Planning and Regulatory division and forms a key part of the major projects teams focused on the revitalisation, economic development, placemaking and renewal strategies of the city centre. There are five key components to the smart city co-ordinator's role: implementing a collaborative strategy; taking a city scale approach to the implementation and integration of technology; enabling economic development through the smart city strategy; stakeholder management, including building networks and increasing buy-in into projects developed by the core advisory group; and organisation and delivery of projects and demonstrating their value.

Reflecting one of the key areas of the smart city co-ordinator's role – collaborative strategy – the council has established strong partnerships with the key regional actors, including the University of Newcastle, state government agencies, and industry and community groups that collectively develop and drive the smart city strategy. The benefits of collaboration extend to funding opportunities with the council recognising the importance of leveraging stakeholders when applying for grants. One such example is the Hunter Infrastructure Investment Fund. Acknowledging that there were multiple stakeholders interested in innovation hubs it was thought that the region could increase its chances of a successful grant application by working together rather than submitting multiple individual proposals. A core partnership was formed comprised of the city, the University of Newcastle, Newcastle Now representing the business community, and Hunter DiGiT representing the community, as well as a series of stakeholders orbiting around the core group representing industry, such as Ai Group, HunterNet, TAFE, CSIRO and Hunter New England Local Health District.

The strong emphasis on collaboration as a way to achieve a smart and innovative Newcastle region is therefore illustrated by the Hunter Innovation Project. With its origins as a grant application it has evolved to encompass the mechanisms for all of the strategic actions. Dr Bavinton explains:

"It started from infrastructure, and now that's just one component. Now it's doing stuff around incubation, data, living lab strategy, anything that involves a lot of organisations needing to come together – it's the vehicle for that." [28]

Within such a collaborative context however, the council recognises the need for strong stakeholder engagement and management to continue project momentum. Newcastle City Council therefore recognises the importance of demonstrating strong leadership and commitment to smart strategy both within the council and within the broader stakeholder collaborations:

"We're the leaders of it. It's the university and us, and that marriage is at the heart of it… The dynamic city-university relationship is played out in cities across the world. That's the core of the value proposition" -Dr Nathaniel Bavinton.

Collaboration and partnerships

Newcastle City Council has an on-going collaboration with Cisco Systems which is currently being formalised as a strategic partnership. Through their relationship, Cisco has helped the city to understand the opportunities of smart city applications relevant to their context, as well as the "enormous ecosystem of partner organisations. IBM, for example, is now a collaborator in one of the city's living lab proposals",[29] explained Bavinton.

" We're the leaders of it. It's the university and us, and that marriage is at the heart of it… The dynamic city-university relationship is played out in cities across the world. That's the core of the value proposition"

Dr Nathaniel Bavinton, Smart City Co-ordinator

Initiatives	
Hunter Innovation Project	A collaboration of government and industry and core component of the city's Smart City Strategy. The project will provide smart city infrastructure, e.g. free Wi-Fi, smart parking and smart lighting, and a flagship innovation hub, to encourage innovation, investment and growth.
I2N Innovation Network	The University of Newcastle has secured $1m from NSW Government to create a network of innovation co-work spaces across the wider Hunter Region with remit to drive innovation in locally significant and competitive sectors
Eighteen04 New Facility	Eighteen04 is a cleantech and smart city incubator. Only a year old, it recently received $300,000 in NSW Government funding to create a new facility in Newcastle's emerging Digital Precinct. The expanded space will enable increased opportunity for nurturing start-ups and innovation.
Kaooma Project	The Kaooma project applied an 'Internet of Things' approach to create a dynamic interaction between people and the built environment. The use of sensors was aimed at improving the understanding of the urban environment.
Smart Crime Prevention Platform	The smart crime prevention platform will use multi sensor analytics including urban noise mapping, pedestrian movements (volume and location) and threshold measures to provide predictive capability to the city.
Indigenous Landscapes: Dual-Naming Interactive Heritage Interpretation	The NSW Geographical Names Board recently endorsed indigenous place names on eight key Newcastle sites. Council is taking an innovative approach through the use of embedded sensor technology and interactive digital and virtual reality content to interpret these sites in the indigenous landscape.
'AAA': All Abilities Access Pilot	Using beacon technology, the city is currently scoping applications utilising beacon and route mapping technology to support the city's disability and inclusive strategy, by helping people move around the city.

"The Hunter Innovation Project (HIP) will provide smart city infrastructure like Wi-Fi, smart parking and lighting, and an innovation hub where sharp thinkers can put their minds together to make our city and region a better place to live, work, visit and invest."

Lord Mayor, Clr Nuatali Nelmes

Digital infrastructure

Implementing smart city systems will include leveraging the existing communication infrastructure and creating new networks for citywide digital connectivity. Free Wi-Fi is already available in the central business district (CBD) and the nbn™ network will also be rolled out throughout the city. The council is considering a supplementary fibre-to-the-premise (FTTP) network to facilitate ultra-high-speed business-to-business transactions within a digital precinct in the CBD as part of the Hunter Innovation Project.

A new city-wide Wi-Fi network will be established through the Hunter Innovation Project, which will provide a free public Wi-Fi offering, but importantly provide the basis for a broad range of sensors which can collect a variety of environmental data from air pollution and noise to pedestrian movements which can be used by citizens via their personal devices or the city to develop planning responses to the problems identified. Low power, wide area networking (LP-WAN) has also been identified as necessary to supplement this communication due to its low cost and efficiency in the built environment.

Summary

The City of Newcastle is being revitalised through a smart city approach. The city aims to maximise the opportunities presented by the new technology, advanced manufacturing and digital economy sectors, to create an innovative, entrepreneurial and liveable city that attracts people and investment.

Smart city initiatives

Outlined to the left are some initiatives of the City of Newcastle that provide part of the foundation work for it to become a smart and innovative city.

The Hunter Innovation project

The NSW Government has committed $9.8 million through the Hunter Infrastructure and Investment Fund to support the Hunter Innovation Project (HIP) – a partnership between Newcastle City Council, the University of Newcastle, Newcastle Now and Hunter DiGiT.[30]

"The Hunter Innovation Project is a collaborative effort and a key component of the council's smart city strategy to provide physical spaces, digital connectivity and city data to increase opportunity for entrepreneurs and businesses to thrive in the digital century.

"It will provide smart city infrastructure like Wi-Fi, smart parking and lighting, and an innovation hub where sharp thinkers can put their minds together to make our city and region a better place to live, work, visit and invest." Lord Mayor, Clr Nuatali Nelmes.[31]

By providing smart city infrastructure, such as free Wi-Fi, smart parking and smart lighting, and an innovation hub underpinned by ultra-high-speed broadband, the project will facilitate the agglomeration of key industries, tertiary institutions and entrepreneurs to create a thriving place for innovation which leverages the region's established strengths in advanced manufacturing, health technology, renewable energy and education. For each direct job created by the HIP, five additional flow-on jobs are expected to be created throughout Newcastle and the region. Over 700 local jobs will be created as an indirect impact.

HIP is an example of how smart city services, technology and increased digital connectivity are being used to drive economic revitalisation and has all of the attributes to be a further test bed for disruptive technologies, including multi-modal ride sharing and transport options.

3
CASE STUDY

City of Melbourne
Future proofing Melbourne as the most livable city

The City of Melbourne has been ranked the number one most liveable city in the world for six years.[32] It has considered itself a smart city for some time, with its renewed strategy and focus being on creating a 'smarter' city to cater for its expanding young residential population, and diverse daytime population of workers, business owners, students and visitors.

Demographically, the Melbourne municipality is a young city with the median age currently around 28 years, a statistic that is expected to remain constant as the Greater Melbourne area grows to be the forecasted home of 8 million people in 2050.[33] The City of Melbourne currently has the largest student population in Australia with around 225,000 students in the city and it has been recognised as a key international student destination due to its social inclusion, diversity, employment prospects and the quality of its universities.[34] The potential that Melbourne's citizens bring to the city is the cornerstone of the strategic thinking and approach to the smart city approaches in 2016.

City profile

The Greater Melbourne area is comprised of 31 LGAs and has a population of close to 4.5 million people.[35] The City of Melbourne municipality covers 37.7 km^2 and has a residential population of 128,963 (as of 2015). It is made up of the city centre and a number of inner suburbs, each with its own distinctive character and with different businesses, dwellings and communities living and working there.

On an average day, around 900,000 people use the city including students, workers, business owners and visitors.[36]

The top employers by industry are professional, scientific and technical services at 15.7 per cent, healthcare and social assistance at 11.1 per cent and education and training at 9.3 per cent.[37]

24-hour pedestrian counting system, City of Melbourne

" ...we look at a smart city project as something that integrates people, place, and technology, with technology very much being the enabler."

Michelle Fitzgerald, Chief Digital Officer, City of Melbourne.

Smart city drivers

The City of Melbourne demonstrates strong and historical leadership in developing a smart city approach and has recently taken another progressive step forward having recently created a smart city office that brings together five core teams spanning a range of council capabilities. Rather than a label, the city positions the smart city as a methodology, a way of giving citizens agency, future-proofing Melbourne and preparing for digital disruption, to be embedded across all of council practices.

"....we look at a smart city project as something that integrates people, place, and technology, with technology very much being the enabler." Michelle Fitzgerald, Chief Digital Officer, City of Melbourne.

A major driver for implementing a refreshed smart city approach is to prepare Melbourne for digital disruption. As described by Michelle Fitzgerald, Chief Digital Officer, disruptive technology – whether that be the Internet of Things, big data and analytics, virtual reality, driverless electric share cars – represents a viable opportunity to protect Melbourne's assets and to accommodate future growth in a sustainable way.

Central to preparing for digital disruption is ensuring employment sustainability. Two thirds of the municipality's jobs are knowledge jobs but understanding the potential of digital disruption on employment – both in making some occupations obsolete while creating new jobs through digitisation and automation – means that the city is preparing for ways for people to transition to new industries, as well as helping new businesses to grow locally and globally. This includes thinking about what pilots, prototypes, collaborations between universities, corporates, and start-ups can be enacted now to create and embed those jobs in the future. Key to this is an emphasis on retaining the knowledge and resource base of the younger demographic and large student cohort, ensuring there are opportunities for them after they complete their studies:

"…we have this incredible resource that is our young people, so if we don't enable them to find clear and sustainable pathways into jobs of the future and set them up on a clear trajectory to create a great life in Melbourne, then we're not doing our job." Bonnie Shaw, City of Melbourne.

There is an emphasis on citizen engagement through encouraging digital entrepreneurial activity and co-design activities such as hackathons. For example, the city ran a digital city hackathon to help prototype Melbourne as a digital city in 2026. The group attracted people from a range of age groups and backgrounds, including professionals, tech people, designers, students, and the retired reflecting a diverse citizen engagement in creating a future Melbourne. The city regularly makes use of citizen-driven solutions through these types of events having also co-hosted an Internet of Things Hackathon

with Telstra in late 2015, as well as the recent Mobility Hackathon in partnership with VicRoads, Public Transport Victoria, Royal Automobile Club of Victoria (RACV) and Mastercard for the Intelligent Transport Systems (ITS) summit. The winning team constructed a congestion-charging app.

Encouraging innovation precincts and entrepreneurial activity through mechanisms such as the hackathons is key to driving business and the economy. By engaging citizens and creating an opportunity to access their knowledge and skills as a resource, the city continues to work towards economic and employment sustainability.

Maintaining Melbourne's liveability is also driving the use of smart approaches in the city's attempt to address digital disruption. This may include using sensors and analytics to help address issues of congestion, improve safety, as well as the city's free Wi-Fi service enabling the use of services such as Ask Izzy (developed by the REA Group and others). Ask Izzy brings a range of services online for homeless people like accommodation, skills building, jobs, and mentoring and in combination with the city's Wi-Fi makes these services more accessible. Addressing the digital divide becomes one way for the city to keep improving liveability for all its citizens.

Strategic focus

The use of smart technologies in the city predates the recent establishment of the city's Smart City Office – the city already had parking sensors, smart bins, an open data platform and initiatives such as Bioblitz, among others. Already viewing themselves as a 'smart city', the council's current efforts are about becoming 'smarter'. The current smart city approach leverages the learnings and insights from its existing projects, as well as insights from other global cities, to inform a formal smart city framework. The city is in phase three of its current smart city approach, identifying the current pain points, core needs and role of the city as it progresses towards a digital future. This scoping phase will inform the smart city strategy submitted to the council, help identify and trial prototypes and projects, and the eventual roll out of smart city projects. Anchoring the strategy around people, place and technology will help Melbourne to remain liveable, sustainable, and to optimise citizen engagement.

A major insight from the city's initial consultation work was the need to help people build knowledge and literacy around change and to include citizens in the process of change:

"…if we are to become a smarter city, we need our citizens to become smarter with us. The work that we're doing around that, the smart city approach, is very much based around enabling our citizens to be active participants in change, not just feel like it's something that's happening to them."
Bonnie Shaw, City of Melbourne.

Enabling citizen participation optimises the capacity for change across the city, positioning the city's population as a resource, particularly the potential of its young demographic profile:

"So if you think about the capacity for change in our city, if we don't take advantage of the incredible resource that are our citizens, we're kind of missing a bit of a trick there; particularly since we have a very young city." Bonnie Shaw, Melbourne City Council.

Council also considers future visions of the city, particularly around future transport trends[38] and also understanding the way it affects the city more broadly:

"An autonomous,electric share-car might not require a one hour parking bay, but safe drop-off and pick-up points across the city instead. This would have implications for the physical design and construction of our city streets."
Michelle Fitzgerald, City of Melbourne.

The implications of smart technologies therefore have an impact across all sections of the city from planning to revenue to the built environment, and the city's approach includes planning for long term digitally driven shifts.

Leadership and organisational capability

There is strong leadership by elected leaders in adopting smart approaches to growing the city. The councillors led the adoption of the open data policy and an open data platform for the city more than two years ago. There is strong support for entrepreneurial opportunities through small businesses and start-ups, as well as a move to technology underpinning city data and analytics, which also increases the transparency of the city's performance. Within this, the CEO is a major champion for the smart city having created the Smart City Office and the Chief Digital Officer (CDO) role. The CDO and Chief Information Officer strategically sit on the executive leadership team to ensure the smart implications for other decisions being made across the council are taken into account.

" You will always have change, but that citizen need remains your constant. If you're going to anchor on something, that need gives you a way of charting a pretty stormy sea. "

Colin Fairweather, City of Melbourne.

Citylab

Citylab employs a four-step process to redesigning council services, using human centre design methods in an agile way.

CityLab is Melbourne's space to prototype and experiment with data-driven ideas and city services. The space aims to engage the community in future-proofing Melbourne against future challenges facing the city by using data to design solutions but ensuring people remain the central focus.

CityLab enables this human-centred approach to city solutions by running hackathons with curated citizen groups to re-design council services and to develop and trial solution prototypes using city data made available through the Open Data Platform. CityLab is an example of how cities can include their citizens in finding ways to know the city and its challenges as well as inspire creative solutions through making city data open and accessible.

"I thought it was really great to see the City of Melbourne doing something so innovative and condensed. I think sometimes design process can get bogged down in group think and they can build out over 6-12 months. So, to see the council take the initiative to try and launch something like a prototype in under four days is really exciting." Luke Barbagallo, Creative Suburbs.[39]

Michelle Fitzgerald, Chief Digital Officer in City Lab

The Smart City Office is placed within the new city strategy and place directorate, combining council activities centred on planning and future-proofing the city, which had previously been siloed.

The Smart City Office was originally built from four existing teams across the organisation – the Melbourne Knowledge team, which showcases the knowledge capability of the city and delivers the knowledge strategy, Melbourne Knowledge Week Festival and Melbourne Conversations; the Research team, responsible for all city data; the GIS team, responsible for 3D modeling, data and mapping; and CityLab, which centres on human centred design and thinking. Since its formation, a new open data team has been added to bring the office to a group of five core teams comprising 40-50 staff, which is one of the largest local government smart city offices in Australia.

The city's smart city approach is being delivered in three phases. Phase one is a process to understand the core needs in the city and what people require of it. Council takes a 'learn by doing approach' using their innovation space, CityLab, to prototype and test experiences and projects before trialing them in public. Phase two involves developing a strategic framework that addresses the needs identified in phase one, identifying a series of levers that the council can use to influence change and projects to be prototyped. Phase three, now underway, is the activation phase where projects are rolled out in collaboration with key city partners and the community.

Flexibility of the framework enables the city to respond to the rapid rate of technological change. Technologies becoming obsolete present a challenge to smart city implementation but the City of Melbourne circumvent this challenge by focusing on citizen need rather than the technology:

"You will always have change, but that citizen need remains your constant. If you're going to anchor on something, that need gives you a way of charting a pretty stormy sea. It may be that those needs will evolve as well, but most of them will remain pretty constant." Colin Fairweather, City of Melbourne

Collaboration and partnerships

The city is vendor agnostic, preferring a multi-vendor approach to provide the best possible systems for the city. The city uses existing infrastructure and networks to implement projects. There is an existing city-wide smart camera network and the city's free Wi-Fi – VicFreeWiFi – is a Victorian State Government project supported by network provider iiNet TPG. The city is providing some delivery support with the project's rollout across the city. Networking solutions for the transitioning of the parking sensor network to real time and the roll out of the LED streetlight program are both commencing in 2016.

Beyond the council's activities, there is significant development activity within the city. Increasing demand for 'smart' buildings mean that smart design components, such as underground waste management solutions, are being built into new infrastructure at the discretion of the builder, but which contributes to broader smart status and efficient management of the city. The nbn™ network will also be rolled out across the city, adding to the depth of its digital infrastructure. An additional asset is the smart grid run by Silver Spring – an American based company appointed by the electricity utilities – and which is a Victoria-wide project.

As the Chief Information Officer, Colin Fairweather describes, this multi-vendor approach and partnering between public and private characterises the city's vendor agnostic approach in its implementation of the smart city. The city will have varying degrees of ownership and influence over infrastructure – ranging from council owned and operated, to being third party owned but maintaining influence, to being third party owned and operated without the opportunity for council influence. This creates a complex vendor and service provider space emphasising the need for multi-vendor approaches to reach the best outcome for the city.

Central to the city's decisions on which infrastructure and networks to leverage, however, is network security:

"Our focus on the networks, it's got to be secure. It's got to be interoperable. It's got to meet certain standards. There's some networks across the city that were built a long time ago, not to the standards we need today." Colin Fairweather, City of Melbourne.

Summary

The City of Melbourne places people at the centre of its smart city approach with technology being viewed as the enabler. Smart city approaches are being implemented to leverage the potential of its local population, in particular its high youth cohort, and to drive sustainable growth. The recent introduction of the Smart City Office illustrates high levels of organsiational support for smart approaches.

Smart city initiatives

Outlined below are five key initiatives of the City of Melbourne that provide part of the foundation work for it to be a smart organisation and smart city which drives sustainable growth.

Initiatives	
Strategy and organisation: Smart City Office	The city's Smart City Office is central to delivering smart city initiatives and comprised of five core teams: Knowledge and Strategy; City Research; GIS; Citylab; and an Open Data team.
	The office comprises 40-50 staff making it one of the largest local government smart city offices in Australia.
Melbourne Open Data Platform	The city has an 'open by default' policy position supported by five Open Data Principles. The city's open data policy fosters greater transparency and accountability, drives innovation and economic opportunities, while creating a cost effective, efficient and responsive government.
	The data is accessible through its open data platform.
Bioblitz	City of Melbourne's first major citizen science program. Experts and the community work together to document species that live in Melbourne. The data will contribute to the city's Urban Ecology and Biodiversity Strategy, aimed at maintaining a strong and diverse eco-system
24-hour pedestrian counting system	Sensor systems that measure pedestrian movement to provide a better understanding of city use which can be used to inform city management and plan for future use.
	An online visualisation tool provides an interactive map of the sensor locations.
Smart Waste management	BigBelly Bins: solar powered bins compact rubbish as it's collected. The bins have 720 litres holding capacity, greater than the 80 litres of the standards public rubbish bin.
	Sensors alert the waste contractor when the bin reaches 80 per cent capacity, optimising waste collection run efficiency. This helps to minimise the number of garbage trucks on the road and reduces congestion.

4

CASE STUDY

Sunshine Coast

Creating a 21st century city

The Sunshine Coast is the fifth largest local government area in Australia – larger than Sydney and Melbourne – and has the tenth largest population in the country. Investment in future industry growth and economic development is being directed at 'high-value' industry sectors such as health and well-being; education and research; professional services and knowledge industries; tourism, sport and leisure; agribusiness; clean technologies; and aviation and aerospace.

Concurrent with this is an interest in developing the region's entrepreneurial culture through a network of education programs, co-working spaces, incubators, industry events, alliances and meetups (Digital Sunshine Coast 2016). The support for a thriving entrepreneurial community and high-value industry is complimented and accommodated by the region's smart city vision.

"…we realised that there was a really good opportunity to be innovative, to be cutting edge… we felt we had the foundations and the interest in our population to develop a smart city." Clr Mark Jamieson, Mayor.

City profile

As of 2014 the Sunshine Coast population reached a total of 335,874 and a population density of 108.9 people per square km.[40] The median age of the region's population is 42.8 years, which is above the national average of 37.3 and indicative of an ageing population.[41]

Tourism, retail and construction are dominant drivers of industry whilst healthcare and social assistance is the largest employer in the region, followed by retail trade, construction, accommodation and food services. The size of the Sunshine Coast region combined with its ageing population profile present a series of significant challenges which the council is addressing through the implementation of smart city technologies and approaches.

" **…we realised that there was a really good opportunity to be innovative, to be cutting edge… we felt we had the foundations and the interest in our population to develop a smart city."**

Clr Mark Jamieson, Mayor.

Alysha Vincent, Smart Centre Officer (Acting) and Michael Whereat Smart City Coordinator at the Sunshine Coast Council's Smart Centre in Bulcock Street, Caloundra

Smart city drivers

The Sunshine Coast council aims to improve the "liveability, workability and sustainability" of the region using information communication and technology (ICT). A changing economy and shift away from traditional industries, combined with growth and recognition of the depth of talent in the region, were driving forces in the council's decision to adopt a smart city approach. As described by Sunshine Coast Mayor Clr Mark Jamieson, "we needed to identify our point of difference to create an interesting platform to develop our future on".[42] The council identified a series of high-value industries to cultivate in the region including health and wellbeing; education and research; knowledge industries and professional services; tourism, sport and leisure, aviation and aerospace; food and agribusiness; and clean technologies.

The region itself provided a unique opportunity to trial smart technologies. Key to its smart city activities is the development of Maroochydore City Centre Priority Development Area (PDA), an opportunity to build a smart city centre from scratch and only possible because the land had been previously underdeveloped as a golf course. The ability to build a smart city in a greenfield site is unique and allows the city to trial the technologies before evaluating their potential to retrofit their existing urban centres:

'We realised very early that the greenfield site gave us an opportunity that was a once off, that very few other places will ever get…. to create a 21st century city."
Clr Mark Jamieson, Mayor.

The unique greenfield site opportunity, combined with a shift in industry to drive the economy, are influential in driving the Sunshine Coast Council's vision of the smart city.

Strategic focus

The Sunshine Coast has an integrated smart city approach (refer fig 2) which is centred on a smart region management platform that underlines and connects six key elements to deliver the council's strategic outcomes: quality communication networks for citizens and industry; renewable electricity via the region's solar farm; a range of city solutions such as smart bins to improve efficiencies in waste collection; a living lab and smart centre for trialing the new solutions and improved accessibility of services for citizens through a citizen mobile application.
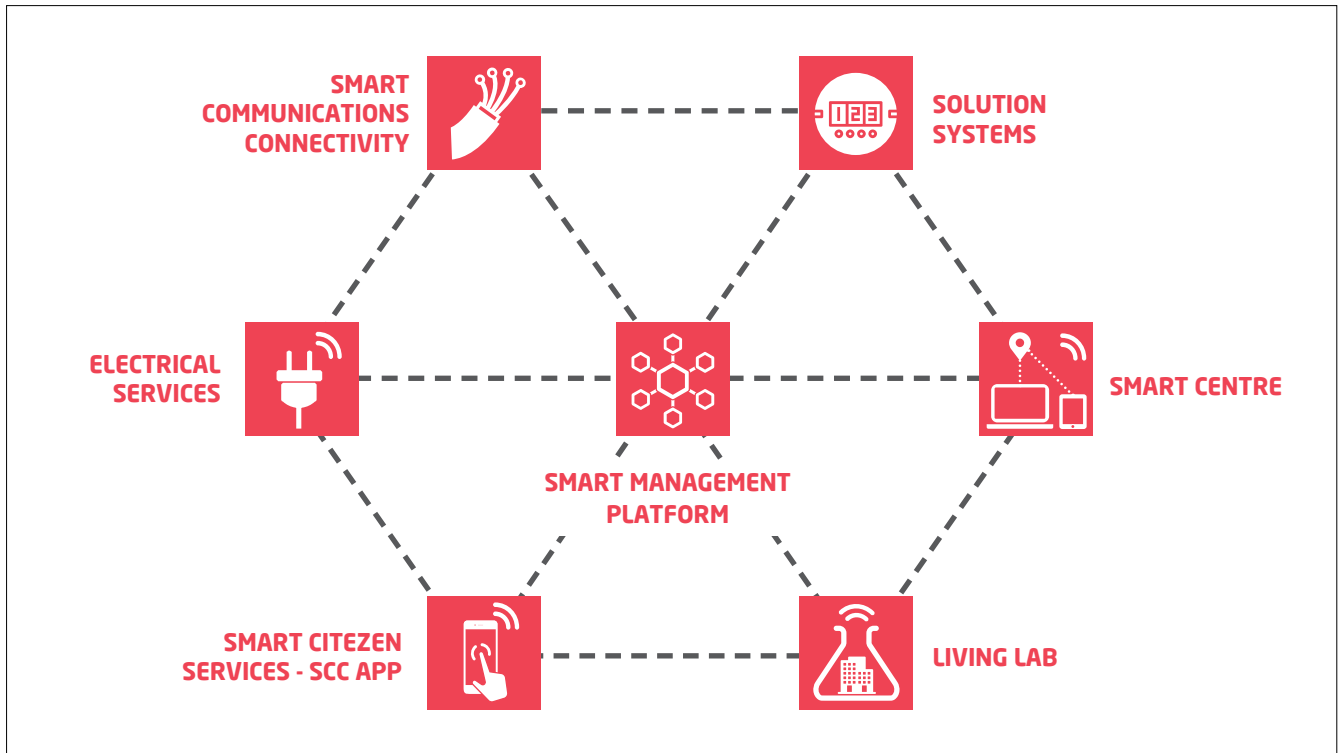
Fig 2: *Smart City Approach*

The smart city approach is supplemented by the smart city framework (fig 3) which brings together 15 smart city solution areas.[43] Developed in conjunction with Cisco and Telstra and involving consultation with more than 20 stakeholder groups, the smart city solutions range from smart lighting, city Wi-Fi to smart health and education. Collectively, each support efforts to drive economic growth, strengthen community, improve service delivery, and improve the region's sustainability.[44] The deployment of each smart city solution varies across each of the three sub regions of the Sunshine Coast, the Maroochydore city centre, the enterprise corridor or the broader region, depending on the replicability and contribution to the strategic outcomes for that sub region. Importantly, the smart region management platform is one platform that local government staff can view and manage all of the smart city solutions across the sub regions.

Importantly the smart city framework ensures a systemised approach to the implementation of the smart city. Systematically managing specifications, construction, process and activity, council will eventually be able to routinely optimise the integration of smart approaches into council activities.

The selection of the smart city solutions within the framework were evaluated by the contribution to the region's economic growth, sustainability goals, improved efficiency of service provision and improvement to the quality of life of its citizens.

Following the community engagement about the attributes of a smart city, the council has continued to communicate the value of the smart city approach to the broader community in innovative ways, including gamification, hackathons and through the Smart Centre and Living Lab located in Caloundra.

"The Sunshine Coast use gamification as a way to educate local students and citizens in the data they collect. For example, we gamify the data that we're collecting about water consumption and make that a sustainability game for schools, seeing how results work between different locations. In this way we provide an educational aspect to how we create a smarter Sunshine Coast." Michael Whereat, Smart City Lead.

Fig 3: Smart City Framework [45]

SMART CITY SOLUTION	MAROOCHYDORE PDA	ENTERPRISE CORRIDOR	BROARDER REGION
Foundational Fibre-optic Network	Deploy	Consider	Consider
Smart Region Management Platform	One Platform		
Smart Lighting	Deploy	Deploy	Deploy
Smart City WiFi	Deploy	In Area	In Area
Smart Sight, Sound and Sense	Deploy	In Area	In Area
Smar Waste Management	Deploy	Consider	Consider
Smart Water	Deploy	In Area	In Area
Smart Power	Deploy	Consider	Consider
Smart Parking	Deploy	In Area	In Area
Smart Transport	Smart Buses & Data		
Smart Citizen Services	Mobile Apps & Open Data		
Smart Signage	Deploy	In Area	In Area
Smart Health	Sensor-Driven & Remote Health		
Smart Education	Connected & Flexible Education		
Smart Lab & Hut	Deploy	In Area	In Area

Legend

● Deploy in Area

◖ In Area

◌ Consider for Future Deployment

■ Areas

■ Across Areas

Leadership and organisational capability

The Sunshine Coast's smart city framework was completed in early 2015 and was empowered through the corporate plan, enabling smart city principles to be embedded across the organisation. As a 'living framework', the framework has since been updated to accommodate its implementation. The implementation stage is a three-year program which will drive the mainstreaming of smart approaches across the region's practices, processes and infrastructure:

"We take the new and turn it into the new business as usual. It becomes part of what we do through a systems-based approach… the vendors all want to come in and introduce their own products into our environment. We are developing processes and skilling the organisation to determine and select the products that fulfill our program objectives and meet our smart city principle criteria. Working this way and doing this in-house drives better outcomes and increased council and regional capability." Michael Whereat, Smart City Lead.

The development of the smart city framework had initially started out as making a smart city centre and to produce a 21st century city. However, the elected leaders realised that during the development of the smart city framework and by involving the executive, that in order to achieve the outcome they were seeking they needed to scale up the approach across the region using the city centre as a key catalyst. This has strengthened smart city capacity across the local government leadership and services:

"The difference is a much stronger executive and political focus on what we now call smart cities and the deeper penetration of technology into how we service the outdoor environment particularly." Brian Beswick, Chief Information Officer.

An increase in executive sponsorship of information and technology within the organisation has enabled the Chief Information Officer (CIO) and team to grow the capacity of smart approaches with a strong agenda and commitment of resources. The CIO's office has been able to use its expertise in digital capability and data capturing to understand ways in which data can be scaled to meet business and community need. More recently this has meant establishing a project to make use of big data analytics and create a data centre of excellence.

Collaboration and partnerships

The size of the Sunshine Coast region means that it cannot rely on rates as the financial foundation to fund new projects and smart activities. Recognising this, the council is exploring other funding options and sees potential for the council to partner with a range of stakeholders and sharing in the dividends of new developments. However, the council identifies the state and federal governments as the two biggest and most influential partners that they need for support. This is particularly pertinent to the council's plans for an international submarine fibre cable which will enhance the region's economic competitiveness by linking Queensland with international economic centres. The council's efforts are around de-risking projects to make it attractive to both government and industry partners to work with council.

"Sunshine Coast Council is happy to be the lead agent and do all the de-risking, both politically and environmentally, to get that done. As I said, we will take a share of the dividend long term. That will be the payback for our investment." Clr Mark Jamieson, Mayor.

Sunshine Coast Council's partnering strategy therefore recognises that they must move beyond 'business as usual' approaches to achieve the return on investment necessary for a large council to continue providing the infrastructure and opportunity for their region. This is also reflected in partnerships with industry.

" The difference is a much stronger executive and political focus on what we now call smart cities and the deeper penetration of technology into how we service the outdoor environment particularly."

Brian Beswick, Chief Information Officer.
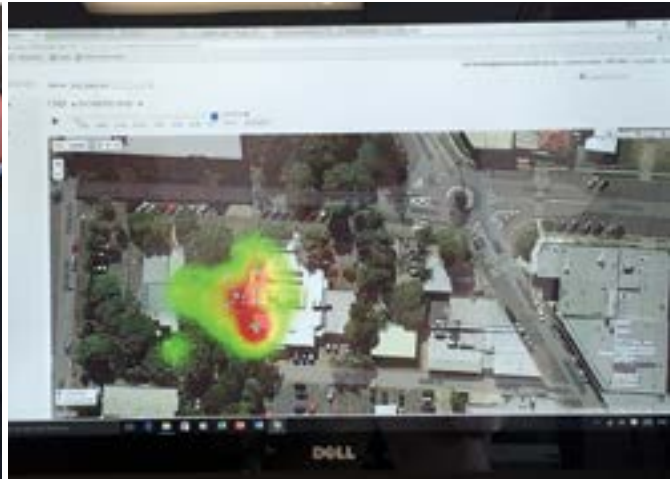
Living Lab at Caloundra: Integrated parking sensor/lighting pole and smart bin providing realtime data feeds to smart citizen application and the city's regional management platform, improving the efficiency of the city.

While partnering with Telstra and Cisco in the development of their smart city framework, the council conducted market sounding activity in July 2014 to gain an understanding of the possibilities for smart city solutions, and had over 28 groups respond to the request. Key to evaluating the responses was the consultant's ability to tune into the Australian and Sunshine Coast's context – their particular assets and capabilities.

This is reflected in the council's approach to infrastructure. The council's smart city framework relies on the foundational infrastructure of the smart region management platform and fibre and wireless networks. Maintaining control of network connectivity was critical to the council's approach to infrastructure and drove the council's decision to obtain a carrier licence which was fundamental to the council protecting their assets.

"Through the carrier licence we are seeking to protect our smart city assets and investment together with creating a network to support the future submarine cable connection to our key business nodes – and to data centres in Brisbane, Sydney and beyond. We see this as providing short, medium and long term strategic benefits for the region. We are beginning to have a greater insight into how we manage this as we transition from a traditional to digital economy." Michael Whereat, Smart City Lead.

Smart Centre and Living Lab

Sunshine Coast's Smart Centre and Living Lab plays a key role in positioning the region as a leader in, trialing smart technology and communicating the council's smart activities to the public. The Smart Centre is a space dedicated to community consultation and demonstrates the technologies the council is trialing. The Smart Centre is the heartbeat of the larger 'Living Lab' – a designated area where smart technologies are trialed.

Currently the Smart Centre demonstrates projects such as sensor bins, smart lighting poles, public Wi-Fi and smart parking technologies all being trialed in the broader living lab. An analytics dashboard is also on display, which shows the data both generated and gathered by smart technologies and sensors, and which informs council decision-making. The Smart Centre illustrates the council's move towards greater transparency of their management, data and processes – a key characteristic of a smart approach to city management that Sunshine Coast Council is taking:

"So through open data and our open budget approach, people can walk in here and find out exactly what's happening. There is no mystique about it at all. In fact, it's a case of we're really proud of what we're doing."
Michael Whereat, Smart City Lead.

Summary

The Sunshine Coast Council is implementing smart city initiatives to gain a competitive advantage and drive economic growth in the region, improving the day-to-day lives of the local community. The unique opportunity to develop a smart city from scratch as well as retrofit the existing built environment has enabled the Sunshine Coast to become an industry leader.

Smart city initiatives

Outlined below are four key initiatives of the Sunshine Coast Council that provide part of the foundation work for it to be a smart organisation and a leading smart city which drives innovation and growth.

Initiatives	
Smart City Framework	A framework of 15 services that are supported by two core technology layers: Smart Region Management Platform and a communications layer.
	Services include: Smart Sight, Sound and Sense (audio-equipped IP cameras, sensors); safety, reduction maintenance costs by remote diagnosis; Smart Waste Management; Smart Water; Smart Power; Smart Parking; Smart Transport; Smart Citizen service; Smart Signage (incl. location-based and behavioural targeting advertising); Smart Health; Smart Education; Smart Lab and Hub
Living Lab	A designated area in Caloundra where smart technology solutions are trialed, e.g. smart parking and smart lighting technologies.
	If the trials are successful, the technology is then gradually installed across the region.
Smart Centre	The 'Smart Centre' demonstrates the smart city initiatives and technology being trialed in the Sunshine Coast.
	The public can walk in to see real-time results from the Living Lab and discuss issues with council representatives.
Smart App	A free app provided by the council which provides residents with a wide range of information and services, including: significant events such as regional celebrations or festivals; updates on road closures; and facilitates communication between council and the community, for example, providing easier ways to report issues such as potholes.

5

CASE STUDY

City of Boston

A digital pioneer

The City of Boston is in the heart of the burgeoning innovation economy of the Commonwealth of Massachusetts and is the economic and cultural anchor of a substantially larger metropolitan area called Greater Boston.

The City of Boston is one of the cities in the United States leading the way in encouraging and displaying innovation and smart approaches to urban problems. The city covers 124km^2 and is home to 667,000 people, making it the largest city in New England. Greater Boston is well placed with more than 50 colleges and universities and home to many large technology firms creating a unique location for innovators.[46]

Smart city drivers

Commentators have labeled Boston a digital pioneer in many ways. The previous mayor, Tom Menino, employed the first chief information officer in 2006; Boston was the birthplace of new urban mechanics, an internal innovation team whose mission, as described by Nigel Jacobs, Co-Founder, New Urban Mechanics, is broadly "to invent the future of city services", and in 2015 launched the Connect Citizen application in partnership with Waze to ease traffic congestion, to name a few.

Cities like Boston have become aware that data and urban analytics will eventually become as important to their citizens' well-being as the transport system. Boston, the heart of the globally recognised innovation ecosystem currently retains an estimated 40 per cent of university graduates and has the highest percentage of postgraduate qualifications per capita. Affordable housing and transport congestion are two of the primary urban problems facing young entrepreneurs, so developing smart solutions to these problems is paramount. So too, as Jascha Franklin-Hodge, Chief Information Officer, explains, is "closing the expectation gap" of citizens who increasingly prefer a digital service, rather than making phone call.[47]

> **"...having a mayor who is willing to embrace technology, who understands that when you bring technology to bear on certain business applications, it isn't just a layer that you add on, that sometimes it means fundamentally changing the way you do business within that organisation."**
>
> Jascha Franklin-Hodge, *Chief Information Officer*

Leadership

The City of Boston has benefitted from innovative and strong city leadership that has led the transformation to a digital city. As Hodge explains the stability of government as an organisation means that change is atypical unless there is a major push factor and it is difficult to enact change without the support of strong leadership:

"…having a mayor who is willing to embrace technology, who understands that when you bring technology to bear on certain business applications, it isn't just a layer that you add on, that sometimes it means fundamentally changing the way you do business within that organisation." Jascha Franklin-Hodge, Chief Information Officer

In the case of Boston, following the legacy of innovative mayor Tom Menino, the current mayor Marty Walsh and his team implemented a dashboard called 'City Score' in 2015. The City Score is a single number to indicate Boston's overall health, combining 24 different metrics, from crime to Wi-Fi availability, energy consumption, the response time for filling potholes and tree maintenance to name a few. As Hodge explains, "the dashboard isn't meant to be the definite answer but it's to be a window into a fantastically complex organisation of 18,000 employees, 45 departments, thousands of different services. How does one person manage that? They can't unless they're able to have tools that allow them to see things that need further enquiry or where things are going great". The dashboard provides a tool for engaging the city leaders, the administration and citizens in a conversation that leads to co-design of smart solutions to urban issues.

The key difference with cities like Boston, Chicago and New York, is that the city government and elected leaders are driving the change for the use of urban information and technology to improve planning, offer better services and engage citizens. For Boston, where the citizen median age is 31 – an often tech savvy and a highly entrepreneurial demographic – using urban information and technology smarts to solve urban problems is critical. Urban congestion and affordable housing remains the limiting factor for the innovation economy in Boston, so developing smart ways to solve this is critical for the economic productivity of the city.[48]

Boston is also supported by world-leading institutions and urban entrepreneurs who are devising solutions to urban problems, including the MIT media lab, creating sophisticated decision support tools to assist city government in using real time data to visualise the impact of planning solutions.[49]

The Mayor's Office of New Urban Mechanics (MONUM)

Founded in 2010 by the city's previous mayor, Tom Menino, the Mayor's Office of New Urban Mechanics (MONUM) is an agile and entrepreneurial innovation team.[50] Tom Menino was given the nickname 'the urban mechanic' because of the way he worked. His philosophy as described by Jacobs was, "how do we take an intimate people-first approach, but also layer on top of that technology and design and creativity to flavour our approach to innovation".

The team, originally composed of two existing city employees, increased to a team of 14 and is tasked with exploring ways to deliver innovation. City governments are by nature conservative and risk adverse and instead like to be stable

and reliable in the provision of services. Adopting a risk-taking innovation culture is not an easy migration. As explained by Jacobs, "innovation doesn't happen other than in the context of a willingness to take risks and occasionally having to deal with failure".

To defray this notion of risk, MONUM is able to shoulder the responsibility of projects, which means that engaging in creative new products that push the boundaries is less of a risk for the department itself, and this in turn generates more innovative approaches across the city as an organisation.

MONUM therefore makes collaborative opportunities with city departments and citizen groups in an effort to push innovation forward. The team co-designs, co-builds, and co-deploys projects, describing themselves as entrepreneurs rather than consultants. In the long term, as explained by Nigel Jacobs, this approach aims to, "…invert the culture in local government by finding ways to empower people… with the hope that we'll inspire them to continue to do that over time". Collaboration and offsetting risk are positioned as integral to embedding of innovative practices within departments.

Challenges

Like Australian cities, Boston is also limited by its geographic size and the challenges in developing urban solutions that work across jurisdictions. As Hodge explains, if a citizen calls from the City of Cambridge about a pothole, the City of Boston can't help them at the moment. So Boston will continue to take leadership in solving problems that it can address and also learn from other cities that may have the capacity and scale to address different problems. Furthermore, industry and citizen-led solutions play an emerging role in providing solutions that transcend jurisdictional boundaries. For example, transit data has been used to create an "eco-system of applications" for citizens to use. Google Maps, Citymapper and Ride Scout make apps that provide multi-modal transportation tools for citizens using government data, but in a way that allows them to traverse jurisdictional boundaries – in some cases even global boundaries. As Hodge explains: "I can use Google Maps anywhere in the world to get on the subway and that's because there's a data standard that exists around that and Google has made that investment because it's in their business interest to do so." So by city governments making data available in a contextualised format, industry is able to lead the development and evolution of services to meet citizen needs.

Data is key to driving 'smart cities' and a significant challenge for city governments is to, firstly, have the systems, policies and processes in place to share government data in a useable way. Information is typically kept in separate databases. Making these work together is crucial, but the task is often underestimated, explains Jascha Franklin-Hodge, "the city still has more work to do", with most of its digital information now residing in a 'data warehouse' – a big computer system where it can be easily accessed and analysed. Similarly, the data can sometimes lack contextual framings that make it

useful to third parties. This includes publishing information without descriptors of codes or values, explaining why the data is presented in a certain format rather than another, and details on frequency of data collection and updates, as well as reliability. This lack of greater context surrounding the data limits the data's usability and is something the city sees as challenge. Additionally, cultural lethargy and resistance to change within the organisation, along with funding issues are seen as barriers to a smart city approach.

Secondly, city governments should determine their role in acting as a facilitator for others to share and exchange data for the public good. In 2015 Mayor Walsh announced the data-sharing partnership with Google-owned popular traffic app, Waze, to help Boston citizens navigate traffic congestion. The government shares information such as road closures and in return the users share real data about traffic conditions which feeds into Boston's Traffic Management Centre, which provides data for city engineers to adjust traffic signals thereby easing congestion. Increasingly, the proliferation of smart devices will continue to fuel the need for participatory urbanism, where solutions to urban problems are citizen led. This was very much evidenced at times of disaster, such as Hurricane Sandy.[51]

Digital inclusion

Reflecting the city's understanding of the potential of technology to beneficially impact people's lives, the city has extended its information and technology capacity to provide a city-wide analytics team that focuses on using data to improve quality of life and enhance the effectiveness of government operations. Increasing the efficiency of governance includes assisting departments to access, visualise, analyse, and use data that is relevant to their core business challenges to improve performance and service delivery, resulting in an improved outcome for both the department and the city users.

However, the city's focus on harnessing the benefits of technology extend beyond increased government efficiency. The city has a strong emphasis on digital equity and digital inclusion. This means delivering policy that encourages investment in the city's broadband infrastructure and delivering accessible and affordable internet to every resident and business, including the delivery of tools and skills necessary to access the internet.

Digital inclusion extends to all users of the city. Whilst access to free Wi-Fi is available the access to reliable charging places is more difficult. The city is piloting 'smart benches' which include solar panels to fuel USB chargers and usage sensors in an effort to increase equal access for citizens to city services including the homeless.

6

CASE STUDY

City of Amsterdam

The open city

Amsterdam has a long history of innovation and is known for its freedom, ideas, arts and entrepreneurship and also its social innovation and diversity.

In 2016 it was recognised as the European Capital of Innovation for its holistic vision of innovation related to four areas of urban life: governance, economics, social inclusion, and quality of life.[52] The City of Amsterdam is the heart of the metropolitan area housing over one third of the city's 2.5 million citizens.[53]

Smart city drivers

Amsterdam's smart city approach is key to encouraging innovation from the bottom up. Driving innovation is linked to increasing the city's liveability and sustainability, embracing smart growth and social innovation. For Amsterdam, being a smart city is about the liveability of the city for the people who work, live and visit it each year.

Amsterdam's leadership in smart city approaches comes from a unique set of factors, including its culture and demography of early adopters coupled with a strong social conscious; the local and national policy imperatives which desire a leadership position in clean energy transition with aggressive greenhouse gas (GHG) emission targets; diverse range of entrepreneurial and large corporates who have a strong commitment to corporate social responsibility and see a strong business case and opportunity for smart technology solutions.

Against this backdrop, the smart city ecosystem involves several key components, including the Chief Technology Officer within the government administration, the private-public Amsterdam economic board, a cultural platform called Pakhuis de Zwijger (which facilitates meet ups and debates), a science and a technology research institute, plus many other starts ups and non-government organisations.

Central to achieving these smart goals is Amsterdam Smart City (ASC), an independent organisation which acts as the hub and key facilitator of the smart city for the City of Amsterdam.

Governance and leadership

The Amsterdam Smart City (ASC) initiative distinguishes the city's approach to 'smart' from the other case studies in this report.

Rather than being delivered through the municipal government, Amsterdam Smart City, the key facilitator, is an independent foundation financed by seven partners: KPN, the national telecom company; PostNL, which is the equivalent to Australia Post; Alliander, electricity grid operator; ARCADIS, a big engineering firm; Amsterdam Arena, which is the national soccer stadium; the Amsterdam Economic Board; and the University of Applied Sciences of the City of Amsterdam.

The organisation's Strategy Advisor for Low Carbon and Connected Urban Planning, Frans-Anton Vermast, explains that the move to an independent organisation was a result of a previous and less successful attempt to implement a smart city approach from within government where collaboration across departments was challenging. The new independent platform established in 2008 – at arm's length of the government – providing "space to move around and execute smart city projects".[54]

Despite being an independent organisation, the government still maintains some influence as part of the Amsterdam Economic Board with a 10 per cent stake in the total budget and financing and the contribution of seven full time equivalent staff (FTEs). The strategic partners also contribute one FTE from each organisation and contribute financial resources.

Within the Amsterdam approach to smart city, the city government plays a small role and focuses on facilitating collaboration between government, private partners and smaller institutions. Projects or 'moonshots' are pitched by the partners and are required to meet three criteria to be considered smart:

1.   The project must contribute to the local economy.

2.   The project must improve government efficiency.

3.   The project must contribute to the quality of life of the citizens.

The ASC's role in the development of the project is variable dependent on the project phase, being heavily involved in the early stages which require bringing people and partners together, performing a monitoring and largely hands-off role during the running of the pilot and then becoming more involved again when a successful project needs to be scaled up.

Eight years since the commencement of the Amsterdam Smart City program, the national government is now undertaking a national smart city strategy.[55]

The whole city is a living lab

The Amsterdam Smart City platform approaches the city itself as a living lab and an area to pilot smart city projects. Inherent to this approach is an attitude supportive of open data, smart growth and an entrepreneurial ecosystem that drives innovation.[56]

Being open

The City of Amsterdam won the Smart City Award with its Open Data Program. The program is based on the premise of sharing city data for use by businesses and entrepreneurial citizens to develop smart applications that can address urban issues faced by Amsterdam. The city's approach is open platform, open source and open data. The development of applications such as 'Park Shark', which helps to calculate the cheapest and nearest parking option near the desired location, is an example of how open data can be successfully used to improve the experience of the city.

Start up in residence

Amsterdam Smart City also has a 'start up in residence' program aimed at supporting entrepreneurial activity and delivering city-based solutions from the data. Through the program, ASC has enhanced the collaborations between accellerator/incubator organisations and the municipal government through improved communication and training of civic servants. The provision of development budgets for start ups, together with structured mentoring and evaluation has also increased digital social innovation.

Liveability

A core goal of the Amsterdam Smart City is to increase amenity of its urban spaces, of which sustainability can be used as a key indicator. A current project lead by Alliander aims to provide one solar panel for every citizen in Amsterdam – 850,000 panels. The challenge for this project is that the panels can't be fitted onto each residential building, so the team is sourcing the roofs of factories and larger buildings to generate the solar power to be delivered to Amsterdam consumers.

Another project focuses on increasing the liveability for residents by better regulating visitor flow to and from major events held at the Amsterdam Arena. KPN is using the data to model ways to facilitate increased mobility so not only is there less congestion for visitors but that there are ways of moving people to and from events that are less intrusive for the local residents.

Summary

The Amsterdam Smart City initiative sees the city as an open platform where products and services are user-centric. Products are tied to the openness of city data and the Amsterdam Smart City makes a direct correlation with the quality of city life and citizen driven solutions, suggesting that the most liveable cities will be cities with the best smart applications for citizens. Enabling an environment that supports this type of activity requires a paradigm shift moving from ownership to availability, and allowing for failure and uncertainty, as such the whole city becomes a living lab where smart projects are deployed in the specific context of the city:

"The concept of smart cities is like art: the context is more important than the product." Ger Baron, Chief Technology Officer, City of Amsterdam.[57]

The Amsterdam Smart City Platform

The Amsterdam Smart City Platform (ASC) is the heart of Amsterdam's smart city ecosystem. This organisation was created in 2008 to speed up and facilitate the take-up of new technologies that would benefit quality of life and sustainability in the metropolitan region. Since 2008, ASC has developed into a platform with over 200 project partners active in more than 150 innovative projects across several themes, including energy, mobility, and circular economy. On its community website, over 1900 members of the smart city community can add new projects. ASC has two types of partners: programme partners and project partners. The programme partners sit on the board and provide staff to the ASC organisation. As of 2015, there are eight strategic partners: the City of Amsterdam, the Amsterdam Economic Board, Alliander (energy grid company), KPN (telecom/ICT), Arcadis (natural and built asset design and consultancy firm), PostNL (logistics), Amsterdam Arena (stadium) and Amsterdam University of Applied Sciences. Each core partner pays an annual fee and commits human resources to the organisation: they have a dedicated officer at ASC, and have a three-year renewable commitment.

The key roles assumed by ASC include being first port of call for innovative project ideas, a network broker, a connector between urban stakeholders, city branding and importantly is the trusted third party facilitator.

Glossary

Term	Definition
5th Generation (5G)	5G is the term used to describe the next generation of networks used for wireless mobile communication. It will eventually supersede networks beyond the 4G LTE mobile networks standard and offer faster data transfer between mobile devices and sender stations. As of mid-2016 there was no standard, so the definition is still very fluid. It is assumed that 5G networks will not become commercially available until the 2020 timeframe. The standard is still being defined and might not become commercially available until 2020.
Digital native	The term 'digital native' refers to a person born or brought up during the age of digital technology and communications, who is therefore familiar with computers and the internet from an early age.
Fibre to the premise (FTTP)	FTTP describes the approach used by Australia's national broadband network (nbn™ network) to bring high-speed (broadband) internet to residential and commercial buildings, also referred to as last-mile communication. It captures the approach of replacing outdated copper wires with fibre optics to increase the amount of data that can be carried across the network.
Global Smart Cities and Communities Coalition (GSC3)	The GSC3 is a network of cities, communities and regions to enable smart city developments through the sharing of best practices and approaches for managing cities and communities. It places an emphasis on the development of liveable cities and communities in regards to their economic development, social inclusion and environmental impact.
Hypercat Australia	Hypercat is a UK-developed alliance and standard that enables free communication from any connected IoT sensor or device being used to monitor an environment. Increasingly, IoT is being used by smart cities to help inform decision-making and improve city services, from air quality and energy usage to traffic flows and asset utilisation. More information: http://www.hypercat.io/australia.html
Internet of Things (IoT)	The term 'Internet of Things' describes the concept of connecting everyday objects, which can range from products to street furniture and buildings. Objects that are part of an Internet of Things are able to send and receive data through advanced networking and processing capabilities, thus becoming part of a networked system. A development of the internet in which everyday objects have network connectivity, allowing them to send and receive data.
Low power, wide area network (LPWAN)	LPWANs are used to transfer data wirelessly over large distances. They are used for M2M communication and to communicate between objects and sensors that are powered by batteries. The low data transfer rate ensures reduced power consumption and therefore longer battery life for wireless objects and sensors.
Machine to machine (M2M) communication	M2M communication describes the technical capability of machines to communicate with each other, either using a wired network or wirelessly. It forms the technical foundation for the Internet of Things concept.
National Broadband Network (nbn™ network)	The nbn™ network is an Australian national data network initiated to deliver broadband connection to retail service providers in an effort to bring high-speed internet to all customers. nbn™ co is a government-owned corporation responsible for the implementation and operation of the nbn™ network.
South Australian Broadband Research & Education Network (SABREnet)	The SABREnet is a broadband network using fibre optics to provide high-speed communications between major research and education sites in South Australia.

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About us

The Future Cities Collaborative

The Future Cities Collaborative is an initiative of the United States Studies Centre at the University of Sydney, in Australia. In 2007, the world reached an invisible but momentous milestone: more than half of its population now lives in cities. Cities are the heart of the world's economy and are home to the majority of people, but they also present monumental challenges. The Future Cities Collaborative responds to these challenges by supporting city leaders with thought leadership, new research and policy directions, and collaborative approaches to developing sustainable, productive and liveable cities of the future.

As our cities grapple with the pressures of urbanisation together with new economies and disruptive business models, an examination of local approaches to smart cities innovation ecosystems is the next logical step in assisting city shapers create the best and most sustainable, resilient and productive communities.

Thanks to our supporter, Telstra

Telstra is a leading telecommunications and information services company. Telstra offers a full range of services and compete in all telecommunications markets in Australia, operating the largest mobile and Wi-Fi networks. Globally, it provides end-to-end solutions including managed network services, global connectivity, cloud, voice, colocation, conferencing and satellite solutions. Telstra has licenses in Asia, Europe and the United States and offer access to more than 2,000 points of presence across the globe.

The United States Studies Centre

The United States Studies Centre (USSC) at the University of Sydney deepens Australia's understanding of the United States through research, teaching and public engagement. Through rigorous analysis of American politics, foreign policy, economics, culture, and history, the Centre has become a national resource, building Australia's awareness of the dynamics shaping American society — and critically — their implications for Australia. USSC has provided a focus on the intersection between urban planning and the environment, leveraging Australian and US resources since 2009 with the foundational support of the Dow Chemical Company's Sustainability Program and the NSW Government. USSC is proud to be building stronger links between Australia and the US through policy development, knowledge exchange, and programs such as the Future Cities Collaborative.

Authors

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Sandy Burgoyne has 25 years corporate experience in developing and leading business strategy, marketing, change and business transformation within the telecommunications, information technology, retail service and not-for-profit sectors. In 2007, Burgoyne returned to her passion of urban and physical geography to apply her commercial skills and focus her career on the collaboration between industry, government and community to develop smart and sustainable cities. She is the Founding Director of the Future Cities Collaborative, where she works to inspire and develop city leaders to build great cities by bringing together innovative policy approaches, research and practice to the urban challenges they face.

Burgoyne holds a Masters of Sustainable Development from Macquarie University and Bachelor or Arts (Geography) and Diploma of Education from Flinders University of South Australia.

Sophia Maalsen

Sophia Maalsen is the Ian Fell Post-doctoral Research Fellow at the University of Sydney, where she is researching the role of technology in 'smart homes' as a locus to address future environmental and social challenges. Prior to joining the University of Sydney, Sophia was a postdoctoral researcher on the EU-funded Programmable City Project where she investigated the digital transformation of cities and urban governance. In particular, she worked on the development of the Dublin Dashboard, a city metrics indicator designed to provide Dublin City Council and the residents of Dublin with real-time and relevant data on the city's performance. Sophia has also worked in the Enabling Built Environments Program at the University of New South Wales, specifically on a project that investigated how and why people with a disability were undertaking DIY home modifications. Her particular expertise is in understanding the intersection of the material, digital and the human and how this affects lived experience.

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