



Smart Cities

Advance Communities towards
Sustainable, Resilient, Inclusive,
Safe, Kind, and Loveable



Foreword

Cities are the powerhouse of the modern world. They occupy 3 percent of the Earth's surface but account for more than 80 percent of the global GDP and 70 percent of global greenhouse gas emissions. The number of people living in cities has more than doubled over the last 40 years and is projected to constitute 68 percent of the world's population by 2050.

Future Cities offer immense possibilities to advance communities, but also present undeniable challenges for environmental and social sustainability. They need to evolve towards empowering collaboration where government, citizens, private sector, and academia work together in co-creating a better future for all.

Today, City Governments are in a unique position to leverage smart technology in implementing citizen-centric solutions to meet the needs that come from rapid urbanization, climate change, digital revolution, and demographic shifts. Digital transformation requires a holistic approach that strategically integrates technology, policy, infrastructure, and other solution elements in driving developments that offer shared outcomes for governments, businesses, and citizens.

For this reason, NCS and Eden Strategy have collaborated to co-develop a unique point-of-view on Smart Cities and a framework to help Smart City Leaders truly address the complex challenges that governments and citizens face now and in the future.

We look forward to working with like-minded partners in harnessing technology to build cities that are Sustainable, Resilient, Kind, Inclusive, Safe, and Loveable.

Sam Liew
Managing Partner,
NCS Gov+

Contents

Key Points	1
Study Introduction	2 - 4
The Truly Smart City	5 - 8
City Archetypes	9 - 15
The NECESCity™ Smart City Framework	16 - 23
Concluding Remarks	24
Appendix:	
City Archetype Methodology	25
NCS Case Studies	26 - 31
References	33 - 36
Biographies	37 - 38

Key Points

The purpose of this NCS-Eden paper is to help city leaders create a holistic Smart City plan through a unique point-of-view that argues for an outcomes-driven approach towards Smart City planning.

- This study reveals that the World's leading cities encourage citizen engagement and public-private-people partnership in pursuing their visions. They are moving away from the traditional tech-centric view of Smart Cities and towards prioritising co-creation as a cornerstone of their Smart City planning.
- Truly Smart Cities adopt a citizen-centric approach and orient themselves towards a strategic, outcomes-based approach. We observe six common strategic outcomes across leading Smart Cities: Sustainable, Resilient, Kind, Inclusive, Safe, and Loveable.
- Most cities fall within a set of archetypes which have commonalities in their citizen needs. Using these archetypes, city leaders can develop a clearer understanding of their city positioning, including which strategic Smart City outcomes to aspire towards. They can draw inspiration from similar cities that have successfully developed citizen-centric, outcomes-based Smart City solutions. These six archetypes are: Prosperous, Compact Community; Sophisticated Metropolis; Urban Powerhouse; Emerging Mega Hub; Promising Urban Centre; and Developing, Crowded City.
- Armed with an understanding of citizen-needs and strategic outcomes, city leaders need an approach that allows them to systematically pull together various solution elements to form a holistic Smart City plan. The NCS-Eden Collaborative Eco Smart City (NECESCity™) framework can address this need.
- NECESCity™ is a trademarked, holistic system that includes the parameters of urban functions; stakeholders; solution elements; technology enablers; operating principles; planning considerations; and desired outcomes. This framework serves as a 'master key' to help city leaders systematically create an outcomes-based Smart City plan that truly meets the needs of their citizens.

Study Introduction

City governments are in a unique position to address the greatest challenges of our time.



Purpose

Cities are where some of the most critical advances we make as a society will take place. However, much of the focus in the existing Smart City literature, as well as many smart city strategy discussions, is on the efficacy and efficiency of tech solutions. Drawing on our collective experience designing and implementing Smart City projects, NCS and Eden Strategy Institute (“Eden”) collaborated to form a unique point-of-view on Smart Cities that argues for an outcomes-driven approach towards Smart City planning, that truly address the complex challenges that citizens face in today’s world.

The purpose of this NCS-Eden paper is to help city leaders systematically create a holistic Smart City plan to meet the unique needs of their citizens.

We will explore a fuller definition of Smart Cities; identify commonalities and patterns in city needs through city archetypes; and introduce the NCS-Eden Collaborative Eco Smart City (NECESCity™) framework that serves as a ‘master key’ for end-to-end, holistic Smart City planning.

Methodology and Scope

Eden drew on its extensive database of over 200 Smart Cities from its flagship, bi-annual Global Smart City Government Rankings, which features good practices and case studies from leading Smart Cities. Eden also conducted an extensive review of literature from Smart City practitioners and city leaders.

As part of the research and analysis for this paper, Eden further conducted global trend analysis based on secondary research, to identify pressing global trends that would affect city planning.

Eden further validated the insights with the NCS Gov+ team, leveraging their experience as technology providers to city leaders to gain insight into the current and emerging Smart City technologies.

With this, Eden and NCS co-created an end-to-end, holistic Smart City planning framework that pulls together essential planning elements to practically implement successful Smart Cities.

We began with trend analysis to understand emerging themes affecting city planning.

Current Trends

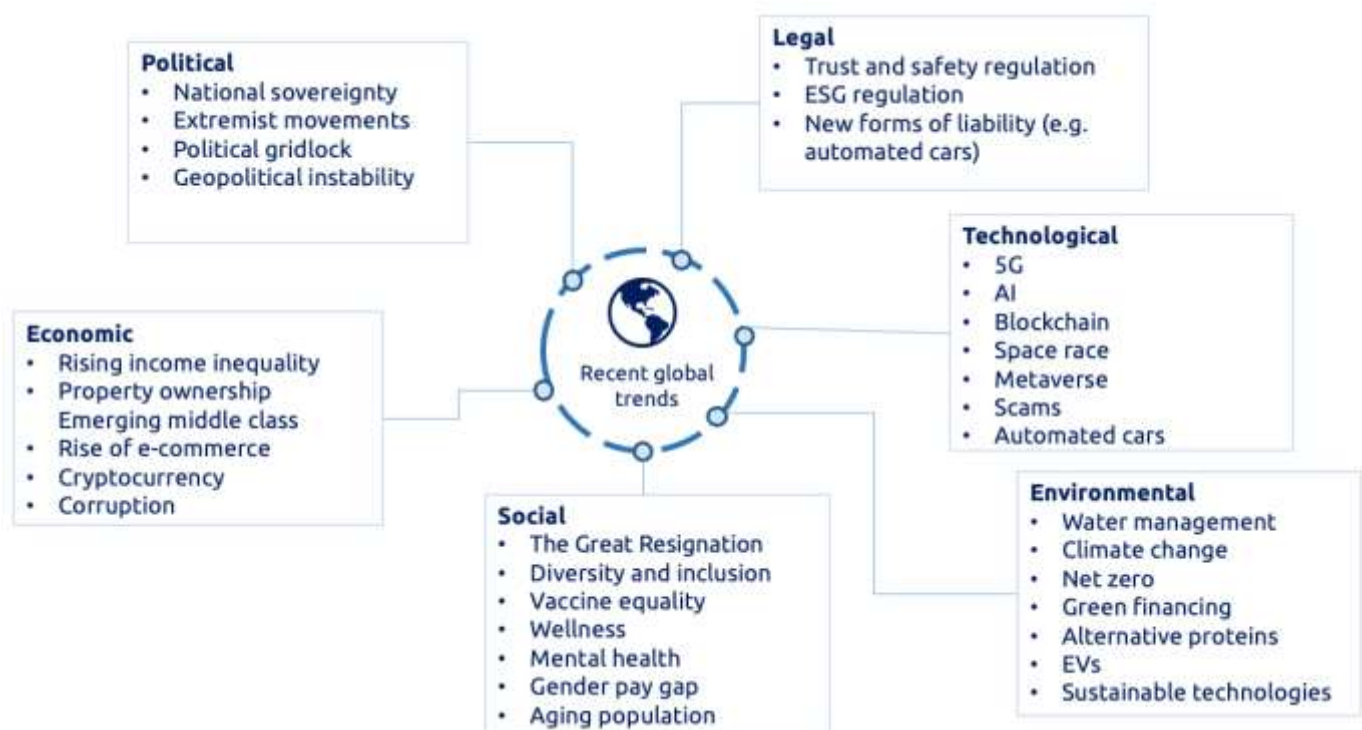
People have always been drawn to cities as the centres of trade, culture, learning, and economic opportunity. Today, approximately 57 percent of the global population resides in cities, with the number projected to increase to 68 percent by 2050.¹ Alongside rapid urbanisation and population growth, cities have also become concentrated settings for social, environmental, economic, and political challenges. In the face of increasingly complex and wide-ranging issues, it is imperative for city leaders to leverage their resources to develop effective and targeted 'Smart City' solutions for their citizens' current and future needs.

Understanding global trends is key to understanding citizen needs. We have conducted literature review on global trends to complement our insights from hundreds of

discussions with city governments and smart city practitioners. In Figure 1, we distil examples of trends that could have fundamental implications on citizens' lives, including how people eat, work, live, study, play, shop, and communicate.

For example, we identified climate change as a recurring theme affecting how cities are planned and designed to cope with climate disasters such as flooding, heat waves, and food shortages. Rapid technological advances such as digitalisation and social media use have seen the rise of scams, fake news, and online harms that would affect a city's cybersecurity architecture and digital trust efforts. Increasing wealth inequality can have an impact on a city's affordable housing and homeless mitigation strategies.

Figure 1: Recent global trends



¹ World Bank (2020)

Emerging Trends

Looking ahead, we identified emerging trends such as decentralisation and virtualisation, with Non-Fungible Tokens (NFT) driving digital property ownership, decentralisation and user ownership with Web 3.0, and the virtualisation of physical spaces with the metaverse. These new advancements will signal fundamental changes to the way people interact and use public spaces; the metaverse has been hailed as the “digital facsimile of how we live in the physical world”.²

Cities will be crucial to advance the adoption of these new ways of life, for example, by building digital infrastructure, upskilling talent, and migrating public services.

For example, the Seoul Metropolitan Government has announced its intention to be the first major city to enter the metaverse, called “Metaverse Seoul”. It has plans to

establish a virtual communications ecosystem for all areas of its municipal administration by 2023. Seoul’s platform will host a variety of public services, historic sites, and cultural events that residents can access with VR technology. They have also announced a virtual city hall, “the Metaverse 120 Centre”, where residents and local officials can meet in their avatar forms, to access public services or file complaints.³

This plan is part of South Korea’s Seoul Vision 2030 plan, which aims to make Seoul “a city of coexistence, a global leader, a safe city, and a future emotional city”.⁴

In the face of these current and emerging trends, city leaders are presented with the opportunity to influence the direction of urban development, and design cities which are smart, liveable, loveable, and future-ready.



² Bloomberg Cities Network (2022)

³ Gaubert (2021)

⁴ Ibid.

The Truly Smart City

Our concept of the “Smart City” needs to expand beyond a tech-centric lens and adopt a citizen-centric lens that sees technology as an enabler to meet the real needs from the ground.

Earlier depictions of Smart Cities have been oriented around installing cutting-edge technology infrastructure and software to create more wired, networked, connected, and intelligent urban areas.

This tech-centric approach has led to failures or only partial successes of many Smart City projects, because they did not directly address citizens’ deeper needs and concerns. For example, India’s 100 Smart City Mission has had mixed results with cities outside of the major capitals, such as Amaravati, Bhagalpur, Muzaffarpur, and Shilong unable to complete projects within the original six-year timelines due to digital talent and financing gaps.⁵

Another high-profile project in Toronto, which promised a community built “from the Internet up”, was derailed due to citizens’ concerns over privacy and fears of “surveillance capitalism”.⁶ Toronto is now moving towards a new city vision which prioritises affordability, sustainability, and environmental-friendly design over glossy, new technologies.

City leaders, Smart City practitioners, technology companies, and multilateral organisations around the world are embracing this shift towards a more citizen-centric approach in defining and designing Smart Cities (see Figure 2).

Figure 2: Examples of broader definitions of Smart Cities⁷

Organisation/City	Definition of Smart Cities
Boston	A smart city seeks to transform how government operates by putting the needs of residents and users first and using the best tools and resources it can leverage to solve real challenges.
European Commission	A smart city is a place where traditional networks and services are made more efficient with the use of digital solutions for the benefit of its inhabitants and business. It goes beyond the use of digital technologies for better resource use and less emissions. It means smarter urban transport networks, upgraded water supply and waste disposal facilities and more efficient ways to light and heat buildings. It also means a more interactive and responsive city administration, safer public spaces, and meeting the needs of an ageing population.
New York City	Being smart means addressing issues that affect residents in a way that is user-centred and preserves people’s digital rights.
Philadelphia	A city that uses integrated information and communication technology to support the economic, social, and environmental goals of the community.
Portland, Oregon	A smart city is one that uses data and technology to improve the lives of, and prevent further harm to, underrepresented groups including Black, indigenous, people of colour, and disabled communities.
Singapore	Singapore as a Smart Nation where people will be more empowered to live meaningful and fulfilled lives, enabled seamlessly by technology, offering exciting opportunities for all.
UNDP	Smart cities use technology and innovation to improve the urban environment - leading to improved quality of life, greater prosperity and sustainability, and engaged and empowered citizens.
UNECE	A smart sustainable city is an innovative city that uses ICTs and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects.

⁵ Earth.org (2022)

⁶ Guardian (2021)

⁷ Urban SDK(2022); European Commission; UNECE; UNDP Singapore

Leading Smart Cities strive towards an outcomes-based approach rather than a tech-centric approach. We observe six common strategic Smart City outcomes across leading Smart Cities: Sustainable, Resilient, Kind, Inclusive, Safe and Loveable.

Based on our study of more than 200 cities worldwide, leading Smart Cities typically strive towards achieving one or more of the following six strategic outcomes: Sustainable, Resilient, Kind, Inclusive, Safe, and Loveable.

Sustainable

Environmental sustainability is one of the most prominent challenges facing society, leading to a global conversation around climate change and resilience.

Frankfurt and Vienna are examples of cities which have placed sustainability high on their agenda. Frankfurt embarked on its journey to reduce carbon emissions back in 2013, with the objective of halving energy use and using only renewable sources of energy by 2030⁸. In developing its sustainability masterplan, it engaged transdisciplinary experts and sought citizen feedback in setting targets and creating their strategic roadmap.⁹ A key strategy for Frankfurt is to catalyse citizen behaviour change to accelerate energy transition, using incentives such as cash bonuses for energy savings, environmental education programmes for school children, and energy savings guidebooks for the public.¹⁰

Vienna has long been a champion of bottom-up sustainability solutions that can scale at the city level, including initiatives such as citizen-owned power plants, sludge-based home heating, electric car sharing, and increasing access to consultancy services and funding for local businesses to 'green' their businesses. It has committed to reduce per-capita carbon emissions to 80 percent of 1990 levels by 2050.¹¹ A 2017 review revealed that Vienna is well on track to achieve its goals for carbon reduction, waste management, social inclusion, and energy reduction.¹²

Resilient

Leading cities which strive towards resilience tend to focus on strengthening their foundations to safeguard essential citizen needs such as livelihoods, clean water, housing, and education, in the face of disruptions such as pandemics and natural disasters.

Cities such as New York City and Tokyo have developed smart city strategies which have been instrumental in their disaster response. New York City's OneNYC 2050 strategy, released in 2019, outlined eight goals and 30 initiatives to make their city future-ready.¹³ For example, their goal to modernise its infrastructure includes initiatives to encourage universal broadband access and digital inclusion.

During the pandemic, the city helped elders stay connected during the lockdown by partnering with LG and T-Mobile to distribute 10,000 tablets to elders living alone in public housing. The city's Economic Development Corporation has also been building advanced manufacturing capabilities over the years, which enabled them to design and produce personal protective equipment (PPE), hand sanitisers, and ventilators.¹⁴

Tokyo's disaster management approach combines advanced technologies with human-centric designs. Tokyo reinforces quake-proof infrastructure with a combination of policy instruments and technology. For example, its Disaster Preparedness Tokyo App enables people to access disaster prevention information easily.

⁸ Rueter (2016)

⁹ Schnapper (2019)

¹⁰ Sustain Europe (2019)

¹¹ Smart City Wien Framework Strategy (2014)

¹² European Bank for Reconstruction and Development

¹³ OneNYC (2020)

¹⁴ Ibid.

Kind

An emerging theme that cities are striving towards is the drive to create a kinder, caring, and more compassionate society. Among the initiatives that we observe in cities include technology-based initiatives to improve the lives of vulnerable segments, encouraging volunteerism across society, and implementing policies to recognise the value of care work.

Seattle spends USD 90 mn annually to address the problem of homelessness, but 12,000 people continue to remain on the streets.¹⁵ As such, Seattle has partnered with technology partners such as Amazon and Tableau to develop a data modelling solution to automate the manual process of reporting on investments, budgets, and outcomes related to tackling homelessness. The City's Human Services team has also embarked on developing an app to help its outreach workers connect the homeless to housing and other resources.¹⁶

Over in Barcelona, the "Caring City" initiative is a series of 68 initiatives, programmes, and proposals to socialise the importance of care work, by recognising its social value and ensuring the right to provide and receive care in fair and decent conditions. Barcelona is also recognised for its pioneering work in mental health. Barcelona's Mental Health Plan for 2016-2022 is a series of proposals launched in coordination with organisations and professionals in the mental health sector; the Suicide-Prevention Telephone helpline is a measure that operates 24 hours a day and is run by specialist volunteers providing active listening and emotional support, who will activate emergency services if an imminent or in-progress suicide attempt is detected.¹⁷

*Truly Smart Cities
strive to be
Sustainable, Resilient,
Kind, Inclusive, Safe,
and Loveable.*

Inclusive

Diversity and inclusion are key global issues, and cities are striving to make their infrastructure and services more inclusive, especially for underserved segments of society such as the elderly, people with disabilities, low-income households, and refugees. Fukuoka City's "Fukuoka 100 ~ Living Healthy for 100-Years" strategic plan supports the health and long-term care of its aging population. Under this plan, the Digital Medical Home Era establishes a smart home care structure that augments traditional care services with new technologies such as virtual care and online medical interviews.¹⁸

In Rotterdam, the city council allocated USD 5.6 mn to regenerate Bospolder-Tussendijken, one of the city's poorest and most diverse neighbourhoods, with a combination of projects that weave together sustainable energy transition, improved housing stock, climate change adaptation, and social inclusion and integration. The initiative aims to foster a sense of social cohesion and inclusion among a community which had previously scored the lowest in a survey-based index of people's Connectedness, Satisfaction, Capacity, Participation, and Living environment. Social Impact by Design is a programme under this initiative that invites stakeholders and inhabitants to propose projects that help address the district's prominent challenges; these projects are currently in pilot phase, and tackle pressing issues such as improving outdoor spaces with climate adaptive measurements.¹⁹

Safe

Cities are also prioritising citizen safety and public order, in a climate of heightened scrutiny of violence against women and girls. Online safety has become another pressing issue, with the rise of scams, cyberbullying, and harmful content.

Quito developed a hotline called "Stop the Harassment" that allows citizens to report harassment cases on public transport in real-time. Each report activates a response mechanism notifying the driver to activate an alarm in the bus. The Stop the Harassment Brigade gets in touch with the victim within three minutes and offers options file a

¹⁵ Coleman (2018)

¹⁶ Derrick (2019); City of Seattle

¹⁷ Barcelona Caring City

¹⁸ Accenture (1970)

¹⁹ Resilient Cities Network

complaint or receive protection, and the police wait for the victim at the next stop to offer support. Since 2017, the platform has received more than 1,500 complaints of sexual harassment.²⁰

Cities are paying increasing focus on data privacy and cybersecurity. Sydney adopts a security-by-design approach to open data and ensures the ethical publication of data. It takes a citizen-centric approach to its data policies, following six principles of Consent, Checkability, Choice, Control, Convenience and Content.²¹ Singapore battled a surge in scams recently and launched an AI-powered app called ScamShield which can identify, filter, and block scam messages with 95 percent accuracy. The app consciously in-builds privacy by analysing messages on users' devices rather than on the government's servers.²²

Loveable

Cities are also tapping into their rich culture and heritage to create loveable cities. Art, history, tradition, and culture are core elements of placemaking, which draws visitors and unites the city's residents. Guadalajara, known as Mexico's Silicon Valley, embarked on a journey to develop a digital creative hub in the historic centre. This included developing an innovation centre to spur growth, investment, and employment in creative industries such as TV, film and cinema, digital animation, and interactive multimedia.²³

In Indonesia, Bandung developed a vision to create a liveable and loveable Smart City, rooted in creativity and heritage. Bandung hosts a variety of workshops, conferences, and festivals aimed at encouraging creativity and developing new product prototypes. For example, the DesignAction.bdg workshop is organised to stimulate civic engagement to design more inclusive public spaces. Fifty-six percent of Bandung's economic activities are design-related, with fashion, graphic design, and digital media as the some of the top subsectors in the local economy.²⁴

Citizen engagement

Citizen engagement is a commonality across leading Smart Cities in their efforts to achieve the six strategic outcomes of Sustainable, Kind, Resilient, Inclusive, Safe, and Loveable.

Most of the city case studies mentioned above adopted bottom-up approaches, with citizen co-creation a cornerstone of each initiative. They demonstrated deep commitment to engaging citizen feedback and encouraging citizen engagement in jointly developing the city's vision and participating in initiatives. This resulted in thoughtful, deeply human-centric solutions that were adopted by the community, a key example being Rotterdam's Social Impact by Design programme (see 'Inclusive' section above) which solicits citizen feedback to tackle pressing issues.

NCS' vision for the truly Smart City is a city that advances communities by strategically integrating technology, policy, infrastructure, and other solution elements in key urban functions.

NCS Vision

Based on our extensive research and analysis of good Smart City practices, our vision for the truly Smart City is a city that advances communities by strategically integrating technology, policy, infrastructure, and other solution elements in key urban functions to become sustainable, resilient, kind, inclusive, safe, and loveable.

The following City Archetypes section will illustrate how different cities are able to enjoy the latitude of interpreting these outcomes to suit their individual contexts.

²⁰ El Comercio (2018)

²¹ Barbaschow (2019)

²² Tay (2021)

²³ CCD; Arup

²⁴ UNESCO Creative Cities

City Archetypes

City archetypes help us understand commonalities in different cities so that city leaders can adopt a citizen-centric, outcomes-based Smart City approach to develop solutions suited to their contexts.

Every city is unique and has different contexts, assets, strengths, and aspirations, and needs. Through review of existing studies by leading Smart City practitioners such as Shell and the Centre for Liveable Cities as well as our analysis of more than 200 cities, we observed six major archetypes that cities fall into. These archetypes help us understand the commonalities and patterns in cities, as determined by citizen needs, budgetary concerns, behaviours and mindsets, as well as technology implementation considerations. Cities can be qualified as one of these six major archetypes based on the parameters of

population size, density, and ability to invest.²⁵ The archetypes are: Prosperous, Compact Community; Sophisticated Metropolis; Urban Powerhouse; Emerging Mega Hub; Promising Urban Centre; and Developing, Crowded City (Figure 3).

These archetypes will help point smart city practitioners or city leaders to the typical citizen needs and considerations across different types of cities. This will inform city leaders about the development of Smart City solutions suitable for each city's context.

Figure 3: Six major city archetypes



²⁵ Shell; Centre for Liveable Cities

I. Prosperous, Compact Community

Example: Amsterdam, Copenhagen



Population size and density

Prosperous, Compact Communities usually feature a low to mid population size across a small land area. Citizens here are accustomed to a high quality of life, and enjoy sufficient space to live, work, and play. There are some pockets of density in downtown areas, but the city also has many low-density suburbs.

Citizen Needs

Beyond meeting essential needs, Prosperous, Compact Communities have typically evolved to be concerned about maximizing citizen welfare. Some of these cities use technology to fulfil the higher order needs of citizens, level inequalities, live sustainably, and strengthen the social compact among citizens. Population growth in Prosperous, Compact Communities is often slow, and such cities may face an ageing population. This typically underpins a desire for a kinder, more inclusive, and more sustainable city.

Ability to Invest

Prosperous, Compact Communities typically have a high Gross Domestic Product (GDP), which corresponds with a high ability to invest. Their economies usually centre around specialised, high-value goods and services.

Technology and Policy Considerations

Prosperous, Compact Communities have existing sophisticated physical and digital infrastructure. In choosing new technologies, these cities typically look for premium-quality solutions. Most citizens may be digitally-savvy, but cautious about further tech adoption if it infringes on their digital rights and privacy. Priority technical features include automation, high bandwidth (5G, 6G) and throughput, as well as data privacy and AI ethics.

In terms of policy intent, such cities prioritise heavy citizen consultation and consensus-building, initiatives which enable social transfers, and ethical technology development.

Case study: Copenhagen

Copenhagen tops the rankings of many liveable cities as well as the UN Happiness Index. The wealthy Danish capital adopts an inclusive strategy for urban planning, including jobs, affordable houses, emphasis on the environment and citizen health, and fostering social bonds. Danish authorities have a robust collection of basic data about citizens, businesses, and real estate in digitising services across administrations and sectors. The availability of high-quality basic data enables data-driven, effective Smart City solutions to meet various challenges related to urbanisation and climate change.

Copenhagen is committed to reach carbon neutrality by 2025 by transforming its energy sector, to power electric generation and heating systems with renewable energy from wind turbines and biomass.²⁶

The city has achieved a 42 percent reduction in carbon emissions since 2005, while experiencing a 25 percent growth of its economy. Citizen mindsets are shifting towards “living small” and consuming less, which can affect the types of Smart City investments the city takes on. For example, European travellers’ “flight shame” movement is leading to more government investment into train networks.²⁷

²⁶Mathiesen, B. V., Auken, I., & Skibsted, J. M. (2019)

²⁷ Birnbaum (2019)

II. Sophisticated Metropolis

Example: Los Angeles, Barcelona



Population size and density

Sophisticated metropolises usually have a large population size spread across a large land area. They typically feature a highly dense downtown area, with most of the citizens living in the suburbs.

Industrial and economic activity is usually spread out in mini hubs across the sprawling city, resulting in the perception of the city as sparsely populated in areas away from downtown and hubs. They tend to attract youth or people of working age from all over the country or region due to the economic opportunities available.

Citizen Needs

Due to the sprawling geographic area, certain areas of the city are underdeveloped and face issues such as socioeconomic disparities and corresponding social problems such as crime. Hence, it is typically the priority of such cities to level socio-economic disparities and build a more inclusive society.

Such cities are typically concerned about citizens feeling displaced and isolated, lacking a sense of belonging or unity. Hence, placemaking and promoting heritage and culture to create a loveable city is also a priority.

Ability to Invest

These cities usually exist in developed countries and typically feature high-value, service-based economies. Hence, their ability to invest is usually high, but tempered by the scale at which solutions have to be implemented due to the large land area.

Technology and Policy Considerations

Sophisticated metropolises are sprawling cities with well-developed, technology-enabled infrastructure in most parts of the city, but may face disparities across regions. They typically require mid- to high-quality technological solutions. Of priority in their technical requirements include the scalability of millions of sensors, multiple control centres, and multiple integration of different sensors.

In terms of policy intent, Sophisticated Metropolises tend to prioritise widespread data collection and equitable access to amenities.

Case study: Barcelona

For Barcelona, inclusivity is important as smart citizens are an important part of its Smart City transition. The City has taken several steps to advance this agenda of “digital democratisation”. For example, it launched a network of FabLabs, small-scale workshops offering digital tools and skills for innovation using advanced technologies. FabLabs has trained 5,000 students in digital production and IT literacy. The city has also developed a programme to train working professionals in technology and digital skills such as programming, 3D, and digital production courses; more than 50,000 people have taken up technology upskilling courses since the programme was launched.²⁸

Importantly, Barcelona has provided access and opportunities for citizens to take part in decision-making, with key platforms such as Decidim, a digital participation and democratic platform where citizens can co-create future ideas and policies for the city by debating, submitting, and tracking citizen proposals for the city. Some examples of citizen proposals include a strategic plan for the city's coastal areas, ideas to increase accessibility of one of the oldest neighbourhoods in the city, Montbau, and ideas for remodelling the neighbourhood of Bon Pastor.

²⁸ Ajuntament Barcelona

²⁸ Ibid (2019).

III. Urban Powerhouse

Examples: Singapore, Hong Kong

Population size and density

Urban powerhouses tend to be concentrated over small geographical spaces such as islands or city-states. Their rapid growth attracts talent globally, leading to a large population size. Its downtown core and suburbs are densely-populated; tall buildings or skyscrapers are common, sometimes creating a sense of congestion.

Citizen needs

Citizens facing high costs of living are concerned with maintaining their upward economic trajectory and competitiveness in the global economy. At the same time, they are attuned to global trends, and are beginning to express concerns about issues such as environmental sustainability and citizen engagement. Sustainability, resilience, and inclusivity are therefore often priority agenda items for Urban Powerhouses.

Ability to Invest

Urban powerhouses are major commercial hubs within a country. They are wealthy and have highly-developed, well-planned infrastructure, and designed to function as efficiently as possible.

Technology and Policy Considerations

Citizens are digitally-savvy and embrace tech-enabled solutions readily. Urban Powerhouses boast a large pool of tech talent due to previous strategic investments in high-tech and next-generation industries.

Urban Powerhouses are typically concerned with maintaining their reputations for being on the leading edge. These cities seek to maximise efficiency and are open to adopt emerging technologies. They usually request premium-quality, cutting-edge technology. Priority technical features include the ability to layer on digital twins, predictive analytics, and artificial intelligence onto their existing infrastructure.

In terms of policy intent, Urban Powerhouses prioritise linking their investments in Smart Cities to create good, cutting-edge jobs. Urban Powerhouses are particularly keen to use their technological investments to maintain their economic and technological advantage.



Case study: Singapore

Singapore's efforts in recent years have shifted towards delivering government services with empathy and citizen-centricity. For example, its government launched the LifeSG app in 2020, providing over 40 digital government services to cater to a citizen's journey and their key life moments; enhancing their renowned efficiency with more citizen-centric lens.²⁹

In 2021, Singapore launched its Singapore Green Plan 2030, a whole-of-nation movement to advance the sustainability agenda. Key aspects of the plan include setting aside 50 percent more land for nature parks, quadrupling solar energy deployment, embracing electric vehicles, increasing carbon taxes, and producing 30 percent of its food supply locally.³⁰ We expect this to translate into different smart city initiatives such as floating solar systems, smart grids, charging infrastructure, and high-yield vertical farms.

²⁹ Smart Nation (2020)

³⁰ Singapore Green Plan 2030

IV. Emerging Mega Hub

Examples: Bangkok, Jakarta



Population

Emerging mega hubs are experiencing an influx in population due to rapid urbanization and increasing migration from all over the country. Citizens live in densely-packed, low-income housing closer to the centre, with more affluent, spacious housing at the perimeter.

Citizen needs

Citizens are hungry for growth and want modern infrastructure, stable economic growth, good governance, and opportunities to develop competitive, digital skillsets. The emerging middle class in these cities aspire for greater wealth and higher living standards.

The Promising Mega Hub wants to build a reputation as a commercial hub in the region and is undergoing rapid modernisation in its bid to move towards becoming an urban powerhouse.

For these cities, it is important to build resilience to maintain their upward trajectory for economic growth and quality of life.

Ability to Invest

Emerging mega hubs are undergoing aggressive industrialisation, and are still in their growth phase, and therefore have a highly-variable ability to invest, typically mid to low.

Technology and Policy Considerations

Emerging mega hubs typically require small-scale pilots to prove the efficacy of a smart city solution, and need to demonstrate a clear return on investment (ROI). Priority technical features include solutions which are scalable to millions of sensors, and provide easy and effective analytics on data collected.

In terms of policy intent, Emerging mega hubs prioritise innovative solutions that build the city's reputation, promote economic growth, and increase the quality of life for their citizens.

Case study: Jakarta

Jakarta's Smart City 3.0 Framework consists of two central objectives: "To be an innovative city" and "to create a window of happiness for the people". Jakarta is driving forward digital transformation with smart technologies such as 5G, the Internet of Things (IoT), and ICT to improve access to and the quality of public services.³¹

For example, Smart Mobility is a pillar of its Smart City vision. The Jakarta Government is building a centralised system for streetlights that connects more than 90,000 LED lights. This centralised streetlighting system will be fitted with automatic sensors to enable the dematerialisation of electricity in Jakarta. Jakarta has also built physical and digital transport infrastructure to improve connectivity between cities and satellite cities. For example, digital apps provide easy access to data about transport schedules and station locations.³²

³¹ Melissa Fitzgerald -, & Fitzgerald, M. (2021)

³² Syalianda, S. I., & Kusumastuti, R. D. (2021)

V. Promising Urban Centre

Examples: Penang, Marrakech



Population size and density

Promising urban centres typically have a low population size across a small or mid-sized land area. These cities typically have an urban core which is the economic centre, but citizens generally live in the low-density suburbs.

Citizen needs

Citizens here look for economic opportunity and aspire to more modern standards of living. Hence, such cities are concerned about attracting foreign direct investment (FDI), modernising and developing existing infrastructure and digital connectivity, increasing economic growth, creating good jobs, and nurturing talent.

For these cities, it is important to build resilience in order to maintain their upward trajectory for economic growth and quality of life. They may also be concerned about sustainability, given the global focus on climate change and its importance to investors.

Ability to invest

Promising urban centres have underdeveloped infrastructure and their economy usually centres around a few dominant industries. This results in a low to mid ability to invest, depending on their economic growth.

Technology and Policy Considerations

Promising urban centres typically require low to mid quality technology solutions. Wide-area connectivity (e.g., Lora-wan) is often a priority technical feature, due to the need to network the city.

In terms of policy intent, these cities prioritise economic enablement (e.g., smart factories, export corridors) and links to their trade policy (e.g., FDI matching, Special Economic Zones).

Case study: Penang

Penang aims to turn the city into a smart and digitalised international city by 2030 under its Penang 2030 plan. Historically a hub for labour-intensive manufacturing, Penang currently designs and produces high-value-added technologies such as integrated circuits and software to embedded systems.

To achieve its Penang2030 vision, Penang is undergoing the large-scale Penang South Islands (PSI) transformation, a three-island development that will combine advanced technologies for next-generation industries with eco-friendly masterplans. PSI is expected to make Penang an attractive investment destination for global corporations. PSI is also expected to include a Green Plan promising big outcomes such as 100 percent renewable energy to power the Green Tech Park, and 40 percent reduction in urban planning emissions.³³

³³ Channel News Asia (2021)

VI. Developing, Crowded City

Examples: Manila; Delhi



Population size and density

Developing, crowded cities are heavily populated over a large land area. The city centre is populated with dense housing and in some cases, slums.

Citizen needs

Developing, Crowded Cities have patchy infrastructure development and management. Their economies are often non-industrialised and focused on trading, agriculture, or low-energy, low-skill manufacturing. Quality of life is low and citizens have limited access to essential services such as health, education, and safe shelter. Corruption and crime rates are high due to weak governance structures.

For these cities, resilience and safety are the most important factors that can improve the standard of living for citizens. Sustainability may also be a key concern, if the cities are in geographical regions which are particularly susceptible to harmful effects of climate change such as natural disasters.

Ability to invest

Developing, Crowded Cities' ability to invest is low as they typically have limited financial resources and are overwhelmed with many different problems.

Technology and Policy Considerations

Developing, Crowded Cities typically require technologies which are low-cost and basic in quality. They may also rely on corporations that are willing to sponsor these technologies as part of their Corporate Social Responsibility (CSR) programmes. Priority technical features include the most basic, frugally engineered systems which are easy and affordable to install and maintain.

In terms of policy intent, these cities seek to develop essential tech infrastructure that can improve citizens' livelihoods and quality of life.

Case study: Delhi

In 2021, Delhi was reported as the most unsafe city for women among all metropolitan cities in India, with a registered 10,000 cases of crime against women in the previous year. Delhi aims to improve urban safety through crowdsourced data collection and app-based citizen reporting.³⁴

Delhi's Department of Women and Child Development sought to collect concrete data on the safety challenges in the city, to better understand how conditions could be improved. Delhi partnered with Safetipin, a social organisation which has developed three mobile phone applications – MySafetipin, Safetipin Nite, and Safetipin Site – to collect data from citizens that can help to make public spaces safer and more inclusive. Data collected through the application was aggregated and analysed to develop city recommendations.

This initiative resulted in 50,000 sites audited across the city, including metro stations and low-income neighbourhoods: 7,483 poorly lit sites were identified and replaced with functioning lights; additional streetlights were installed in targeted locations in partnership with the City's Power Secretary to improve public safety; and police control room (PCR) vans were re-routed based on citywide safety.

³⁴ Ani (2021)

The NECESCity™ Smart City Framework

The NCS-Eden Collaborative Eco Smart City (NECESCity™) Framework systematically sets out the core elements of a holistic Smart City plan.



Conversations around Smart City projects typically revolve around requirements specifications and technology functionalities. This technology-centric approach often seeks to retroactively meet some of the outcomes that the city has articulated elsewhere, for example, to be a kinder and more sustainable city.

Our framework helps cities systematically plan for their Smart City initiatives with outcomes in mind, while keeping technology as a key enabler; the six outcomes identified earlier in the paper should typically align with the unique unmet needs of the citizens in each city.

In using this framework, cities should first identify the outcomes they are targeting, using the top-most layer. They then start from the bottom-most layer and work their way up step by step, thinking through the appropriate elements of each layer that would integrate into a holistic and outcomes-based Smart City plan.

This section explains each layer of the framework, and how it can help create a holistic Smart City plan.

Urban Functions

Different city functions are more suited towards achieving different outcomes. For example, “Loveable” as an outcome would likely be more relevant to the urban functions of “Recreation, Culture, Religion” and “Education”. City leaders can start by identifying the most relevant urban function to design a Smart City initiative around.

Stakeholders

In planning a Smart City initiative, city leaders have to engage with various stakeholder groups to understand their needs and perspectives. For example, a “Sustainable” initiative that uses cash incentives to encourage energy savings could require engagement with private sector energy utility providers for commercial feasibility, academics for insights on behavioural change, and the community for feedback on the possible uptake of the scheme.

Solution Elements

The most effective Smart City solutions elegantly harmonise how technology works in unison with other elements of city planning, including policymaking, infrastructural investments, urban planning, design, education, ecosystem development, community assets, grants, technology, and enforcement, in order to achieve meaningful improvements in city performance. For example, a well-planned Smart District, supported by an enabling FDI and export policy, creates greater value when the data from its sensors can be integrated into its facility management practices to improve quality tenant experiences at lower costs. Another example is a Smart District which is designed so that the data from its sensors can be used by educational institutions and businesses who have received government grants for research into smart urban planning technologies, propelling the research and innovation ecosystem forward.

Technology Enablers

Technology is a key enabler of urban solutions, used in conjunction with the other solution elements. Some of the most common types of Smart City technologies today include IoT,

digital twins, video, cybersecurity, Edge intelligence, AI, robotics, cloud, blockchain, and data analytics.

The most effective deployments often combine different Smart City technologies instead of relying on a single technology asset to work in isolation. For example, a sensor network is most effective when combined with data analytics, AI, or data visualization capabilities.

Operating Principles

Our research reveals that the most successful smart city deployments tend to feature the following operating principles: Integrated; Seamless; Inclusive; People-centric; Connected; Sustainable; Predictive; Collaborative; Efficient; Equitable; Secure; Real-time; Accessible; and Scalable.

For example, Columbus is improving shared mobility by encouraging citizens to adopt the multi-modal mobile application, Pivot, that seamlessly integrates trip planning, booking, and ticketing across all forms of public and private transportation. The app is powered by real-time data from mobility partners.³⁵ Pivot users reported easier transfers between transportation modes, easier access to healthcare and entertainment, and greater satisfaction with their transport options, travel time, distance, and flexibility.

Conversely, cities such as Rio de Janeiro’s traffic monitoring systems have been criticised by academics³⁶ for only covering the wealthier parts of town, which exacerbates the digital and socioeconomic divide in the country.³⁷

Planning Considerations

The previous layers have helped to identify the desired outcome, targeted urban function, stakeholder feedback on issues and proposed plans, relevant solution elements, and suitable technologies.

For a smart city initiative to be implemented successfully, we have observed that cities will do well to invest further in research, to identify and prioritise the actual citizen needs, as well as assets and partnerships that the cities can leverage.

³⁵ Smart Columbus

³⁶ Gaffney and Robertson (2016)

³⁷ Jaffe (2016)

Co-creation helps to generate buy-in among city users to ensure adoption, while surfacing better ideas from affected users. Smart policy and governance offer regulatory support for the initiative. Identifying the sufficient talent and expertise requirements will be vital to resource the initiative. Factoring in the affordability of the project against the city budget, and sustained with a sound business model, will help ensure that the initiative will be economically-feasible and scalable.

NECESCity™
*framework helps city
leaders systematically
plan for their Smart
City initiatives with
outcomes in mind,
while keeping
technology as a key
enabler.*

Outcomes

In order to help monitor that the solutions result in the desired outcomes, we suggest that the city conduct independent Impact Measurement. Some principles of smart city impact measurement include face validity; ease of measurement; affordability; continuity; and actionability.

The following list of suggested metrics may be helpful as starting measurements of each desired city outcome:

- **Sustainable:** GHG emissions and waste per capita; number of sustainability initiatives; progress against net-zero goals
- **Resilient:** Incidences of major breakdowns in a city's infrastructure or systems; ability of the city to effectively and expediently recover from the disruptions
- **Kind:** Rates of volunteerism and philanthropy; instances of neighbourly help
- **Inclusive:** Rates of digital inclusion; participation in the workforce; and access to public services across vulnerable segments of the population (e.g., elderly, low-income households)
- **Safe:** Crime rates
- **Loveable:** Tourism numbers; number of arts and cultural events; place branding (e.g., Anholt Country Brand Index rank, UNESCO recognition)

We explore case studies of Singapore, Seoul, San Francisco, and Copenhagen as examples of successful Smart City initiatives that exhibit elements of our NCS-Eden Collaborative Eco Smart City (NECESCity™) Framework.



Desired Outcome: Resilient, Sustainable, Loveable

Singapore is currently developing the Punggol Digital District (PDD), which aims to be a hub of innovation, collaboration, learning, and technology. The PDD is part of Singapore's strategy to "sustain long-term economic growth by creating new development areas island-wide and bringing good jobs and social amenities closer to residents"³⁸ as well as to encourage key growth sectors of the digital economy, such as cybersecurity and IoT. The PDD is expected to house technology firms, create about 28,000 new jobs, and offer residents dining, leisure, and retail options.

The PDD aims to achieve 30 percent higher energy efficiency than standard commercial buildings and zero water wastage. It will be outfitted with environmentally sustainable systems such as a Smart Energy Grid, a Facilities Management system for optimal building management, a Pneumatic Waste Conveyancing System for automated waste collection, rooftop solar panels, and urban farms. These efforts will help increase energy efficiency and reduce the district's carbon footprint.

The PDD also aims to be an inclusive, loveable, and green district for residents. Plans include pedestrianising roads to create a heritage trail for residents to immerse themselves in nature, community, green spaces, and a comprehensive network of infrastructure and facilities to support greener mobility options.³⁹

Urban Functions

Economic affairs; housing and community amenities; environment protection

Stakeholders

Citizens; government; business; academia

Solution Elements and Technology Enablers

The key technology enabler for the PDD is the Open Digital Platform (ODP), digital infrastructure unique to PDD. The ODP integrates various systems that enable building management solutions and resources to be optimised, making the PDD a "living lab" for experimentation and innovation. The key ingredient of the ODP that makes this possible

is its Open Standard Multiprotocol Middleware, which can connect different district management systems on different communications technologies.

The ODP also has a digital twin capability. This will enable technology firms in the PDD to test-bed their solutions, by plugging directly into the digital twin and experimenting without concerns about compromising their solutions or district operations. JTC, PDD's developer, plans to make building data available to innovators – particularly companies situated at PDD – as well as students at the Singapore Institute of Technology (SIT) whose campus will be in PDD, to drive the long-term development of innovative new products and services.

Operating Principles

Integrated; real-time; collaborative; predictive; people-centric

Planning Considerations

The PDD is a joint venture of private and Singapore government-linked entities, who co-invested equally in the project. The Singapore government convened key public agencies to work on the project that include GovTech, the Infocomm Media Development Authority (IMDA), and the Urban Redevelopment Authority (URA), making it a multi-agency collaborative effort.

In the spirit of community, the government also launched an online challenge for members of the public to contribute ideas on designing a digitally-enhanced user experience for the PDD community.⁴⁰

Outcome

The PDD is slated for completion towards the end of 2023. So far, four international companies have confirmed their plans to set up base in Punggol Digital District, a move that will create about 2,000 tech jobs, ranging from data analysts and solution engineers to artificial intelligence and blockchain developers.⁴¹

³⁸ IMDA, JTC, SIT, URA (2018)

³⁹ Ibid.

⁴⁰ Ibid.

⁴¹ Ang (2021)



Seoul, South Korea

Desired Outcome: Safe

Seoul sought to develop an effective method to prevent crime and reduce the social costs associated with incidents of crime, so as to improve the quality of life for its citizens.⁴²

Urban Functions

Public Order and Safety

Stakeholders

Citizens; government; business; academia

Solution Elements and Technology Enablers

Recognising that 95 percent of the five main forms of crime in the city were theft and violence, 62 percent of which occurred in streets and public places, Seoul introduced a Crime Prevention through Environmental Design (CPTED) policy.

The City applied crime preventative design practices in selected high crime areas, by introducing site-specific improvements in line with the principles of CPTED. The interventions included transforming dark alleys into brightly-lit community areas.

This included identifying volunteer residents to paint their front gates yellow and install CCTV cameras and emergency bells linked to the nearest police office; putting up community maps and signs to help visitors navigate the area easily; and creating a community hub at a remodelled water supply facility to increase the area's vibrancy.

Operating Principles

Collaborative; Integrated; Real-time

Planning Considerations

In developing the design methodology, Seoul put together a consortium of citizens, government, business, and academia in order to form a structure of governance representative of relevant stakeholders, offer opportunities for citizen engagement, and maximise the impact of the project by fostering citizen cooperation.

Outcome

In one study site, residents' fear of the possibility of street crime dropped by nine percent. Residents' attachment to the neighbourhood increased by 14 percent.

⁴² SeoulSolution (2016)



San Francisco, USA

Desired Outcome: Resilient, Inclusive

California is in a housing crisis, with more than 40 percent of residents spending over 30 percent of their income on shelter. San Francisco sought to transform the fragmented and time-consuming affordable housing application process into an easy, convenient, and accessible experience.⁴³

Urban Functions

Housing and Community Amenities

Stakeholders

Citizens; government; business

Solution Elements and Technology Enablers

The Mayor's Office of Housing and Community Development formed a partnership with design technology firm Exygy, to co-create a streamlined online portal called DAHLIA (Database of Affordable Housing Listings, Information, and Applications) that helps people learn about, apply for, and gain access to affordable housing units.

Operating Principles

Seamless; inclusive; people-centric; accessible

Planning Considerations

In designing the portal, the team undertook user research with several demographic groups, including low- and middle-income households, seniors, veterans, disabled users, users living with HIV/AIDS, and users with housing vouchers, to better understand the pain-points they've experienced.

Outcome

DAHLIA reduced application information requirements by 75 percent, enhancing convenience for citizens and improving in-house processing efficiency. Since its launch in 2016, DAHLIA has placed 50 households in affordable housing every month, processed more than 650,000 applications, and enabled 97 percent of applications to be completed online in approximately fifteen minutes. This is replacing an in-person, paper-based process that often requires more than 10 pages and hours to complete.

⁴³ Exygy



Copenhagen, Denmark

Desired Outcome: Sustainable

Copenhagen's vision is to become the world's first carbon-neutral capital by 2025, leading in global green growth by using data and innovative technology solutions.⁴⁴

Urban Functions

Environment Protection; General Public Services; Education

Stakeholders

Citizens; government; business; academia

Solution Elements and Technology Enablers

Copenhagen set up an innovation testbed through its smart city energy lab, EnergyLab Nordhavn. The lab seeks to explore the possibility of a fully integrated smart energy system. Launched in 2014, the five-year project brought together partnerships in academia, government, private companies, and the federal government. It is designed as a full-scale smart energy laboratory featuring district heating and smart grid integration.

Operating Principles

Collaborative; sustainable; integrated

Planning considerations

Copenhagen sets aside a generous budget for research and development, to develop leadership in low-carbon technologies and to power its local green economy.

Outcome

Some of its key learnings include the need for energy tax reforms, building energy storage potential, and data collaborations with energy suppliers. The project also uncovered new business models such as peer-to-peer energy exchange among communities of consumers. The project has helped the city government better understand the ways in which it can scale integrated energy initiatives to other districts, and the key success factors of such initiatives.

⁴⁴ Carbon Neutral Cities; EnergyLab Nordhavn

Concluding remarks

While [technology](#) remains a key enabler in Smart City initiatives, the most effective and successful Smart City leaders tend to adopt a citizen-centric, outcomes-based approach. All cities can strive towards six strategic outcomes that we have observed in our study of leading Smart Cities: [Sustainable](#); [Resilient](#); [Kind](#); [Inclusive](#); [Safe](#); and [Loveable](#).

In our study of over 200 cities and research into existing Smart City literature, we identified [six major archetypes](#) that cities fall into. Our hope that these archetypes will inform city leaders on the needs in similar cities and support them in forming targeted Smart City initiatives.

Armed with an informed understanding of their citizen needs and desired Smart City outcomes, city leaders can use our [NECESCity™ Planning Framework](#) to systematically develop holistic plans which integrate the key elements needed for a successful Smart City.

Appendix:

City Archetype

Methodology

Our starting point was Shell's existing work on Future Cities, which developed the six city archetypes of Urban Powerhouse; Sprawling Metropolis; Prosperous Community; Developing Mega-hub; Developing Urban Centre; and Crowded Cities.

We further developed our own in-house tools to operationalise cities within each archetype, based on the empirical parameters of Population Size; Density; and Ability to Invest. We relied on established sources such as the OECD, the Centre for Liveable Cities, and the World Bank, to develop relative qualifying thresholds for each parameter.

City Archetypes	Population Size (no. of inhabitants)	Density (no. of inhabitants/km ²)	Ability to Invest (GDP/capita)	Examples
Prosperous, Compact Community	Low/Mid	Low	High	Amsterdam; Copenhagen
Sophisticated Metropolis	High	Mid	High	Los Angeles; London
Urban Powerhouse	High	High	High	Singapore; Hong Kong
Emerging Mega Hub	High	Mid/High	Low/Mid	Bangkok; Jakarta
Promising Urban Centre	Low/Mid	Low/Mid	Low	Penang; Marrakech
Developing, Crowded City	High	High	Low	Manila; Bangalore

KEY	Population size (no. of inhabitants) High: >3mn Mid: >1mn and <3mn Low: <1mn	Density (no. of inhabitants/km ²) High: >7,000 Mid: <7,000 and >3,000 Low: <3,000	Ability to Invest (GDP/capita in USD) High: >44,000 Mid: <44,000 and >9,000 Low: <9,000
------------	---	--	--

Appendix: NCS' Case Studies

Desired Outcome: Sustainable

Smart Hub

NCS developed a central system which integrates, manages, and analyses data collected from sensors embedded in residential estates for research and planning purposes.

The Smart Hub promotes [sustainability](#) by:

- Monitoring and analysing the performance of key areas such as lighting, pumps and waste collection through data collected from its network of sensors, analytics, and dashboards
- Monitoring and analysing data from of sensors on solar panels, LED lights, and smart pumps in water tanks, enabling the estate to conserve energy and reduce wastage of resources, for example through optimization of maintenance cycles





Desired Outcome: Resilient

Safeguarding Singapore as a global trade hub through eCustoms system

NCS developed an eCustoms System that enhances the effectiveness and efficiency of Singapore's customs administration, increasing Singapore's **resilience** as a global trade hub that is trusted by its foreign trading partners and businesses operating in Singapore.

NCS' eCustoms system supports the national trade infrastructure and cargo clearance at various checkpoints and interfaces with multiple agencies for some of its critical functions such as permit submission, processing and approval.



Desired Outcome: Kind

Prison Operations and Rehabilitation System (PORTS) & Digitalisation of Inmate Rehabilitation & Corrections Tool (DIRECT)

NCS collaborated with Singapore Prison Service (SPS) to harness digital technologies in order to enhance the prisoner rehabilitation journey through the web for studies and communications while managing security vulnerabilities due to the increased demand for data storage and web access points.

PORTS and DIRECT is an initiative of [kindness](#) as it enhances rehabilitation for prisoners by:

- Enhancing SPS' operational efficiency and automate its work processes on a more secured digital platform, allowing officers to spend more time on strategic tasks such as engaging with the inmates and helping them with their rehabilitation
- The use of technology which improves the digital literacy of rehabilitees; aiming to break the cycle of re-offending and ease them back into society



Desired Outcome: Inclusive

Tracking the health status of migrant workers in a pandemic

NCS created the FWMOMCare app, an easy-to-use digital application to help MOM monitor and manage to track the health of migrant workers, provide them with prompt access to medical consultation, and allow MOM to better manage and plan the deployment of its officers and medical teams.

The FWMOM Care app is designed to be **inclusive** with:

- Easy to navigate screen interfaces that would allow the workers to make use of the app on a daily basis without complicating their routine
- Eight different languages to cater to different groups of migrant workers

As of February 2022, there were more than 1.1mn downloads of FWMOMCare. The app is used by hundreds of thousands of migrant workers each day.



Desired Outcome: Safe

Police Beacon

NCS developed a beacon which brings real-time, 24/7 police presence to public places and helps members of the public connect to the police quickly and directly during times of emergencies remotely through cameras, sensors, and communications equipment.

It creates a **safer** environment by:

- Protecting communities around the clock without relying on a huge manpower effort with augmentation via beacons
- Real-time access to the police in times of emergencies, and assistance before Police Officers arrive at the scene
- Provide safety touchpoints for citizens at remote areas where police officers are not immediately present



Desired Outcome: Loveable

Singapore Tourism Analytics Network (STAN)

NCS developed a centralised Singapore Tourism Analytics Network (STAN), to give tourism businesses cost-effective access to a data analytics platform where they can share and consume data.

The tourism businesses/ tourism board can derive insights into the tourism landscape from the platform and leverage these insights to optimise business decisions, for example in curating tourism offerings that tailor to tourists and locals, ensuring that they have the best experience and rendering the city more **loveable**.



Desired Outcome: Multiple

Helping City of Gold Coast better understand movement in the city

NCS's DataSpark provided a data-as-a-service solution to the City of Gold Coast using proprietary telco-sourced and anonymised mobility data to generate more precise insights of people movement around the city.

The solution includes data pipeline of historical and incoming daily data to complement live dashboards and data segmentation.

It helps the City make informed decisions on investment and infrastructure development as well as provide deep insights for predictive analytics.

References

Overall

Eden Strategy Institute (2021). Top 50 Smart City Governments. Retrieved May 25, 2022, from <https://www.smartcitygovt.com/top50-smartcitygovernments>

Study Introduction

Gaubert, J. (2021, November 11). Seoul will be the first city to enter the metaverse. Retrieved May 25, 2022, from <https://www.euronews.com/next/2021/11/10/seoul-to-become-the-first-city-to-enter-the-metaverse-what-will-it-look-like>

Smith, M., & Lobo, J. (2019, June 6). Cities through the ages: One thing or many? Retrieved May 25, 2022, from <https://www.frontiersin.org/articles/10.3389/fdigh.2019.00012/full>

The History of Cities. (n.d.). Retrieved May 25, 2022, from <https://education.nationalgeographic.org/resource/history-cities>

Virtual realities: How cities are moving into the metaverse and beyond. (2022, May 18). Retrieved May 25, 2022, from <https://bloombergcities.jhu.edu/news/virtual-realities-how-cities-are-moving-metaverse-and-beyond>

World Bank: Urban Development. (2020, April 20). Retrieved June 3, 2022, from <https://www.worldbank.org/en/topic/urbandevelopment/overview>

The Truly Smart City

Accenture. (1970, July 13). Accenture helps Fukuoka City establish a digitally enabled health model to help aging citizens stay healthy and live independently. Retrieved May 26, 2022, from <https://newsroom.accenture.com/news/accenture-helps-fukuoka-city-establish-a-digitally-enabled-health-model-to-help-aging-citizens-stay-healthy-and-live-independently.htm>

Arup. (n.d.). Masterplan design for a new digital industry hub in Mexico. Retrieved from <https://www.arup.com/projects/ciudad-creativa-digital-masterplan>

Barbaschow, A. (2019, June 13). Sydney only city in Australia to sign global initiative to back citizen's digital rights. Retrieved from <https://www.zdnet.com/article/sydney-only-city-in-australia-to-sign-global-initiative-to-back-digital-rights/>

Barcelona caring city: Barcelona city council. (n.d.). Retrieved May 26, 2022, from <https://www.barcelona.cat/ciutatcuidadora/en>

Chifuri, H. (2019, August 15). Tokyo Metropolitan Government Spearheading Disaster Preparedness Efforts. Retrieved May 30, 2022, from <https://www.japantimes.co.jp/2019/08/07/special-supplements/tokyo-metropolitan-government-spearheading-disaster-preparedness-efforts/>

City of Seattle. (n.d.). Homelessness Data Model. Retrieved from <http://www.seattle.gov/innovation-advisory-council/projects/homelessness-data-model>

Ciudad Creativa Digital (CCD) . (n.d.). Welcome to the CCD. Retrieved from <http://www.carloratti.it/FTP/CCD/index.html>

Coleman, V. (2018, November 03). Seattle homelessness spending tops \$90 million. Retrieved May 30, 2022, from <https://www.seattletimes.com/seattle-news/homeless/seattle-homelessness-spending-tops-90-million/>

Derrick, A. (2019, March 27). Seattle's Innovation Advisory Council. Retrieved from <https://durkan.seattle.gov/2019/03/the-iac/>

El Comercio (2018). Quito expuso El Programa Bájale Al Acoso en un foro en Argentina. (2018, March 23). Retrieved May 30, 2022, from <https://www.elcomercio.com/actualidad/bajalealacoso-exposicion-foro-argentina-quito.html>

FFM. (n.d.). "Smart City" ideas platform. Retrieved from <https://www.ffm.de/frankfurt/de/mapconsultation/52099>

Frankfurt Green City. (n.d.). From status report to sustainability reporting. Retrieved from <https://www.frankfurt-greencity.de/en/status-and-trends/epilogue/> Frankfurt Green City. (n.d.). Climate protection, learning by doing. Retrieved from <https://www.frankfurt-greencity.de/en/status-and-trends/education/climate-protection-learning-by-doing/>

Guardian (2021, March 12). Toronto swaps Google-backed, not-so-smart city plans for people-centred vision. Retrieved May 25, 2022, from <https://www.theguardian.com/world/2021/mar/12/toronto-canada-quayside-urban-centre>

Making Rotterdam's first resilient neighborhood through social cohesion. (2020, November 20). Retrieved May 26, 2022, from https://resilientcitiesnetwork.org/urban_resiliences/rotterdam-social-cohesion/

OneNYC. (2020). OneNYC 2050 Building a Strong and Fair City. New York: OneNYC. Retrieved from <https://onenyc.cityofnewyork.us/wp-content/uploads/2020/01/OneNYC-2050-Full-Report-1.3.pdf>

Rueter, G. (2016, November 21). Frankfurt shoots for 100 percent renewables. Retrieved from <https://www.dw.com/en/frankfurt-shoots-for-100-percent-renewables/a-36467796>

Schnapper, A. (2019, May 30). Participation in the Frankfurt Citizens' Survey "Smart City". Retrieved from <https://alexander-schnapper.de/2019/05/30/macht-mit-bei-der-frankfurter-buerger-befragung-smart-city/>

Smart Cities in India: Earth.org - past: Present: Future. (2022, March 28). Retrieved May 25, 2022, from <https://earth.org/smart-cities-in-india/>

Smart cities. (2022, May 13). Retrieved May 30, 2022, from https://ec.europa.eu/info/eu-regional-and-urban-development/topics/cities-and-urban-development/city-initiatives/smart-cities_en

Smart City Performance Monitoring: Austria, Vienna. (n.d.). Retrieved May 30, 2022, from <https://www.ebrdgreencities.com/policy-tool/smart-city-performance-monitoring-austria-vienna/>

Smart City Wien Framework strategy. (2014). Retrieved May 30, 2022, from <https://www.wien.gv.at/stadtentwicklung/studien/pdf/b008552.pdf>

Sustain Europe. (2019, October 25). Sustainable Frankfurt. Retrieved from <https://www.sustaineurope.com/sustainable-frankfurt-20191025.html>

Tay, S. (2021, June 08). Meet Singapore's latest weapon against scams. Retrieved May 26, 2022, from <https://govinsider.asia/smart-gov/meet-singapores-latest-weapon-against-scams-open-government-products-scamshield/>

The European Commission rewards Barcelona's suicide-prevention telephone helpline. (n.d.). Retrieved May 26, 2022, from https://www.barcelona.cat/ciutatcuidadora/en/noticia/the-european-commission-rewards-barcelonas-suicide-prevention-telephone-helpline_1171146

UNDP Singapore: Smart Cities. (n.d.). Retrieved May 30, 2022, from <https://sgtechcentre.undp.org/content/sgtechcentre/en/home/our-focus-areas/smart-cities.html>

UNECE: Sustainable smart cities. (n.d.). Retrieved May 30, 2022, from <https://unece.org/housing/sustainable-smart-cities>

UNESCO (n.d.). Bandung Retrieved May 26, 2022, from <https://en.unesco.org/creative-cities/bandung>

What is a Smart City? 5 Leading Cities Give Their Definition. (2022). Retrieved 30 May 2022, from <https://www.urbansdk.com/blog/what-is-a-smart-city-5-leading-cities-give-their-definition>

City Archetypes

Ajuntament de Barcelona. (2019, June 06). Decidim Barcelona. Retrieved May 30, 2022, from <https://ajuntament.barcelona.cat/digital/en/digital-empowerment/democracy-and-digital-rights/decidim-barcelona>

Ajuntament de Barcelona. (n.d.). Barcelona Digital City Plan (2015-2019). Retrieved from https://ajuntament.barcelona.cat/digital/sites/default/files/pla_barcelona_digital_city_in.pdf

Ani. (2021, September 16). Delhi remains most unsafe for women irrespective of drop in crime rate. Retrieved May 27, 2022, from https://www.business-standard.com/article/current-affairs/delhi-remains-most-unsafe-for-women-irrespective-of-drop-in-crime-rate-121091600306_1.html

Bentham, J. (n.d.). Future Cities in a Resource Constrained World. Retrieved May 27, 2022, from <https://www.clc.gov.sg/docs/default-source/urban-solutions/urb-sol-iss-1-pdfs/researchandreports-future-cities-in-a-resouce-constrained-world.pdf>

Birnbaum, M. (2019, November 18). Europe's flight-shame movement has travelers taking trains to save the planet. Retrieved May 27, 2022, from https://www.washingtonpost.com/world/europe/europes-flight-shame-movement-has-travelers-taking-trains-to-save-the-planet/2019/08/02/1bd38486-ac96-11e9-9411-a608f9d0c2d3_story.html

Birnbaum, M. (2019, November 19). What it takes to be carbon neutral - for a family, a city, a country. Retrieved May 27, 2022, from <https://www.washingtonpost.com/climate-solutions/2019/11/19/what-it-takes-be-carbon-neutral-family-city-country/>

Channel News Asia CNA (2021, May 31). Penang South Islands: Making a green mark on the global stage. Retrieved May 27, 2022, from <https://www.channelnewsasia.com/penang-south-islands-making-green-mark-global-stage-2060366>

Mathiesen, B. V., Auken, I., & Skibsted, J. M. (2019, May 21). This is how Copenhagen plans to go carbon-neutral by 2025. Retrieved from <https://www.weforum.org/agenda/2019/05/the-copenhagen-effect-how-europe-can-become-heat-efficient/>

Melissa Fitzgerald -, & Fitzgerald, M. (2021, October 13). Jakarta's Smart City Future & Vision. Retrieved May 27, 2022, from <https://www.enlit-asia.com/grids/jakartas-smart-city-future-and-vision/>

New World Bank country classifications by Income Level: 2021-2022. (n.d.). Retrieved May 27, 2022, from <https://blogs.worldbank.org/opendata/new-world-bank-country-classifications-income-level-2021-2022>

SafetiPin Case study- Delhi. (n.d.). Retrieved May 30, 2022, from <https://safetipin.com/case-study-delhi/>

Singapore Green Plan 2030. (n.d.). Retrieved May 30, 2022, from <https://www.greenplan.gov.sg/>

Six city archetypes. (n.d.). Retrieved May 27, 2022, from <https://www.shell.com/energy-and-innovation/the-energy-future/future-cities/future-city-archetypes.html>

Smart Nation Singapore. (2020, November 11). LifeSG Initiative. Retrieved from <https://www.smartnation.gov.sg/what-is-smart-nation/initiatives/Strategic-National-Projects/lifesg-initiative>

Syalianda, S. I., & Kusumastuti, R. D. (2021). Implementation of smart city concept: A case of Jakarta Smart City, Indonesia. IOP Conference Series: Earth and Environmental Science, 716(1), 012128. doi:10.1088/1755-1315/716/1/012128

The OECD programme on Smart Cities and Inclusive Growth. (n.d.). Retrieved May 27, 2022, from <https://www.oecd.org/cfe/cities/smart-cities.htm>

The NECESCity™ Smart City Framework

Ang, J. (2021, July 29). 4 international companies to set up base in Punggol Digital District, creating about 2,000 jobs. Retrieved June 3, 2022, from <https://www.straitstimes.com/business/economy/4-international-companies-to-set-up-base-in-singapores-punggol-digital-district>

Carbon Neutral Cities (n.d.). Copenhagen. Retrieved May 27, 2022, from <https://carbonneutralcities.org/cities/copenhagen/>

EnergyLab Nordhavn. (n.d.). Clear recommendations from EnergyLab Nordhavn for the sustainable energy solutions of tomorrow. Retrieved from <http://www.energylabnordhavn.com/clear-recommendations-from-energylab-nordhavn-for-the-sustainable-energy-solutions-of-tomorrow.html>

Exygy (n.d.). Scaling Access to Affordable Housing: From DAHLIA to Bloom. Retrieved May 27, 2022, from <https://www.exygy.com/work/scaling-access-to-affordable-housing-from-dahlia-to-bloom>

Gaffney, C., & Robertson, C. (2016). Smarter than smart: Rio de Janeiro's flawed emergence as a smart city. *Journal of Urban Technology*, 25(3), 47–64. <https://doi.org/10.1080/10630732.2015.1102423>

Green Plan Singapore (n.d.). Retrieved May 27, 2022, from <https://www.greenplan.gov.sg/key-focus-areas/overview>

IMDA, JTC, URA, SIT (2018) Punggol Digital District: Envisioning 2030, Retrieved June 3, 2022, from https://www.ideas.gov.sg/public/Punggol_Digital_District_Envisioning_2030

IMDA, JTC, URA, SIT (2018) The future is yours to create at Punggol Digital District. (n.d.). Retrieved June 3, 2022, from <https://www.ura.gov.sg/Corporate/Media-Room/Media-Releases/pr18-02>

Jaffe, E. (2016, May 11). 4 lessons from Rio's 'flawed' smart cities initiative: Blog. Retrieved May 31, 2022, from <https://medium.com/sidewalk-talk/4-lessons-from-rios-flawed-smart-cities-initiative-31cbf4e54b72>

Multimodal Trip Planning Application: SmartColumbus. (n.d.). Retrieved May 31, 2022, from <https://smart.columbus.gov/projects/multi-modal-trip-planning-application>

Seoulsolution. (2016, September 09). Crime prevention through environmental design project. Retrieved May 27, 2022, from <https://www.seoulsolution.kr/en/content/crime-prevention-through-environmental-design-project>



NCS is a leading technology services firm, operating across Asia Pacific, providing services and solutions in consulting, digital, technology, cybersecurity and more. We believe in the power of technology to make extraordinary things happen and to create lasting impact and value for our people, communities, and partners. We bring together people and expertise to harness the best of technology. Our diverse 12,000-strong workforce has delivered a wealth of large-scale, mission-critical, and multi-platform projects for governments and enterprises in Singapore and the APAC region.

The Gov+ Strategic Business Group focuses on building NCS' digital government portfolio, and drive collaboration efforts to strengthen NCS' position as the leading digital catalyst for governments and smart cities across Asia Pacific. NCS will invest in building deep digital government capabilities and work even more closely with Singapore government agencies to further support their digital transformation and innovation needs.



Eden Strategy Institute is an award-winning strategy consulting firm specializing in Business System Innovation. We approach the global issues of urbanization, disease, poverty, illiteracy, and exploitation by formulating strategies, models, processes, and products that help our clients create, realize, and sustain their economic and societal impact. Eden plans and sets up industry blueprints, facilitates co-creation, forecasts and evaluates the outcomes of policy interventions.

We have supported governments and corporations globally to successfully bring Smart City innovations to market using qualitative and quantitative research, design and behavioural economics, business planning, partnerships, as well as impact assessment. We publish the global Top 50 Smart City Government Rankings at www.smartcitygovt.com. Our Practice Areas include Smart Cities, Sustainability, Education Innovation, Healthcare, Social Enterprise, the Emerging Middle Class, and Public Service Transformation. To learn more about our work, please visit edenstrategyinstitute.com.

Our Purpose

We advance our communities by partnering with governments and enterprises to harness technology.

We do this by bringing people together to make the extraordinary happen.

Contact us at
smartcities@ncs.com.sg.