SMART
CITIES

Why Australia's cities of tomorrow start today

pwc   UTS

Contents

Executive summary

- Australia's smart cities agenda has slowly gained momentum, with local and state governments piloting and driving adoption of innovative technology across the built environment.

- With planned government investment in infrastructure, precincts and cities at an all-time high across Australia, now is the time to pick up the pace, build on these catalyst investments and build great, smart places around them.

- Overall, Australia has more than 45 major precincts and precinct programs under development, often at very different stages of smart precinct maturity.

- New partnerships will be pivotal to securing finance and accessing emerging technologies. From consortia with other local government areas (LGAs), to collaborations with private providers, partnering will mitigate emerging risks and boost the chances of successful delivery.

- A city is 'smart' when it's connected and citizen-centric. So, leaders must define target outcomes and align their smart city vision with their precinct. This includes engaging with citizens to co-design and ensure the strategy is tailored to the locality.

Australia's window of opportunity is now

When it comes to planning infrastructure, the smart money is on smart precincts. The concept of smart precincts – places that are enabled, powered and integrated by digital technologies – is gaining momentum, and Australia's smart precincts agenda has every reason to gather speed.

An unprecedented number of precincts are in the planning pipeline nationwide as governments of all levels invest in place and transport infrastructure, renew centres, and renew social and cultural infrastructure.

Many of these investments need to demonstrate to treasury departments that they deliver broader place-based metrics such as liveability, productivity, sustainability and citizen outcomes, alongside traditional economic or financial measures (i.e. positive discounted cash flow). These broader benefits not only paint a more accurate picture for planners, they ensure all stakeholders are speaking the same language in terms of data and planning assumptions, creating a common platform for decision-making.

Amidst this intensive investment planning, governments are seeding investments in smart cities pilots and applications, as evidenced by the NSW Government's $45 million Smart Places Acceleration Program.

Bringing these two streams of effort together will be critical to making the most of Australia's planned investment - driving innovation, advancing citizen outcomes, and achieving higher levels of service from new investment.

To do this, precinct planners need to be careful curators of future amenity, innovative services and surrounding sub-infrastructure in a meaningful way - to reflect the needs of citizens who live, work, play, study in and visit the area. Smart precincts are about creating liveable places by design, not just cities we happen to live in.

With vision, collaboration and decisiveness, Australia's smart city developments can succeed in building better precincts and more sustainable communities, and attracting global tenants and new industries. If not done the right way, we run a real risk of making generational planning errors; we could be counting the cost of retrofitting these sites for decades.

In short, Australia has a rare window of opportunity right now.

> " After all, smart precincts are about creating liveable places by design, not just cities we happen to live in "

Why Now?

No fewer than 45 major precinct developments[1] are in planning throughout Australia right now, from Fishermans Bend in Victoria to the Westmead Health precinct in NSW; and from Tonsley Innovation District in SA to Nambeelup Industrial Area in WA. Meanwhile, nine City Deals are garnering collaboration across governments.

Figure 1: Major precincts under development across Australia

When the modern smart cities movement began in Australia over a decade ago, it was more theory than fact – a conceptual model for the transformation of our cities, promising to connect systems using networked technology, real-time information and data to improve the *human* experience of the built environment.

Since then, we've seen a host of smart cities' pilots, plans and funding programs emerge across Australia. These have been developed at all levels of government, in conjunction with technology companies and property developers. Moreover, they've been made possible using a range of technologies.

This next generation of smart precincts can scale the learning and innovation of extensive pilots across the national infrastructure pipeline, integrating digital technologies, built infrastructure and circular design principles.

1. Precincts were identified by PwC subject matter experts across each jurisdiction. They include ongoing or announced precinct development projects which have potential to embed smart city principles and technologies.

5

Digital dormancy still slowing us down

In 2021, however, some infrastructure remains digitally dormant, with functionality unchanged since the 19th Century. Changes to the way we plan, design and fund smart infrastructure has been cautious, with practitioners citing costs, coordination and inexperience as barriers to next generation smart cities development.

Today in Australia, a combination of circumstances has created a burning platform for a next generation of smart precinct design and development:

- Substantial infrastructure spending by federal and state governments presents a one-off opportunity to reimagine precincts and design places with the sort of smart functionality that citizens demand in the 21st Century.

- Smart precincts have been critically enabled by tech advances such as cloud computing and the Internet of Things (IoT), as well as the saturation of mobile devices and NBN coverage. These developments mean smart precincts are not only possible, they're also more affordable now.

- Worsening climate change impacts – in conjunction with growing awareness around these impacts – is driving demand for greater climate action and circular design. Corporates, citizens and investors expect city design to respond to a changing climate.[2]

Smart precincts represent a chance to design and introduce a range of sustainability solutions, from IoT environmental sensors measuring heat microclimates, to onsite renewable energy generation, to targets for operational greenhouse gas emissions.

- The COVID-19 pandemic has increased digital literacy and generated greater tolerance for the use of data sharing technology (such as QR codes for contact tracing purposes). Citizens are more receptive to data sharing initiatives today than previously.

- Community engagement is increasingly desired with citizens, business and academia. This includes engaging with local Aboriginal communities to ensure a people-centred approach when designing and implementing smart city solutions, as well as improving citizen experiences by supporting access, inclusion and diverse communities.

- Additionally, the pandemic has triggered new ways of working. Workers have embraced remote working technology and communication. Ubiquitous mobile devices and 5G technology present continuously evolving possibilities for smart services and user experiences within precincts, as employers and employees reconsider traditional CBD (and other) office spaces and reimagine their work habits and practices.[3] At the same time, people have become localised within the suburbs they live, driving expectations for better amenity, services and infrastructure in residential areas. There is a collective urge to bounce back and create better places in the wake of fires, floods, and the pandemic.

All these factors have immediate implications for our cities.

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2. PwC (2021), *Building a more circular Australia: The opportunity of transitioning to a circular economy,* available at https://www.pwc.com.au/important-problems/environment-social-governance/building-a-more-circular-australia.html
3. PwC (2021), *Changing Places: How hybrid working is rewriting the rule book*, available at https://www.pwc.com.au/important-problems/future-of-work-design-for-the-future/changing-places-hybrid-working.html

What would 'smart precincts 2.0' look like?

"

Infrastructure technologies that seemed Jetsons-esque less than a decade ago are now commonplace on new building developments.

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Smart, Networked Intelligence

Infrastructure technologies that seemed Jetsons-esque less than a decade ago are now commonplace on new building developments. Think: traffic congestion sensors linked to traffic lights, EV charging docs, retail dispatch services, and even parking bays that direct drivers to the nearest available parking spot.

The next holy grail is networked intelligence, where these types of smart technologies are supported by a digital ecosystem. One example is Barangaroo, one of Australia's most advanced and sustainable commercial precincts. The precinct uses digital twin technology...real time. By embedding a strong digital element into the planning of precincts and public spaces, powered by a decade of learning in the Australian context, smart precincts can open up a host of opportunities for people-first places.

The digital ecosystem therefore is transforming urban planning. We recommend that planners get more value from their digital twin 'data lakes' by linking them to broader strategic planning tools. These enable 'what-if' scenario based analysis of proposed changes to services and infrastructure, and for different population profiles over time. Such tools allow multiple stakeholders to co-develop the sense of place - and define their desired liveability, workability, and sustainability impacts - and bring data insights to life.

image

Barangaroo, for example, is using its digital twin and strategic planning tools to implement long-term initiatives to become carbon neutral, water positive, create zero waste and foster community wellbeing. In fact, it's on track to become the first climate positive precinct of its size in Australia.

Buildings constructed today use similarly innovative technology, with sensors and infratech leading the charge towards achieving circular and decarbonised economies. Advances in technology and design, coupled with behavioural changes, can achieve a tenfold reduction in energy requirements of new buildings, and a fourfold reduction for existing buildings, and it can be done cost effectively.[4]

The Sydney Western Harbour Business Improvement District company is engaging local businesses across Barangaroo to the Sydney Fish Markets on an innovative digital insights pilot. The pilot will pool. The pilot will pool (anonymised) merchant data with mobile, footfall and visitation data to give local businesses and planners deeper insights about customer and visitor behaviours within the precinct. Specifically, the pilot is designed to spark new ideas for economic development, to reactivate the precinct beyond the COVID pandemic, as a place to live, work and visit.

As a tenant of the precinct, PwC has been working with the BID company to develop the pilot. Indeed, if optimised, the Western Harbour precinct has the potential to become a Sydney signature shopfront, generating an additional $2 billion per annum for the NSW economy.[5]

Similarly, Yarrabilba, Queensland, is seeing success as one of the first master-planned communities

in Australia to have developed their own circular economy strategy, achieving 6 star Green Star Buildings ratings.

Smart technology, IOT sensors and circular design drive sustainability outcomes so that public bins send alerts when full, and street lights, sprinklers, motion sensors and weather stations send real-time feedback to reduce water and energy consumption. Yarrabilba is the first master-planned community to provide a fast and free electric vehicle charging station, and has the first electric bus in Queensland.

> **The new holy grail for smart precincts is networked intelligence, where smart technologies are supported by a digital ecosystem.**

4. Lucon O., D. Ürge-Vorsatz, A. Zain Ahmed, H. Akbari, P. Bertoldi, L.F. Cabeza, N. Eyre, A. Gadgil, L.D.D. Harvey, Y. Jiang, E. Liphoto, S. Mirasgedis, S. Murakami, J. Parikh, C. Pyke, and M.V. Vilariño, '2014: Buildings' in *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, available at https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_chapter9.pdf.

5. (PwC 2015)

What makes a precinct 'smart'?

Best-of-breed digital technologies

Expect to see a range of best-of-breed digital technologies on display in smart precincts. Research by PwC and UTS found the most successful smart precincts tend to include:

Personalisation of services

Data is transformative as a way to understand, optimise and personalise services and infrastructure. Smart services will create a greater willingness of citizens to share their data with government and business in return for highly personalised services that improve their experience, help drive operational productivity and support the creation of new, high-value services.

Data sharing

Governments have vast amounts of accumulated data (e.g demographic information about their citizens, records detailing public service usage). So too do private sector partners such as developers and transport operators. Mutual benefit and good governance drive greater data sharing. When shared and combined, these public and private data streams are essential to smart city design, as many of the foundational elements of Smart Precincts are achieved by joining up data to get valuable insights.[5]

IoT

Serving as the backbone hardware for smart precinct developments, emerging technologies such as IoT are driving many smart precinct initiatives, while also evolving in the way they are used. IoT creates unique, user-centric experiences while also improving efficiency and sustainability in communities. Because IoT overlaps physical sectors such as food, water, energy and transport, data interoperability is key to support data flow and data federation.

6. However, this abundance of data presents potential challenges, including data overload, interoperability issues, and management of open data. These challenges are discussed later

'Internet of People'

Wearable fitness devices promote positive health outcomes for citizens of a precinct. When paired with a smartphone or website to track performance, wearables have the added bonus of creating an 'Internet of People'. The popularity of wearables means an increased density of sensors and therefore more potential data sources. They effectively increase ways to connect people to place.

Electrification

Electrification will enhance local mobility and reduce emissions within precincts. Long-term planning should factor in electric vehicles (cars, bicycles, scooters, etc.), plus the need for vehicle charging inbuilt to street or building parking.[7]

Digital Twins

Digital twins provide real-time updates and come with a variety of functions and uses such as building information models (BIM)[8] to support planning and construction, and to plan movement within places. Smart precincts should use digital twins that extend beyond just 'straightforward' data lakes (or similar) to incorporate strategic planning tools - 'what-if' engines that allow you to model different scenarios and give you valuable insights to help you make key decisions, e.g. if a new station is being built in a precinct, what other investment into surrounding infrastructure, services and amenities needs to be made to ensure that the place that is being built meets the current and future wants and needs of the different citizen demographics in the precinct?

Artificial intelligence (AI)

AI will drive greater personalisation of services in smart precincts, optimising systems, augmenting decision-making and driving even greater use of data. Importantly, this growing capability is subject to ongoing standardisation efforts, and requires community engagement around the ethical and responsible uses of AI.[9]

Renewable energy sources, smart sustainability and waste solutions

Renewable energy sources will become increasingly important in Australia's smart cities. So too will sustainability solutions such as vacuum waste systems, which could reduce emissions by 90%, and waste collection costs by 30%. In Western Sydney, for instance, this could save residents $62.8 million per year, and deliver indirect environmental and health benefits.

Quantum computing

Quantum computing has the potential to bring the next great productivity uplift in scale and speed of computing. For smart precincts, this means the possibility of delivering more cost- and energy-efficient solutions to problems such as large scale and granular machine learning and optimisation, currently 'impossible' for today's classical computers.

7. See https://www.researchgate.net/publication/291904806_ Worldwide_Electric_Powered_Two_Wheel_Market

8. See ISO 19650-1:2018 Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) — Information management using building information modelling — Part 1: Concepts and principles https://www.iso.org/standard/68078.html

9. https://www.pwc.com/gx/en/issues/data-and-analytics/artificial-intelligence/what-is-responsible-ai.html

Beyond technology: six success factors

Precincts are smart when they encompass the unique place, experience and connectivity outcomes for users and citizens. That is: when technology is planned with *purpose*.

From PwC's study of exemplar smart precincts (conducted in conjunction with UTS), as well as our work designing and creating several smart city projects overseas, we have observed six critical enablers. These six success factors can help operationalise smart city projects.

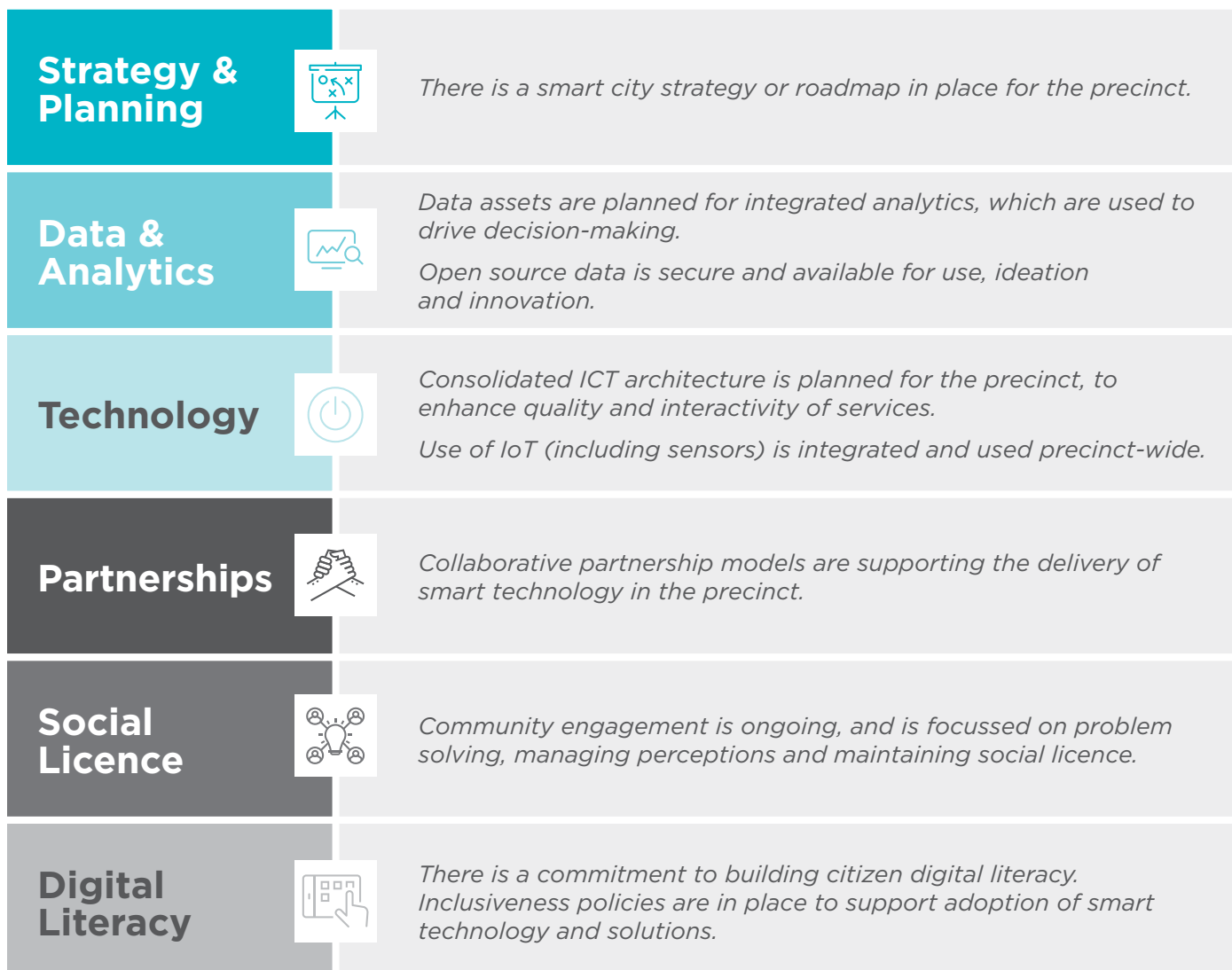|		
Strategy & Planning		*There is a smart city strategy or roadmap in place for the precinct.*
Data & Analytics		*Data assets are planned for integrated analytics, which are used to drive decision-making.* *Open source data is secure and available for use, ideation and innovation.*
Technology		*Consolidated ICT architecture is planned for the precinct, to enhance quality and interactivity of services.* *Use of IoT (including sensors) is integrated and used precinct-wide.*
Partnerships		*Collaborative partnership models are supporting the delivery of smart technology in the precinct.*
Social Licence		*Community engagement is ongoing, and is focussed on problem solving, managing perceptions and maintaining social licence.*
Digital Literacy		*There is a commitment to building citizen digital literacy. Inclusiveness policies are in place to support adoption of smart technology and solutions.*

Figure 3: Six critical success factors for creating smart cities

What defines a smart place is the strategy and partnerships for embedding technology and data elements with communities, and the way in which the community is part of the design and learning process.

There are many ways to blend physical and digital infrastructure but several successful archetypes are set out below.

Success factor	How? Example	Enabler
Connected experiences	Rio de Janeiro's Operation Centre is a cross-departmental, cross-functional initiative that works to improve the city's resilience. Rio de Janeiro's Operation Center was created in response to a particularly devastating storm in 2010. It was designed to manage crisis and emergency situations in a city prone to repeated storms and subsequent landslides in the lower income settlements located on the high slopes. Rio de Janeiro's Operation Centre illustrates the benefits of collaboration, with partnerships forming across government departments, and between public and private stakeholders. Developers worked with several private partners such as IBM, Cisco, Samsung and Google to design and implement new technology capabilities. These capabilities were used to enhance overall city operations, rather than standalone 'smart' initiatives, and the final design improved almost all facets of the city's operations. Rio de Janeiro's facility combines people from 30 departments, staffed 24 hours a day. It coordinates the activities for more than 300 local and state departments, plus private utility and transportation companies. These activities are integrated into a single, digital command-and-control system. Here, initiatives span from real-time traffic monitoring and predictive analytics, to the identification of neighborhoods with higher rates of dengue fever infection.	**Strategy and Planning**
Working in partnerships	In Hangzhou, the local government, Alibaba, and a number of other companies collaborated to achieve greater outcomes across the city. Developing non-traditional partnerships allows governments to secure additional funding, scale investment, access diversified subject and industry expertise, and mitigate risk. Hangzhou's City Brain, designed by Alibaba, is a cloud-based real-time data capture, aggregation and management system. It's the product of local government and private sector collaboration and it's used to optimise traffic flow. Since being piloted in Hangzhou, a number of other local governments (both within China and internationally) have signed up to implement Alibaba's evolving City Brain products, creating a private-public consortium that wouldn't necessarily exist within the traditional models of government development.	**Partnerships**
Open and accessible data sources	Seoul's Open Data Plaza provides more than 5,000 datasets, spanning all areas. Access to open data sources increases transparency, innovation and efficiency. Moreover, a city that can provide an integrated hub of relevant, reliable and secure data sets demonstrates that it has significant digital infrastructures in place. Seoul has over 5,000 datasets readily available, and the city consistently uses these data points to develop insights and generate learnings for the development of products and services for citizens. At the same time, this data is shared with citizens, encouraging participation and contribution. In Seoul, information is provided in the open API format, offering citizens real-time bus schedules, subway updates, locations of public Wi-Fi services, disability services and more. More than 180 apps have been created based on these data sets.	**Data & Analytics**

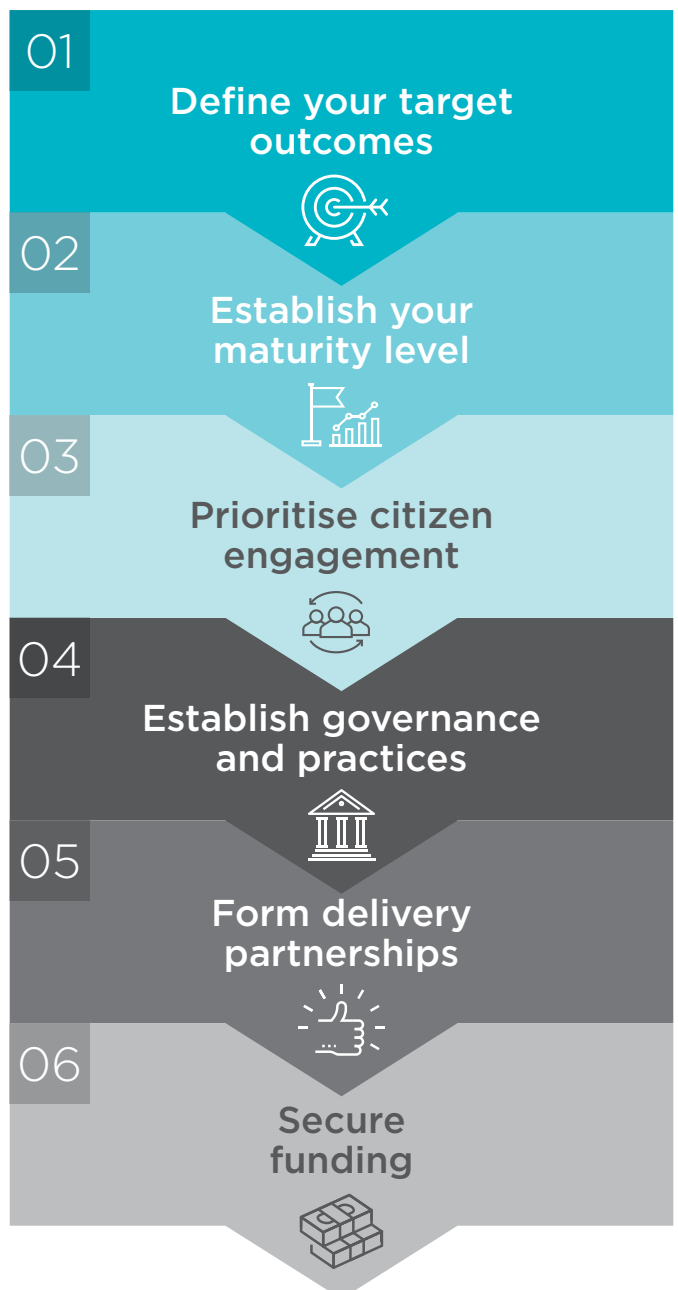| Success factor	How? Example	Enabler
Building trust around privacy	Barcelona now states that data produced by the citizen belongs to the citizen, controlling data flows based on citizens' rights. In creating smart cities or smart city initiatives, a huge quantity of citizen data can be collected and analysed to improve citizens' everyday experiences. At the same time, heightened scepticism amongst citizens when it comes to how this data is used, and how they are being protected, means taking steps to ensure citizens' privacy, as well as incentivising behaviour to share date. In order to develop and maintain social licence to operate, it's important for governments to educate and engage with citizens, as can be illustrated in Barcelona's approach to the capture and use of citizen data. Barcelona's Mayor, Ada Colau, explicitly announced her government's approach towards data privacy and trust when stating that, instead of needlessly taking all the data they could just because the technology allowed it, they are thinking beforehand about how to use it and how best to align the tech agenda with the broader agenda of the city. This approach also meant the city reviewed existing deals between government and private companies in order to identify any partnerships that they believed breached citizens' rights. The fundamental elements of creating a citizen data market include: - acknowledging the entire data lifecycle - creating appropriate governance across the entire data lifecycle - being explicit about how data is to be used (and not used) - providing a value exchange for citizens providing their data - building mechanisms for recovery (and compensation) - being transparent about how the system works including giving data 'back' to data subjects in an appropriate form.	**Social Licence**
Empowering and involving community	In New York, the Mayor's Office invites citizens to participate in open competitions and to propose ideas to solve real urban challenges. With numerous smart city initiatives underway, it is also vital to engage and empower the community when developing strategies. This can include apps to engage citizens and secure feedback, as well as citizen science and grants for developing forward-thinking technology.	**Digital Literacy**

A road map for getting started: Proven steps towards smart precinct success

Getting started

Smart Precincts are moving urban planning beyond a focus on the simple urban form, towards a 'system of systems' that that unlock amenity and functionality in places for communities, businesses and other precinct users.

Based on our study of global smart cities, and our experience, PwC Australia and UTS recommend six steps to get governments operationalising proof of concepts.

These steps embed the critical success factors identified above.

01 Define your target outcomes

02 Establish your maturity level

03 Prioritise citizen engagement

04 Establish governance and practices

05 Form delivery partnerships

06 Secure funding

1. Define your target outcomes

It's essential to define the future state in terms of the outcomes and objectives sought, and to set timeframes and allocation planning resources. These outcomes should be described in terms of real-world achievements that everyone can get behind. This is essential because success will depend on collaboration across your organisation, as well as with other agencies and stakeholders.

Outcomes should align with your organisation's strategy, and must be unambiguous, quantified and measurable. They should target high-impact outcomes, such as improved services and/or citizen experience, more efficient/productive places, more sustainable places, safer places, and/or better connectivity.

Program	Objective[10]
Climate-Smart Malmo	Become a world-leading climate city and Sweden's first climate-neutral city by 2020 with respect to municipal sector activities. Exceed EU's energy target of reducing CO_2 emissions by 20% by 2020.
Smart City Singapore	Address extreme demand on urban infrastructure. To be an Intelligent Island and one of the first countries with an advanced nation-wide information infrastructure, including interconnected computers in virtually every home, office, school, and factory. Enhance quality of life and economic growth.
Masdar Smart City	To be a 'green city in the desert' and a model for sustainable urban development regionally and globally. Also, seeking to be a commercially viable development that delivers the highest quality living and working environment.

Figure 5: Example objectives (international case studies)

10. https://www.researchgate.net/publication/280625245_Designing_Next_Generation_Smart_City_Initiatives_-_The_SCID_Framework

2. Establish the precinct's readiness level

Maturity models help identify where a precinct is currently positioned along its journey. They also help identify the road map for each precinct, in terms of strategy and planning, goals and actions to effectively move cities through the enablers of smart precinct outcomes, such as strategic intent, technology, governance and service delivery, citizen and business engagement, and use of data/ICT.

Understanding the gaps between the current level and future state level will aid with:

- determining critical capabilities needed to progress toward longer-term goals

- identifying what investments and adjustments are required to deliver on those goals

- considering whether any parts of the forward program might be better advanced in collaboration with other cities and wider partners.
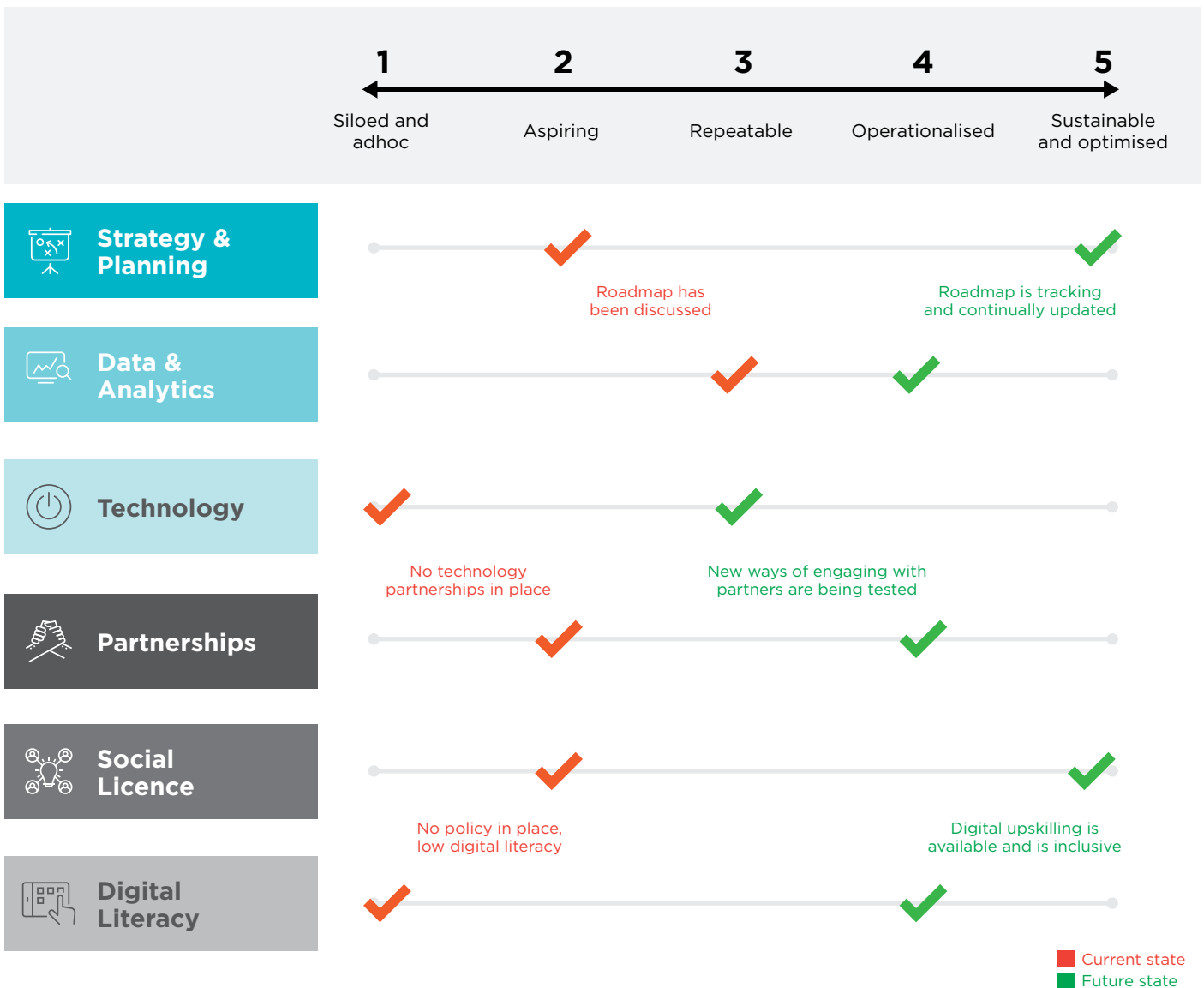

Figure 6: Conceptual example of how to apply a readiness model

Activities	Alignment to outcomes	Impact on enablers	Time to complete	Capability uplift required	Cost to execute	Citizen impact	Total score
01 5G rollout	🟢	🟢	🟠	🟠	🟠	🟢	🟢
02 Partnerships agreements	🟢	🟠	🟠	🟠	🟢	🔴	🟠

Figure 7: Scorecard example

3. Prioritise engagement to understand citizens' needs

Smart precincts are citizen- and community-centric, incorporating citizen and user perspectives throughout development.

Engagement will help ensure all technical planning is sound and aligned to the precinct's purpose and strategy. Community consultation ensures citizens guide and co-design important decisions, and assist with the significant coordination involved in delivering a smart precinct.

Putting community co-design processes in place can uncover community concerns early, and build the social fabric of a precinct.

Acknowledgement of culture and heritage and consultation with Aboriginal owners and communities is foundational, to ensure alignment to Aboriginal and Torres Strait Islander knowledge, values and traditions.

A scorecard approach can help inform this process, incorporating factors such as alignment to outcomes (defined in step 1), citizen consultation, broader government consultation, impact on maturity levels (established in step 2), time to deliver (quick wins versus long-term initiatives), and funding opportunities.

4. Establish governance and practices

The development of a smart precinct is commercially and strategically complex, bringing together different parties from the technology and property sectors, and delivering multi-network infrastructure. Establish governance and practices to clarify who is doing what to deliver the technology and service amenity, and to ensure that the full extent of capability is factored into the design and construction of surrounding sub-infrastructure in a meaningful way.

Every smart precinct requires clear practices and governance around data, to ensure security, trust and privacy. Cyber security, for instance, is not an add-on and should be integral to a broader risk management strategy.

5. Form delivery partnerships

Who will deliver the innovation and amenity citizens want in this precinct? The principle of co-design depends upon continued consultation with citizens, as well as stakeholders in the private and public sectors. Collaborations and consortia (e.g. a cluster of local councils) can dramatically improve the prospects of funding, risk mitigation, and successful delivery.

Here, it's important to know how to engage with different industries and stakeholders across the market. Target outcomes must be clearly articulated so that everyone understands (and aligns their activities to) these end goals.

Various stakeholders can support innovation within a precinct, identifying quick wins, agreeing long term initiatives, and scoping potential funding sources and requirements.

Governments have an enabling role in this innovation, through 'sandboxing' and providing participants with a safe space to experiment and innovate prior to regulatory and planning frameworks being set.

While flexibility is key, governments do also have an important role to develop regulations and standards, and to promote the uptake of standards. One example is where citizens outcomes are embedded in commercial agreements to ensure that these are given priority from procurement through to delivery.

With smart precincts, flexibility for the future is also an important consideration. All technology eventually becomes obsolete and superseded, so project designs must anticipate the need for upgrades in the future. Standards and interoperability frameworks can clarify how tech solutions fit together to ensure future upgrades do not have unintended consequences. Engaging with tech providers and/or other local authorities can help clarify implementation steps and requirements.

6. Secure funding

Finally, determine how the project will be funded, as well as how to measure the benefits to citizens.

With governments at every level committing funds for smart infrastructure, now is the time for smart precincts to secure investment. Various models of investment exist, including joint investment, private financing, and traditional grant funding. Where public funding is needed, a strong case that demonstrates value for money and a positive economic return is needed.

While smart precincts have the potential to deliver value to residents in terms of improved quality of life, they can also drive the local economy. Quantifying these benefits and mapping the value delivered then becomes the basis for a business case.

To effectively demonstrate value, smart city initiatives should be measured with both quantitative assessments (such as cost-benefit analyses) and outcome indicators that reflect holistic gains for citizens.

Some smart precinct business cases identify a 'benefits catalogue' to define the evidence base for how investments deliver short, medium and long term benefits. These catalogues can be used to both prioritise between options and to quantify the economic benefits of the selected project. In order to build a strong case for funding, the benefits to citizens, governments, and businesses should ideally be quantified and monetised to test return on investment (ROI) and help prioritise potential interventions.

When considering the business case for a smart precinct project, benefits must be framed in terms of the outcomes sought for key beneficiaries. Once funding is allocated and prioritised in different areas, governments can move towards executing a proof-of-concept solution.

An example where many of these 6 steps have been done successfully is the Smart Western City Program. As a City Deal, the program has been co-developed over 24 months with all three levels of government, that outlines the infrastructure, services and resources needed to ensure the Western Parkland City is a future-focused, digitally enabled city. across the three levels of government during the development of each commitment regardless of who is leading. This program highlights the importance of having a clear roadmap and strategy that is able to be iterated upon, and engaging with the private sector early through a market sounding process. This meant that at Gate 1 the program was given an overall HIGH level of confidence that the project is being effectively developed and delivered in accordance with the Government's objectives.

The Smart Western City Program is one of four commitments in Western Sydney and is led by the NSW Government while another, the Digital Action Plan, is led by the 8 local governments in Western Sydney. Governance and practices are in place to establish a collaborative approach across the three levels of government during the development of each commitment regardless of who is leading.

Smart Places Benefits Framework

Government	Industry Academia	Community
Citizen satisfaction	Improved efficiency	Employment opportunities
Economic growth & productivity	Commercialisation	Reduced cost of living
Induced private sector investment	New markets and services	Amenity and place
Reduced cost of operations	Supply chain efficiencies	Improved environment / reduced waste

Figure 8: Benefits framework

- What do these steps look like for your organisation, and how will you tackle each one? Is it possible to anticipate (and pre-empt) roadblocks for each stage?

- How mature is your organisation?

- Have you identified the proven technologies that can deliver the outcomes you seek? How will you prioritise and assess potential solutions?

- How will you co-design solutions with citizens, private sector partners, and other public sector jurisdictions?

- Flexibility is an essential ingredient in smart precinct design. How can you ensure the ability to exit from arrangements without incurring undue penalties or disrupting the ecosystem?

- What might the regulatory landscape look like in the coming years, and how might your projects anticipate this? How can you build a permitting and regulatory framework that facilitates smart infrastructure deployment?

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Resources

Organisations and Resources to be Aware Of

Standards Australia - Smart Cities Roadmap
The roadmap is a tool to identify how standards can support Australian communities and compliments the growth of Smart Cities and communities.

https://www.standards.org.au/news/on-the-road-to-safe,-sustainable-and-smart-cities

Smart Cities Council Australia New Zealand
SCCANZ is a member-based organisation dedicated to helping catalyse action and investment in technology and data solutions.

https://anz.smartcitiescouncil.com/

Centre for Digital Built Britain
The CDBB is a partnership between the Department of Business, Energy and Industrial Strategy and the University of Cambridge to understand how the construction and infrastructure sectors could use a digital approach to better design, build, operate, and integrate the built environment.

https://www.cdbb.cam.ac.uk/

United Nations - Sustainable Development Goals (UNSDG's)
The Sustainable Development Goals are a collection of 17 interlinked global goals designed to be a "blueprint to achieve a better and more sustainable future for all". The SDGs were set up in 2015 by the United Nations General Assembly and are intended to be achieved by the year 2030. Goal 11 is "Sustainable Cities and Communities". A description of the goal and the indicators underpinning measurements of progress can be found via the link

https://sdgs.un.org/goals/goal11

WaterNSW
Manages and operates 42 water storages across NSW, delivering water for environmental, domestic, town water, stock, industrial and irrigation purposes to all of the major river systems in Western NSW, Greater Sydney as well as the Hunter, Bega, and Iron Pot valleys in coastal NSW.

https://waterinsights.waternsw.com.au/

Australian Urban Research Infrastructure Network

AURIN provides thousands of datasets from hundreds of data providers can be retrieved through the AURIN Portal, and over 100 analytical and visualisation tools provide extensive scope for spatialising, integrating, manipulating and mapping diverse data from across multiple research disciplines.

https://aurin.org.au/

Australian Computer Society

The ACS releases an annual "Digital Pulse" report. The report from Deloitte Access Economics and the ACS provides an annual snapshot of trends in the Australian digital economy and workforce. The 2021 report considers how the technology workforce and digital ways of working in Australia have been impacted in the year since the COVID-19 pandemic began. While strong demand for additional technology workers in Australia is expected to persist, this edition focuses on three key areas to improve the quality, in addition to the quantity of technology workers.

https://www2.deloitte.com/au/en/pages/economics/articles/australias-digital-pulse.html

Australian Human Rights Commission

The AHRC has released a report on Human Rights and Technology. The sets out a roadmap for responsible innovation—taking advantage of the promise of new technology, while upholding our human rights. The Report's recommendations aim to ensure that new technologies are developed and used in ways that are inclusive, accountable, and with robust human rights safeguards.

https://humanrights.gov.au/our-work/rights-and-freedoms/projects/human-rights-and-technology

Digital Twins and Interactive Visualisation Tools

NSW Spatial Digital Twin

The NSW Digital Twin Minimum Viable Product (MVP) platform aims to respond to the NSW State Infrastructure Strategy by developing a 4D (3D+time) Foundation Spatial Data Framework. This includes providing presentation capability which allows visualisation and interrogation of 3D and 4D data models. The goal is to help the NSW Government with infrastructure assets planning and management, integration with land use planning, data collaboration, and sharing.

https://www.spatial.nsw.gov.au/what_we_do/projects/digital_twin

Digital Twin Victoria

Digital Twin Victoria is Land Use Victoria's pilot which brings together digital twin technology, rich 3D and 4D spatial data, artificial intelligence and sensor data and more to visualise and model places virtually, before investments reach the real world.

https://www.land.vic.gov.au/maps-and-spatial/projects-and-programs/digital-twin-victoria

Fishermans Bend Framework - Victoria

The Framework is a long-term strategic plan for the development of Fishermans Bend to 2050 intended to guide investment and development by the Victorian Government, local governments and the private sector.

https://www.fishermansbend.vic.gov.au/__data/assets/pdf_file/0020/35093/Fishermans-Bend-Framework.pdf

South East Qld Digital Twin

Built on the Terria platform, the SEQ Digital Twin a virtual model of the real world and capable of performing advanced analytics by machine learning. Its foundational architecture and organising principle are highly precise spatial data.

https://qld.digitaltwin.terria.io/

NSW City Viewer

Development approvals in NSW along with 3D building models and cadastral data.

https://giraffe-city-dev.web.app/nsw

DBB Gemini Principles

The Gemini Principles paper, released in 2018, proposes principles to guide the national digital twin and the information management framework that will enable it.

https://www.cdbb.cam.ac.uk/DFTG/GeminiPrinciples

Data Privacy and Governance – Training, Templates and Tools

Office of the Australian Information Commissioner (OAIC)
Available from the OAIC, these training resources are designed to help organisations and agencies develop or improve their privacy training programs.

https://www.oaic.gov.au/privacy/training-resources/

DDMM Digital and Data Trust Principles
The Australian Data and Digital Council (Digital and Data Minister's Meeting) has committed to using data and digital technologies to improve the lives of Australians, now and into the future. This includes projects to drive smarter service delivery and improved outcomes for you. Through bringing together ministers from the Australian Government and all state and territory governments, the Council seeks to improve the way jurisdictions work together to deliver data and digital projects.

https://pmc.gov.au/sites/default/files/publications/trust-principles.pdf

NSW Data Governance Toolkits
The Toolkit contains twelve modules that are designed to help agencies improve their ability to govern their data. The modules are:

- Module 1: Introduction to Data Governance
- Module 2: Legal and Policy Context
- Module 3: Data Governance Model
- Module 4: Strategy and Planning
- Module 5: Organisational Structures
- Module 6: Assigning roles and responsibilities
- Module 7: Leadership
- Module 8: Data-driven Culture
- Module 9: Workforce Skills and Capability
- Module 10: Technology
- Module 11: Data Management
- Module 12: Data Governance Checklist

https://data.nsw.gov.au/data-governance-toolkit-0

Smart Cities – Training, Templates and Tools

Smart Places Masterclass (Recorded video)
A 10-part Smart Places Masterclass Series developed in the lead up to the NSW Smart Places Summit in June 2021 focussed on the core drivers of human trust, privacy preserving data management and cyber security strategies, and how Government might incorporate these principles in driving better engagement with communities:

- Session 01 - Building Trust when creating Smart Places
- Session 02 - Smart Place Standards
- Session 03 - Digital Twins
- Session 04 - Data Sharing and Use, AI and Data Governance
- Session 05 - Smart Places Maturity Models
- Session 06 - 5G and Smart Places
- Session 07 - Precincts and Public Spaces
- Session 08 - Cyber Security in Smart Places
- Session 09 - An overview of IoT in Smart Places
- Session 10 - Investing in Smart Places

https://www.dpie.nsw.gov.au/our-work/strategy-and-reform/smart-places/smart-places-masterclass

Tools and Templates
The NSW Government has developed a range of tools to help place owners to deliver smart places in NSW. These policies and guidelines are referred to as "foundations" in the Smart Places Strategy and will help ensure smart solutions are rolled out in a consistent and efficient way. The policies and guidelines apply to all NSW Government Agencies and can be adopted by local councils, place and precinct owners and developers. The tools include:

- NSW Smart Infrastructure Policy
- NSW Digital Twin
- NSW Internet of Things (IoT) Policy
- Artificial Intelligence Tools
- NSW Cyber Security Policy
- NSW Information Management Framework (IMF)
- NSW Government Open Data Policy
- NSW Data Governance Toolkit
- Data Sharing Agreement Generator

https://www.dpie.nsw.gov.au/our-work/strategy-and-reform/smart-places/tools-to-deliver-smart-places

Social Licence – The Smart Places Customer Charter

A ready-made resource for place owners (including councils) to adopt.

https://www.dpie.nsw.gov.au/our-work/strategy-and-innovation/smart-places/smart-places-customer-charter

Partnerships – the Smart Places Advisory Council (expertly chaired by Dr Oppermann)

Designed to try and create and foster partnerships

https://www.dpie.nsw.gov.au/our-work/strategy-and-innovation/smart-places/smart-places-advisory-council

Cyber Security Resources

Australian Cyber Security Centre

The ACSC has developed prioritised mitigation strategies to help cyber security professionals in all organisations mitigate cyber security incidents caused by various cyber threats. This guidance addresses targeted cyber intrusions (i.e. those executed by advanced persistent threats such as foreign intelligence services), ransomware and external adversaries with destructive intent, malicious insiders, 'business email compromise', and industrial control systems.

https://www.cyber.gov.au/?gclid=CjwKCAjwzMeFBhBw EiwAzwS8zBFY5Y8K-KMRePdniEGtbbnDoV1-Ic2iog34u J8eZWyy5OT0ga6gvxoCxH8QAvD_BwE&gclsrc=aw.ds

ACSC Essential 8

The ACSC has developed "Strategies to Mitigate Cyber Security Incidents" as a prioritised list of mitigation strategies to assist organisations in protecting their systems against a range of adversaries. This baseline, known as the Essential Eight, makes it much harder for adversaries to compromise systems. Implementing the Essential Eight proactively can be more cost-effective than responding to a large-scale cyber security incident. The Essential 8 website contains information on:

- Essential Eight Maturity Model
- Essential Eight to ISM Mapping
- Implementing Application Control
- Assessing Security Vulnerabilities and Applying Patches
- Microsoft Office Macro Security
- Restricting Administrative Privileges
- Implementing Multi-Factor Authentication
- Strategies to Mitigate Cyber Security Incidents
- Strategies to Mitigate Cyber Security Incidents – Mitigation Details

https://www.cyber.gov.au/acsc/view-all-content/essential-eight

Telecommunications Resources

GSMA 5G Guide
The GSMA represents more than 750 mobile operators worldwide and over 350 companies in the broader mobile ecosystem, including handset and device makers, software companies, equipment providers and internet companies, as well as organisations in adjacent industry sectors. The 5G Guide and its associated business case model and 5G Readiness tool were developed in 2019 by the GSMA's 5G Task Force.

https://www.gsma.com/wp-content/uploads/2019/04/The-5G-Guide_GSMA_2019_04_29_compressed.pdf

Australian Communications and Media Authority
ACMA has developed information, guidance on 5G and the topic of EME (electromagnetic energy) and other 5G topics.

https://www.acma.gov.au/eme-5g-and-you#eme

Australian Mobile Telecommunications Association
AMTA has released Edition 1 of the State and Territory 5G Infrastructure Readiness Assessment.

https://amta.org.au/5g-infrastructure-readiness-assessment/

6G Research Flagship
The world's first 6G Mobile Communications program was established in 2019 aiming to deliver 6G by 2030. The 12 whitepapers developed by hundreds of experts internationally address topics on:

- 6G Drivers and the UN SDGs
- Business of 6G
- Validation and Trials for Verticals towards 2030's
- Connectivity for Remote Areas
- 6G Networking
- Machine Learning in 6G Wireless Communication Networks
- Edge Intelligence
- Research Challenges for Trust, Security and Privacy
- Broadband Connectivity in 6G
- Critical and Massive Machine Type Communication towards 6G
- Localization and Sensing
- RF enabling 6G – opportunities and challenges from technology to spectrum

https://www.6gchannel.com/6g-white-papers/

Rules as Code

Observatory of Public Sector Innovation
OPSI's 2020 report, Cracking the Code, provides an introduction to the Rules as Code (RAC) concept, its potential and considerations relating to its use in the public sector. It explores:

- The current state of government rulemaking and why this is creating three interrelated problems for governments.
- The RaC concept, use cases and related and preceding efforts.
- The case for RaC as well as a number of considerations that need to be explored in relation to the concept.
- A number of future scenarios that help tease out how RaC could develop in government.
- Practical advice and guidance relating to the operationalisation of RaC in a public sector context.

https://www.oecd-ilibrary.org/docserver/3afe6ba5-en.pdf?expires=1622354350&id=id&accname=guest&-checksum=ECACF29D8C7F4EAEA08717AC7952F511