Deloitte.

Urban Future
With a Purpose

**12 trends shaping the future
of cities by 2030**

Foreword

2020 will go down in history as a defining year for the future of the world and its cities.

The World Economic Forum has recommended a Great Reset in the aftermath of the COVID-19 pandemic. The European Commission has called for a green, fair and just economic recovery; and C40 has argued that this is a once in a lifetime opportunity for shifting our future direction, with the sustainability of the planet as the major concern. At such a pivotal moment, Deloitte embraced the challenge to envision what the impact of the pandemic on urban environments might be.

The pandemic disrupted the very core of urban living: social distancing challenged the density in which our cities are built; lockdown policies reduced substantially the opportunities for human interactions that trigger innovation and creativity; the switch to online has destabilised local economies and commerce; and new patterns of working are shaping urban planning and design. On top of all of these changes, the pandemic has brought into focus the need for a sense of belonging and connection.

The urban environment is well placed to respond effectively. If in the next 40 years, the world builds the equivalent of a city like New York each month[1], the role of cities in driving change will be paramount. Cities have the human capital, the infrastructure and scalability potential to drive change and create a green, digital and inclusive society of the future.

As strong believers in the potential of cities, we see the need to listen to the main actors to understand what we might expect to happen next. With the invaluable support and insights from experts — researchers, practitioners, policy makers and city leaders — we have developed a set of 12 trends that cities can follow on the pathway to sustainability, resilience and prosperity, leveraging technology and innovation.

While the intention should be for these trends to manifest to as many cities as possible, we do not mean that every city should adopt every trend. In times of financial constraints and cost-cutting challenges, there is no 'one-size-fits-all' solution, as the local government authorities of each city face their own issues and timelines, adjust to their political environments and development circumstances, and respond to their unique dynamics. Our guidelines set the stage for what a resilient and sustainable urban future looks like, with the aim of influencing the development of strategies and helping governments balance short-term pressures and longer-term needs. Cities may pick just one or several of our trends, or try to pursue them all. Some cities are already on a good path forward but can use this moment to embrace disruptive change in a holistic way, as these 12 trends are inter-connected and depend on each other, making the success of implementation dependent on a well-integrated strategy.

The 12 trends cover: the need to deal with climate emergency – both through mitigation (low-carbon cities) and adaptation strategies (resilient cities); the data and technological environment that supports and strengthens the capacity of cities (smart cities); and the human-centred approach, unavoidable for attaining Sustainable Development Goals and nurturing strong communities (inclusive cities).

We believe that the roadmap to the future will involve a number of critical factors: the relevance of public-private partnerships to drive the development of our cities towards a common purpose; the need for the current 10 to 20 year-long planning

process to become more agile, reflecting today's world requirements; and need for dialogue and collaboration between cities for sharing, alignment and commitment, particularly towards successful responses to global climate risks. There must be an understanding that the challenges we face today are complex and demand collective action.

Finally, I want to share my deep appreciation for the support and insights of the participants who assisted us with their invaluable contributions, namely: Carole Mancel-Blanchard (Member of Cabinet of European Commissioner for Cohesion & Reforms, Elisa Ferreira), Jeff Merritt (Head of IoT and Urban Transformation at the World Economic Forum), Jukka Mäkelä (Mayor of Espoo), Kent Larson (Director of City Science group at MIT Media Lab), Kirby Brady (Chief Innovation Officer of San Diego), Kok Yam Tan (Deputy Secretary of Smart Nation and Digital Government Office, Singapore), Maimunah Mohd Sharif (Executive Director of UN-Habitat), Markus Elkatsha (Urbanist at MIT Media Lab), Mohamed Ridouani (Mayor of Leuven), Paulo Rosado (CEO of OutSystems), Rui Moreira (Mayor of Porto), Sameh Wahba (Global Director, Urban, Disaster Risk Management, Resilience and Land Global Practice at the World Bank), Sandy Carter (Vice-President of Amazon Web Services Worldwide Public Sector Partners and Programs), Uwe Brandes (Faculty Director, Georgetown University Global Cities Initiative) and Yvonne Aki-Sawyerr (Mayor of Freetown). Your words and conversations enlightened the way and enriched this study.

Our special thanks go also to the city of Cascais and Miguel Pinto-Luz, its Deputy Mayor, for leading this effort with us and being a trusted partner in our work on the future of cities.

The research and analysis in this report reinforce our belief that we must go through a transition from Urban Living to Human Living, breaking the loneliness and disconnection in some environments and creatively setting the rules for restoring a vibrant, humanised and bonded spirit that makes a city bloom and a sustainable society in which to prosper. It is part of what we picture as Urban Future with a Purpose.

The changes we present here are achievable. Let's make them happen. Together. And now.

Miguel Eiras Antunes
Global Smart City, Smart Nation
and Local Government Leader

Executive summary

Living and Health	Mobility	Economy

Green Planning of Public Spaces

Cities tend to be planned and designed for people, with 'green' streets, new corridors and public spaces as centres of social life. A clean and green city has the potential to capture and store carbon dioxide. While traditionally characterised by a high density of population and buildings, cities are now rethinking their structure and functions to achieve ecosystem resilience, human well-being, and sustainable urban living.

15-Minute City

Cities tend to be designed so that amenities and most services are within a 15-minute walking or cycling distance, creating a new neighbourhood approach. A flexible concept of compact planning should be that all amenities are within a 15-minute walk or bicycle ride, and that there should be different types and prices of housing in each neighbourhood, more green spaces, and walking and bicycle routes.

Inclusive Services and Planning

Cities are evolving to have inclusive services and approaches, fighting inequalities by providing access to housing and infrastructure, equal rights and participation, and jobs and opportunities. The prosperity of a city is more likely to depend on social inclusion levels. Governments around the world are proactively implementing (preventing and curative) inclusion-focused solutions, with the aim of leaving no one behind.

Smart Health Communities

Cities are developing health care ecosystems that are not only focused on diagnosing and treating sickness but also on supporting well-being through early intervention and prevention, leveraging digital technologies. They will move away from being designed and funded to treat individual patients one by one, to having a greater appreciation of the interconnectedness of communities. The social determinants of health will be better understood and government and the private sector will collaborate to address some of these challenges.

Mobility: Intelligent, Sustainable and As-a-Service

Cities are working towards offering digital, clean, intelligent, autonomous and intermodal mobility, with more walking and cycling spaces, where transport is commonly provided as a service. Transformation in urban mobility dynamics is primarily user-centred. Some major changes in how people move around in cities are already under way, but the trend will accelerate further over the next decade along with an accompanying energy revolution and technological developments.

Digital Innovation Ecosystems

Cities tend to attract talent, enable creativity and encourage disruptive thinking, developing themselves through an innovation model approach, and a combination of physical and digital elements. Cities can see new sources of employment and economic growth emerging, with the creation of new businesses and jobs relating to technological innovation. Cities are also likely to become experimentation facilities and living labs for digital transformation and remote hubs for digital nomads.

Energy and Environment

Circular Economy and Producing Locally

Cities are adopting circular models based on a healthy circulation of resources, and principles of sharing, re-use and restoration, with an emphasis on limiting municipal waste volumes and on producing locally – for instance, urban farming. Cities around the world are trying to develop a restorative and regenerative economy by design. Circular economies act as catalysts for efficiency and innovation, with a gradual decoupling of economic activity from the consumption of finite resources and an increasing effort to foster local production (of energy, food, etc).

Smart and Sustainable Buildings and Infrastructure

Cities aim to have regenerated buildings, and to leverage data to optimise energy consumption and the use and management of resources in buildings and utilities: waste, water and energy. Cities are leveraging digital technologies to enable buildings to become interactive elements in the energy system by optimising energy consumption, distributed generation and storage. Vertical and rooftop gardens may become commonplace. New sustainable construction materials are being promoted and utilities are turning smart, in order to meet environmental targets.

Government and Education

Mass Participation

Cities are evolving to be human-centred and designed by and for its citizens, promoting mass participation by the ecosystem in a collaborative process and following open government policies.
A smart and sustainable city is one created by and for its citizens in a collaborative ecosystem involving academia, businesses, NGOs and the public sector, with local governments acting as platforms for this co-creation model, and technology leveraged as a powerful enabler.

City Operations Through AI

Cities are adopting automated processes and operations (orchestrated by a city platform) and following data-driven planning approaches. Using artificial intelligence, technology-powered infrastructure supports cities in automating operations, creating efficiencies, solving problems and delivering better services. Cities tend to also leverage digital twins for better planning and forecasting.

Safety and Security

Cybersecurity and Privacy Awareness

Cities tend to promote awareness of the importance of data privacy and to get prepared for the impact of cyberattacks, since data will be an important city commodity. While investing in cybersecurity may be a strain on city budgets, the cost of not doing so can be even larger with losses mounting into billions. To cope with rising cyber risks and privacy issues, cities are creating robust cybersecurity strategies and policies, in response to any cyber failure, data loss, financial impact, or major service disruption.

Surveillance and Predictive Policing Through AI

Cities are leveraging artificial intelligence (AI) to ensure safety and security for their citizens while safeguarding privacy and fundamental human rights. Increasingly aware of the need to monitor and improve areas of high crime and areas prone to natural hazards, they are using smart solutions such as biometrics, facial recognition, smart cameras and crowd management. However, how to apply these while respecting privacy and liberties remains a critical question.

A special thanks to our interviewees

Carole Mancel-Blanchard
Member of the European Commissioner Cabinet for Cohesion & Reforms, Elisa Ferreira

Jeff Merritt
Head of IoT and Urban Transformation, World Economic Forum

Jukka Mäkelä
Mayor, Espoo, Finland
Intelligent Community of the Year, Intelligent Community Forum 2018
Among the top 6 in European Capital of Innovation Awards in 2019 and 2020
Most Sustainable City in Europe in 2018, the Intelligent Community Forum (ICF)
Most Sustainable City in Europe in 2016 and 2017, Telos Research Institute (Tilburg University)

Kent Larson
Director of City Science Group, MIT Media Lab

Kirby Brady
Chief Innovation Officer, San Diego, USA
Top-performing city in United States for being data driven, Governing Magazine 2018
IDC Smart Cities North America Awards in the Administration Category 2019

Kok Yam Tan
Deputy Secretary of Smart Nation and Digital Government Office, Singapore
Ranked 1st in IMD Smart City Index 2020
Smart City of 2018 at the Smart City Expo World Congress
IDC Asia Pacific Smart City Awards 2020 for Transportation – Connected and Autonomous Vehicles, Public Transit, Ride-hailing/Ride-sharing
IDC Asia Pacific Smart City Awards 2020 for Smart Building/Smart Tech Parks

**Maimunah Mohd Sharif**
Executive Director, UN-Habitat

Markus Elkatsha
Urbanist at City Science Group, MIT Media Lab

Disclaimer: The findings, interpretations, and conclusions expressed in this report do not necessarily reflect the views of the entities, the executive directors or the governments the above mentioned interviewees represent.

Miguel Pinto-Luz
Deputy Mayor, Cascais, Portugal
IDC Communities and Cities Award "Smart Cities and Communities Europe and Central Asia Awards 2020"
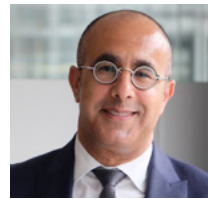
Mohamed Ridouani
Mayor, Leuven, Belgium
European Capital of Innovation (iCapital) in 2020
Voted 2nd best "small town" in the world to live, Monocle's Small City Index 2020
European City of Sport in 2021
European Green Leaf in 2018

Paulo Rosado
CEO and Founder, OutSystems

Rui Moreira
Mayor, Porto, Portugal
Porto innovation ecosystem awarded the "Smart City Innovator" prize at the Annual Investment Meeting in Dubai 2020
Mentor City in the European Commission's "100 Intelligent Cities Challenge"
Voted best "small town" in the world to live, Monocle's Small City Index 2020

Sameh Wahba
Global Director, Urban, Disaster Risk Management, Resilience and Land Global Practice, World Bank

Sandy Carter
Vice-President of Worldwide Public Sector Partners and Programs, Amazon Web Services (AWS)

Uwe Brandes
Faculty Director, Georgetown University Global Cities Initiative

Yvonne Aki-Sawyerr
Mayor, Freetown, Sierra Leone
#FreeTownTreeTown- Freetown committed to planting one million trees

Glasgow, Scotland
Circular Economy
and Producing Locally

Vienna, Austria
City Operations Through AI

Toronto, Canada
Cybersecurity and
Privacy Awareness

Paris, France
15-Minute City

Stockholm, Sweden
15-Minute City

Louisville, USA
Smart Health
Communities

Leuven, Belgium
Mass Participation

Espoo, Finland
Digital Innovation Ecosystems

New York, USA
Digital Innovation
Ecosystems

Nice, France
Smart Health
Communities

Lappeenranta, Finland
Circular Economy
and Producing Locally

Chicago, USA
Smart Health
Communities

Porto, Portugal
Digital Innovation
Ecosystems

**Copenhagen,
Denmark**
Mobility: Intelligent,
Sustainable
and As-a-Service

Shenzhen, China
Mobility: Intelligent,
Sustainable and As-a-Service

Calgary, Canada
City Operations
Through AI

Hong Kong
Circular Economy
and Producing Locally

City Operations
Through AI

Portland, USA
15-Minute City

**Melbourne,
Australia**
15-Minute City

Los Angeles, USA
Mobility: Intelligent,
Sustainable
and As-a-Service

Shiraz, Iran
Green Planning
of Public Spaces

San Diego, USA
Mass Participation

Tel-Aviv, Israel
Cybersecurity and
Privacy Awareness

Tokyo, Japan
Cybersecurity and
Privacy Awareness

Mexico City, Mexico
Mass Participation

Cape Town, South Africa
Circular Economy
and Producing Locally

Kanagawa, Japan
Surveillance and
Predictive Policing
through AI

Quito, Ecuador
Inclusive Services
and Planning

Lisboa, Portugal
Green Planning
of Public Spaces

**Nagareyama,
Japan**
Inclusive Services
and Planning

Medellin, Colombia
Inclusive Services
and Planning

Cascais, Portugal
City Operations
Through AI

Singapore
Smart & Sustainable
Buildings and
Infrastructure

**Adelaide,
Australia**
Smart & Sustainable
Buildings and
Infrastructure

Smart Health
Communities

Surveillance and
Predictive Policing
through AI

Rio de Janeiro, Brazil
Surveillance and
Predictive Policing
through AI

Fukuoka, Japan
Smart & Sustainable
Buildings and
Infrastructure

Freetown, Sierra Leone
Green Planning
of Public Spaces

Seoul, South Korea
Circular Economy
and Producing Locally

Current Challenges:
a driver for future solutions

A portrait of world cities by 2030

In 2018, 55 per cent of the world's population lived in urban areas. By 2030, urban settlements are projected to house 60 per cent of people globally and one in three people will live in cities with at least half a million inhabitants. By that time, it is expected that urban areas will contribute 80 per cent of global GDP and account for three-quarters of total global energy demand, and that urban consumers will account for 81 per cent of global consumption. Linked to these growth projections, an uptick in total urban consumer spending is imminent.[2][3] Further, changes in the world economic order are expected with urban economic power shifting eastwards.

The massive shift towards urban living will require a robust and successful management of the growth, especially in areas where the population density will increase particularly rapidly. While the pressure of growing populations is a key factor for cities, other relevant challenges must also be addressed by urban planners in order to create sustainable cities.

As we enter a decade of action, cities should aim towards the accomplishment of the United Nations Sustainable Development Goals by 2030 – not only SDG11 "Sustainable Cities and Communities" but all 17 targets, as cities have a broad impact on human living. A study of 167 cities worldwide[4] found that 77 per cent included each of the SDGs in their plans. The same study found that cities have made progress towards goals such as "No poverty", "Decent work and economic growth" and "Quality education", but "Climate action" and "Reduced inequalities" are lagging behind. African cities are finding the biggest problems in meeting the SDGs.

Additionally in order to meet the target of limiting global warming by 1.5°C by 2050, as set out by COP21, national and local governments need to make greater efforts to define policies and measures for achieving carbon neutrality and so protecting the planet.

For example, the European Commission has already set a goal for the EU to become the first carbon-neutral continent by 2050 and has issued a Green Deal Strategy aimed at fostering a green economy and urging governments to take action. Indeed, there are more international initiatives and policies targeting cities in particular as drivers of action for climate mitigation and adaptation.

Cities globally are engaging with stakeholders to drive collaboration to deal with the economic and environmental effects of the expansion of urban sprawl and changes in living habits, and the unwanted social effects created by fiscal deficits, growing populations, and racial segregation. Cities of the future need to tackle a number of economic, social and environmental challenges.

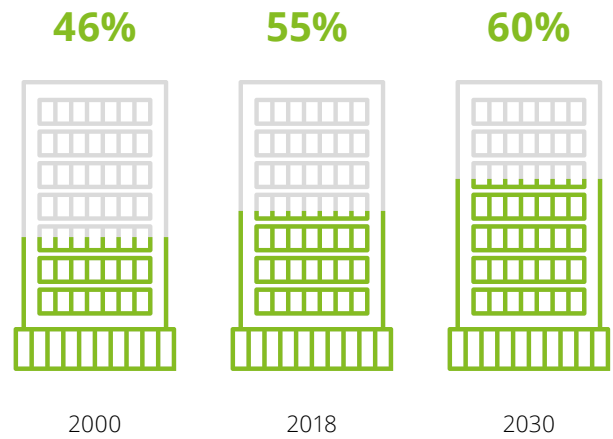"If you look into the 17 SDGs, 64 per cent of the policies in them are to be implemented in cities."

Maimunah Mohd Sharif
Executive Director, UN-Habitat

Evolution of global cities

Number of megacities
(cities with more than 10 million inhabitants)[5]

14
1995

33
2018

43
2030
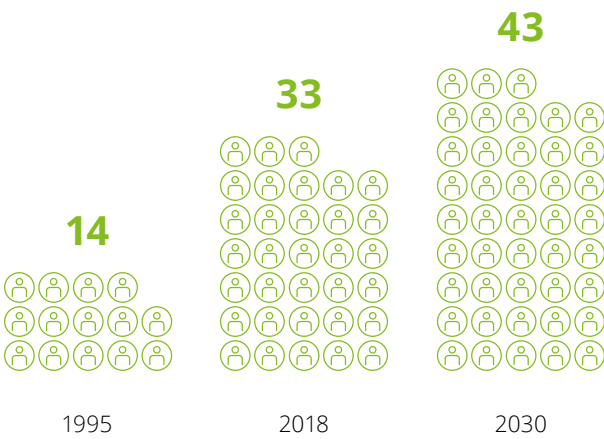
Urbanisation rate
Percentage of people living in urban areas[6]

46%
2000

55%
2018

60%
2030

Megacities by 2030[7 8]
(cities with more than 10 million inhabitants)

Moscow
London
Paris
Istanbul
Tianjing
Beijing
Seoul
Tehran
Tokyo
Osaka
Chicago
New York City
Delhi
Chengdu
Nanjing
Los Angeles
Cairo
Baghdad
Ahmedabad
Shanghai
Mexico City
Karachi
Dhaka
Shenzhen
Mumbai
Kolkata
Guangzhou
Hyderabad
Bogota
Bengaluru
Chennai
Manila
Bangkok
Ho Chi Minh
Lima
Lagos
Rio de Janeiro
Luanda
Dar es Salaam
São Paulo
Jakarta
Buenos Aires

- Existing megacity
- New megacity by 2030

★ **Highest GDP:**
New York – USD 2.5tr

★ **Largest Population:**
Jakarta – 38 million

★ **Highest GDP growth:**
Bengaluru – 8.5%

13

Challenges

Economic

- **Affordable housing**: Population growth and increased migration into urban areas have led to lack of affordable housing in cities. In some of the most developed economies, the problem of homelessness has intensified. Whereas the median household income in 32 megacities increased by just 8 per cent between 2015 and 2020, average house prices increased by 24 per cent.[9] Many cities in emerging markets have no choice but to accommodate a rise in informal housing markets.

"There is a big trade-off in cities: the benefits of agglomeration versus the costs of poorly managed urbanisation. The benefits of agglomeration are increased productivity, knowledge spill-over and access to specialised services. The costs of poorly managed urbanisation are well known: these include congestion; pollution — both air and water; crime and violence; and the inability to access affordable housing among other things."

Sameh Wahba
Global Director, Urban, Disaster Risk Management, Resilience and Land Global Practice, World Bank

- **Technical skills and talent gap**: In 2019, the WEF forecast that about 133 million new jobs would emerge by 2022 connecting humans, machines and algorithms, and lead to strong demand for technical skills.[10] As more people switch to remote working, cities must compete for the best talent in order to thrive.

- **Digitalisation of services and cybersecurity**: Digitalisation to provide better services to the public, thereby increasing competitiveness, is a major challenge facing cities. As physical and digital infrastructure proliferates at speed, the risk of cyberattacks increases. In 2019 there were 63 per cent more cyberattacks than in 2017, causing losses in excess of EUR 0.82 million (USD 1 million).[11]

- **Financial constraints**: Developing economies would require an additional EUR 1.06 trillion in public infrastructure spending to meet the existing demand. However according to the National League of Cities, cities experienced an 11 per cent fall in sales tax revenue in 2020.[12] The World Bank has estimated that the pandemic resulted in a fall of 15 to 25 per cent in city revenues[13], as a result of which local governments will be facing budgetary constraints. Cities must find innovative models for generating revenue streams and leveraging public private partnerships (PPP).[14]

Social

- **Urbanisation**: Urbanisation in megacities has led to resource scarcity, an increase in carbon emissions[15] and an overburdened public infrastructure. It has also led to the rise of transnational economies and new models for cities, such as polycentric megacity regions. The UN estimates that 60 per cent of the world's population will live in cities by 2030.[16]

- **Aging population and urban health**: With an aging population in cities, there is growing pressure on healthcare and social security systems and a declining workforce.

- **Social segregation and inequality**: The pandemic has severely damaged global prosperity and was expected to push around 88 million new people into extreme poverty in 2020. The problems facing the poor are compounded by outdated urban planning policies that create unequal exposure to risks from factors such as flooding, violence and mobility restrictions.[17] But social segregation in cities goes even further: minorities are set apart in cities and there is a need for greater equality in terms of gender, race, sexual orientation and disability.

- **Accessibility and mobility**: In the European Union, urban mobility accounts for 40 per cent of CO2 emissions from road transport.[18] Urbanisation and continuing dependency on cars lead to congestion, and create concerns about emissions and safety: mobility is a key challenge for planning green and sustainable cities.

Environmental

- **Climate change**: Climate change is a major concern for cities which consume 75 per cent of energy globally[19] and account for 70 per cent of CO2 emissions.[20] Increasing greenhouse gas emissions, driving ocean acidification and climate change, is threatening the resilience of natural ecosystems and leading to a rise in sea levels – the effects are already being felt in coastal cities. The role of cities in this battle is key, both for mitigation and adaptation.

- **Soil degradation**: Soil erosion not only leads to loss of fertile land but also results in pollution of waterways, flooding and damage to aquatic ecosystems. Degradation in the quality of soil also has impact on human health and well-being.

- **Waste management**: Throw-away consumerism and one-time-use products are major causes of a waste management crisis: landfill waste pollutes groundwater and nearby ecosystems. Global production of waste is set to increase by 70 per cent by the middle of this century, with half produced in cities.[21]

- **Air pollution**: Greater numbers of the population are breathing polluted air, increasing the importance of educating citizens about the harmful effects on public health. World Health Organization (WHO) has reported that 7 million annual premature deaths are caused by air pollution.[22]

City Landscape by 2030

Economic

- Cities will account for **80 per cent of global GDP** by 2030, up from 70 per cent in 2018.[23]

- Cities need **300 million new homes** by 2030.[24]

Social

- By 2030, consumers in large cities will account for **81 per cent of global consumption**.[25]

- Per capita spending is projected to fuel **75 per cent of consumption growth** by 2030.[26]

- The growth in urban land consumption will **outpace population growth by as much as 50 per cent**.[27]

Environmental

- Energy consumption in cities will rise to around three-quarters of global demand.[28]

- Some cities have committed to reducing GHG emissions by 94 per cent by 2030.[29]

- By 2030, the cost of natural disasters for cities may be three times greater than in 2020.[30]

The fight for resilience

Historical disruptions have shaped cities worldwide and the current pandemic will do the same. Cities have been able to reimagine themselves for the better and achieve progress after each catastrophe.

The 1755 Lisbon earthquake led to the birth of earthquake engineering;[31] the cholera outbreak in London triggered the first public health policy on urban sanitation in 1848;[32] and a fire in Chicago in 1887 led to vertical construction and the first skyscrapers.[33][34] The damage done by World War II reinforced the idea of a just and democratic model city for all its inhabitants, and as a result, governments initiated massive housing and rebuilding programmes in their devastated cities, with high-rise structures separated by green spaces.[35][36][37]

COVID-19 will be no different and must trigger a fightback for resilience, after having led to an increase in unemployment and poverty, and damaging the global economy and our 'normal' ways of living.

"The city will transform in many ways as a result of this crisis to become more inclusive and more livable."

Sameh Wahba
Global Director, Urban, Disaster Risk Management, Resilience and Land Global Practice, World Bank

What is the impact of COVID-19 in cities?

With 90 per cent of COVID-19 infections reported in urban areas, cities have felt the greatest impact from the pandemic.

"One of the most interesting issues is density and it may be one of the most controversial issues. Affluent people fled high-density cities in this country for low density suburban and rural areas, but in fact, if you look at the record around the world, the high-density cities had among the best track records in dealing with the pandemic."

Kent Larson
Director of City Science Group, MIT Media Lab

Mobility[38 39]
- Immediate 92 per cent reduction in travelling during lockdown reported by transit agencies[40]
- Greater need for sustainable mobility and sustainable alternatives to private cars, with an acceleration of regulatory changes to support low emission vehicles

Safety and Security[41 42 43]
- Immediate increase in phishing and other cyber attacks since the pandemic
- Increased security risk due to remote working, and a rise in social inequalities and racial tension

Economy
- Immediate rise in unemployment levels, and skills gaps uncovered
- Increase in remote working, creating a need to attract talent to the cities
- Upsurge of digital payments and 77 per cent year-on-year growth in e-commerce during 2020, affecting local economies[44]
- Greater need for diverse economic structures based on green investment and jobs - EUR 3.0 trillion stimulus by G20 economies for green recovery (30 per cent of total global stimulus)[45]
- Changes in the housing and real estate market, with increased demand for balconies and gardens (some in suburbs)

Living and Health[46]
- Immediate 20-40 per cent reduction in air pollution levels in major global cities due to lockdown and the fall in economic activity during 2020
- Critical gaps in healthcare systems all over the world, highlighting the need for preventive medicine
- Made clear the need for compact urban planning

Energy and Environment[47 48 49 50]
- Immediate six per cent contraction in global energy demand and seven per cent reduction in carbon emissions in 2020 as compared to 2019
- Energy investment is expected to fall by around EUR 328 billion (USD 400 billion), slowing the progress towards clean energy
- Growing attention to climate policy and environmental resilience

Government and Education[51 52 53]
- Inability to access public infrastructure and services showcased the need for digitalisation of city operations to respond to a crisis, although in 2020 759 million homes across the globe lacked internet connection
- Greater need for integrated governance strategies to become more resilient to shocks
- Opportunity for digitalisation of schools and education

"A single major challenge that all cities face is the re-establishment of trust in communications between stakeholders within urban communities."

Uwe Brandes
Faculty Director, Georgetown
University Global Cities Initiative

"It is a wake-up call for all of us to see how we can improve our sustainable development and cities' design. Normally, with disruption comes opportunities, and we have seen cities seizing the opportunity, not only tackling the pandemic and its consequences, but also reconsidering to build back better, greener, more just and in a more inclusive way."

Maimunah Mohd Sharif
Executive Director, UN-Habitat

Time to act

Whereas some local governments embraced disruption and started to rethink the way in which cities were planned, others simply accelerated some of the plans that had previously been put on hold. Research undertaken in 167 cities worldwide[54] shows the lasting impact of COVID-19 on urban centre planning: 68 per cent of cities admit to reconsidering urban planning and the use of space; 54 per cent are re-thinking mobility and transportation; 54 per cent are accelerating the shift to online healthcare; and 53 per cent admits that it has changed permanently how people live, work, socialise and travel in their city.

Although it is not yet fully clear what will be the impact on cities in the aftermath of the pandemic, as Kent Larson (Director of City Science Group at MIT Media Lab) states, there is an urgency for change to create a green, digital and inclusive society. Seeing a moment of opportunity, institutions like the World Economic Forum suggest a Great Reset of capitalism, while international institutions and policy makers demand a 'green-focused' recovery.

Examples of initiatives by cities
in reacting immediately to the pandemic

Vancouver, Canada[55]
Accelerated a smart-city project with remote working, leveraging its geographic information system transformation and enterprise data and analytics programmes to provide critical support.

Newcastle, UK[56 57]
Repurposed its Urban Observatory - an IoT sensor, machine learning-based system to develop a data dashboard to inform local authorities of changes in social behaviour and track whether social distancing norms are respected.

Bogota, Colombia[58]
As an immediate response to the pandemic, Bogota added 52 miles of temporary bike lanes to the existing 342- miles Ciclovia network at the beginning of 2020.

Singapore[59]
The government has announced a 30 per cent increase — SGD 3.5 billion (EUR 2.1 billion) — in its ICT investment to accelerate digitalisation as technology becomes increasingly vital in enabling citizens and workers to resume normal activities and businesses to reopen safely after the COVID-19 'Circuit Breaker'.

Sioux Falls, United States[60]
The city of Sioux Falls deployed an AI, IoT and cloud-based platform (Coronavirus Emergency Response (CoVER) platform) to apply the vast amounts of data within their systems to mitigating the impact of the virus.

Montreal, Canada[61]
The city has implemented an ambitious Safe Active Paths circuit to allow citizens to adopt active mobility methods in greater numbers. It has moved forward plans to build 327km of bike paths in response to COVID-19.

Milan, Italy[62]
A breakdown in the food aid system due to the COVID-19 led to the establishment of a permanent joint food aid system by all the public and private entities involved in distributing food aid, enabling consistent and comparable data about the food distributed to more than 20,000 people.

Rotterdam, Netherlands[63]
Rotterdam is undertaking sustainable projects and initiatives as a part of its COVID-19 green recovery. It has set up a fund of EUR 9.5 million to support initiatives such as retrofits, solar, wind power and 'green roofing' all over the city.

"All those trends – whether low carbon cities, resilient cities or smart cities – will need to adopt a people-centred approach. They will need to follow an inclusive approach and work with citizens, ensuring that the poor are protected against the impacts of climate change, which tend to affect them disproportionately."

Sameh Wahba
Global Director, Urban, Disaster Risk Management,
Resilience and Land Global Practice, World Bank

Urban Trends:
Shaping the future
of cities

The sections that follow describe the trends that we believe will shape the future of cities.

Green Planning of Public Spaces

Smart Health Communities

15-Minute City

Mobility: intelligent, sustainable and as-a-service

Inclusive Services and Planning

Digital Innovation Ecosystems

Circular Economy and Producing Locally

Smart and Sustainable Buildings and Infrastructure

Mass Participation

City Operations Through AI

Cybersecurity and Privacy Awareness

Surveillance and Predictive Policing Through AI

Each trend is organized in order to reply to four questions:

- **What is the trend?**
  An explanation of what it means and the implications for a city
- **Why the trend is important?**
  The reasons why is must be followed by cities and the impact it could have

- **How it should be implemented?**
  A list of key topics to be aware of
- **Where to see this in action?**
  Some examples of cities that are at the forefront of change

Trends are not mutually exclusive nor equally applicable to every city in the world. However, city leaders should take a holistic approach as most of these trends are interconnected and are dependent on or complement each other.

Green Planning of Public Spaces

Michael Flynn
Global Infrastructure, Transport
and Regional Government Leader

Cities tend to be planned and designed for people, with 'green' streets, new corridors and public spaces as centres of social life.

"This pandemic has really put into sharp focus how fundamental urban planning is, because it is about design. If you don't design for access, you won't have access. In your urban planning you're also planning for livability."

"Green infrastructure creates a more livable city. Our city has suffered from floods, loss of biodiversity, poor air quality. Trees will really restore that."

Yvonne Aki-Sawyerr
Mayor, Freetown, Sierra Leone

"Planting greenery, first and foremost, is one way for us to reduce the outdoor ambient temperature from rising to a high level. But it is not just that. A green city that is close to nature also offer greater livability."

Kok Yam Tan
Deputy Secretary of Smart Nation
and Digital Government Office, Singapore

Urban areas are traditionally characterised by high population density and heavy construction to support modern amenities, such as transport and commercial buildings. They now face increasing pressure from expanding populations, limited resources and the growing impact of climate change. One of the indicators for measuring SDG 11 is the area of public and green space in a city. Although the accepted minimum standard is 45 per cent (30 per cent for streets and 15 per cent for green spaces), cities do not meet it. On average just 15 per cent of land is allocated to streets even in planned areas of new cities. In unplanned areas, it is only 2 per cent. This lack of natural space creates an unhealthy urban living environment.[64]

Cities should be driving a decarbonisation agenda. Becoming low-carbon, and changing the way they are planned is the first step towards mitigate carbon emissions and achieving ecosystem resilience. At the same time, they should ensure an urban planning capable of facing the pressures of climate in the adaptation agenda. Green public spaces entail:

- A higher number of trees in cities — "Treepedia" from Senseable City Lab (MIT), which measures the canopy cover in cities, places Singapore at the top of its the 'Green View Index' with 29 per cent coverage; followed closely by Sydney (26 per cent) and Vancouver (26 per cent).[65 66 67]

- Creation of more and larger public parks and nature-based solutions in the urban environment — such as river banks, forest areas and trees in streets — fostering a closer connection to nature even in cities with high population density.

- An increase in walking and cycling facilities instead of car-centric designs and parking areas, with space for children and adults to enjoy outdoor activities and fostering a sense of security and safety.[68 69] (According to a study by C40, a network of the world's megacities committed to addressing climate change), investing in a shift to mass transit and developing walking and cycling corridors can reduce carbon emissions in cities by 5 to 15 per cent).

Cities around the world are recognising the benefits of a green approach to urban planning, as it has the potential to lower urban temperatures, mitigate air pollution and build natural environmental resilience. The World Economic Forum's Global Agenda Council on the Future of Cities has included increasing green canopy cover in its list of top ten urban planning initiatives.[70]

Why are green public spaces relevant for cities and their populations?

Enhanced quality of living: C40 shows that polluted air leads to almost 4.5 million premature deaths a year and afflicts children in particular with conditions such as asthma. Urban forest areas, when properly designed, can help improve air quality, demonstrating the need to distribute trees within urban areas in a way that avoids reinforcing inequalities in health outcomes.[71][72]
The town of Tengah in Singapore offers a good example of how urban planning can provide more healthy living standards by building infrastructure underground.

Enriched physical and mental health: WHO guidelines suggest that green spaces may help to improve mental health. A study in London found that for every one-unit increase in the density of trees per kilometre of street, the number of antidepressant prescriptions fell by 1.18 per 1,000 residents.[73][74]
With regard to physical health, other WHO research estimates that between 23 and 25 per cent of global disease could be avoided through management of green cover. Several studies suggest that green space reduces premature mortality rates.[75][76][77]

Improved resilience and equality, as part of an adaptation strategy: Deforestation has put some regions much more at risk from the consequences of climate change. Tree planting contributes to protection against landslides and recurring flooding, and hence reinforce the resilience of the city. Eliminating differences in tree coverage and green spaces between areas of a city reduces inequalities, as it provides the benefits of better health and wellbeing to everyone. An absence of green amenities, typically in low-income areas of a city, creates hotter neighbourhoods and greater exposure to climate risk. Research by Stanford University found that in Sabah (in Malaysian Borneo) a malaria outbreak coincided with a reduction in green coverage. The study found that a 10 per cent rise in forest loss led to a 3 per cent increase in cases of malaria.[78]

Reduced emissions to get closer to the sustainability and climate goals of the Paris agreement: Green spaces help with progress towards the environment goal for decarbonisation. For example, strategic placement of trees in cities can help to cool the air by between two and eight degrees Celsius, thus reducing the urban 'heat island' effect, and the need for air conditioning by 30 per cent.[79]

"If we can move roads underground, we'd be able to release a lot of space for recreation, for nature, for business, and we create a different sort of surface connectivity by allowing pedestrians to use the space."

Kok Yam Tan
Deputy Secretary of Smart Nation and Digital Government Office, Singapore

"Cities will be driven by living, not by working."

Paulo Rosado
CEO and Founder, OutSystems

"Due to dysfunctional land and housing markets, poor people locate in cities close to jobs in the unbuilt spaces. These are mostly hazard prone areas such as landslides and flooding. Their lives stand to be at risk. This is what the resilience agenda aims to tackle."

Sameh Wahba
Global Director, Urban, Disaster Risk Management, Resilience and Land Global Practice, World Bank

"Lots of cities are taking climate targets as their responsibility. They know that due to the concentration of population they have the possibility of making a huge impact on the green and climate transition, and they take on their own commitments to achieve results in this aspect."

Carole Mancel-Blanchard
Member of the European Commissioner Cabinet for Cohesion & Reforms, Elisa Ferreira

"It is really hard to take assets away from people, there's a lot of resistance to change. If you say we're going to close down a street or take away parallel parking, the community will object. What happened in the pandemic, when people weren't driving and the streets were empty, was that you could take away the parking and move cafes out into the street. Now that people realise how great that is, it's going to be hard to take that away."

Kent Larson
Director of City Science Group,
MIT Media Lab

Watch and listen to the insightful conversations about this trend.

How to ensure a successful implementation?

Understand sustainability drivers and societal targets: To help meet environmental targets, green spaces should be designed with an understanding of both the existing ecological situation and the end goal for achievement. This 'impact study' is crucial in order to plan the journey from the starting point to the end goal, embracing the cultural and social dynamics of the city.[80] Assessing the risks should be part of this process: for example, some cities lack information of which zones are more prone to flooding.[81]

Promote an equal, fair and integrated urban planning: Compared to city centres, suburbs are often neglected in the development of areas for walking and green spaces. For example, a study conducted in Melbourne observed that for each ten kilometres in distance away from the city centre, the tree cover fell by more than 2 per cent. A shortage of urban tree cover can leave suburban areas more vulnerable to the impact of rising air temperatures.[82] Moreover, it is important that the creation of new corridors and green spaces should occur without displacing long-term low-income residents from an area. As an example, the restoration of New York City's Prospect Park increased real estate prices and attracted new wealthy residents: this drove poorer residents from the area, particularly among the black community.[83] An integrated perspective is needed, as walking and cycling corridors must be accompanied by an updated mobility strategy with proper incentives for reducing private car usage.

Do not underestimate the power of community engagement: Community engagement is crucial for obtaining buy-in from local people to green and livable urban planning. The City of Porto is creating healthy corridors in Campanhã under its Urbinact initiative, which is supported by community engagement initiatives.

Active community engagement is also essential for ensuring local involvement in refurbishment and maintenance projects.

Ensure funding and financing: Limited budget resources could hinder prioritisation of green cover. Cities might therefore consider innovative funding methods for green spaces. For example, Atlanta used impact bonds to develop its Proctor Creek neighbourhood. Washington, DC used similar bonds to fund the development of personnel.[84] Other traditional financial instruments can also be leveraged.

Where to see this in action?

Freetown, Sierra Leone

Freetown is one of the most crowded cities in the world, characterised by rapid but uneven growth. For instance, 38 per cent of the city's expansion had taken place in either medium — or high-risk areas. This hazardous expansion had resulted in the growth of slums in flood-prone areas and environmental degradation. The Mayor has pointed out that building in flood-prone areas is made worse by incomprehensible urban planning and the scarcity of affordable housing. Adding to the challenge, the city does not have the mandate for urban planning decisions.

In January 2019 Mayor Yvonne Aki-Sawyerr launched the 'Transform Freetown' plan, a three-year vision for developing the city, to address Freetown's socioeconomic challenges and environmental vulnerabilities. The plan encompasses four clusters and 11 priority sectors. The clusters are: resilience, human development, a healthy city, and urban mobility. The government launched several initiatives under the plan, to address a range of issues from waste management and housing, to improving urban planning and tackling environmental degradation. Among others, the Mayor has pointed to building and constructing (for the first time ever) a wastewater treatment plant; work on a sanitary landfill; the introduction of recycling; and the training and funding of qualified gynaecologists, paediatricians and obstetricians, "which will be a game changer because it will help reduce the number of people who die at birth".

The #FreetownTheTreeTown campaign is an initiative to reduce erosion and run-off and to increase vegetation cover in the city by 50 per cent by 2022, by planting one million trees. This is seen by the Mayor as a way to combat the rise in air temperature associated with deforestation. "The city has suffered from floods, a loss of diversity and poor air quality, and trees will help restore that."

For phase one implementation of the campaign in 2019, the city council partnered with various federal ministries, the World Bank and the Environmental Foundation for Africa to plant and grow 500,000 trees in targeted areas to address recurring hazards and avoid potential disasters — such as a series of landslides and floods in 2017 which left more than a 1,000 inhabitants dead or missing and had an economic cost of over EUR 25.5 million (USD 30 million)[85] —, restore natural ecosystems, and protect the water supply and sanitation infrastructure.

As of 2020, the city had planted 245,000 seedlings and nursed 15 different species of trees across a number of sites. They will continue planting them in houses, schools, public spaces and o ffices areas. Followed by an assessment of the tree canopy through machine learning, tree growth will be tracked through a locally developed Treetracker app, and the survival of the trees will be ensured through employment community stewards and the issue of impact tokens as a reward for good care. The initiative has created 553 green jobs amongst tree planting communities to ensure long-term sustainability of the strategy. "They are based in communities, they have responsibility for particular tree planting zones, for tree plant catchment areas, and they water them. But there is a jobs element here, also built into the nature of the trees that are planted. We have gone for economic trees: you are able to harvest mangos, cashews, fruits, moringa herbs, which have a commercial value. The community or the household will benefit from that."

The city has also appointed climate change ambassadors, the local chiefs, to create awareness and avoid destruction of trees for fuel in cooking, as "82 per cent of the fuel used in Freetown for cooking is wood-based".

The objective is to ensure equitable distribution of vegetation coverage across the city and to include the entire community in the process so that Freetown becomes more resilient to future challenges.[86 87 88]

Lisbon, Portugal

As the use of cars increased, Lisbon's streets became more congested. This led to a reduction in space for pedestrians and exposed the problems with urban design that prioritised making space available for cars and other vehicles.

To deal with the challenge, the city prioritised the development of pedestrian and cycling corridors. The city is building cycle paths in the city's central artery and uptown avenues. It is working towards having 200km of bike lanes by the end of 2021, so that 93 per cent of the population has access to a cycle lane within 300 metres of their home. It is also creating a total of 27 cycle-pedestrian bridges.[89][90]

Lisbon has also taken initiatives to refurbish community squares as green public spaces. For example Martim Moniz Square, historically a commercial space, was transformed by grass covering and roof gardens with the aim of 'returning the space to the city'. Praça de Espanha, a disorganised area, was turned into a green zone dedicated to walking and cycling.[91][92]

Lisbon launched 'LIFE LUNGS' to implement a municipal climate adaptation strategy for increasing the resilience of the city through green infrastructure. By developing more green spaces, it aims to tackle rising temperatures caused by urban heat islands.[93] Only two days after Lisbon was awarded the title of European Green Capital in 2020, 4,500 people from all over the city and surrounding areas planted 20,000 trees. The city plans to be 100% carbon-neutral by 2050.[94][95]

Lisbon is also connecting its green areas to the Vale de Alcântara green corridor. It connects the city's natural amenities, including Monsanto Park and the Tagus River, with cycle paths and walkways, providing greater access to green spaces.[96]

Shiraz, Iran

Growth in the population led to excessive construction projects in the city, poor living conditions, pollution, and high energy consumption. To deal with the situation, the municipality started reforestation of the city's periphery under an initiative called 'the Green City' project, which ran from 2008-2018.

The project targeted all citizens of the city, with a special focus on those living in areas of high unemployment and crime and also on tourists visiting the city.

The project had four elements: urban forest development, roof parks, linear parks, and roof gardens. The government created green spaces, recreational areas, linear parks along streets, and roof parks. It also encouraged planting on rooftops, and tax rebates were offered to private sector construction projects that were in alignment with the city's development plan.

As a result, the per capita green space increased from 13m^2 to 85m^2. The project also increased ground water resources and produced 325,000 cubic metres of oxygen each day, improving the air quality in the city.

2,876 hectares around the city were transformed into forests of olive trees. Olive oil from the trees increased the municipal income, and reduced the city's dependency on imports of olive oil. Another outcome was the prevention of 'illegal' construction and settlements around the city borders.

Following successful cooperation between authorities at different levels, state and local, a national law has been proposed for the implementation of similar projects in Fars Province (covering an area of 40,000 hectares). Other cities have signed an agreement to follow the example of Shiraz.[97]

The vision of Yvonne Aki-Sawyerr

Yvonne Aki-Sawyerr,
Mayor, Freetown, Sierra Leone

How do you see that COVID-19 has affected urban planning in cities at a local and global level?
It is clear that cities have reacted to ensure that the recovery is green and just. There have been all kinds of investment but for me the perspective was not that simple. My situation is that urban planning is currently not done by the city, so although legislation in the Local Government Act of 2004 devolves land use planning and issuing building permits to the Council, it is actually not done by the Council. What the pandemic has demonstrated without a doubt is the fundamental importance of urban planning as a preventive measure within the context of a health crisis and pretty much everything else that can go wrong in a city: sanitation, poor transport networks, and limited access to housing or to health. The pandemic has shown why we need planning to be devolved, and why we need to invest in it…. You are not going to prevent a pandemic, but you're going to make responding to it easier.

Is #FreetownTreeTown and tree planting a sustainability initiative or part of a long-term vision for the city?
Green infrastructure within our cities is part of planning. In urban planning you are also planning for livability and better air quality, and trees and water have a role to play – we can't underestimate how important it is to have trees in order to have water. But there are also jobs. We have created 553 direct jobs through #FreetownTreetown to date, mainly young people who serve as tree monitors. They are based in communities, have responsibility for particular tree planting zones and tree plant catchment areas, and for watering them. They also use the Tree Tracker app to track tree growth and they get paid based on the growth of the trees under their care. We have gone for economic trees: you are able to harvest mangos, cashews, fruits, and moringa herbs, which have a commercial value. The community or households will benefit from that.

There is also a long-term perspective, which includes mitigating the risk of flooding and improving water caches. It does not happen overnight, but it is really important. Green infrastructure allows for a more livable city. (…) Our city has suffered from floods, loss of biodiversity and poor air quality, and trees will restore that.

How do you engage with the community to raise awareness and create engagement on what is the best approach to plan for Freetown?
We had a lot of media coverage when we started #FreetownTreeTown. Setting a goal of a million trees was dramatic and definitely a conversation starter, and sometimes that's what you need to do to make sure people sit up and see what you're doing. From a community perspective, the rollout involved the concept of tree giveaways in different parts of the city. Now that we've done the planting, we have also created climate change ambassadors who are the 'champions' within their communities. There is a risk of the trees being destroyed through construction, but there's an even bigger and more immediate risk, which is the fact that we have a value chain for charcoal in which a lot of people get their employment – 82 per cent of fuel oil used for cooking in Freetown is wood-based…. (…) I'm not saying it is easy, but so far so good.

How do you see the role of technology supporting you in urban planning in the future?
Technology is very relevant and necessary, and we use a lot of it. The Treetracker app provides an opportunity for sustainability because it means that we can monitor every tree and finance it. Planting trees is an expensive business…. Being able to track and monitor the growth of the trees is key, and that is something we use technology for. We have another app called Go Cam, which basically allows someone to do their shopping in the market using an app: we are testing the software for property identification and database and building permits…. Tech is very much a part of how we are looking to plan the city better.

What is the role of the private sector helping you and Freetown achieve this one million tree goal?

Our private sector is fairly small. In terms of the money that we need to fund the additional 700,000 trees, relying on our private sector to fill that gap isn't something that would be feasible. What we have done is to design an impact token. We have X number of trees, convert them into a token, and anybody in the private sector anywhere, including individuals, can buy them. That is the system we are trying to build now.

What are the key factors for this vision of yours to succeed?

You need a dedicated team, as this is a huge challenge. The first step is to identify what you need (not every tree is required everywhere) and we needed slope stabilisation to prevent run-off during the rainy season on the slopes and also regenerate mangroves. For slope stabilisation, you need to understand which types of trees, to understand the soil. The technical element can't be overlooked.

Having identified what types of trees, you then need to nurse the trees: you don't just come with seeding. From a funding perspective, we were able to convince the nurseries to grow them without immediate payment: they took a risk alongside us, because when they started growing, we had no money to pay them, only our commitment. That was a success factor. Another one is getting partnerships that work along the value chain, so that the nurseries became our partners. Community engagement is also an element for success. This is not something you can do on your own: in our case, we had to sign a Memorandum of Understanding with the district next to us because a number of water catchment areas are not physically in Freetown.

What are the other priorities in your agenda?

#FreetownTreetown is an intervention within one of our 19 targets. This is one intervention within one target. And those 19 targets track back to 11 priority sectors, which in turn are grouped into four clusters: resilience, human development, healthy city, and urban mobility. You can write the range of what we are doing in one page, but it takes a lot to deliver, and we are trying to do it within a fairly short space of time.

Our targets are ambitious. They range across sanitation; increasing the collection of liquid waste; building (for the first time ever) a wastewater treatment plan; a sanitary landfill; training qualified gynaecologists, paediatricians and obstetricians, which will be a game changer because it will help reduce the number of people who die in birth. We are also introducing a cable car and urban planning.

What is your vision of a city in the future? How will Freetown become your dream city?

My dream would be planning the city with zones, with a structural plan, local area plans, building permits and building regulations. We don't have building regulations, so there is nothing stopping you from building. To have controls over what landlords build so that there is better quality of life, and all of this done within the context of a green city.

Listen to the full interview.

Smart Health Communities

Stephanie Allen
Global Public Health and Social
Services Leader

Cities are developing health care ecosystems that are not only focused on diagnosing and treating sickness but also on supporting well-being through early intervention and prevention, leveraging digital technologies.

"The pandemic quickly catalysed the awareness of the relationship between public health and community-based health and in many cases highly localized insights into neighbourhood-based health. Public health goals are only relevant to the degree to which they can be implemented at the local scale of the community or the urban neighbourhood."

Uwe Brandes
Faculty Director, Georgetown
University Global Cities Initiative

The pandemic and health crisis have made the case clear: communities have a role in creating a better health environment. And there is a reason to continue with this approach when the crisis has ended.

Globally, five of the top ten causes of death are related to unhealthy behaviour.[98] This brings into the spotlight the need for preventive medicine. The factors that affect a person's health and behaviour are complex; therefore communities (physical and virtual) must play a part.

Cities will develop healthcare ecosystems that move away from purely focusing on diagnosing and treating sickness and injuries to supporting well-being through early intervention and prevention. Instead of being designed and funded to treat patients individually, healthcare services will have a greater appreciation of the interconnectedness of communities. The social determinants of health will be better understood, and government and the private sector will collaborate to address the challenges.

As care moves outside hospital walls new community players and disruptors will have a crucial role in the new ecosystem. Scientific advances and the affordability of personalised healthcare (genomics, micromics, metabolisms and behavioural economics) will ensure that care is tailored to individuals and their families. The citizens' health journey will be underpinned by interoperable data and analytics guiding them through positive health choices and behaviours.

Cities have a responsibility to create a healthy environment. Smart Health Communities (SHC) engage patients, companies and public entities to deliver digital health services, in order to develop and shape communities, reducing costs dramatically, improving wellness and longevity, and promoting economic growth.

As cities of the future are expected to be densely populated, having an organised health ecosystem will be crucial. Furthermore, growing digitalisation and integration of IoT across a city's ecosystem is making the development of smart health infrastructure a priority. Governments around the world are acting as enablers and catalysts of change. A city, as a geographic SHC, can drive a shift towards preventive and curative therapies as well as providing solutions that foster collective and cooperative healthy behaviour, and generate and analyse interoperable data to predict risks and evaluate impact. While privacy is a concern, investment in smart public health initiatives generates a substantial ROI for cities whilst improving public health and well-being.[99]

A Smart Health Community:
- Empowers proactive health and well-being management
- Fosters community building and wellness
- Enables digital health tools and behavioural science
- Ensures affordable health for all
- Makes meaningful use of data analytics to improve outcomes
- Enables an innovative healthcare ecosystem

Smart Health Communities target consumer-centric health and are usually co-owned by public and private entities and citizens. For example New York established an evidence-based SHC named NDPP (the New York State Diabetes Prevention Program) for adults with diagnosed prediabetes or who are at high risk of developing Type 2 diabetes. The programme enhances reach and convenience while enabling participants to use virtual monitoring and engage with life coaches and fellow participants.[100 101 102]

"By 2022, more than one billion people are expected to own wearable technologies. These include sensor-enabled rings, like the one I wear, which capture essential health data. When aggregated by location, these health insights can help cities understand and anticipate the next public health crisis. We're working with tech companies and municipalities like Jersey City in the United States to help unlock the power of this data in an ethical and anonymised way."

Jeff Merritt
Head of IoT and Urban Transformation,
World Economic Forum

Job-to-be-Done:
Sustain Well-being   **Enabling Tasks**   Job-to-be-Done:
Receive Care

Monitor
health continuously
to identify conditions
and risks early

Assess
personalised
health
needs

Finance Care Equitably

Build Infrastructure

Derive Insights

Create and Connect Datasets

Empowered

Radically
Interoperable
Data
+
Open Secure
Platforms

Individual
Health
Financial
Behavioural
Social

Environment
Scientific
Environmental
Geographical

Consumer

Institutions
Businesses
Government
NPO / NGO

Population
Public-Health
Socio-Economic
Financial

Advise
consumers to
influence behaviour
and sustain
Well-being

Treat
consumers
with tailored
"n of 1"
solutions

Support
consumers to
mantain health
and well-being

Why are Smart Health Communities relevant for cities and citizens?

A SHC powered by interoperable data can transform the entire healthcare ecosystem with real-time access to data and advanced capabilities to capture, interpret and act on it. It enables citizens to be more aware. The value of having a SHC became evident when COVID-19 spread globally, as those that embraced strong public partnerships were the ones that did better in the crisis. A study in 167 cities found that 54 per cent consider that the pandemic has accelerated a shift to online healthcare and that this change will have a long-lasting impact. The same percentage is confident that this is a lesson to be learned and understood: cities need to pay more attention to the health and wellbeing of citizens.[103] During the pandemic and health crisis, interconnected healthcare communities played a critical role in:

• Establishing platforms for accelerated secure information transfer and awareness drives; continuous risk monitoring; and real-time data generation, centralisation, and distribution

• Enabling health product developers to utilise insight engines to boost research into cures

• Building a support infrastructure by establishing localised health care hubs, advice platforms and finance/social assistance support gateways, along with engagement portals between care providers and patients.

Some reasons why Smart Health Communities will be the Future of Health:

Increasing digital transformation in community care: Digitally-enabled health services are rapidly becoming mainstream, particularly in areas such as primary care, collaborative maternity support, and specialist nursing. An analysis in 2020 by the Healthy London Partnership, a group specialising in complex public health issues, predicted that digital adoption could increase capacity in primary care by 25 per cent.[104] Remote medicine and telehealth services have recently been attracting the most investment by cities.[105]

Removing barriers to care and create social equity: SHCs remove barriers to care, such as physical access difficulties, healthcare affordability and variations in Health Care Provider (HCP) management (due to their interconnected community) thereby improving healthcare standardisation and engagement. According to Health-Tech Digital, "NHS England's National Diabetes Prevention Program (NDPP) is demonstrating the improvements to patient care achievable with digital adoption. Treatment pathways for this demographic are typically poorly attended, with less than 50 per cent of eligible people receiving the available support. The NDPP opened its program to telehealth providers, and as a result have seen dramatically higher engagement rates and outcomes across the target demographic."[106]

Facilitating data collection, centralisation, distribution, and management: SHCs utilise technology-enabled tools (GPS-enabled technology, trackers and apps) to ensure secure collection and dissemination of large volumes of healthcare data. Most cities already do this for epidemic diseases.[107] Furthermore, the focus is on boosting centralisation of data to improve access and data management efficiency. SHCs also handle secure mass distribution of healthcare-promoting data, which in turn helps improve understanding of healthcare operational processes, demographic needs, regulatory requirements, and patient information. The success of SHCs is possible only via cooperation and collaboration, and many private technology firms have increased their investment and innovation in this area. Popular technology solutions today act as value drivers and data enablers, for example by streamlining record maintenance, supporting cost assessment, and analysing patient and healthcare system movements. For example, Apple HealthKit is a health-targeted solution that is currently widely used by SHCs.

"In Cascais, with all the healthcare authorities – the national health authorities – we have helped in creating dashboards and heat maps, trying to anticipate the next step of this virus. My team was working on a daily basis, trying to use technology to help building up knowledge surrounding COVID."

Miguel Pinto-Luz
Deputy Mayor, Cascais, Portugal

Improving inventory planning: SHCs also focus on optimal use of collected data for predicting risk, continuous learning/knowledge exchange, and conducting research and evaluations. Various tools such as RFID tags, smart cabinets, blockchain and AI-enabled supply chain operations contribute to optimisation of data use by SHCs. Inventory management and frequent or real-time data collection also support programme evaluation by an SHC.

Creating a sense of community and boosting the importance of preventive medicine: By leveraging geographic proximity and data sharing in virtual environments, cities can create a sense of community. Additionally, it raises the issue of preventive medicine, stimulating new behaviour and awareness of the importance of physical activity, nutrition and well-being. 47 per cent of cities in advanced economies already educate public about chronic diseases[108] and most of the cities invest in real-time air-quality information.[109]

How to ensure successful implementation of Smart Health Communities?

Work to generate trust: The rapid deployment of vaccines against COVID-19 made clear the importance of public trust in science and healthcare ecosystems. In an environment driven by data, trust is a critical success factor for this interconnectedness to achieve its full potential.

Invest in a data privacy and security infrastructure: Establishing a data-driven interconnected SHC creates a high risk of data security breaches – which can lead to deaths. It also results in increased public scepticism. So in order to sustain a SHC and encourage individuals to share their data on the network and feel safe about it, cities must invest in a strong cybersecurity infrastructure and increasing transparency within the system, by leveraging smart technology solutions and designing cybersecurity guidelines.

Establish a partnership between public and private stakeholders: A primary challenge in building and growing a SHC is to maintain community partnerships. By establishing a strong public-private partnership cities can support healthcare transformation initiatives via improved mass reach, funding support, regulatory compliance assistance, and greater access to resources. Collaborative working among stakeholders can help transform a city into a SHC. Every stakeholder brings unique support:

· **Government agencies:** Can help in improving cost-effectiveness of SHC via public programmes and payment models, or by increasing security by establishing data-sharing agreements and cybersecurity policies, acting as platforms and ecosystem connector

· **Technology companies:** Can support a SHC with digital strategies and network construction. Technology companies can help with secure data collection, analysis and interpretation

· **Healthcare and life sciences players:** Can help in improving accessibility and affordability of healthcare assistance, research and expertise, along with ease of engagement. ESI Thoughtlab found that 86 per cent of 'sprinter cities' (those more advanced in achieving SDGs) partner with hospitals to improve healthcare access, with a clear return on investment[110]

· **Media and NPO/NGOs:** Can provide support with mass-awareness drives which can help build trust and improve the willingness of individuals to participate in a SHC

· **Social care entities:** Organisations and entities responsible for social care and support can contribute their knowledge and experience, as well as data to support the ecosystem

· **Citizens:** By sharing their data, experiences and behaviours with the community.

"We're talking about these frameworks for measuring and monitoring everything that we are doing. For us in the City of San Diego, what we are looking at is: what does it look like to now include some outcomes-focused metrics in all of the work that we are doing."

Kirby Brady
Chief Innovation Officer, San Diego, USA
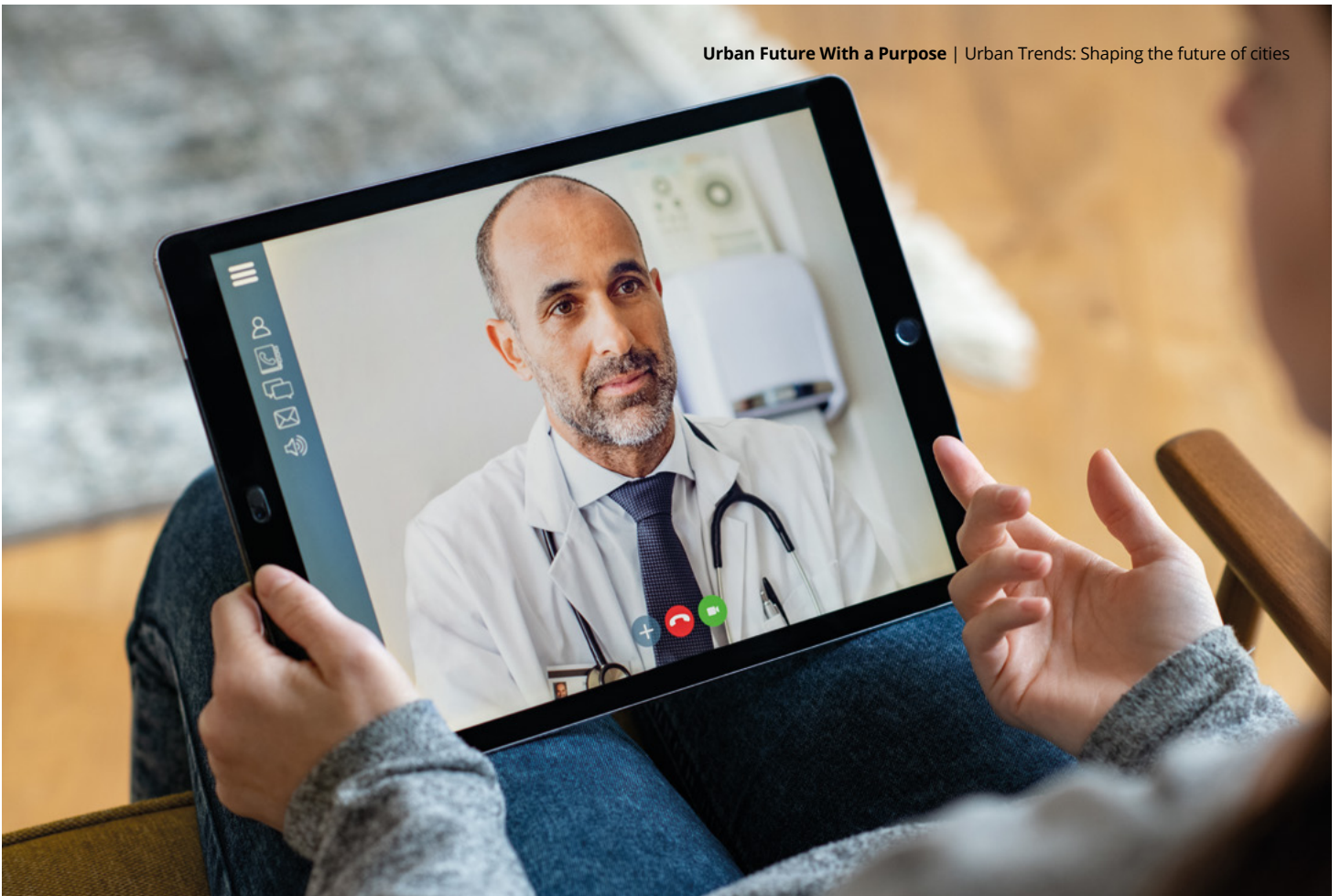
Collaborate with technology companies to launch awareness creation programmes and knowledge sharing platforms: Many social groups, especially in underdeveloped and developing areas, do not prioritise health treatment unless it is absolutely necessary. As healthcare shifts toward treating people before they get sick, with increased focus on predictive care using advanced technologies, community partners and government agencies must prioritise awareness and knowledge sharing programmes. Having such platforms and programmes in place will help individuals to become more aware of the benefits of SHCs, which in turn will encourage mass participation.

Establish community-driven funding hubs to strengthen the reach, support capabilities and operational efficiency of SHCs: Most SHCs are supported and established by collaboration between various stakeholders, and establishing a community funding hub can ensure better funding opportunities, to achieve a wider reach and bigger impact.

Restructure policies and consider incentivising SHC development plans to encourage community stakeholders and government to collaborate, organise and invest, with an intention to build a more interdependent and interconnected city healthcare and well-being system, with a clear focus on outcomes.

Watch and listen to the insightful conversations about this trend.

Where to see this in action?

Chicago, USA

Chicago is prioritising the establishment of a highly interconnected health and wellness ecosystem. To do so, the city launched Healthy Chicago 2.0 in 2016 and Healthy Chicago 2025 (a cross-sector collaboration) in September 2020. This is the city's multi-stakeholder plan to maximise the well-being of its residents and health equality.

The focus is on reducing health inequalities by developing partnerships and community engagement, addressing the root causes of poor health, increasing access to healthcare and human services, improving health outcomes, utilising data and maximising research.

The Healthy Chicago 2.0 initiatives were directed towards changing people's living conditions. As cited in a report by the Chicago city government: "During Healthy Chicago 2.0, instead of just treating diabetes or counselling people on what to eat, we also worked on strategies to increase access to healthy foods and create more walkable neighborhoods." As a part of the Healthy Chicago 2025[111] plan the focus is on closing the racial life expectancy gap, and continuing to prioritise other issues such as ending the HIV epidemic, improving mental health, and creating a drug-free society. The city conducts knowledge sharing and awareness events to communicate with residents about healthcare essentials and educate them about public health issues. Technology is used extensively to power innovative tracking and delivery models. For example, the city tracked public Twitter messages using a supervised learning algorithm for possible foodborne illness complaints that may have been linked to food consumed in establishments under the purview of the city's food inspectorate, leading to early and targeted inspections.

The impact of the Healthy Chicago 2.0 programme on priority areas such as tobacco use, healthy mothers and babies, and HIV prevention along with financial grants has included a reduction in the percentage of high school students smoking cigarettes (down by 13.6 per cent between 2011 and 2017), and in 2019 an all-time low in teenage birth rates and the lowest HIV transmission rates since 1990.[112] Aspects of clean air and walkability were also prioritised and EUR 123,000 was awarded in 2019 to six community organisations.

Multiple community stakeholders have supported the initiatives, including local entities like CDPH and Lurie Children's hospital.[113]

Cascais, Portugal

The municipality of Cascais has made health a key priority when developing its smart city strategy, with a focus on the creation of a strong interrelated healthcare community with strategies targeted at proactive healthcare management. Cascais was one of the first municipalities in the country to claim local responsibility for managing health, as part of Portugal's decentralisation strategy in this area.

Through its 'Vida Cascais' programme, the city has a local integrated offering for health, education and social services, including access to telehealth appointments, updated information on physical and mental wellbeing (for instance, the 'Espaço S' psychotherapies support) and a free colon cancer screening programme. There is a strong network of informal caregivers to take care of citizens' health, as well as a door-to-door drug delivery service that also collects and monitors health indicators about the most vulnerable communities. Other initiatives such as a 'Health Municipal Strategy' and 'Health Academy' (Academia da Saúde), under the motto 'Everyday +Health', benefit from the ecosystem that has been created – involving the private sector, hospitals, civic organisations, citizens, with the municipality as an enabler.

Through these efforts, along with a commitment to protect the quality of life, the city became a role model for managing the pandemic. In May 2020 the Cascais City Council (Câmara Municipal de Cascais) announced a programme for mass testing of the population for coronavirus antibodies, covering all 200,000 inhabitants. The city was the only one in Portugal to adopt such as strategy, to "help [citizens and visitors] enjoy as normal a summer season as possible despite the crisis."[114]

Leveraging its Command Centre (powered by CitySynergy – Deloitte's Smart Places Operating System) and its digital platforms, Cascais has worked with national healthcare institutions, integrating information from all testing centres, and establishing communication channels with citizens. Outcomes have included:

- A holistic overview of the entire COVID-19 management process in one single platform (suspicious cases, tests schedules and results, infections, maps showing the spread of infection)

- Maximum efficiency of health, emergency and related resources

- Engagement by citizens in the fight against COVID-19, promoting clear communication channels

- National and international perception of confidence and security, a key to restoring the city's tourism-based economy.

By February 2021, more than 56,000 tests had been scheduled and managed through the platform (a 91 per cent test realisation rate), which has ten call centre operators working on the health crisis. The platform is also supporting the city's programme for the mass vaccination of its population against the virus.

Cascais also announced in 2021 a plan to test students in all schools within the municipality, offering a broader coverage than the national government's policy at that time. The initiatives have also targeted community-based knowledge sharing and health education.

Nice, France

Nice has an ageing population with almost one-third of its residents over 60 years old, and access to high quality healthcare, notably at-home care, has become a priority for the city's administration.[115]

As a response to growing community needs, the city of Nice launched a smart health project, which brings together stakeholders in healthcare to create tools and services for senior citizens to enable independent living. A part of the project is a living lab, in which users are directly involved in the evaluation and testing of new products and services. Additionally, an e-Health Business Innovation Centre and co-working space is supporting start-ups and boosting the creation of new jobs in the 'silver economy'.

Other plans within Nice's smart health community project include training for health professionals and citizens in digital health technologies and the launch of a number of research and EU-funded projects.

The initiative's impact on the community is evident in successful implementation of multiple initiatives. For instance, according to impact data published by USE (Urban Sustainability Exchange) about 550 medical, nursing and ergotherapy students have received training, over 100 seniors have participated in internet and digital health education workshops, and 600 children have attended health education courses that use games and digital devices.[116 117 118]

Louisville, United States

Louisville is prioritising development of smart health communities with a focus on the optimal use of technology to facilitate data collection and drive informed interventions.

AIR Louisville made GPS-enabled 'smart' inhalers available to individuals with asthma. Each time an individual took a breath, the inhaler logged the location, time, weather, and pollutants in the air. The individual then received notifications about bad air quality days and information that helped predict the time and location of asthma attacks.

The data was also used to calculate the healthcare costs of poor air quality, which was shared with city officials to help them understand where to concentrate air purification efforts.

Data generated from smart inhalers were shared with patients' physicians, improving healthcare engagement, data sharing, and access. It also improved insights for doctors into how often their patients were using emergency inhalers, which helped them to determine the most effective asthma medication dosage for each patient and to avoid excessive use of emergency inhalers.

As a result, the city was able to achieve the following milestones:[119]

- A 82 per cent reduction in the use of asthma rescue inhalers: 29 per cent of previously uncontrolled participants gained control over their asthma

- On average, AIR Louisville participants more than doubled the number of their symptom-free days

- AIR Louisville participants slept better, with an average increase of 19 per cent in symptom-free nights.

The city understands the importance of educating patients about proper healthcare practices and plans to build further on the strategy.

15-Minute City

Diogo Santos
Consulting Partner,
Deloitte Portugal

Cities tend to be designed so that amenities and most services are within a 15-minute walking or cycling distance, creating a new neighbourhood approach.

"I would like to live in a self-sustainable city. As an urban planner, I focus on the importance of neighbourhood planning and the 15-minute city offers you that self-sustainability."

Maimunah Mohd Sharif
Executive Director, UN-Habitat

"The way we think about commutes has changed. Now that many of us have had the opportunity to work from home, there will be less tolerance for long rides to work. This will change how we lay down our transport network, and how we plan cities."

Kok Yam Tan
Deputy Secretary of Smart Nation
and Digital Government Office, Singapore

"Companies are planning to have local satellite offices near where people live, that will reduce commuting. It may well end up with a lot of underutilised property in cities that could be converted to more affordable housing and in these suburban areas it will encourage the development of the assets of the city: villages, kind of micro cities. Cities can be a network of more livable resilient communities. This is an inevitable trend."

Kent Larson
Director of City Science Group,
MIT Media Lab

This is all about 'living locally'.

The '15-minute' city concept – developed primarily to reduce carbon emissions by decreasing the use of cars and motorised commuting time – is a decentralised urban planning model, in which each local neighbourhood contains all the basic social functions for living and working. Many people argue that the concept of creating localised neighbourhoods in which residents can get everything they require within 15-minutes by walking, cycling or on public transport will ultimately improve the quality of life. Such spaces entail multi-purpose neighbourhoods instead of specific zones for working, living and entertainment, reducing the need for unnecessary travel, strengthening a sense of community, and improving sustainability and livability.

Today most cities have 'operation-based' neighbourhoods, with separate areas used predominantly for business or entertainment; and fragmented urban planning results in a sprawl, with people having to travel long distances across the city to get to their destination. In contrast, compact cities of the future, or 'hyperlocalisation', prioritise strategies for urban infrastructure that aim at bringing all the elements for living and working into local communities.

The '15-minute' city is an iteration of the idea of 'neighbourhood units' developed by American planner Clarence Perry during the 1920s. The theory of 'new urbanism', an urban planning and design concept promoting walkable cities, subsequently gained popularity in the US in the 1980s. Similar versions of 'urban cells' or 30- and 20-minute neighbourhoods have also emerged across the globe in the past decade.

The re-zoning model will gain further traction in future, boosted during the COVID-19 pandemic by new ways of working that require less transport. With climate change as a major global concern, C40 in its C40 Mayors' Agenda for a Green and Just Recovery[120] has recommended this model for cities worldwide, arguing that its pedestrianisation approach contributes to a reduction in greenhouse gas emissions and supports environmental sustainability. Most notably, the '15-minute city' was popularised in 2019 by Paris and is a flagship initiative in the current programme for the city.

The aim is to make essential amenities, different housing types and more green spaces available within a 15-minute walking or cycling distance. Some cities like Paris and New York, which are relatively more mature with regard to this concept, have launched

participatory budgets to promote local engagement as a part of their city transformation strategy. Cities that focus on new urbanism and flexible concepts, such as Bogota, Seattle and Milan, are prioritising investment in walking and cycling infrastructure. While this approach may not be entirely applicable to every city – for example it is probably more suitable for a big metropolis than for smaller cities – remote working and the digitalisation of services have increased the impetus to apply the principle of neighbourhood planning regardless of city size.

Why is this idea relevant for cities and their citizens?

Enhanced environment protection and sustainability: The '15-minute' city strategy has focused on transit-oriented development, which promotes denser, mixed-used development around public transport services and pedestrianisation, accelerating a large-scale shift away from reliance on private motor vehicles. Increased travel sharing and use of non-motorised modes of travel help reduce carbon emissions from cars.

Increased convenience and sense of community: An article in the Financial Times reported how '15-minute' cities cut down on unnecessary travel requirements and also promote local community engagement. They also provide open outdoor public space (such as 'Streateries' in Georgetown), reduce traffic congestion, and enhance the livability of neighbourhoods. There is faster fulfilment of essential needs, making living in cities more convenient and less stressful.[121]

Paving the way for affordable housing: Real estate development in the past has often led to displacement of former residents and gentrification of the area. With multi-purpose neighbourhoods, however, and proximity between home and workplace, there will be an adjustment to housing prices, making areas more affordable to live in.

Improved resilience via multipurpose neighbourhoods: Establishing commercial spaces to encourage local buying and equality in living structures and professional opportunities, along with strong community acceptance of different cultures, act as pillars for resilient living.

As cities work towards recovery from the COVID-19 pandemic, the '15-minute' city concept can be an organising principle for urban development. It offers a socially concentrated yet highly functional blueprint for a new urban inclusive lifestyle that might find wide scale acceptance, particularly since lockdowns associated with the pandemic have forced people to re-orient their lifestyles to 'go local' and re-discover their neighbourhood.

How to ensure a successful implementation?

Not all cities are ready to adopt a flexible city concept. However, they should all take into consideration certain principles highlighted in the C40 Mayor's Agenda to establish a strong flexible city.

Core principles[122] of a flexible city concept (such as a 15-minute neighbourhood) include:

- Ensure easy access to basic amenities including groceries, fresh food and healthcare in every neighbourhood.

- Build a multicultural neighbourhood that includes different housing types and levels of affordability, with the convenience for everyone of living close to the workplace.

- Have abundant green spaces to ensure access for everyone to the natural environment and clean fresh air.

- Establish smaller-scale offices, and retail, hospitality and co-working spaces, so that more people can work closer to home or in a virtual set-up.

- Create walking and cycling corridors to facilitate 'soft' transportation and reduce the convenience of travelling by car. (One-way roads in Barcelona and the removal of car parking spaces in Amsterdam are just two examples.)

Correlate sustainability goals and urban planning initiatives: Develop a mobility infrastructure in every neighbourhood aimed at low/zero-carbon emissions through active modes of travel such as walking and cycling.

"Cities must follow an integrated approach to planning, both in terms of policy making and implementation, creating mixed use, compact cities."

Maimunah Mohd Sharif
Executive Director, UN-Habitat

"There is little guidance as to how actually quantify the current performance of a community, what interventions will improve it, how to model, and how to get industry and governments and communities to align."

Kent Larson
Director of City Science Group,
MIT Media Lab

"We need to have a corresponding conversation about metropolitan mobility systems. There is no community, no single urban center, that lives in isolation, which is why I believe it is necessary to take a critical look at delivering cost-effective regional transit systems, especially in sprawling poly-nuclear metropolitan regions. Access to speciallized labor is wholly dependent on these systems."

Uwe Brandes
Faculty Director, Georgetown
University Global Cities Initiative

Ensure community endorsement: In some cities, a 'compact city' approach will require extensive changes and big costs, and this will demand substantial community endorsement and involvement. Although it is usually seen as a top-down approach to city planning, a 15-minute city design relies for its success on the endorsement of citizens, who need to be made aware of the benefits and embrace the change. At Georgetown University they refer to the need for a new governance structure which they call "Place Management Organization".

Decentralise core services: Build smaller communities with community-scale solutions, particularly for services that would otherwise generate high traffic volume, such as healthcare, education and grocery retail. For example in 2019, as part of its Green New Deal, Los Angeles announced its intention to build a decentralised community-infrastructure in which all low-income residents live within half a mile of fresh food. During COVID-induced lockdowns many cities experimented with decentralisation of community-based services. In Lagos in Nigeria, closed schools were converted to smaller markets, so that residents had access to food and medicines near to their homes. Such decentralisation measures help in reducing longer distance travelling and avoiding large crowds of people in central markets.[123]

Launch schemes to promote affordable housing in every neighbourhood: Cities can achieve this by establishing mandatory affordable housing requirements for any new development or by implementing concepts such as inclusionary zoning (instead of segregated zoning). Additionally, incentives or density bonuses can be provided to urban planners and developers, to encourage the creation of affordable and inclusive communities. Johannesburg in 2020 emerged as an example of deploying the inclusive housing concept, with a framework for increasing affordable housing and addressing the lack of social mix in race and income across the city.[124]

Allow flexible use of urban spaces and properties across neighbourhoods: Cities could promote diverse use of buildings and public spaces to derive maximum value from the infrastructure and boost community engagement.[125]

Watch and listen to the insightful conversations about this trend.

Where to see
this in action?

Paris, France

The mayor of Paris, Anne Hidalgo, aims to decarbonise the city's economy and make Paris a healthier place for its citizens through her programme *La Ville Du Quart d'Heure* (the quarter-hour city). The idea of a carbon-free city was one of the factors that inspired the launch of the flexible city programme in Paris. The initiatives focus on reducing carbon emissions and prioritising pedestrians and cyclists. The ultimate aim is to build communities where all the essential needs of Parisians are met within 15 minutes of their homes on foot, or by bicycle or public transport.

The city council has made commitments to improve the quality of life for all its citizens. The priority areas include easy access to workplaces, stores, schools, clinics and cultural activities. This ecological transformation is based on four pillars: proximity, diversity, density, and ubiquity – aiming to fulfil the basic social functions of living, working, supplying, caring, learning and enjoying.

The city has adopted an approach of 'hyper-proximity' and 'multipurpose localities': this seeks to reduce drastically the number of car lanes to free up road space for pedestrians and bikes, and to utilise public spaces for purposes such as daytime schools serving as sports facilities and places for night-time leisure activities. Plans also include the creation of 'children streets' near schools. Other initiatives (focused on local commerce and local community engagement) enhance the city's cultural offerings by setting up performance spaces in its squares that are currently dominated by cars, and to build booths across the region staffed by local employees offering community cohesion services.

As a part of transportation planning, the mayor has announced EUR 350 million of funding for pedestrianisation, that will focus on creating a cycle lane in every street in the region by 2024 and removing 60,000 parking spaces for private cars.

The successful execution of this transformational work is evident in a new public garden replacing a parking lot in the Minimes barracks. As a part of the same initiative, the surrounding buildings were renovated into 70 public housing apartments at a cost of EUR 12.3 million. These housing complexes include commercial spaces such as offices, day care facilities, a clinic, and a café staffed by people with autism. The Place de la Bastille has also been transformed as a part of the city's EUR 30 million plan to increase green cover and pedestrian areas and cycle lanes.[126 127 128 129 130]

Portland, USA

For Portland the focus is on developing long-term strategies relating to land use in an urban environment, targeting affordable housing, public transport, income inequality, city walkability, social/community-based engagement, and inclusion.

In 2009, only six per cent of the population of Portland were living in areas with a substantial presence of all three 20-minute neighbourhood factors - density, distance, destinations.[131]A detailed plan to expand 20-minute neighbourhoods was developed as a part of its Climate Action Strategy. The plan included a target by 2030 for 90 per cent of the city's residents to be able walk or cycle to meet all their basic daily, non-work needs.[132]

Currently the city is working on initiatives such as a shared-use parking permit pilot[133], and pricing options for equitable mobility.[134]

It has been reported that the downtown area and the majority of Central Eastside already have one or more of the 20-minute neighbourhood factors. The city plans to continue prioritising improvements for pedestrians by building sidewalks and pathways, in addition to removing in the medium to long term barriers to walking such as steep slopes, freeways and difficult street connections.

The city is also working towards reversing the exclusionary zoning practices of the past by building more types of houses in the same locality and through better spatial planning. In a 2020 article, Mayor Ted Wheeler has stated: "I'm not going to pretend that the changes to the zoning code that we're about to adopt rectify all of the past harms. They don't." The same article also commented, "He said he believes that letting more types of housing and mixes of incomes into neighbourhoods represent a critical step forward."[135] [136]

Stockholm, Sweden

While cities around the world are considering urban transformation based on neighbourhood-level planning concepts such as 15/20-minute cities, Sweden is pursuing a hyperlocal variation, a 'one-minute city', on a national scale.[137]

In 2020, a plan was piloted by the Swedish national innovation body Vinnova and design think tank ArkDes. The approach focuses on "the space outside your front door — and that of your neighbours adjacent and opposite". The 'Street Moves' project implements change on a single-street level, which is being tested in four sites around Stockholm.

As a result of this transformation, residents will be able to decide how street space is used and allocated, through community workshops and consultations.

The concept encourages every location to activate individual blocks using shared spaces. The models used in the transformation strategy draw inspiration from 'parklet' models and contribute to Sweden's commitment to become a carbon-neutral city by 2045.

The goal isn't to make everything available within one minute, but rather to reimagine the patches of street immediately outside the home as "critical connecting spaces for communities" and not just "places to move and store cars." If successful, Sweden plans to implement the programme in every street in the country by 2030.

Melbourne, Australia

Melbourne has been prioritising urban planning targeted at distinctiveness, livability and sustainability. In 2017 a long-term planning strategy Plan Melbourne 2017-2050 was introduced with a focus on the concept of living locally. The strategy aims to provide all the necessities for its citizens within a 20-minute radius from their home (a catchment area of 800m2), through active and public transport mobility options. The plan was launched in 2018 as a part of the 20-Minute Neighbourhood Pilot Program[138] that was implemented in two stages:

• Established neighbourhoods (2018): Focus only on the established localities of Strathmore, City of Maroondah and City of Brimbank

• Greenfield neighbourhoods (2019): Research projects in Mambourin and Beveridge North West.

A report on the 2019 pilot programme highlighted opportunities such as streetscape improvements through improved walking and cycle paths, pedestrian safety improvements (particularly around schools), planning control reviews to support housing diversity in some neighbourhoods, and 'pop up' shops and street trading developments.[139]

The city government aims to explore similar business and community development approaches in other neighbourhoods in the medium-long term.

Mobility: Intelligent, Sustainable and As-a-service

Harald Proff
Global/DCE/German Automotive Sector Leader

Anant Dinamani
US Future of Mobility co-Leader

Rasheq Zarif
US Future of Mobility co-Leader
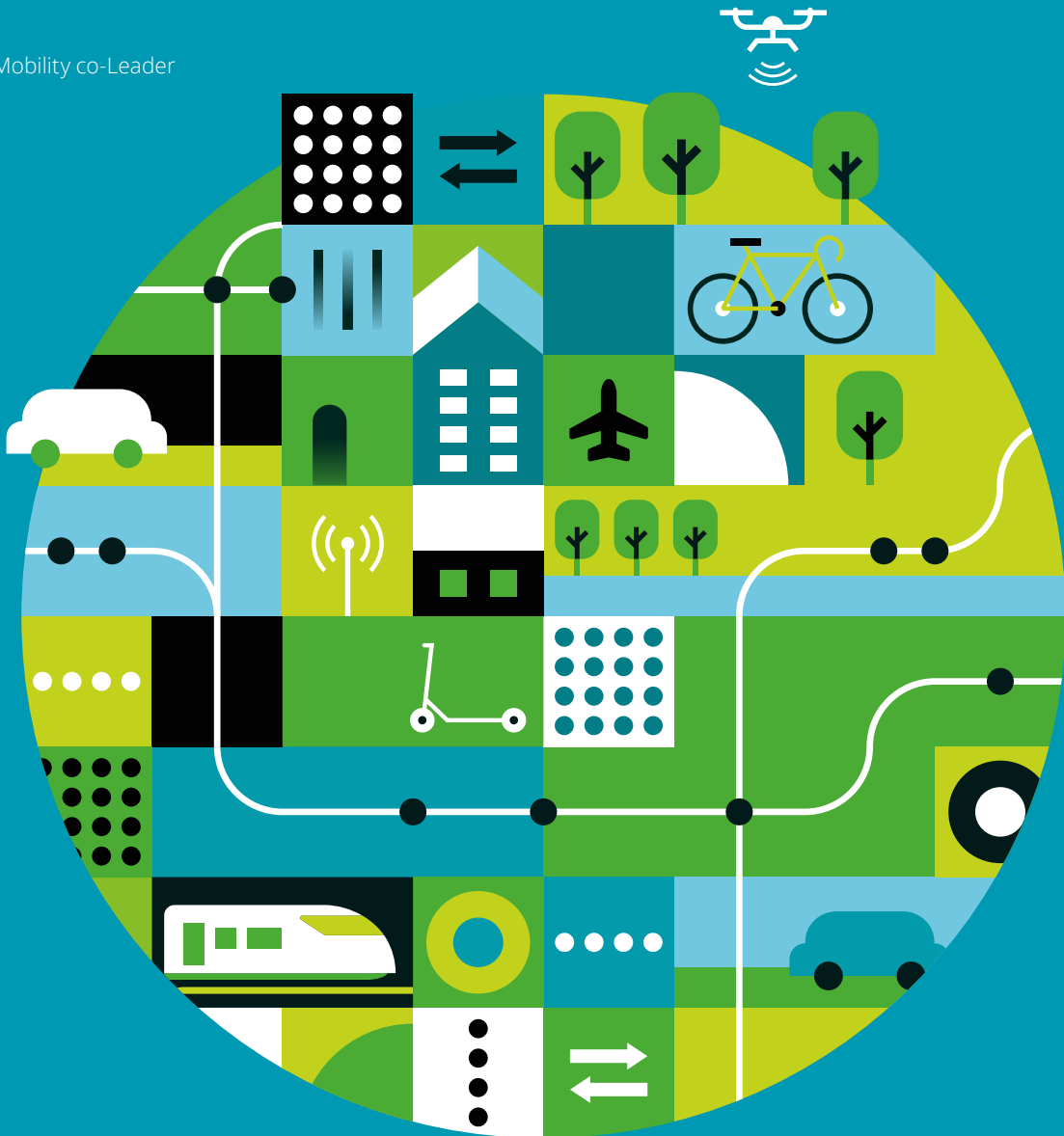
Cities are working towards offering digital, clean, intelligent, autonomous and intermodal mobility, with more walking and cycling spaces, where transport is commonly provided as a service.

"It took a pandemic for us to dive in and realise the capabilities of our technology—to prove that we can seamlessly convene individuals across the world and enable productive dialogues, to demonstrate that we can connect with medical professionals from our home without sacrificing quality or privacy. I'd like to see us embrace and further expand access to these technologies, which means travelling less."

Jeff Merritt
Head of IoT and Urban Transformation,
World Economic Forum

"The Commission set the target of doubling the amount of safe bike lanes over the next decades, initially to 2,300 kilometres."

Carole Mancel-Blanchard
Member of the European Commissioner Cabinet for
Cohesion & Reforms, Elisa Ferreira

This is one area where cities should expect huge disruption. Are you ready for robot taxis? For passenger drones flying in the sky? For tunnels under cities? To give up on your car, and embrace transportation-as-a-service? What implications will this have for your urban environment?

A transformation in the dynamics of global urban mobility is primarily user-centred. Some major changes to how people move around in cities are already under way, but the trend will accelerate further in the next decade, with electrification, autonomous driving, smart and connected infrastructure, modal diversity, and mobility that is integrated, resilient, shared, and sustainable – powered by disruptive business models. In response to an ESI Thoughtlab survey, 54 per cent of city leaders admitted that they will rethink mobility and transportation in the aftermath of the COVID-19 pandemic.[140]

Less need to travel
It is expected that in general people will travel less than in the past. With new urban planning concepts such as the '15-minute city' promoting compact environments, 'connected corridors', and changes in the way that people work, movements within town will decrease substantially. As Jeff Merritt puts it, "That's the future, its lots of options and hopefully less travel every day." Bicycles, scooters and even walking will increasingly be the preferred options in community neighbourhoods. From Bucharest to Brussels, and from Lisbon to Lyon, the coronavirus pandemic has triggered unprecedented investment in cycling around Europe. More than EUR 1 billion has been spent on cycling-related infrastructure and 2,300 kilometres (1,400 miles) of new bike lanes were rolled out between the beginning of the pandemic and October 2020.[141]

Electrification
It is estimated that in 2030, electric vehicles (EVs) will have around 32 per cent of the total market share for new car sales globally.[142] But there will be differences between regions. For example Deloitte projections suggest that in 2035, vehicles not powered by internal combustion engines will make up more than 80 per cent of new vehicle sales in China but less than 50 per cent in the USA and between 35 and 55 per cent in Europe, depending on the scenario.

Connectivity and automation

Recent Deloitte research in the United States estimates that by 2040 up to 80 per cent of passenger miles travelled in urban areas could be in shared autonomous vehicles.[143] This development will be led by major technology-based corporations or the automotive and transport sector and by technology-based start-ups. Solutions such as passenger drones by Ehang and drone delivery by Amazon are making rapid advances. Connectivity and automation will transform the mobility not only of people but also of goods, as logistics companies increasingly use autonomous technology to meet the rising demand for goods. A Deloitte article on autonomous trucks mentions that eight start-ups have raised a collective EUR 1.2 billion for self-driving trucking initiatives, in a move that could revolutionise logistics.[144]

Sharing

Cities will also benefit from an increase in on-demand multimodal mobility and Mobility-as-a-Service (MaaS) platforms, such as in Helsinki. For instance, residents will be able to plan and book door-to-door trips digitally, use the same travel card for all transport modes, and have access to automated last mile cargo shipment services and end-to-end real-time visibility of freight in transit, with seamless payment models.[145] According to Deloitte projections, by 2025 shared driver-driven vehicles will account for more than 10 per cent of miles travelled in the United States.[146] A study in 167 cities states that investments in real-time public transportation apps and MaaS apps generate high returns[147] as smart transport systems can help to reduce unnecessary trips and create asset efficiencies. MaaS and Mobility-on-Demand will also affect corporate mobility. Why not to offer mobility packages to employees instead of a car as part of their benefits package?

"We started testing autonomous vehicles quite early, but it will be a while before we have the technological capabilities to be able to implement this confidently in a very widespread manner. A more realistic scenario is that cars will become electric and electronic before they become autonomous."

Kok Yam Tan
Deputy Secretary of Smart Nation
and Digital Government Office, Singapore

"By 2024, 80 per cent of the buses will be electric and all the others will be driven by natural gas. The underground grid is being extended in the city, allowing for public transport to regain its market share."

Rui Moreira
Mayor, Porto, Portugal

"In the meantime, there remain technological challenges to autonomous vehicles. How do I scale them across cities? How do I deal with weather differences? There are some challenges that may be peculiar to us, for example, our storm weather conditions that is not tested in the States or in Europe."

Kok Yam Tan
Deputy Secretary of Smart Nation
and Digital Government Office, Singapore

"In the path to be a carbon neutral city, one of the most important steps is to create sustainable low-emission and efficient mobility systems."

Miguel Pinto-Luz
Deputy Mayor, Cascais, Portugal

Intelligent mobility

With data playing a central role in some of these shifts, customised travel is something that cities will start to deliver – with convergence between all aspects of infrastructure, policy and technology powering the new era of 'intelligent' mobility. The value of this mobility is forecast to grow to EUR 850 billion by 2025, representing more than one per cent of global GDP.[148] Huge amounts of data open up opportunities for a flexible mobile ecosystem with the capacity to make available solutions that are adaptable and capable of meeting the needs of different segments of the population, such as children, elderly people, families with children, and tourists. Just like any company that wishes to operate in a particular market, cities will segment their customers (citizens) in a mobility context and implement strategies for each market segment.

These drivers apply to the transportation of both passengers and goods, and will change the urban landscape. Sustainable, smart and resilient mobility is also a pillar of the European Commission Urban Mobility Strategy released in December 2020.[149] This document states that in order to achieve a 90 per cent reduction in greenhouse gas emissions from transport by 2050, it will be necessary to prioritise the optimal utilisation of data, a deployment of automated mobility on a large scale, and integrated mobility solutions such as connected electronics for multimodal transport.

Why is sustainable and smart urban mobility relevant for cities?

Innovative urban mobility and planning solutions help to create a convenient, connected, user-friendly, and sustainable future.

Improves quality of living and reduces impact on the environment: New mobility models, particularly non-motorised, are being used extensively as a consequence of COVID-19. Cities such as Bogota, Paris, Jakarta, Sydney and Los Angeles created more cycling lanes and walkways in 2020 to provide physically distant travelling when public transport was most affected.[150] [151] A C40 study highlighted that enabling next generation mobility (electric vehicles) can reduce emissions by 10 to 25 per cent.[152]

Reduces congestion and air pollution: A recent study led by ESI ThoughtLab found that smart urban mobility solutions can help cities tackle the problem of traffic congestion. The INRIX 2020 Global Traffic Scorecard[153] cited Bogota as the city most affected by traffic congestion, with drivers losing 133 hours per annum. Investment in tech-enabled mobility solutions should therefore be a priority. Ride sharing, combined with a reduction in the number of private cars on the roads, will also contribute to a reduction in congestion – as well as in air pollution and noise.

Enhances convenience for travellers: Smart-safe mobility solutions provide highly data-powered integrated and automated offerings that deliver a better experience for citizens. This also creates a need for intelligent safe-mobility features that safeguard users' data.[154]

Saves lives and reduces the number of accidents: Around 1.35 million people die in road accidents each year, with an average of 3,700 deaths each day.[155] Low-income countries have less than one per cent of the world's vehicles but 13 per cent of all deaths. Changes in mobility will reduce the number of deaths.

Fosters a better use of public space: A reduction in the number of rides leads to fewer vehicles on the road and fewer parking spaces. This enables a better use of public space, as it frees up areas for social interaction.

"Transport is responsible for a quarter of greenhouse gas emissions in Europe. It is really a sector where we need to ensure a transition to clean systems."

Carole Mancel-Blanchard
Member of the European Commissioner Cabinet for Cohesion & Reforms, Elisa Ferreira

"I am completely bored with this Smart City IoT systems that try to optimise the flow of traffic so you get more throughput of cars. I am more interested in getting rid of cars in cities."

Kent Larson
Director of City Science Group, MIT Media Lab

"One of the major parameters that will change is the need to rethink mobility systems. How will public transit adapt to health risk? Not only in terms of densities, availability and frequency of service, but also in terms of how to introduce other forms of transportation, especially non-motorised transportation, like bicycle lanes, wider sidewalks for walking...."

Sameh Wahba
Global Director, Urban, Disaster Risk Management, Resilience and Land Global Practice, World Bank

Watch and listen to the insightful conversations about this trend.

How to ensure a successful implementation?

Some critical factors must be taken into account to ensure a successful transition.

- **Approach**: Cities should aim to embrace a holistic approach. It is important to understand the total mobility mix and find ways to manage the entire transport system – which is broader than what cities and metropolitan areas are used to. In addition, in order to organise the supply side to fulfil the demand for 'smart mobility', cities should start small to drive the transition, starting with a minimal viable ecosystem (involving or being led by private sector players) and then adding additional features over time, in an agile approach.

- **Infrastructure**: Invest in infrastructure – physical, energy, digital and telecoms – that supports effective transformation. Due to the needed investment (in innovation and technology development, and also in physical and technological infrastructures), technology-based solutions will have a bigger impact in developed economies. Investment will define the leaders and the followers. Additionally, it is important to ensure that investment covers all segments of the population, so that mobility does not create exclusion.

- **Vehicles**: A new generation of vehicles is needed — for example robots for the last mile, drones, flying taxis, autonomous trucks, or even the hyperloop. In addition, there should be a resurgence in the use of some existing vehicles, such as motorbikes and bicycles, and a strong focus on micro-mobility.

- **Mobility management**: Two key elements are the management of assets (infrastructure and vehicles) and management of users / clients (interface with clients, client data and information management), given the citizen-centric approach of the future of mobility.

- **Policies and regulation (governance):** Regulation must adapt to the new circumstances. These should cover vehicle security and liability in cases of accidents, data management and privacy, interoperability, connectivity, risk and responsibility and cybersecurity.

Where to see this in action?

Los Angeles, USA

Los Angeles is working towards implementing sustainable and smart mobility solutions. The city aims to reduce air pollution by accelerating the electrification of transport.

- According to a recent study, LA accounts for about half the electric vehicles in the United States and has committed to having five million electric vehicles by 2030.[156]

- LA's urban mobility plan has a focus on improving the accessibility and environmental friendliness of its public transport system. LA has introduced CNG buses, and in July 2020 deployed the first of 40 zero-emission electric buses on its orange rapid line.[157] The entire LA Metropolitan Transportation Authority (Metro) bus fleet is expected to be electric by 2030.[158]

With a target to improve the air quality further, LA launched a Zero Emission 2028 Road Map 2.0 in 2019. The initiative involves advisory partners such as BMW, Tesla, Greenlabs, CSUN, Itron, PCS Energy, and others.

"We are committed to help the Greater LA region go further, faster. That's why we are moving toward an additional 25% reduction in greenhouse gas emissions and air pollution — through accelerating transportation electrification — by the time the world arrives in Los Angeles for the 2028 Olympic and Paralympic Games." - The Transportation Electrification Partnership's Leadership Group.[159]

Although not exclusively the result of mobility initiatives, studies show a drop in air pollution in LA by 10.6 per cent between 2017 and 2018, and by another 11.8 per cent between 2018 and 2019.[160]

In December 2020, the city launched an urban air mobility programme to analyse the issues identified by diverse local stakeholders in the public air space and property rights. The programme is likely to support the development of solutions to build and integrate a community-centred aerial mobility technology with its other multimodal platforms.[161 162 163 164 165]

Shenzhen, China

Shenzhen has been a frontrunner in switching to electric mobility, particularly in its public transport system. In 2017 Shenzhen became the first city in the world to electrify all public (16,000+) buses with a view to cutting emissions, reducing noise pollution, and improving air quality.[166] [167]

The impact of this switch became evident in 2018, when the city recorded some of the cleanest air among all Chinese cities. The average amount of fine particles (PM2.5) in the air throughout 2018 dropped to 26 micrograms per cubic metre, one of the lowest levels in 15 years.[168]

Further building on its aim to boost sustainable mobility, the city announced in January 2019 that 99 per cent of its entire taxi fleet (over 21,000 vehicles) was now electric-powered.[169]

The city continues to see an increase in investment by EV car manufacturers. For instance, in May 2020 Volkswagen announced plans to build a new factory near Shenzhen.[170]

Copenhagen, Denmark

Copenhagen has been one of the frontrunners in establishing a strong urban mobility infrastructure with a focus on non-motorised transport.

According to 2020 data, 45 per cent of the city's inhabitants commuted by bike, travelling around 1.4 million kilometres every day. The city is also the home of the world's busiest cycle path with around 40,000 cyclists a day.[171]

A focus on urban mobility solutions has helped Copenhagen to provide affordable mobility to its citizens. For instance the cost of public transport is just 1.83 per cent of average monthly income. Furthermore, 100 per cent of the city's metro rail system is automated to level 3 or 4 of Grade-of--Automation as defined by the IEC 62290-1 standard, making it one of the leading cities for new technology adoption and changing mobility infrastructure.[172]

Smart and sustainable mobility initiatives are part of the plan to become a carbon neutral city by 2025.

The vision of
Kok Yam Tan

Kok Yam Tan
Deputy Secretary of Smart Nation and
Digital Government Office, Singapore

How does COVID-19 affect the way Singapore is planning for the future and how do you see the pandemic affecting cities and the digitalisation roadmap?
I think that there are three lessons or three developments we can draw from this as a general point. The first point is about the need for cities to be built or to be organised to be resilient and responsive to stress.

The second point is working from home. Before COVID-19, there was inertia about moving away from how we traditionally work, although the connectivity allowed for it. Now that the practice has become widespread, it will change how our workplaces relate to the physical city itself; it will change how we lay down our transport network infrastructure and how we plan cities.

The third point is how we can limit our individual carbon footprint by minimising travel, driving together to one place for a meeting, etc. We can use that to reset how the city operates to become greener and more sustainable and to minimise our energy use and our carbon footprint.

Singapore had several initiatives to fight against COVID-19, like Vigilant Gantry and SPOTON. What can you share with the rest of the world from your experiences?
In Singapore, as part of crisis response, we rely on public sector capability to roll out some of the digital solutions; we just had to do it overnight. You've got to have a system where you need to tell everyone where to get their masks, what is the general situation. You have to tell businesses where to get financial support, where to get economic support. So information dissemination is key and you need to do it fast.

A second challenge was contact tracing, which is about gathering information, making sense of it, and trying to figure out the linkages and associations. This is another area where we applied technology.

A third point tends to be overlooked because we take it for granted. To be able to work, you have to rely on a good communication infrastructure. Over the years we have invested heavily in this, and because of this we have broadband that is accessible to almost all households in Singapore. So the issue of digital exclusion is much less severe, even at a time when people were having to avoid their workplace and educational institutions for a while.

Looking post COVID-19, what are the priority initiatives you think lie immediately ahead for Singapore?
I think we are very sensitive to climate change because we are an island, and climate change is the crisis of our time. In Singapore, we have to prepare ourselves for rising sea levels, as well as to do our part in mitigating the effects of climate change through the use of technology to reduce our energy footprint, whether in transport, in buildings, or in industry. A second point is how does Government work with citizens and companies and continue to accelerate this digitalisation movement. A third point, linked to sustainability, is the need to develop a circular economy, and in Singapore we want to be able to become resourceful and resilient.

How important is the concept of livable density for the development of the city, and how important is this for you in the future?
It's very important. There's a physical reason for greenery – it helps reduce the air temperature of the place. It can get hot in Singapore and planting greenery, first and foremost, is one way for us to prevent the outdoor temperature from rising to a high level. Besides that, there are other more direct benefits. A green city that is close to nature also offers greater livability, a better standard of living. People exercise more. Others delight in the variety of bird species that can be found, and have taken to nature photography. Our land area is small, so we try to make good use of what we have, for example, by building park connectors that allow people to enjoy long stretches of greenery for hiking or biking.

In your view, is Tengah the city of the future?

It is a greenfield site, which is rare to come by in Singapore, so we decided to push the ambition in how we use the land.

What is your view about smart buildings and smart infrastructure?

I think that there is both a need for smartness in buildings, driven by environmental sustainability, and the technology to enable this smartness. In the past the construction of buildings was very sensitive to the weather, to the climate, to where the wind is blowing, and to what happens in winter and spring. Somehow over time, this was lost because buildings became weather-proof: we have heating, air conditioning, and we did not really care about the weather outside. But in the past five to ten years, because we have sensors, we have moved back to a time when we can construct a building that is sensitive to what is happening outside. By making use of the weather elements (solar irradiance to optimise solar capture and by smartly controlling internal temperatures), we are able to have buildings that are just as comfortable but at the same time have a much lower carbon footprint. The next bound is to extend this smartness to a district level rather than at a single building level – this is what we are doing to a certain extent in Punggol. The paradigm shift from a smart building to a smart district gets me very excited.

How do we convince developers to be sustainable and smart when sometimes it is more expensive?

I think that a combination of regulation, penalties, and subsidies is needed. I think the State has a role to play in terms of giving, and providing subsidies to pilot, to trial, and to let industry discover which technology works. There may be upfront investment but there is also a payback. In terms of regulation, whether it is green building standards or super-low energy standards, I think it's useful to start having them in place to set certain baseline practices. Another option is to use pricing, for example a carbon tax, so that everyone internalises some of the cost of sustainability.

How can we get participation from all segments of the population?

There are different levels of participation. The first is just awareness and knowing that the digital service exists. The second aspect is access: having good broadband and good internet access. I think the highest form of participation is contribution and co-creation, and this is something that we continue to work towards. People must feel that what we are doing is a good thing to provide the extra piece of information to the government, so that the government can respond and serve the people better.

In Singapore, there was controversy recently around collecting data. How do you find a balance between advancing some use cases and at the same time respecting privacy concerns?

The whole point of collecting data and making better use of it is to serve citizens better and the last thing we want is to spook the people that we are trying to serve. We need to be sensitive to how people feel about data collection and data use. We also need to communicate and to be very clear about what we are doing, learn and improve, and always have an open mindset in listening to what people have to say. We are very fortunate that Singaporeans are a practical lot who intrinsically understand the value and need for data to be shared and used well.

How do you see the future of mobility in the city or in the nation?

We started testing autonomous vehicles quite early, but if I can be honest about this, it will be a while before we have the technological capabilities—and I mean globally—to do this in a widespread manner.

What I think is more realistic is that cars will become electric and electronic before they become autonomous. Once you move from something with a petrol or a diesel engine to something that's run by a battery and electronics, I think the scope for automatic, intelligent and autonomous mobility is just great. But this will take time. I think it's likely that electrification will come first before automation, and autonomy will probably come in stages, so that there is some intermediate level of autonomy before you get to full autonomy.

In Singapore, our interest is in public transport because it is the most obvious way to reduce congestion and the need for roads. If we can squeeze eight cars or ten cars into one bus, the volume of transport will be much lower.

Listen to the full interview.

Inclusive Services and Planning

Deborah Sills
Global Government and Public Sector
Consulting Leader

Josh Hjartarson
Human Services National Leader,
Canada

Cities are evolving to have inclusive
services and approaches, fighting
inequalities by providing access to housing
and infrastructure, equal rights and
participation, and jobs and opportunities.

"Inclusion is not a feel-good thing. Obviously it is about equity, it is the right thing to do, but it is also fundamental for the economic survival of cities."

Sameh Wahba
Global Director, Urban, Disaster Risk Management,
Resilience and Land Global Practice, World Bank

"In lockdown we asked people to stay in the house and to experience social distancing. How about those who have no house?"

Maimunah Mohd Sharif
Executive Director, UN-Habitat

"Whether low carbon, resilient or smart, cities will need to revolve around a people-centred approach. They will need to have people at the centre, so an inclusive approach working with citizens is key, to ensuring that the poor are protected against, or less affected by, the impact of climate change."

Sameh Wahba
Global Director, Urban, Disaster Risk Management,
Resilience and Land Global Practice, World Bank

"At the end of the day if you have a city that is livable, sustainable, resilient, and competitive, but which is not inclusive, then something is fundamentally wrong in that city", Sameh Wahba of the World Bank states in an interview for this study. It is now more important than ever to emphasise the importance of social inclusion across cities by celebrating and supporting the heart of the community ecosystem – its people.

Cities are not only centres of economic development; they are the confluence of equality, healthy communal coexistence, and prosperity for all. Public space is used by residents differently, and the differences must be taken into account when planning a city. Social inclusion should be a key pillar of urban growth and development for the cities of the future, bearing in mind the three building blocks identified by the World Bank: spatial inclusion (proving affordable housing, water, and sanitation), social inclusion (equal rights and participation), and economic inclusion (creating jobs and offering citizens opportunities for economic development).

Cities should be planned and designed to generate social and economic outcomes for everyone, avoiding the costs that occur when people are excluded. Although the poor are usually the most affected, cities will also remove the barriers caused by differences in gender, age, race, nationality, disability or religion. Inclusive design could mean building gender-inclusive urban centres to provide safe and secure spaces for carers and installing wheelchair accessible features for those with mobility difficulties. Inclusive design may mean building greener and safer neighbourhoods for all citizens and investing to create secure and joyful spaces for children to play and accessible places for the elderly, making cities pleasurable for the silver generation. An inclusive social care system will embrace migrants and offer them tailored services that address their particular needs and context, and opportunities as everyone else. An inclusive city fights gentrification. These inclusion initiatives, among many others, are supported by one of the criteria in the UN's Sustainable Development Goals: "By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, particularly for women and children, older persons and persons with disabilities".

There are already some signs of cities prioritising inclusion. A survey of 167 cities worldwide found that 40 to 47 per cent of cities use metrics to track progress towards inclusion goals, even though the majority are in advanced economies. The same source indicates that 80 per cent of Cities 4.0 (those that are ahead in smart city initiatives, have superior infrastructure and made great progress towards SDGs) ensure that the disadvantaged are involved, while only 45 per cent of others have it is a concern, which shows the discrepancies among cities in this particular aspect.[173]

Both technology and mass participation are needed to accelerate the trend towards social inclusion. Digitalisation enables governments to facilitate access to a range of services, accelerate business opportunities, analyse societal gaps, educate mass audiences, collect real-time data, boost data-driven decision-making, facilitate predictive and proactive governance, and engage larger audiences in social activity. It also frees up government capacity to re-direct finite administrative and case management resources to those who need it most.

Although it is a fundamental requirement for social inclusion, technology may also create disparities. Currently, half the world's population is offline, which reinforces "the need to look at connectivity and communication as a public good", as stated by the Executive Director of UN-Habitat. In some regions, lack of affordability for technology solutions and the societal digital divide have been identified as hurdles to progress. City planners should remain aware of the large numbers of 'digitally invisible' citizens, to avoid skewing the results of city analysis, compromising urban planning efforts, and even contributing to a widening of the inequality gap. Solutions such as government-funded mobile phones or internet access, or community centres, could potentially mitigate the adverse effects of technology.

In addition to technology, mass participation is a second catalyst for social inclusion. Cities have traditionally been planned by male architects from formal backgrounds. Bringing diversity to the creation process is a critical measure to avoid inequalities and create inclusive and equity-centred cities by design.

"We need to understand that inclusion and equity is not simply 'good to have': it is essential. It is a foundation that we build on and it is an enabler of thriving communities. A thriving community is good for the economy, a thriving community is good for culture and good for art, it is good for creativity and it is good for innovation."

Jeff Merritt
Head of IoT and Urban Transformation,
World Economic Forum

"The city of the future leaves no one behind. Inclusivity is also about people with disabilities, women and children."

Maimunah Mohd Sharif
Executive Director, UN-Habitat

Why is social inclusion relevant for cities and citizens?

Improves livability and cohesion: Inclusive cities eliminate spatial fragmentation, embrace mix-development, respect differences, and create the right environment supported by infrastructure for everyone to thrive. It is the foundation for a vibrant, safe and innovative city, leveraging agglomeration and diversity. For example, to make the London public transport network convenient and more accessible, the Royal London Society for Blind People created a Wayfindr to enable visually-impaired people to move independently through their various environments – whether completing day-to-day tasks or exploring new places– by giving them access to reliable directions from their smart phones and other devices.[174]

Enhances economic competitiveness and productivity of cities: In a more inclusive and well-integrated city there is frequent interactivity between stakeholders, which results in enhanced productivity and economic growth for all communities. Analysis by Deloitte in Australia has estimated that the economic dividend to the country from a more inclusive society would be EUR 10.4 billion annually,[175] close to one per cent of Australia's GDP. The same is evident in US cities, as the following graph shows (fig.01).[176]

Improves resilience: By creating a connected and inclusive physical and digital infrastructure, cities can give their residents access to an improved range of shared services, achieving joint economies of scale and accelerating prosperity. Inclusive cities also provide opportunities to expand knowledge sharing, promoting collaboration across the entire population, which in turn builds a more resilient society.

Fig.01 There is a positive correlation between inclusion and economic health in US cities
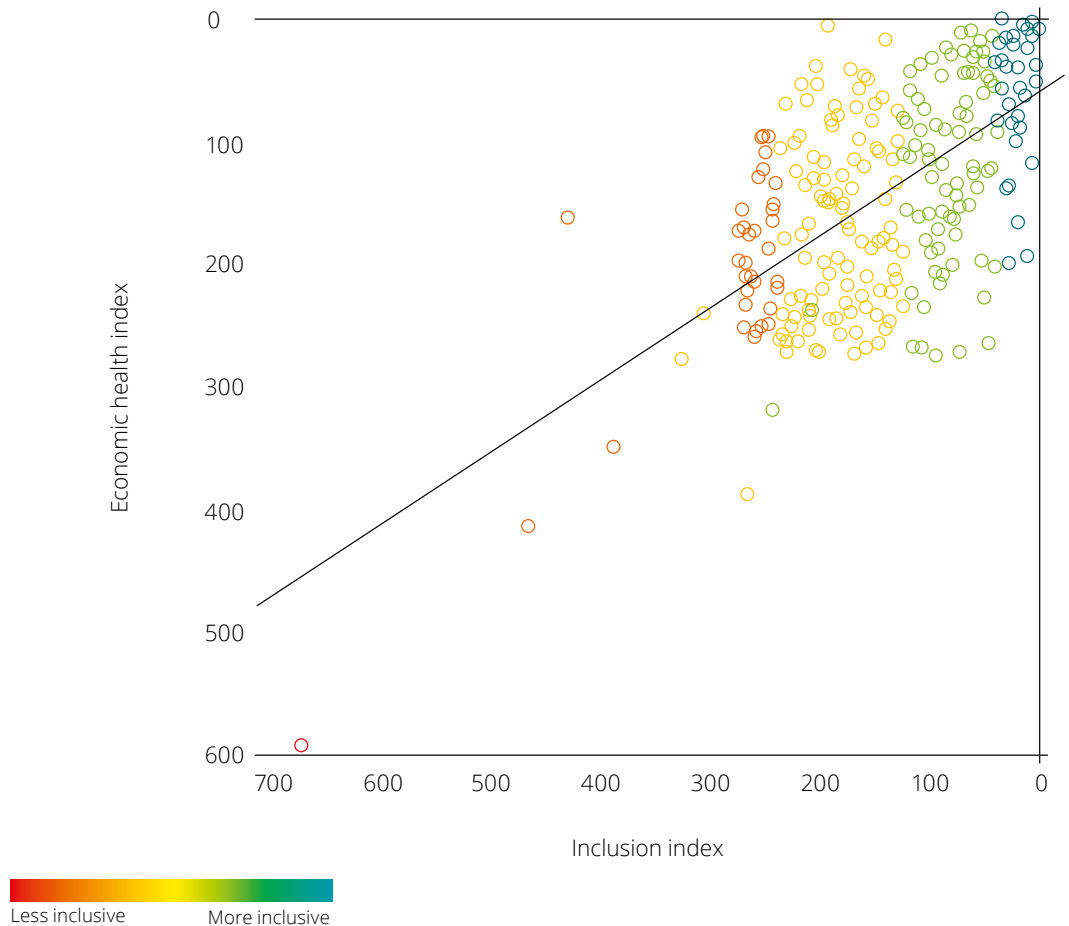
Source: Urban Institute, "Measuring inclusion in America's cities" April 25, 2018.

How to ensure the successful creation of an inclusive city?

Implement proactive multi-sector solutions, both preventative and curative: To address multi-dimensional issues, while building an integrated approach to urban and inclusive city planning, measures for inclusion should be prioritised, such as combining access to land, citizen engagement, violence prevention, and measures to support skill-building in localities.

Promote an integrated planning approach instead of a fragmented one: A lack of inclusivity when planning housing and public infrastructure is typically the starting point for inequality. High population density is a driver of economic growth in a city, but it also makes residents vulnerable to health risk. For example, during the COVID-19 crisis, some neighbourhoods could not provide social distancing arrangements; and a project developed by the World Bank to map COVID-19 hotspots found that they were locations of public infrastructure (such as water fountains and public toilets).[177]

Follow an equity-centred by design approach: For decades, local and national governments have been employing inclusive design, also known as universal design, primarily in the form of infrastructure improvements that accommodate physical disabilities—such as audible walk signals and wheelchair ramps. Moving a step further, equity-centred processes and policies can help reduce systemic barriers faced by historically marginalised and excluded groups, elderly, children or others. When rethinking programme structures, communication platforms, and digital algorithms, cities should try to move towards inclusive and equity-centred design. It means considering the outcomes and not only intentions, and also embedding equity of access and process in the design, transformation and delivery of services.

Improve technology solutions, their adoption and digital skills, supported by adjusted regulation: To boost participation, inclusion and interaction within a city's ecosystem, city leaders could launch digital literacy programmes, improve the broadband infrastructure, and develop policies for affordability. Additionally, leaders should invest in promoting digital skills to ensure that everyone can participate in the digital transition.

"We need to work in order to ensure that digital transformation does not leave people behind."

Carole Mancel-Blanchard
Member of the European Commissioner Cabinet for Cohesion & Reforms, Elisa Ferreira

"Technology can play a major role in fighting exclusion: by strengthening land administration systems and geospatial infrastructure, hence ensuring the protection of land rights, especially for poor and most vulnerable households; by fostering engagement by citizens in urban policy making – which is critical; and by enabling people to access jobs and to match the skills with the needs of the labour market."

Sameh Wahba
Global Director, Urban, Disaster Risk Management, Resilience and Land Global Practice, World Bank

Pursue data equity: Data collected and analysed for decision-making must accurately represent the entire underlying population and minimises bias. The use of AI and algorithms introduces a risk of using potentially distorted datasets in the design of services and programmes. Improper use, handling and interpretation of data could exacerbate social inequalities and bias.

Establish inclusive living labs: Create and foster dedicated public spaces and environments where city planners can test solutions, assess their desirability, acceptance and impact, and evaluate whether to scale them up to the whole city,[178] in a co-creation process involving everyone.

Use agile methods to respond rapidly and anticipate citizens' needs: With increasing amounts of data collected and processed to meet citizens' needs, many governments have moved to the cloud to scale up their services. For instance, Rhode Island modernised its unemployment insurance contact centre during the pandemic using cloud technology, going from a capacity of just 75 to 2,000 concurrent calls.[179] Governments can follow the Netflix model, and use algorithms to anticipate people's needs and organically adapt their services to the individual. And agile approach is critical for adjusting quickly.

Watch and listen to the insightful conversations about this trend.

Where to see this in action?

Medellín, Colombia

Two decades ago, the city of Medellín was infamous for its high homicide rates, economic inequality and social exclusion: in 2012 over 6,000 people were killed. However the city started transforming into an urban inclusive community through an integrated planning approach to improving connectivity, education and public facilities, with a special focus on the poor.

The initial stages of transformation began in the 1990s, when the focus was on restructuring public spaces and the landscape through targeted territorial regeneration initiatives that involved connectivity enhancement and community participation, with a special focus on increasing the competences of excluded citizens.[180] Initiatives such Medellín Metrocable, the world's first cable car system for public transport, connected the city's poor neighbourhoods with the city centre, subways and bus networks. San Javier outdoor escalators, public outdoor escalators connecting one of the poorest and most violent neighbourhoods (Comuna 13) on steep hills to the city centre, was another key project in 2011 that contributed to the development of an inclusive city.

An important focus of the strategy was on education. The local government created public facilities including of libraries and schools across all neighbourhoods, many located near to subway stations to promote accessibility. Likewise, parks and sports facilities were also built in areas surrounding the cable car stations.

There was also investment in the programme "Medellín, the most educated" for educating people – especially in early childhood and primary education – as a powerful way of reducing poverty and improving society.

There are other initiatives that make Medellín a global case study in social inclusion. More recently, programmes such as the adoption of open government policies (accessibility of data and public information) investments in ICT (free internet access zones)[181] and social co-creation practices (like Mi-Medellín for mass participation)[182] have contributed to the creation of a smart Medellín.

Quito, Ecuador

Some years ago, sexual harassment on public transport was increasing at an alarming rate in Quito. In 2014, 81 per cent of women travellers reported being a victim of sexual violence in public.[183]

As a social inclusion initiative, the Bájale al Acoso campaign was launched in 2017 to fight sexual harassment in the public transport bus system through instant reporting via SMS text messages. A victim can send a message to the authorities with the word 'harassment' and the bus ID: a response mechanism is activated immediately, notifying the driver, setting off an alarm inside the bus, and sending an alert to a Brigade that gets in touch with the victim within three minutes.[184] The initiative is ongoing and has helped to protect thousands of women and build a safer city. As a result, in the first two years of implementation 2,800 cases of sexual harassment were reported, and 73 perpetrators were prosecuted.

The Bájale al Acoso strategy has raised broader public awareness and is contributing to the building of a more equal and inclusive society. Similar initiatives against sexual violence were introduced into schools to support children (3,607 cases were registered between 2014 and May 2020).[185] Buenos Aires in Argentina and other cities are replicating the Bájale al Acoso project. The strategy will also be replicated in the metro system in Quito.[186]

Nagareyama, Japan

With a population of 200,300 inhabitants (as of March 2021), Nagareyama has aimed to be the best Japanese city for raising children. Under the motto "Think Motherhood, Think Nagareyama", the city has evolved since 2009, when the programme was launched.

The problem of an aging population and low birth rates is not exclusive to this city, and is common to all Japan. Nagareyama, in Chiba Prefecture, developed a marketing strategy to attract younger people. Among the objectives were to develop organised urban green spaces, increase public services and infrastructure to support parenting and children's education, and promote family activities and tourism events to attract non-residents. The programme targeted women as the individuals most likely to be attracted by a livable city.

Listening to the priorities of women, the city implemented changes to its public transport system, with a child drop-off and pick-up point in day care centres to alleviate the daily burden of mothers working in the Tokyo metropolitan area. The strategy has also created entrepreneurship programmes for mothers and co-working facilities to balance their work and personal lives. Green spaces have been improved, and Nagareyama is now seen as the forest city nearest to metropolitan Tokyo.

The population of the city has recovered: the average number of children per family rose from 1.16 in 2007 to 1.53 in 2017.[187]

The vision of
Sameh Wahba

Sameh Wahba
Global Director, Urban, Disaster Risk
Management, Resilience and Land Global
Practice, World Bank

What are the main challenges brought on by COVID-19 that cities are facing right now?
Cities have been in the front line of the COVID-19 pandemic and found themselves having to take all the necessary measures to curb the spread of the virus. That led them to take measures to close down economic activity. Lockdowns have affected all sorts of businesses, public and private, service delivery and in particular the poor – the 1.6-2 billion people currently working in the informal sector and lacking access to social safety nets. Cities also have to care for those who are affected, and have to maintain essential services like garbage collection, probably at a higher cost, and at the same time, jump start the recovery, all the while operating with insufficient municipal finances.

Because of the lockdowns and drop in economic activity, many cities lost 15 to 40 per cent of their annual municipal finances because of the fall in tax revenues. This obviously affected their ability to maintain delivery of services, let alone invest in improving, maintaining and building new infrastructure.

Do you think that the way we will plan cities in the future will be different because of the pandemic?
Several things will change without a doubt.
The big trade-off that has always happened in cities is between the benefits of agglomeration and the costs of poorly managed urbanisation. The benefits of agglomeration are increased productivity, knowledge spillovers, access to specialised services, and access to better-paid jobs and to higher quality services. The costs when urbanisation is not managed well however are: congestion, land pollution, air pollution, water pollution, crime and violence, and the inability to access affordable housing. As a result of the pandemic, all these issues will start getting much closer consideration from city planners.

From a land use and zoning perspective a few things will change, relating to infrastructure standards and the upgrading of slums and informal settlements. Furthermore, a planner must also consider the integration of nature with urbanisation – green and blue spaces, as well as overcrowding and occupancy thresholds, and urban and rural linkages. One of the major changes will be to mobility systems: how will public transport adapt to health risks; how to encourage other forms of mobility such as bicycles lanes and wider sidewalks? In the long run, a gradual transformation towards the so-called '15-minute' city is nothing new – it is a return to well established planning concepts such as the old neighborhood planning unit, and mixed-use development.

Lastly, another very big variable is the future of work. This requires a strengthening in the digital infrastructure of cities and will have an impact on land. So the city will transform in many ways following the COVID crisis to become more inclusive and more livable.

If you had to choose what are the main trends that you see for 2030, what would they be?
The main trends will be at the intersection of the forces shaping our world today: urbanisation, conflict, climate change and technology. First, we are going to witness the rapid spread of suburbanisation, mainly in Africa and in Asia. The second is conflict, which is on the rise, with its impact on displacement. Third is climate change, which is the biggest trend. Then, obviously, technology. You take the intersection of these four different forces, and that's where that city of tomorrow will be.

At the intersection of climate change with urbanisation, you have a very important role for cities as the drivers of the decarbonisation agenda. Cities are responsible for 70 per cent of greenhouse gas emissions, so they need to be the major part of the solution towards achieving the targets of the Paris Agreement.

Another important trend is the adaptation and resilience agenda in cities. This is because, when poor people locate into cities, dysfunctional land and housing markets lead them to locate close to their jobs in the unbuilt spaces – often landslide and flood prone areas, which puts their lives at risk.

We should also consider the intersection of technology with urbanisation. How do you harness smart technology to reshape the city, mobility, and the delivery of services?

All the trends, whether low-carbon, resilient or smart cities, will need to revolve around a people-centred approach. They will need to have people at the centre, so there must be an inclusive approach, working with citizens to ensure that the poor are protected against or less affected by the impact of climate change.

What can be done in to make our cities more inclusive? What would be the role of technology?
There are three dimensions to exclusion in cities that we have to work on in order to achieve an inclusive city: spatial, economic and social. Working on all three dimensions is key, but a particular problem is how to enable access to land and housing.

Land and housing markets are dysfunctional, so fixing them is the first critical intervention, to enable better access to economic opportunities. It goes along with targeted interventions on skills, and preparing people to match the need for skills in the labour market. Regarding citizen engagement, it's about voice and accountability, it's about taking part in shaping the future of your cities to identify what are the priority investments at the neighborhood level, at the city level, and it's about participating to influence the direction that your city is taking and to have a voice in contributing to better service delivery.

Technology can have a major role to play in all these: in strengthening land administration systems and protecting of land rights especially for the poor and vulnerable households; and also in citizen engagement, in urban policymaking, and in matching people with jobs.

What is the importance of smart and sustainable buildings and infrastructure for achieving your objectives regarding the resilience and sustainability of cities?
Cities are responsible for a large proportion of greenhouse gas emissions. Having greener and more resource-efficient buildings might cost more to build but they cost less to maintain and have much lower levels of emissions. Smart infrastructure like intelligent traffic systems, congestion pricing, and mobility systems, making the city infrastructure more responsive as well as improving the delivery of services such as garbage collection and water sanitation. I do not really like the label 'smart cities' because I don't think that there are dumb cities out there. I think there are cities that just need to harness technology to serve their needs better, in ways that will vary from one city

to the other, depending on their needs, depending on their ability to leapfrog, depending on the capacity and such.

How would the city you would love to live in 2030 look like?
A city that has the soul of Cairo, the urbanism of Lisbon or Paris, the vibrancy and creativity that you find in many cities around the world including in Asia, Africa, the Middle East and Latin America. Most importantly, it is an inclusive city. At the end of the day if you have a city that's livable, that's sustainable, that's resilient, that's competitive, but is not inclusive, then something is fundamentally wrong in that city. Inclusion is not a feel-good thing, it is the right thing to do, it is fundamental for the economic survival of cities.

Watch the full interview.

Digital Innovation Ecosystems

Jean Gil Barroca
Global Public Sector Digital
Modernisation Leader

Cities tend to attract talent, enable creativity and encourage disruptive thinking, developing themselves through an innovation model approach, and a combination of physical and digital elements.

"Our first value is customer and resident orientation (....). Collaboration is the key to having this kind of innovation or startup ecosystem."

Jukka Mäkelä
Mayor, Espoo, Finland

"The difficulty is to attract the first ones. Once you start attracting one or two or three, there is a sort of copycat effect, which really worked nicely. (...) When we look at the ecosystem, we have more than 450 mapped tech start-ups, more than 50 incubators, co-working spaces and over 70 R&D centres, which for a city with only 215,000 inhabitants and 42 square kilometres is quite a remarkable. In the two years from 2016 to 2018, we had an increased turnover and there were more jobs created, at a rate twice higher than in previous years."

Rui Moreira
Mayor, Porto, Portugal

"Data alone doesn't do anything, but if cities can create environments that people want to live and work in, and if they have a data infrastructure that can be used by entrepreneurs in ways better than competing cities, they will probably come out on top."

Kent Larson
Director of City Science Group,
MIT Media Lab

Traditionally companies and industrial parks have been concentrated in suburbs of the city, but start-ups and digital nomads are now bringing innovation and ideas to the city centres. As population numbers increase in urban areas, cities compete for investment, skilled workers (talent) and cultural prominence, and this is turning urban regions into innovation hubs, leveraging data. Studies of venture capital (VC) investment in the United States illustrate this trend: innovation moving from suburbs to downtown cities[188], creating what the World Bank defines as "the collection of stakeholders, assets, and their interactions in city environments resulting in technology (in particular ICT)-based innovation and entrepreneurship".[189]

You may find some cities with an innovation or technology department and individuals working in a silo, trying to innovate from there. This is not what we mean. Cities will adopt a multidimensional approach to innovation, the so-called quintuple innovation helix framework (of interactions between university, industry, government, public and environment)[190], and city governments will act as platforms enabling the right connections, policies, places and infrastructure to make the ecosystem flourish, solving the town's most prominent challenges, bringing change to the city, to industries and the world.

Cities will be Living Labs for digital transformation and centres of experimentation, using data to develop pilots that can be scaled up. For example Barcelona has been described as: "a grand laboratory for its creative talent, its resident communities and its knowledge centres".[191] By putting talent attraction at the centre of its strategy, a city develops with the goal of being the most attractive host (of people, companies and research centres), in order to facilitate ecosystem development. The City Hall has to develop the right skills, data collection and usage, and modernise its governance model to foster collaboration and encourage open innovation. Increasing the level of adoption of digital innovations in high priority economic sectors generates a positive impact on local competitiveness, by opening up new sources of employment and economic growth, deriving from the creation of new businesses and types of employment.[192] Similarly it supports the uptake of disruptive and promising digital technologies. In New York City, the technology sector has increased at a faster rate than other sectors, becoming a new source of direct and indirect employment. Similarly, Bangkok has been adding over 3,000 direct jobs a year to its ICT industry.[193]

Remote working has lengthened the list of cities that can adopt this strategic position. In line with the 'rise of the rest' theory put forward by Richard Florida in 2019,[194] the shift from enterprise attraction to talent attraction makes it possible for smaller cities to thrive in a post-pandemic world, using data as a source of competitiveness in the digital innovation environment. It is a time also for small remote hubs.

Why is this idea relevant for cities and their citizens?

At the end of the day, this model will only flourish when accompanied by a co-creation approach. Cities will benefit greatly: not only economically – by maintaining and generating growth – but also by empowering individuals to become problem solvers, ready to find the best solutions for common challenges, and driving change in the public sector.

Overall increase in revenue and employment opportunities – local economic growth and competitiveness: The positive correlation between growth in the ICT industry and job creation has been observed in cities. For example, Medellín generates over EUR 82 million a year from Business Process Outsourcing (BPO) and has attracted several multinationals to establish BPO centres in the city.[195] Porto is another example of economic value created through an innovative ecosystem approach.

Lower cost of innovation and higher levels of success: New technology has lowered the cost of innovation. With a city providing a platform for innovation, everyone can benefit from proximity and intensive interaction, making it easier and cheaper to create value. For example, technologies such as 5G, cloud and social networks have made it easier to innovate, with fewer resources.

Community value and better services through innovation: Creative brains combined with advances in technology are the recipe for innovation. Being home to all that in the city results in better public digital services and a better place to live. Moreover, co-creation can reduce the costs of service provision, by as much as 60 per cent in some cases.[196] For example, 'the Studio' in Dublin engaged employees and other stakeholders to innovate methods for improving the efficiency of working.[197] In one instance a public employee who led a team of labourers maintaining clear gutters and sewers developed a new design for the city's drains: this new design required less time

"The pandemic has created opportunities for second and third-tier cities. In most countries, the innovation, the talented people, the companies, and the venture funding, were concentrated in cities in the US such as New York, Boston, San Francisco… but what has happened now is that the playing field has been levelled to a certain degree and I think what we were talking about with data is an example of a creative smaller city. Providence Rhode Island or Kansas City, in the middle of the country, could in certain ways begin to compete with the Boston and New York."

Kent Larson
Director of City Science Group,
MIT Media Lab

"The activism and the new governance structures that are being created locally are a bespoke community-responsive way to dealing with some of these global trends. This is where both the speed of policy making and leadership from locally elected officials become a total game changer for how problems are solved and how new futures are embraced and ushered into local economies."

Uwe Brandes
Faculty Director, Georgetown
University Global Cities Initiative

"iCapital was also the proof that innovation is being done also outside the university, in terms of climate policy, mobility, city planning and other areas, such as education. I was also happy because it is about societal innovation."

Mohamed Ridouani
Mayor, Leuven, Belgium

"A lot of these innovations can be adopted very quickly, simply because there is no established system in place right now. (...) All the greatest new emerging ideas will probably be deployed in these smaller communities before they replace the legacy systems in more developed parts of the world."

Markus Elkatsha
Urbanist at CityScience Group, MIT Media Lab

to clean and so enabled workers to improve their efficiency. The city has patented the innovation. This example highlights the multiple levels of value creation – from efficiency at work to commercial patenting.

Impact beyond municipal boundaries and acceleration of innovation and progress in emerging cities: By serving as living labs and experimentation centres, cities not only create value at a local level but can also rapidly scale it up to a regional, national or even global level. A thirst for doing things differently in order to keep up, as Markus Elkatsha from MIT Media Lab has pointed out, enables emerging cities, especially from the Global South, to benefit from new technologies and innovative approaches to urban development, for example blockchain for property titles and records.

How to ensure a successful implementation?

Capacity to attract talent and expertise and open talent networks: Either by attracting companies and focusing on the ease of doing business, or by offering a better quality of life, cities can attract the best talent and create the right environment to prosper.

Foster agile processes and avoid a risk-aversion culture: Agility is another aspect of urban innovation ecosystems. A parameter for judging a city's innovation level is its ability to bring people together to capitalise on new talent and technology, using small cross-functional teams to prioritise projects and deliver quickly. Creating agile teams is a catalyst for success in this model. For example, the city of San José uses scrum practices in its Office of Civic Innovation & Digital Strategy to prioritise the work that the office needs to do. The scrum technique makes it easier to increase accountability, remain aligned while working autonomously, and use iteration to foster continuous improvement.

Add the required skill sets and gain an awareness of the opportunities that new technologies offer: Adding tech talent to cope with the technological changes is a top priority for city governments.

Ensure data mastery and interoperability standards: To extract maximum value from the ecosystem, cities must manage data properly and create standards for interoperability, enabling easy and seamless data exchange between stakeholders, partners and even between cities and nations.

Embrace a new way of management and leadership: Digital innovation hubs require a different governance model that entails: considering the ecosystem as a community; looking for new and innovative ways of procurement (such as collaborative processes to co-create city services); creating an open environment where the private sector has an important role; and developing public-private partnerships as dynamic coalitions for testing and learning.[198]

"I hope that Leuven can be some kind of open source city, where we share the things that we do here that might work on a different scale in different places. I don't want to be protectionist."

Mohamed Ridouani
Mayor, Leuven, Belgium

"As people can work anywhere, that doesn't make the places where they choose to work less important. It actually makes it more important. If I can work anywhere, I am going to anywhere, I am going to be very careful about where I choose to live."

Kent Larson
Director of City Science Group,
MIT Media Lab

"Communities need to think beyond integrating new technology and data outputs, and reflect on changing knowledge frameworks and the leadership necessary to create the fertile ground to achieve desired outcomes in civic innovation."

Uwe Brandes
Faculty Director, Georgetown
University Global Cities Initiative

Watch and listen to the insightful conversations about this trend.

Where to see this in action?

Espoo, Finland

Espoo is among the European forerunners in innovation and sustainable smart city development. Home to the leading innovation and technology hub in the Nordic countries, strong research institutes, SMEs and global company headquarters alike, Espoo is an innovation ecosystem in Finland. It hosts an active startup hub and some of the most valuable Finnish companies, and also Aalto University and VTT Technical Research Centre of Finland – two important players in the innovation scene.

Espoo is also home to the highest density of international talent and the highest education level of all Finnish cities with 52 per cent[199] of residents over 24 years old holding a university degree. A truly diverse city, it welcomes more than 150 nationalities and 680 international companies. As of 2020, 50,000 of its residents were foreign-language speakers[200] and this figure is expected to grow to about 30 per cent of the population by 2035. This is one of the reasons why Espoo became the first city in Finland to use English as one of its service languages.[201]

In 2018, Espoo received the accolade of Intelligent Community of the Year[202] from the Intelligent Community Forum (ICF). "The point is not to be the most sustainable city or to be the most intelligent city, the point is to be the most sustainable or most intelligent community", said the Mayor.

The development of a digital economy in Espoo has increased the city's wealth generation capacity. This in turn has led to the creation of improved public services for the city residents. In 2020 Espoo was awarded the title of Finnish Capital of Innovation[203] and was in the top six in the European Capital of Innovation (iCapital)[204] Awards of the European Commission.

As the second largest and fastest-growing city in Finland with close to 300,000 inhabitants, Espoo is also far from traditional. Characterised by the lack of a single centre, Espoo has a network city structure with five urban centres, all equipped with great access to services and nature close by.

Espoo's services are built on a mixture of experimentation and co-creation, through a 'City-as-a-Service' approach[205]. The city incentivises all stakeholders in municipal services – companies, knowledge institutions, associations and residents – to provide feedback in order to refine existing public services and promote the creation of new ones together. This drive has been branded with the slogan "Make with Espoo"[206], where the city seeks to position itself as a place where development is driven first and foremost by the client's best interest: its residents.[207] As the Mayor has stated, "Our first value is customer and resident orientation. We need to have a good collaboration with our residents, our companies, our universities and our research centres. Collaboration is key to having this kind of innovation ecosystem or start-up ecosystem."

Listen to the full interview.

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New York, USA

In July 2010, Mayor Bloomberg and Katherine Oliver (Commissioner of The Major's Office) launched NYC Digital, an agency to look after development of a digital strategy throughout the city. Simultaneously, the mayor initiated efforts to encourage tech startups to open offices in the city, by offering tax cuts.

The city initiated a programme of actions that included: endorsing co-working and collaborative spaces aligned with mentor and incubator networks; nurturing entrepreneurs to attract venture capital into start-ups; inviting engineering institutes to support educational programmes in the city and enhancing skill sets through training; and running competitions to engage the community in (based on city problems). These actions were carried out in collaboration with citizens and private sector businesses.

New York also involved under-developed neighbourhoods by training and providing new employment opportunities generated by the network. Amongst the first individuals to complete this programme, 20 graduates (about 70% of the total number) gained full-time employment, 15% became entrepreneurs, and the others joined formal education programmes.

Thus, the city has been able to develop one of the largest tech-innovation ecosystems, even with limited tech talent, which is a constraint that many cities face.[208][209]

Porto, Portugal

In 2016, the city of Porto set out to position itself as a city of innovation and creativity. It established what is now known as the Porto Innovation Hub, an innovation aggregator where the city functions as a living laboratory, bringing together businesses, entrepreneurs, citizens and the Municipality of Porto to foster problem solving, improving the city, and creating differentiating businesses.[210]

Collaborating with the University of Porto (which has consistently ranked at the top of Portuguese universities),[211] in projects like 'Stepping out Innovation',[212] the city has promoted knowledge sharing between its institutions. Another feature of the project is 'In-House Innovation'. Cooperating with citizens and stakeholders, the city seeks to redesign its services in a way that responds to the needs of citizens, whilst also becoming more cost efficient and accessible.[213]

In 2020, thanks to the Porto Innovation Hub, Porto won the Smart City Innovator Award[214] at the Annual Investment Meeting Conference in Dubai in the Future Cities category. When asked which were the most decisive aspects that led to achieving this accolade, Rui Moreira, Mayor of the City of Porto, answered that among several success factors some that should be highlighted were the people of Porto and its academic institutions, the city's infrastructure and the uncommonly high safety levels to be found in the cities of Portugal. The city felt that it needed to develop its ecosystem before it moved somewhere else.

Although Porto is well known as a tourism destination, city leaders have sought to re-establish Porto not only as a service city, but also as an industry leader, aiming to stop the brain drain of local talent and strengthen its economy. Faced with companies requesting engineers to emigrate, the Mayor asked "If we have the talent, if we have the academia, if we have the people, why can't we attract that sort of activity to come to Porto?". The city has implemented a strategy of attracting companies to invest in the city, reinforcing its already good health system, schools – both private and public –, the qualified labour, and inviting these companies to come and invest in there.

In 2018 Porto won the World Excellence Award for Best Startup-Friendly City of Europe[215] for being a burgeoning tech start-up scene and one of the few municipalities in Europe that had a start-up programme to encourage and stimulate entrepreneurship. The Porto Digital Association, a partnership between the city of Porto, the University of Porto, and the Metro of Porto has also borne fruit. Porto has been chosen as a mentor city in the European Commission's '100 Intelligent Cities Challenge'.[216] This decision came from the recognition of the city's digitalisation efforts and their potential for scalability. The city was also showcased in 2020, earning the number one spot in Monocle's Small Cities Index[217] for its green ambitions, its friendly business environment, inclusiveness and accessibility.

This has been a successful strategy for the second largest city in Portugal, with outcomes in the business sector including "a rate of job creation twice greater than the previous years, local start-ups and scale-ups achieving a growth rate of 26 per cent and established companies a growth rate of 7.7 per cent between 2016 and 2018."[218]

Circular Economy and Producing Locally

Irena Pichola
Global Public Sector Climate
Change Leader

Cities are adopting circular models
based on a healthy circulation of resources,
and principles of sharing, re-use and
restoration, with an emphasis on limiting
municipal waste volumes and on producing
locally – for instance, urban farming.

"It requires vision and engagement from local administrators and the private sector. A circular economy can change the face of our cities and, at the same time, be the engine of our recovery."

Ursula von der Leyen
President of the European Commission

"We want to be able to be resourceful and resilient as well. Last year, we opened our fourth desalination plant, we are also looking at how we can grow more of our own food. When planning for our city, we invest in capabilities that will allow us to be more circular in the use of resources, and to be more self-reliant in some of these areas."

Kok Yam Tan
Deputy Secretary of Smart Nation
and Digital Government Office, Singapore

Do you know that on average a car is parked more than 90 per cent of the time? Or that the average office is used only 35-50 per cent of the time? That 30 per cent of food is wasted?[219] That half of all waste is produced in cities? Given the waste in cities, in assets, resources, utilities, space and time, the way forward is to develop a circular economy.

We know that industrialised growth leads to urbanisation and greater extraction and consumption of natural resources, which puts tremendous pressure on the natural environment. As a solution, cities must lead the change and embrace more viable methods of production and consumption to reduce waste.[220] Increasingly, cities are developing aspects of a circular economy, which entails decoupling economic activity from the consumption of finite resources and designing waste out of the system.

What does it mean to live in a city with a circular economy? It's a city that promotes better use of resources through procurement policies: that consumes less, and also reuses and recycles water, energy, products and materials; that recycles and manages waste according to regulations; that stimulates an economy of repair, borrowing and second-hand commerce; that nurtures a sharing mindset (car trips, spaces and materials); that fosters a better use of resources in construction (10-15 per cent of building materials are wasted during construction); that stimulates an innovative approach to how the city and its citizens consume, store and use resources.

A circular economic model is one of the pillars of the European Union's European Green Deal strategy[221] and there are already some examples of its application, as well as policies and mechanisms to fund the transition. For example, in Berlin a 30,000 square metre section of the Potsdamer Platz hosts a network of connected green roofing, urban space and a constructed treatment pond for storm water. The pond is treated naturally, so only a limited amount of energy is needed to clean the water, which is used for irrigation and flushing toilets.[222]

Cities may also increasingly encourage a 'produce local' approach to food and energy. Urban and small-scale farming is gaining traction in some urban centres as a way to deliver fresh and healthy food, establish direct contact with food producers and reduce carbon emissions, while strengthening the local economy. Innovative approaches make better use of space and light, such as vertical farming, hydroponics, LED indoor farming and rooftop farming. The energy revolution is also contributing to the circular economy through decentralisation of energy production, mainly through renewable sources (such as biogas, wind, solar, wood biomass and waste), off-grid and micro-generators, paving the way for self-sufficiency whereby cities generate as much energy as they consume, creating communities of energy, and offering further economic opportunities.

Why is circular economy and local production relevant for cities and their citizens?

Allows a better use of resources: Currently, over 90 per cent of the raw materials used globally are not recycled back into the economy. According to the UN Environment Statistics, a fully circular economy would cut resource use by 28 per cent. The livability quotient of cities also improves as waste in open-air dumpsites is reduced, and waste water treatment processes are used. As the demand for consumption increases with urbanisation, a circular economy is expected to reduce material consumption, by improving the longevity of materials as well as recycling.

Reduces carbon emissions and energy use: UN Environment statistics indicate that a circular economy can reduce carbon emissions by 72 per cent. Circular economy practices in the energy sector supply chain, from generation through to storage transmission, distribution and consumption, are crucial for achieving the goal in the Paris Climate Agreement to reduce emissions and restrict the increase in the global temperature to 1.5° C.

"The most long-lasting initiative we have is the water company, owned by the city of Porto, which distributes water, and takes care of sewage. We have just transformed it into a utility company and we are starting to produce electric energy through solar energy. We started of course as many other cities have started traditionally: by using public buildings, schools, the town hall, our rooftops, to produce energy for our own consumption. But that was only the first step. Now we are moving to the second step where we believe cities will have to produce their own electricity and they will have to start redistributing the energy and selling the energy to its citizens."

Rui Moreira
Mayor, Porto, Portugal

"We also would like to have a community where the resources that you need – energy, clean water, food – are all produced near the point of consumption, getting rid of these global supply chains, flying in vegetables from other parts of the world. There is no reason why that can't be produced locally."

Kent Larson
Director of City Science Group, MIT Media Lab

"We are going to see tremendous innovation not just in how communities conceptualize a local circular economy, but how they invent new locally-defined markets to generate local co-benefits and synergies and directly impact participating stakeholders. In a sense, digitization will newly empower local decision-making."

Uwe Brandes
Faculty Director, Georgetown
University Global Cities Initiative

Creates resilience in food supplies and energy production and delivery: At present, 84 per cent of fruits and 46 per cent of vegetables disbursed in the UK are imported.[223] Climate change threatens the steady supply of food globally, and local production therefore contributes to self-sufficiency, as it is more resistant to supply chain shocks. As an example, in Chiang Mai, Thailand, an urban farm built on a former landfill site has been helping to feed nearby residents who lost their tourist-dependent jobs at the start of the COVID-19 pandemic.[224] To be less dependent on foreign supplies and to mitigate the risks from disruption or natural disasters, this approach to producing locally (food, energy etc.) could be critically important. Shorter supply chains are also part of the climate adaptation strategy.

Increases disposable income and creates new jobs: Developing a circular economy is expected to increase the average disposable income of individuals by reducing costs and prices of products and services, and a conversion of unproductive to productive time. For example, the average disposable income for EU households would rise by EUR 3,000, or 11 per cent more than the current development path, by 2030.[225] A local energy production model also creates additional revenue streams for households, and would have a big economic impact, especially in developing countries. A circular economy also opens up opportunities for new jobs.

Improves the sense of community: Promoting a circular economy and local production can increase the sense of community among city dwellers.

How to ensure a successful transition?

Funding the transition: Once implemented, a circular economic model with local energy production should deliver financial and environmental benefits; however the cost of transition to this model could be expensive. To finance investment in a circular economy, cities can borrow by issuing bonds, such as municipal and green bonds. Some cities have used this option: in 2019-20 there was a large increase in issues of debt and equity instruments relating to the circular economy. For example, the Australian government (through a public body CEFC) established an EUR 58.2 million Australian Recycling Investment Fund to invest in circular economy projects.[226]

To encourage further adoption of the circular economy model, cities can also provide incentives, through subsidies or tax breaks. For example, Cremona in Italy is testing the introduction of a tariff on non-recyclable waste: residents are being given orange 60-litre garbage bags; and for each additional bag they use, their garbage collection fee increases.[227]

Flexible and simple regulatory structures and smart procurement: By applying green public procurement criteria and mechanisms such as pre-commercial procurement, governments can lead by example. Regulations are also a potential way of promoting a circular economy, but they need to be flexible and evolve accordingly. For instance in Vancouver, a Green Demolition by-law requires homes created before 1940 to be deconstructed instead of being demolished, and a minimum of 75 per cent of construction materials should be reused or recycled.[228]

Create or rethink metrics to measure circularity: Cities lack standardised methodologies and metrics by which institutions can measure and assess circularity, and this makes it difficult to achieve progress. However, some organisations have made attempts to define and measure circularity. For example, the Ellen MacArthur Foundation's Circulytics is a measurement tool that shows the extent to which an entity has achieved circularity across its entire operations.

Leverage national or regional policies and invest in awareness campaigns: Although cities can lead the way, national and regional alignment is crucial for ensuring successful implementation, as different sectors present different challenges. Engagement and involvement by citizens is also of paramount importance, and this will require awareness and information campaigns to encourage behavioural change.

"The European Union put together a recovery package worth almost two trillion euros. It is the largest stimulus package in our history, and it will finance a green recovery, built on the principles of the circular economy. Massive resources will soon be available to foster a green recovery inside our cities."

Ursula von der Leyen
President of the European Commission

Watch and listen to the insightful conversations about this trend.

Where to see this in action?

Seoul, South Korea

The Seoul Metropolitan Government launched the Sharing City Seoul programme in 2013, an initiative that uses technology to support businesses, with a sharing concept to reduce waste and underutilised capacity, cut municipal costs and boost new business opportunities.

The initiative aims to encourage collaboration and sharing public and private resources to tackle city challenges, promote participation by citizens, and facilitate the growth of local businesses. Through the initiative, the city government also launched several 'sharing projects' to promote the adoption of the sharing principle to deal with social and environmental issues.

The Seoul Sharing Promotion Committee established a 'Seoul Sharing Hub'. The idea was to showcase a pool of online platforms created by various organisations for sharing, in order to enhance the convenience for citizens in accessing data. Further, the online 'Seoul Sharing Hub' produces, stores and delivers such data, and also networks with domestic and overseas organisations, enterprises and media, and connects them with various institutes.

To launch Seoul Sharing City, a series of lectures were held in 2013 and the municipality organised events on sharing business models. In addition, the municipality held an exhibition and several launch events with over 60,000 attendees to further engage stakeholders in the sharing economy. Regular sharing 'festivals' still take place and in 2016 the city hosted a Sharing City Seoul International Conference.

The city government has supported new start-up businesses and larger corporate companies in providing sharing services, including municipality-owned co-working space. To date, Seoul has supported 108 sharing projects in the city and given subsidies of EUR 1.2 million.

Through the sharing initiative, membership of the Seoul Car Sharing Program rose from 373,513, in 2014, to 2.3 million by mid-2018. This programme alone is estimated to have cut CO_2 emissions by 486 tonnes, due to reduced car ownership.

Since 2014, over 800m2 in public community centres, including the City Hall, were shared for EUR 110 per hour: 1,250 shared spaces have been registered for use and over 600,000 users have benefited.[229] [230]

Glasgow, Scotland

With an aim to become one of the world's first circular cities, the city launched 'Circular Glasgow' in 2015, a programme of steps for the city and business community to facilitate economic development, resource recovery and reuse, and a reduction in carbon emissions.

Three key areas were identified for initial analysis due to their crucial economic implications for Glasgow: healthcare, education, and manufacturing. As a sub-sector of manufacturing, the food and beverage industry was a starting point for implementing circular economy initiatives; this was followed by the construction, finance, tourism and creative sectors.

To crowdsource ideas and increase public and SME engagement, Glasgow held a Circle Lab Challenge in April 2018 which reached 600,000 people across 13 countries. This led to three new projects focused on running large events and conferences consistent with circular economy principles.

In 2017, the Scottish government won the Public Sector category at The Circulars, WEF for its work in placing the circular economy at the centre of its economic strategy. Circular Glasgow was a finalist in the same competition in 2019.

To date, Circular Glasgow has involved 650 firm in its initiatives. The Glasgow experience is being extended nationally: Zero Waste Scotland has launched 'Circular Cities and Regions: Scotland'.[231]

Cape Town, South Africa

The Western Cape Industrial Symbiosis Program (WISP) provides business members with time and technical expertise, connecting companies with unused or residual resources such as materials, energy, water, assets, logistics and expertise.

The project, launched in 2013, has more than 300 members in the network and has identified over 3,000 resources. To date, it has generated EUR 2.8 million in financial benefits to businesses, through additional revenue, cost savings and private investments.

In the first five years of its operation the achievements of WISP included: 27,000 tonnes of waste diverted from landfill; avoiding 74,000 tonnes of GHG emissions; EUR 2.5 million in financial benefits for member companies; and the creation of 143 jobs in the local economy.[232]

Lappeenranta, Finland

Lappeenranta, a municipality in south-eastern Finland, is a centre of bio-based industries with 12 per cent of the workforce employed in the environmental and clean tech sectors. In 2018 the municipality launched its Lappeenranta 2033 Strategy to develop a green city with environmentally friendly business operations. Guided by the 2033 Strategy, it was the world's first city to start exclusively using EKOenergy-certified renewable electricity.

Through the strategy, waste from local factories is converted into construction materials. The new materials thus formed have reduced carbon emissions and are suitable for the extreme weather conditions in the Artic. This initiative is expected to reduce city's carbon emissions by 80 per cent by 2030, as well as to create new jobs and income opportunities for local industry.

In 2020, the city was awarded the European Green Leaf in recognition of the steps it has taken towards its carbon neutrality goal for 2030. The award has prize money of EUR 75,000 which will be used to extend green practices further across the city. The city also plans to organise international webinars and conferences with aim of establishing itself as a 'green ambassador'.[233][234][235][236][237]

Hong Kong

In 2019, although Hong Kong had 300 traditional and industrial farms, almost 90 per cent of the region's total food of supply was imported. Further, with limited space, a growing population and the growing impact of climate change, the region faced a challenge of food insecurity.

To tackle the situation, Hong Kong Special Administrative Region Government established a new policy for urban farming as a commercially productive practice. As a result, urban farms were created across the region. Supported by local NGOs, rooftops were converted into farms to support community food production and mitigate the impact of climate change.

60 rooftop farms have been developed in the region, with a total area of about 15,000m^2, with 1,500 new farmers contributing to the effort.[238][239][240]

Smart and Sustainable Buildings and Infrastructure

Sérgio Carvalho
Tech Director | Global Smart Cities
Asset Architecture Coordinator

Marco Macagnano
Digital Real Estate Leader | Real Estate
Advisory | Deloitte Canada

Cities aim to have regenerated buildings, and to leverage data to optimise energy consumption and the use and management of resources in buildings and utilities: waste, water and energy.

"In order to meet the goals of the Paris Agreement to limit global warming, we need to see in the next ten or so years the majority of our buildings become net zero carbon. Any guess on how many cities currently meet that goal? Less than one per cent. There is a staggering challenge here."

Jeff Merritt
Head of IoT and Urban Transformation,
World Economic Forum

Imagine having a city where residents have a high level of wellbeing and yet still do not make extensive use of the planet's resources. In 2019, the Coalition for Urban Transitions estimated that it should be possible to cut emissions from cities by about 90 per cent by 2050 (15.5 GtCO2e by 2050) using proven technologies and practices, in particular for buildings and infrastructure. It is estimated that 36.5 per cent can be cut from residential buildings and 21.2 per cent from commercial buildings.[241] Buildings are currently responsible for 30 to 40 per cent of total city emissions; and in order to achieve the COP21 target by 2050, emissions from buildings must be 80-90 per cent lower than they are today.[242]

Many buildings are energy inefficient and contribute heavily to carbon emissions. In the EU, as of February 2020, roughly 75 per cent of building stock was energy inefficient.[243] So there is a long way to go: a 2019 Navigant report stated that only five per cent of the smart city projects that it tracked had a focus that was primarily on building innovation, and just 13 per cent had 'some level of focus'.[244]

The World Green Building Council defines a green building as one that "in its design, construction or operation, reduces or eliminates negative impacts, and can create positive impacts, on our climate and natural environment; preserve precious natural resources and improve our quality of life".[245] Given the pressure on cities to act on climate change, green buildings are going to invade our urban centres. Besides being built with sustainable and ethical materials, they will be energy, water and resources-efficient, environmental-friendly by design, and capable of producing their own energy (electricity prosumers). Vertical and/or rooftop gardens will foster quality of living and a good environment for those who live in them or use them.

Green buildings will also leverage data and digital technology to improve the efficiency of infrastructure components and to adapt better to stakeholders' usage. Flexible office operators will apply an Office-as-a-Service or Real Estate-as-a-Service approach, involving a 'pay as you go' and 'pay as you grow' revenue model, aligned with an outcome of improved experience and productivity.

Gartner predicts that by 2028 there will be over four billion connected IoT devices in commercial smart buildings.[246] They will be powered by telecommunications infrastructures, with 5G and High Efficiency Wi-Fi (6 or 6E) at the forefront, and will have smart utilities for power, waste and water.

As of May 2020, 28 major cities had signed the World Green Building Council's Net Zero Carbon Buildings Commitment,[247] which calls for cities to reach net zero carbon in operation by 2030 for all assets under their direct control, and to advocate for all buildings to become net zero carbon in operation by 2050.

Efficient smart infrastructure will evolve with a focus on a people-first approach to construction. This will help city leaders to implement a more holistic wellbeing concept for contributing to a better quality of life through smart and sustainable buildings and a well-integrated and intelligent city infrastructure. According to a study led by ESI ThoughtLab, smart waters meters and smart grids have an adoption rate of around 68 per cent globally.[248] The trend is upwards.

Smart and sustainable buildings open up a future to environments that do not just support our ways of living, but actually augment and enhance them. Smart buildings will serve as ambient social infrastructure that connects and interacts with occupants to improve their circumstances, by bringing features, services and information right to our location. Through smart buildings people no longer occupy a space, they engage with a place. With smart buildings architecture has evolved from designing structures and objects, to the design of systems and interactions. This leads to a human-centric future, where each interaction by the smart building with its occupants becomes an opportunity to learn and improve or enhance that interaction the next time around. Buildings tend to be integrated like never before into the way we work and live – as a result of a correlation of building and human performance.

Why are sustainable and smart buildings relevant for cities and their citizens?

Lower consumption of energy, materials and other resources via sustainable construction, smart technology, and optimal data utilisation: Constructing a building is highly energy-intensive and polluting. A report in 2018 by the Global Alliance for Buildings and Construction, the International Energy Agency and the UN Environment Programme found that building construction and operations were

"As we enter 2021, cities are looking to embrace clean technology offerings and are now pulling this tech in house, and the rapid adoption of clean tech innovation is one of the investment areas for environmental sustainability."

Sandy Carter
Vice-President of Worldwide Public Sector Partners and Programs, Amazon Web Services (AWS)

"In the past, the construction of buildings was very sensitive to the weather, to the climate, to where the wind is blowing, and to what happens in winter and spring. Somehow over time this was lost because now all buildings are made from concrete: we have heating, air conditioning, and we do not really care about the weather outside. But in the past five to ten years, because we have sensors, we have moved back to a time when we can construct a building that is sensitive to what is happening outside. By making use of the weather elements (solar irradiance to optimise solar capture and by smartly controlling the internal temperatures), we are able to have buildings that are just as comfortable but at the same time have a much lower carbon footprint."

Kok Yam Tan
Deputy Secretary of Smart Nation and Digital Government Office, Singapore

"Examples of smart infrastructure include intelligent traffic systems and other geospatial data and information which can make infrastructure planning more responsive to citizens' needs and enable the efficiency of service delivery, garbage collection, water sanitation…."

Sameh Wahba
Global Director, Urban, Disaster Risk Management, Resilience and Land Global Practice, World Bank

"The question now is whether we are able to look at smartness at a district level. This is what we are doing to a certain extent in Punggol – using the different characteristics of different buildings to manage energy better in a way that the heat generated by one building can be used for another building for example, and that is possible through digitalisation. The smart building space is moving into a smart district place."

Kok Yam Tan
Deputy Secretary of Smart Nation and Digital Government Office, Singapore

responsible for 36 per cent of energy use globally.[249] A WEF report also stated that of the 40 per cent greenhouse emissions generated by buildings, three--quarters come from building operations and from their construction and materials. Rating systems such as LEED, BREEAM, G-SEEK, CASBEE and Green Star have been established to assess the use of building materials. Sustainability in the use of building materials, energy-efficient, and technology-powered processes would help establish a more environmentally-aware approach to construction.

Capacity to adapt and adjust to circumstances and needs: For a built environment to be sustainable, it needs to be resilient in its usefulness and relevance. An unoccupied energy-efficient building is not a sustainable building. In a digital world of remote working and online shopping, the value proposition of buildings needs to change to meet the evolving needs of the workforce and society in general. A smart building therefore lends itself to being more operationally sustainable since it can adapt and reconfigure more easily to changing conditions. It can provide digitally enabled services to occupants, and ultimately utilise data-driven insights about building performance and usage to make improvements and adapt accurately over time. Furthermore, the smart building is able to utilise these new insights in order to understand how building energy performance relates to human activity as well as floor space. It will therefore be possible to measure the sustainability and efficiency of a building in supporting user outcomes, its productivity and experience.

Lower greenhouse emissions to contribute to net zero: Big cities are already aware of the environmental impact of poor buildings and infrastructure, and are acting to deal with the problem. In 2019 Bill de Blasio, Mayor of New York City, announced a ban on the construction of new all-glass buildings. Organisations such as the Intergovernmental Panel on Climate Change (IPCC) are also advocating a ban on 'all-glass' skyscrapers and greater use of alternate construction materials and alternative solutions such as solar PV windows that can be integrated within a building's envelope.[250] [251]

The European Commission has a Renovation Wave programme to promote effective action on public and private building stock in order to help make Europe climate-neutral by 2050. Currently, roughly 75 per cent of the building stock is energy inefficient, yet almost 85-95 per cent of today's buildings will still be in use in 2050.[252]

Boost public health and the quality of living both indoors and outdoors: Smart and sustainable buildings, able to adapt to the specificities of their occupants, have a positive impact on the physical and mental health of them. Better air quality and reduced environmental noise help occupants to improve productivity, their decision-making ability, and response to crisis; and they alleviate psychological distress. According to the WEF's 2021 Net Zero Carbon Cities report, Europe has the potential to achieve about EUR 29 billion in cumulative human health benefits by 2030 due to reductions in air pollutants. Smart technology in buildings also improves convenience and accessibility, promoting inclusion and adding to the quality of life.

Overall improvement of city landscape: Smart and sustainable practices applied to buildings and infrastructure change the city landscape completely, making it greener and more attractive. Smart buildings are massive information generators, with the average commercial office building producing about 150 GB of data each day. This creates an opportunity for cities to become more granular in city planning. With every new development or building, city planners and authorities can evaluate the overall impact on the surrounding context and social circumstances, and offer more pointed guidance on how best to fit the context, while putting in place standards for operational data sharing. Furthermore, city authorities are also able to incentivise the inclusion of social amenities where data analysis indicates this would be beneficial, for example, requiring the inclusion of green space or a library in exchange for permission to build additional commercial office space, thereby creating a win-win scenario for the city and the building owners. This knowledge sharing economy is the future of the smart and sustainable built environment.

How to ensure a successful implementation?

Define a vision, technological guidelines and develop a roadmap: It is not about technology, but about digital transformation fostered by technology – and it starts with the vision. It includes an analysis and selection of smart technological developments that will bring value to all stakeholders, the establishment of technological guidelines to which the suppliers of infrastructure will have to respond, allowing for synergies; and the development of an implementation roadmap.

"Developing greener, more resource efficient buildings that take into account life cycle costing would be critical both for our ability to align with the Paris Agreement, but also for making these buildings more responsive and adapted to people's needs."

Sameh Wahba
Global Director of Urban, Disaster Risk Management, Resilience and Land Global Practice, World Bank

"A combination of regulation, penalties, and subsidies is needed. The State has a role to play in terms of giving, and providing subsidies to pilot, to trial, and to let industry discover which technology works. There is upfront investment but there is also payback. (…) Let's be realistic: builders and developers will be asking what is the minimum to do. Having those regulations and standards will guide them rather than leave them guessing or doing less than is desired."

Kok Yam Tan
Deputy Secretary of Smart Nation
and Digital Government Office, Singapore

"It is a big task and we need to get people around the table and to be very transparent and direct about what has to happen. It is not going to happen unless we have a very clear action plan and very clear responsibility and accountability."

Jeff Merritt
Head of IoT and Urban Transformation,
World Economic Forum

Watch and listen to the insightful conversations about this trend.

Stimulate and prioritise sustainability-targeted renovation, construction and restoration projects to ensure improved operational energy efficiency and carbon reductions. This can be done through policies, regulations, penalties or carbon taxes. Cities around the world are making commitments to sustainable development. For instance, in a global awareness and activation event of the World Green Building Council (WorldGBC) in 2021, ten new companies gave a pledge to act on Net Zero Carbon Buildings Commitment.[253] The effort must led by local governments but involve developers, real estate companies and technology providers. According to a Deloitte analysis, in a newly-created building, an additional 20 per cent in construction costs for optimisation purposes brings a 30 per cent reduction in operational costs over three years, leading to a reduction of ten per cent in the total cost of ownership for the building. Incentives must be created according to the use purpose of the building. The tool 'revitalization calculator' also helps the city decision making process regarding further use or reuse of the property by answering questions about whether to revitalise the building or to leave it as it is.

Launch incentive plans to promote alternate materials and build a strong engagement ecosystem: Through programmes and available funding, such as the European Commission's Renovation Wave, opportunities for collaboration and knowledge exchange initiatives should be developed with a focus on urban management and quality infrastructure investment.

Beyond investing in buzzwords like 5G or sensory-tech solutions, extract value from data: Bear in mind what the city needs and ensure that data is used and transformed into value for achieving optimisation.

Promote data sharing standards and policy:
As an example of current initiatives for integrating information and communication technology in sustainable development, the European Commission's Digital Agenda is one of seven identified pillars for growth in the European Union, within which a key aspect is enhancing interoperability and standards. Simply generating data is not enough to support sustainability agendas. Availability of data must be combined with a thorough understanding of how to use it. The road from data to knowledge happens when information is made actionable.

Where to see this in action?

Singapore

Singapore has been one of the early adopters of green architecture and sustainable urban planning initiatives. In 2005, it introduced the Green Mark certification scheme, an initiative to drive Singapore's construction industry towards more environment-friendly buildings. This scheme was intended to promote sustainability in the construction environment and raise environmental awareness among developers, designers and builders when they start project conceptualization and design, as well as during construction. The goal was for "at least 80 per cent of the buildings in Singapore to be green by 2030".[254] The city has extended the certification to Districts, such as industrial parks and education campuses.

 A key example of a smart building is the Sands Expo and Convention Centre in Singapore's Marina Bay Sands. This was awarded the LEED Platinum in 2019 for building operations and maintenance, making it the first MICE venue in Asia Pacific to obtain an award for its sustainable green building initiatives ranging across energy-saving, lighting and air-conditioning systems, waste management, indoor plumbing, its carbon footprint and education. The Sands Expo and Convention Centre was also the first MICE facility in South East Asia to obtain ISO 20121 Sustainable Events Management System certification in 2014 in addition to being certified by Singapore's Building and Construction Authority.

According to Ministry of National Development, "As of January 2018, about 3,200 building projects in Singapore have met the BCA Green Mark standards. These cover more than 94 million square metres, which is around one-third of the total gross floor area of Singapore's building stock".[255]

Singapore has since introduced a new construction design called biophilic design, which is being used to increase occupant connectivity to the natural environment using direct nature, indirect nature, and space and place conditions. Richard Hassel, Co-Founder, WOHA, stated in a recent interview stated that, "A biophilic building attempts to replace walls, windows, columns, signs, and neon, with leaves, bark, birds, and insects." He referred to Khoo Tech Park Hospital as an example: this is currently the most biophilic hospital in Asia with 700 species of native plants on the site.

One of the best current success stories is the Oasis Downtown building, which has a green plot ratio of 1,100 per cent, i.e., there is 11 times the amount of nature in the building than there would be if there were no building on the plot. Richard Hassel estimates that if just ten per cent of new buildings follow the same trend and achieve a 1,000 per cent green plot ratio, the city can be retrofit rapidly to achieve the equivalent of 100 per cent green cover for the city.[256]

As part of the strategy to green the city landscape and improve environmental sustainability, the city has also in place the Housing and Development Board (Singapore's public housing authority) Green Towns Programme - a ten-year plan to make HDB towns more sustainable and livable by 2030. Two projects stand out:

1. *Punggol*. Smart and Sustainable Punggol is one of the milestones of the Strategic National Programs of Smart Nation Singapore: this is the plan to develop Punggol as Singapore's first eco-town since 2010. As stated on the Smart Nation website, Punggol will be "a green and sustainable town that minimizes wastage and maximises resource efficiency. (...) Residents living in the Punggol Northshore housing district can look forward to having their homes outfitted with built-in smart sockets and smart distribution boards that enable smart applications for the home, such as better monitoring of household energy consumption. Around the estate, features such as smart lighting will help save energy. In addition to the provision of solar panels by HDB on the roofs of housing blocks, JTC, SIT and SP Group will also collaborate on smart energy grid solutions to integrate energy generation and storage systems such as solar photovoltaic and batteries within PDD so as to optimise energy consumption and reduce carbon footprint by up to 1,500 tons annually. The implementation of pneumatic waste conveyance systems will also benefit the wider Punggol

community. It allows for waste to be collected via air suction in underground pipes, minimising the traffic, noise, pests and smell nuisances associated with traditional waste collection."[257]

2. *Tengah.* This 42,000 homes eco-smart city aims to be a clean state, cooler by design[258] – Singapore's first smart and sustainable town. Some of its features are:

- Smart energy management, using artificial intelligence

- Smart lighting will be utilised to manage the amount of lighting levels within the precinct, based on volumes of human traffic.

- Automated waste collection, a system that uses high-speed air to transport household waste.

- Smart-enabled homes, each equipped with smart switched socket outlets and a smart distribution board. Energy consumption can be managed through a mobile app.

- HDB will be pilot a centralised cooling system to regulate the temperature within residents' flats, aiming at being more energy-efficient than individual air-conditioning units.[259]

Adelaide, Australia

Adelaide is focused on improving living in the city via innovative initiatives to re-develop and utilize space, in order to improve access to smart, clean, and inclusive surroundings. U-City is an example of this.

In 2020, Uniting Communities (a not-for-profit organization) launched an innovative and futuristic U-city project (costing EUR 82 million), known as 'the vertical city, within a city'. It is a 20 storey-high structure that includes integrated community components along with local community facilities. The property utilises sensor technology to optimise operational energy efficiency, by managing lighting, heating and ventilation systems depending on occupancy levels. It also features an embedded electricity network with a 55-kilowatt solar PV array on the roof, gas-boosted solar hot water provisioning, and natural ventilation throughout all living spaces.

In addition to having advanced tech-enabled energy efficiency solutions, the property promotes a sustainable multi-use development approach by combining assistive-technology-powered for disability and senior living accommodations with a social services hub, a café, residential apartments, and offices and retail space.

As a result of embedded technology solutions and design, the building can offer optimum energy and environmental performance, while being energy efficient and sustainable. It is currently the 'greenest' building design in South Australia and is likely to use 45 per cent less energy and 30 per cent less water than a comparable new building.

Fukuoka, Japan

Fukuoka has been an inspiration internationally for green architecture and urban landscaping. The city continues to build on its smart and sustainable infrastructure strategy, with a focus on water sustainability.

As a recent initiative, the city developed a system that can simultaneously monitor and control the water flow and pressure to each area of the city via special sensors. This system can increase and decrease the water pressure in specific areas as required under precise operation. It monitors and controls water leakage. Additionally, using prediction models based on analytics from the sensor data in the system, the city can forecast how much water each area requires, to achieve effective water distribution throughout the city.

The city understands that public awareness projects, as well as technical optimisation, are essential to achieve water-conscious urban development. Multiple knowledge sharing and public awareness initiatives have therefore been launched to educate the citizens of Fukuoka about the importance of saving water, at schools and through various civic engagements.

As a result, 90% of the city's citizens are dedicated to saving water. Moreover, the amount of water used by Fukuoka citizens is the smallest among all Japan's major cities.

Mass Participation

Rebecca Kapes Osmon
Global Public Sector Human
Services Leader

Cities are evolving to be human-centred
and designed by and for its citizens,
promoting mass participation by the
ecosystem in a collaborative process
and following open government policies.

"There are bigger trends we can observe, but in order to really solve problems and change the way in which cities actually work, you have to get local, you have to engage and empower local stakeholders."

Uwe Brandes
Faculty Director, Georgetown
University Global Cities Initiative

"In planning cities we are planning for the people. We don't plan cities for cars, we don't plan cities for buildings, we plan cities for people."

Maimunah Mohd Sharif
Executive Director, UN-Habitat

"Tech is very much a part of how we're looking to better plan the city."

Yvonne Aki-Sawyerr
Mayor, Freetown, Sierra Leone

What does my ideal experience in my city look like? How can our city contribute to a brighter global future? How would we like our children to grow up in the city? What would our community want our city to be known for around the world?

These are some of the questions you will be asked in cities where there is open government and mass participation. These are places where citizens, social innovators, civil society organisations, businesses and academia are part of the process of building their cities (in a quintuple helix model[260]), closing the gaps between local government and the ecosystem.

As the Executive Director of UN-Habitat has stated, if we want to create sustainable and inclusive cities "We cannot draw a plan in the air, on the sixteenth floor of a building, without putting our foot on the ground". Through mass participation, supported by open data and technology, and with local government acting as a platform, cities can use the citizen as a 'sensor' and benefit from greater innovation, better utilisation of resources and an increased sense of ownership. Co-creation through mass participation is a bi or multi-directional human-centred approach, rather than just a bottom-up or traditional top-down approach.

Cities are increasingly innovative in the way they promote participation, both sporadically for specific services and regularly for strategic planning, as it is critical for a healthy democracy. And technology plays a key role in enabling innovation – for instance, mobile applications and reporting websites overcome the need for groups to meet in person to discuss new ideas and collaborate; and digital currency opens the door to gamification strategies (average 44 per cent of 167 cities in a survey admitted to engaging their citizens through some form of gamification)[261] and reward systems for good behaviour. As an example, this is what the City Hall of Freetown, Sierra Leone is doing, by issuing impact tokens to reward citizens, corporations and institutions that grow and sustain trees within the city.

But to ensure the three principles of open government are met (participation, collaboration and transparency), it is necessary to have open data platforms and other initiatives. Participatory budgets are a good starting point. Some cities go a step further and provide citizens and the ecosystem with real-time access to information, to keep them informed about changes that affect where they live. For example, the Seoul Metropolitan Government (SMG) launched a smart city platform, which it claims to be the world's first digital administrative system.

Based on the view that 'citizens are the mayors', the platform provides citizens with the same real-time access to information as the mayor on matters such as transportation, disasters and air quality. The platform can be accessed through SMG mobile website and digital information kiosks in metro stations.[262] Other examples are 'Better Reykjavik' in Iceland, that allows citizens to submit their ideas on almost all city activities, from school schedules to new market areas and parks; London, which created the London Datastore, a free and open data-sharing portal where anyone can access data relating to the city;[263] and the city of Lublin, which has an initiative called the Green Citizen's Budget with allocated funding of EUR 0.44 million to encourage residents to suggest ideas for improving urban greenery.[264]

Ultimately, cities will progress towards having true platforms for collaboration, fostering co-creation and leading to new governance models (co-governance), where responsibility is shared among the participants and is not just a burden on the local government. From this perspective, a new culture is created, and citizen engagement emerges as critical for ensuring the long-term sustainability of policy initiatives.

Why is mass participation relevant for cities and their citizens?

Sense of belonging and identity trigger behaviour change: Mass participation leads to the creation of a new culture and environment which foster a sense of belonging and identity. By feeling part of what is designed and created, citizens and the ecosystem develop strong ties and connection and commitment to the place where they live, resulting ultimately in behaviour change.

Accountability and commitment yield success of solutions and practices: For all aspects of the ecosystem, from communities and citizens' organisations to corporations and non-governmental organisations, mass participation offers opportunities for representation, exercising political rights and influencing policy decisions. This gives a sense of ownership to citizens and stakeholders, who are responsible for projects and their results. Studies indicate that cities with high levels of participation have stronger communities and more empowered citizens, better service offerings, and are better equipped to achieve their social, environmental, and economic goals.[265] MIT has stated the importance of creating 'consensus platforms' to generate long-term and

"You can think of the city as-a-service, as we do in Espoo. (...) It is easy to use digitalization and ask your residents and customers about services provided. If you have that customer orientation, you are going to the right way and it is quite easy to improve your services."

Jukka Mäkelä
Mayor, Espoo, Finland

"There are different levels of participation. The first is just awareness and knowing that, for example, the digital service exists. The second level is access, and I mentioned that we have good broadband and most people have generally good internet access. The highest form of participation is really contribution and co-creation. This is something that we continue to work towards."

Kok Yam Tan
Deputy Secretary of Smart Nation and Digital Government Office, Singapore

"Power doesn't belong any more just for the pinnacle of the pyramid, to the guy in the top of that pyramid. Power must be shared with each and every actor in the script for the development of a city."

Miguel Pinto-Luz
Deputy Mayor, Cascais, Portugal

"A critical issue is consensus. Communities must bring all stakeholders together to agree on a shared vision of the future. So many good ideas get blocked at the community scale because there is a lack of trust, or people don't understand what's being proposed, or they're just focused on their narrow self interest and not concerned about the larger community (...). Needed is a data-driven consensus building tool. Ideally it would be an dynamic, algorithmic approach that could help achieve civic homeostasis that is akin to a natural ecosystem in harmony."

Kent Larson
Director of City Science Group, MIT Media Lab

"Just ask your residents, and remember that. It sounds like a small thing, but it is very important. It gets easier with digitalisation and you manage to improve your services by just starting to ask."

Jukka Mäkelä
Mayor, Espoo, Finland

"Inclusion is about having voice and accountability. It is about citizens taking part in shaping the future of cities, identifying what are priority investments at the neighbourhood level, at the city level, participating to influence the direction that one's city is taking. It is the ability of citizens to have their voice contributing to better planning and better service delivery."

Sameh Wahba
Global Director, Urban, Disaster Risk Management, Resilience and Land Global Practice, World Bank

effective results and even leverage 'smart contracts' to ensure that commitment is easily traceable, for instance using a public ledger record, to trigger alarms when a contract is violated.

Smashed silos and open lines of communication for feedback and improvement: Citizens can provide invaluable feedback for the improvement of existing services and developing new ones. For example Seoul, where more than 90 per cent of citizens are smart device users, has a successful online policy suggestion system that enables citizens to contribute their ideas for new policies online and discuss them with city officials.[266]

Inclusivity experienced in all aspects of the ecosystem: The inclusive nature of co-creation enables citizens, private entities, NGOs, and academic institutions to contribute equally and share their experiences, concerns and visions for the city.

Climate targets can only be achieved through broad participation: Cities are dependent on the actions of their citizens for achieving their sustainability goals, so citizen buy-in is a critical component of success. A resilient ecosystem of partners and suppliers is vital for coping with unexpected, disruptive events. Cities that have advanced the furthest in most Sustainable Development Goals (referred to as sprinter cities) are twice as likely as others to team up with financial institutions and academic and research institutions to work towards the UN' SDGs.[267] 60 per cent of cities responding to the ESI Thoughtlab survey say they use a participatory budgeting process for achieving the UN Goals.

How can cities strive for successful mass participation?

Engage the city population at scale and combine physical and virtual interactions whenever possible: Millions of citizens may be affected by certain decisions, and cities should engage and collaborate with as many groups as possible – through both physical gatherings and also virtual environments and touchpoints. For example, Madrid City Council used a Decide Madrid platform to facilitate participatory budget decisions. From 2016 to 2019, citizens have decided how EUR 360 million was spent. Over 400,000 residents have provided input via Decide Madrid on matters affecting the city's three million residents.[268]

Follow the digital imperative but create a smart population for smart cities: Smart cities will fail to deliver much value if they are catering to a population that is inadequately equipped to benefit from the opportunities they create.[269] [270] It is important to have a diverse group of citizens with backgrounds and specialities to bring new ideas to the table. In addition, citizens need to be willing to take part in new initiatives and be open to learning new technology skills. MIT has mentioned the importance of making data understandable so that everyone can digest it.

Ensure accessibility and inclusiveness for all citizens: Cities like Stockholm, Reykjavik, Amsterdam and Copenhagen have suggestion platforms on their websites and other initiatives for community engagement. Cities worldwide have also developed apps for citizens to provide feedback and updates on infrastructure and environment. These communication tools must be inclusive and non-discriminatory, which means it should not reinforce the digital divide by excluding the 'non-digitally-savvy', such as many elderly people.[271] To avoid this problem, cities can invest in community centres, digital literacy programmes or partnerships with students to fully engage non-tech citizens and enable their participation.

Establish clear governance processes and transparency to boost trust - an enabler of open governments and collaboration: Clear and easy to understand processes combined with recurring mechanisms allow for culture assimilation and a successful participatory environment. Trust is critical for this model to succeed; transparent approaches and practices are the only way to create co-responsibility and involvement.

Proper alignment of objectives and expectations and clear connections between participation and decisions taken: When asking someone to participate, it is important to explain objectives, provide clear feedback and specify consequences of participation. Citizens and other stakeholders must understand how their inputs have led to decision-making.

"This is my own belief: we need to move from community participation to community engagement."

Maimunah Mohd Sharif
Executive Director, UN-Habitat

"What we can expect today is that a lot of the interaction with the city will mimic the way we interact with the organisations, which is through apps, being alerted when we need to do something, doing it with one click of a button, getting it done. Those interactions to be in real time, very short, very rewarding in the sense of not wasting time. That's going to be a competitive advantage for cities, definitely."

Paulo Rosado
CEO and Founder, OutSystems

"They say that once you start with participation, especially when it comes to mobility and traffic, it is a never-ending story, because people only think about what is happening in front of their house. But that is not true. If you are open in a discussion, and you are honest about what you want to achieve, people can think with you in a broader sense."

Mohamed Ridouani
Mayor, Leuven, Belgium

Watch and listen to the insightful conversations about this trend.

Where to see this in action?

Leuven, Belgium

In 2020, the European Commission awarded the city of Leuven in Belgium the title of European Capital of Innovation to commemorate its innovative ideas and frameworks to implement them. The city's citizens are participants in testing these ideas, in a truly co-creation approach. This award was the culmination of the city's work in putting its citizens at the core of municipal decision-making, through cooperation, co-creation and celebrating diversity.

One such initiative was 'Leuven, Maak het Mee' or 'Leuven, Co-Create'[272]: a project which called for citizens to submit their ideas on how to improve the city's livability. By the end of 2019, more than 3,000 people had registered to submit proposals, and a total of more than 2,231[273] ideas were proposed, with over a 1,000[274] making it into the city's plans. "Thousands and thousands of ideas came in and were processed, and if they went into the budget, you got an answer and would be kept updated on the realisation of it", commented Mayor Mohamed Ridouani on how Leuven Co-Create was implemented. Implementation for some ideas has already started, and citizens will be kept updated as part of the process.

Co-creation is also seen in Leuven as a pillar for the development its sustainability strategy, utilising collaboration to devise the roadmap for its flagship project Leuven 2030[275]. Leuven 2030 is a mission-driven NGO that was founded to establish Leuven's climate transition strategy, aiming to transform into a carbon-neutral, resilient city, with a goal to cut carbon emissions by 65 per cent by the end of the decade[276]. The roadmap for Leuven 2030 was co-created with 70 experts laying out a path to carbon neutrality and including 13 programmes centred on sustainable buildings, sustainable mobility, green energy, sustainable consumption, green and resilient spaces, and funding.[277][278][279] Leuven 2030 engages citizens in a innovative model of cooperation. "It is a governance model, it's not just a network",[280] where every layer of society has an equal stake:[281] government, the citizens, companies, the city's knowledge institutions, and semi-public institutions like the public transport companies each have a 20 per cent share of the voting. These parties represent the Leuven ecosystem in a structural and systemic collaboration model, Quadruple Helix.[282]

Cooperation was also a key factor in Leuven's policies in the fight against the COVID-19 pandemic, with projects like 'Leuven Helps'[283] an online platform launched during the initial wave of the virus to connect citizens in need with local volunteers. Although Leuven was the first to implement it, this model has been applied in over 300 communities globally, from France to New Zealand.[284]

Another important feature in the development of Leuven is Leuven MindGate[285] "which brought the city, companies, and knowledge institutions together to create one of the world's top innovation ecosystems. Companies cooperate with the government and knowledge institutions to create a thriving economy and jobs. The government invests in education to create a knowledgeable workforce, and invests in infrastructure to create an ideal entrepreneurial climate. "This is a platform, but also our common economic agenda. Leuven MindGate positions Leuven worldwide as the place where you have top-notch, high-tech health solutions and creativity and the crossover between these things, biotech for example, and in products that are very well shaped and that are ready to use."[286]

The city aims to be a Future Lab for Europe, testing and finding solutions to future problems in the city and then scaling to other cities and countries.

Leuven stands out as a city where the mayor's vision is fully committed to inclusion and participation, seeking to make co-creation the defining ethos of its city building process, and entrusting the city to its residents through collaborative practices. "We have been able as a kind to survive all over these thousands of years, not through survival of the fittest, or the struggle for life: it's because humankind has the ability to collaborate. That's how we overcame natural disaster and diseases."

Mexico City, Mexico

With the fourth largest population globally, and over half its population under the age of 26, Mexico City faced geographic and social division. Known infamously for corruption and crime, only eight per cent of its Gross Domestic Product (GDP) came from the creative industries.

To tackle these challenges and become more agile, a government experimental and creative office was established, Laboratorio para la Ciudad (Lab for the City), as the very first programme of its kind in Latin America, to address the city's problems through innovative, cross-team participation. It was active from 2013 to 2018.

The Lab became a space for prototyping and testing, in which new ways of approaching relevant city issues were launched. The Lab incubated pilot projects and promoted meetings around civic innovations and urban creativity, in collaboration with government agencies, citizens and the academic sector.

One success of the initiative has been a system for enhancing the city's microbus network, which is used by about 70 per cent of the population daily. By leveraging open-sourced gamification, almost 3,000 citizens rode every route in the network, a distance of about 1.4 times the circumference of the globe. Peatoñinos was another successful initiative, aiming to close streets for play activities for children with the motto "Liberating the streets for children and play". It was undertaken in areas of the city with high levels of marginalisation, large child populations, and few open play spaces.[287]

In a very short time, the Lab made substantial progress in breaking down barriers that have existed for decades.[288] [289] [290] The city now has a Digital Agency for Public Innovation, founded in 2019 and tasked with designing, implementing and monitoring the city's policies regarding data management, open government, technology governance and interoperability.[291]

San Diego, California, United States

In 2015, an audit report highlighted several development opportunities for the city to engage with residents needing to report non-emergency issues. It concluded with a recommendation to establish a centralised customer service centre and mobile application to report right-of-way maintenance (ROW) issues such as potholes, illegal dumping and damaged sidewalks.[292] This recommendation was further refined after a 2015 City of San Diego Residents Survey revealed that most residents preferred digital methods (website or mobile app) for reporting issues, rather than phone calls.[293]

In 2016, San Diego introduced an app for its citizens called 'Get It Done San Diego'[294] for reporting non-emergency issues. Users could report problems like potholes or graffiti and connect directly to the work tracking system. Designed for seamless usability, the app allowed users walking down the street to take a photo of a problem and upload it. Get It Done would then automatically utilise satellite technology to provide a report to city officials the precise location of the problem.

From a small beginning, the app has been scaled up, from "this platform that was affectionately referred to at the outset as the pothole app" to a platform that digitalises other aspects of city management. "We've since grown it to multiple departments beyond just streets and street repair, to include other types of city services that you can request, whether it's doing a passport appointment, whether it's missed collection for your house, your trash wasn't picked up that day", says Kirby Brady, Chief Innovation Officer of San Diego.

In the future, citizens may expect to have an even more centralised platform, with a larger number of municipal services as the city continues its digitalisation progress.

 "There's an opportunity to continue to provide more city services, we're actually pushing to increase the number of departments that are on this platform because at the end of the day, if you are a resident of the city of San Diego our vision for a smarter city is that you have one point, one source of truth, one access point for all the services for the city and that makes it easy. So my version of a smarter City for San Diego is to make it kind of a stop shop for the customer and as quickly as possible", says Brady.

Starting in 2016, the app had collected 38,500 reports, and was downloaded 9,500 times in its first six months.[295] As of March 2021 the cumulative total number of downloads was 130,552 across operating systems (including both Web and Mobile submission), with 1,000 reports received per day.

The app is being redesigned with a better user interface, and new reporting features are constantly added to the system to improve the customer reporting experience. Survey integration is being implemented for customer feedback and Online Web Portals are being implemented to improve the document submission process, which in turn will improve the department's work efficiency.

For emergency issues, San Diego has developed a public reporting application '311' that enables citizens to notify the city of problems in their community, using Geographic Information Systems (GIS). With the GIS technology in the app, citizens can view maps of their neighbourhood and see other problems that have been reported nearby. Through the app, citizens feel more empowered to participate in their community since they have a direct opportunity to engage from their mobile phone. The 311SA app received the Smart 50 Award in 2019 for being one of the world's top fifty transformative smart projects.[296]

The vision of
Maimunah Mohd Sharif

Maimunah Mohd Sharif
Executive Director, UN-Habitat

What is the impact of COVID-19 in urban ecosystems? How do you see them changing as a result of it?

It is a wake-up call for all of us to see how we can improve our sustainable development and city design. Normally opportunities come with disruption and we have seen cities seizing opportunities, not only to tackle the pandemic and its consequences, but also to reconsider how to build back in a better, greener, more just and more inclusive way. Our challenge at UN-Habitat is to build on these opportunities together with other stakeholders for a sustainable urban future. We need to concentrate our efforts on how to build back better through design, planning and investment. This is an opportunity to look into our urban development, our city design, to rethink how we can put a new model of integrated planning in place, while creating links between smaller cities and rural districts in metropolitan areas.

What would you say are the main trends shaping the future of cities?

We are talking about future cities, but cities – North and South – have different recovery plans and different ways of looking at things. There is no one-size-fits-all solution, although future cities need to concentrate on inclusive recovery, health infrastructure, housing and income.
We locked down and asked people to stay at home, but what about the people who have no home? The people who are most vulnerable live in slum areas, and must be taken care of. It is very important for us to look at accessible, affordable and adequate housing for all, at housing as a human right. Almost 30 per cent of households in cities and 40 per cent of the population are offline[297], which means that we need to look into connectivity and the communication infrastructure. Last but not least, we need to focus on integrated planning and greener planning, not only at a city level but at a metropolitan level too.

What do you think is critical to make sure that the cities of the future are more inclusive?

When we talk about cities, we are planning for people. We don't plan cities for cars, we don't plan cities for buildings; we plan cities for people. When planning a city, we should be as inclusive as possible, bringing all sectors of city dwellers into the process. We need to move from community participation to community engagement. It is very important for us to look into participation and inclusivity, because in the United Nations our mantra is 'leaving no one behind'. How should we do that? We need to get feedback from the people. We cannot draw a plan in the air, on the sixteenth floor of the building, without putting a foot on the ground. Social inclusion, to me, is a crosscutting issue that should not be segmented by sector.

How do we make urban planning more sustainable? How do you see cities in Africa and Asia following this approach?

When you talk about planning the future of cities and planning urban sustainability, it is very important to think in terms of urban accessibility. We know that the rate of urbanisation will be the highest in Africa and in Asia at 1.5 to 2 per cent[298] in many countries in these regions, so it is very important to have control and plan urbanisation, including the extension of cities. We provide guidance for this, through our normative work, legislation and governance. We are working with governments in Asia and Africa to achieve the 17 SDGs, especially SDG 11.

We increasingly see citizens, the private sector, corporations and NGOs working together to design the cities where we live and work. How do you see this happening across regions and what do you see as an obstacle?

I believe in the principle of 4Ps: Public, Private, People and Partnership. If you do not involve one of them then you cannot move forward. Apart from the 4Ps, there should be a top-down approach to a certain extent, as we need visionary leaders, and a bottom-up approach in response to it, with ideas coming together at the centre. I think this is the way we move forward.

Regarding obstacles, different countries have different challenges. I would like to group them into 'software' and 'hardware'. Software involves governance, an enabling environment for law and regulation and

policies for the future. The other, the hardware, is whether they have the technology and the data for this policy formulation, whether they have the political will to really move forward and change things.

Also, it is important to consider capacity: whether a country has the capacity, the knowledge, the human development and the talent to move forward.

Finally, I always believe in an integrated approach, not a fragmented one, and this is already embedded in the New Urban Agenda, the accelerator of the SDG framework by guiding and tracking urbanisation around the world.

How do you see the relevance of national strategies aligning with the city strategies?

National governments should engage with local government when they are formulating a national policy for the cities. National governments play a crucial role in supporting cities, not only in terms of policy but also in terms of providing the hardware and the software, the governance, the rules and procedures, the investment and the finance. We need to link national urban policy with local government in order to implement the urban policies and the achievement the Sustainable Development Goals, particularly SDG11.

What's your call for action to speed up the achievement of SDG 11 and other SDGs, and what can we expect to achieve by 2030?

2020 started with the Decade of Action, and then came the global disruption from COVID-19. But with destruction comes the opportunities for action. If you look at the total of the 17 SDGs, 64 per cent of the policies for achieving them must be implemented in cities. We need to commit to long-term action with a long-term policy, and to harness the transformative potential of responses to the pandemic. We need to move forward now. There is no planet B; this is our only planet. We have to move forward together, the North and the South, to achieve a green recovery and build back better and safer. We must make it happen and turn the future into reality, for today's and future generations.

Watch the full interview.

City Operations Through AI

Sérgio Carvalho
Global Smart Cities
Asset Architecture Coordinator

Jean Gil Barroca
Global Public Sector Digital
Modernisation Leader

Cities are adopting automated processes and operations (orchestrated by a city platform) and following data-driven planning approaches.

"Technology itself is a mega trend that is happening now, it is not just an enabler of change. It is something that—like it or not—is quickly entering into every element of our lives, into our homes, and or workplace, into our cities."

Jeff Merritt
Head of IoT and Urban Transformation,
World Economic Forum

"Data is the soil; from this, new opportunities grow."

Sandy Carter
Vice-President of Worldwide Public Sector Partners and Programs, Amazon Web Services (AWS)

"What we have been working on is the transformation of data into relevant information for strategic decisions that we can make. This will improve immensely the governance and the efficiency of the city and ultimately the transparency of the decisions made by politicians or by public authorities."

Rui Moreira
Mayor, Porto, Portugal

In ancient Rome in the first century AD, the invention of aqueducts was critical for population growth. In the late nineteenth century skyscrapers in Chicago were important for managing land scarcity. Many other technologies and solutions have contributed to the foundation and development of vibrant cities. Artificial intelligence (AI) is now emerging as an essential part of how cities work.

Machines run 24/7, and there are operations and tasks that cities perform that will become increasingly smart and powered by process automation and artificial intelligence. AI will contribute to the optimisation of operational efficiencies, benefiting city managers and ultimately citizens through reshaped service delivery. Gartner predicted that by 2021 30 per cent of city government service interactions would be fulfilled and/or completed, at least in part, through an AI-powered conversational channel.[299] But the investment in AI is broader. 66 per cent of 167 cities inquired for ESI Thoughlab study are investing heavily in AI and 80 per cent will do so over the next three years. North American cities (83 per cent) and small cities (74 per cent) lead in the use of AI.[300]

While chat assistants are currently among the most common solutions powered by AI, cities will evolve to have digital platforms as 'city brains', where all urban activity is orchestrated and operated, providing a holistic view of the city, allowing for events correlation, fast and assertive 'root cause' analysis, predictive analysis (through machine learning) and incident management, and providing operational insights through visualisation. If the behaviour of almost every citizen is registered through anonymised data, and 5G technology enables cities to become huge connected ecosystems, it will be of paramount importance to maximize data value and improve planning and decision-making using AI and data analytics, on the way to a cognitive city. Gartner predicted in 2019 that a city platform will be a mature smart city solution in five to ten years' time, when it is expected that one to five per cent of cities will be using a city platform to manage their operations.[301]

With a clear vision, proper infrastructure and data governance in place, cities should be expected to embrace digital transformation and leverage cloud computing and the Internet of Things, design new operating models that foster integration between inter-dependental departmental services, and automate intelligent operations further using AI – fostering better quality of services, and greater efficiency and effectiveness.

But cities can go even further. We see cities like Dublin and Singapore, among others, creating a Digital Twin – a dynamic digital replica of their physical assets and environments and their interdependencies – for urban planning purposes, and using machine learning to predict future events and trends. A Digital Twin can be used for example to provide support for day-to-day operations, to simulate a natural disaster and its potential impact on the city, or to evaluate the flow of breezes that cool the city and the trees to ensure shade in streets and parks. With the evolution of new technologies with higher processing capabilities (namely, fast problems root-cause analysis identification). Digital Twins will become increasingly powerful in enabling data-driven decisions, and will have a high adoption rate among city governments, with a promise of turning cities more resilient.[302]ABI research has predicted that by 2025 the number of Digital Twins will exceed 500.[303] And ESI ThoughtLab predicts that the percentage of cities making large investments will increase the most for Digital Twins, rising from 11 per cent in 2021 to 31 per cent in three years' time—an increase of almost 300 per cent.[304]

Why are AI-enabled city operations relevant for cities and their citizens?

Quicker responses and better services: Leveraging big data analytics and machine learning enables a city to understand better what is happening and to adapt to a continuously changing environment, thus allowing for faster responses to new challenges. AI-enabled operations take data from all sensors and devices, so that the city can prevent faults or breakdowns, or identify a fault the moment the system goes down and put it right faster and automatically.[305] Additionally, the city assesses its data and is always learning and responding to the needs and changing habits of their stakeholders (for example with a new bus lane or bicycle lane) and also receives service requests and suggestions from them. In the aftermath of the COVID-19 outbreak, 40 per cent of cities have admitted that timely access to data and advanced analytics are crucial for running a city.[306]

Safer and secure cities: Data from connected devices and AI-driven applications are used with analytics and image processing to understand what is going on in a city. Predictive tools can be used for example to help identify potential locations and times for certain crimes,[307] and to support responses by the emergency and law enforcement agencies. For example, traffic intelligence and identification counts and predicts

"A big trend we saw is using IoT sensors or sensor-based devices to gather data, especially during COVID, when people had to stay six feet apart. In fact, International Data Corporation (IDC) said that the use of IoT to gather data to make better decisions went up by 400 per cent from last March to now [March 2021]."

Sandy Carter
Vice-President of Worldwide Public Sector Partners and Programs, Amazon Web Services (AWS)

"I tend to not really like the label 'smart cities', because I don't think that there are dumb cities out there. There are cities that just need to harness technology to serve their citizens' needs better, and that will vary from one city to another, depending on their needs, depending on their ability to leapfrog existing older technologies, depending on their capacity."

Sameh Wahba
Global Director, Urban, Disaster Risk Management, Resilience and Land Global Practice, World Bank

"If you zoom out completely, you can see cities as a living organism. Digital systems usually work as the nervous system, memory and nervous systems of these artificial mega organisms."

Paulo Rosado
CEO and Founder, OutSystems

"Cities really need to focus on their data sources, their data quality, their data quantity, and a lot of that can be solved by IoT sensors – whether it's sensors for traffic, in health care areas, in their arenas (...) Gathering that data and being able to use that data will be critical."

Sandy Carter
Vice-President of Worldwide Public Sector Partners and Programs, Amazon Web Services (AWS)

"Citizens don't want a city that reacts to what is happening; they are asking for cities that will anticipate the future, and that is what AI and all the knowledge that we are collecting here are for."

Miguel Pinto-Luz
Deputy Mayor, Cascais, Portugal

vehicle counts and flows, detects vehicle moving in wrong direction, identifies vehicles of interest, and so on. Crowd monitoring enables the city to notify the police department when crowd numbers reach threshold limits or vary significantly from predictions. For example the crime rate in Surat, India fell by 27 per cent after the implementation of AI-based safety measures.[308]

Efficient cities: AI in smart cities enables automation of municipal activities and operations on a large scale, reducing the duplication of efforts and improving effectiveness. It transforms the way in which cities operate and deliver public services, creating efficiencies and finding synergies. For example, Seoul established an integrated public transport system that uses smart cameras in subways to obtain information on passenger volumes and adjust the speed and frequency of trains in real time accordingly. It also installed sensors that monitor train components to prevent failures before they occur.[309] São Paulo has developed a solution for estimating and predicting air quality using AI and big data analytics, using data from the mobile network complemented with data from weather, traffic and pollution sensors. This helps calculate pollution levels 24-48 hours in advance, allowing local governments to take preventive actions.[310]

Higher touchpoints between government and citizens: AI enables tailored and personalised liaison between local government and residents. The most effective policies can be developed applying AI to feedback from citizens. For example in North Carolina government offices use AI chatbots to speed up the process of responding to residents' questions.[311]

Better disaster management and long-term planning: Another benefit of the application of AI and machine learning to city operations is in supporting short-, medium- and long-term planning. By connecting data from different sources, namely agencies, citizens, businesses, tourists, etc., the city urban planner can better identify trends and predict future needs and changing habits. City leaders can take data-driven decisions such as where to build a new school, or reinforce the bus network, or whether to open a new health centre in a district where the population is aging. That information is of paramount importance, not just for city planning; it has also value for businesses, enabling a better balance between demand and supply.

How to ensure a successful deployment?

Start with data strategy and governance: Data governance and transparency are particularly important for cities that adopt AI solutions. Stakeholders within cities need to be made aware of how their data is going to be used – and for what purposes – so that people can trust the system. It requires an adjustment to the current city governance to make sure it entails a change of approach to data-driven decision-making – and eventually to an automated and integrated operation centre. A city must ensure the transparent exchange of quality, real-time, open data, and the ability to enrich the data – through monetisation mechanisms, a clearing house or blockchain for instance. Even if the city decides that some of the data is free, control mechanisms must be but in place to control abuse. Without this governance, trust in a city's data market place (and its accuracy) will be fragile. Data governance models should build trust into their systems for data collection, privacy and data exposure, as it is key for political and public support. According to Gartner, by 2023 30 per cent of smart city initiatives will lose public support and be discontinued for lack of integrated services and data analysis.[312]

Be aware of privacy issues and stimulate a culture of trust: While the use of data can contribute to better delivery of services, privacy is a concern that must be properly addressed. Cities must respect data protection and security legislation and ensure proper use of personal data, in order to win and retain public confidence.

Ensure data standards and interoperability: It is crucial to maintain data standards and interoperability within the city, to facilitate seamless integration and analysis. Standardised methodologies like ISO 37120 and commercial data orchestrators facilitate that interoperability. Data integration would benefit from the existence of an API portal in the city – to protect the city's digital platforms (or 'city brains') and sub-systems against threats, vulnerabilities, and with controls over access with single sign-on and identity management, providing end to-end security.

"Technology is rarely the biggest challenge when it comes to enabling citywide deployments; behaviour change is. There is no shortage of amazing technology platforms to integrate data and solutions across silos. The challenge is we have to rewrite the very DNA of city operations; that means breaking down rigid organizational structures with separate leadership, separate budgets. Without these behaviour changes, we won't maximise the value of digital platforms."

Jeff Merritt
Head of IoT and Urban Transformation,
World Economic Forum

"Sidewalk Labs was a very ambitious project, with a lot of good ideas, but for whatever reason they failed to build trust with the community, or to communicate the value proposition and how/what they were proposing would improve people's lives. In the end it is all about trust."

Kent Larson
Director of City Science Group,
MIT Media Lab

"If you have the right data source and the right data quality and quantity of data, that is unbiased, you'll get the right information out. However, this is a massive challenge. The problem today is that, according to DOMO, every person on Earth generates 1.7 megabytes of data every second[313]. How do you make sure that data sources have has no bias in them?"

Sandy Carter
Vice-President of Worldwide Public Sector Partners and Programs, Amazon Web Services (AWS)

"It is not enough to simply put a technology platform in place, and hope that changes everything. We need to think about the governance structures that have to accommodate these platforms, we need to make sure we are beginning to change behaviours to enable more collaboration among public servants."

Jeff Merritt
Head of IoT and Urban Transformation, World Economic Forum

Avoid algorithmic bias: All AI systems use algorithms, which may be biased in the way they function. It is particularly important that algorithms should not be biased in a way that deepens inequalities (for instance, between racial or ethnic groups). Having a diverse team working with data can mitigate this.

Prepare the right skill set among the city workforce: Cities will have to provide many government workers with effective short-term training programmes and lifelong learning to help them adapt to AI. Existing educational programmes will also have to be revamped to provide skills in AI to individuals entering the workforce in the future.[314]

Follow a citizen-focused approach to operations: Putting citizens, local businesses and visitors at the centre when designing city operations is the way to delivering better city services.

Watch and listen to the insightful conversations about this trend.

Where to see this in action?

Cascais, Portugal

Cascais, Portugal, is a coastal resort town with a population of 211,000 that attracts more than 1.2 million tourists a year and aims to be "the best to live for a day or a lifetime". To drive efficiencies in infrastructure, transport, public safety and other services, the city has a mission to "test innovative solutions capable of being scaled." It has developed a large portfolio of technology-based services ranging from energy-efficient buildings to remote payments for parking.

However, Cascais faced challenges as it evolved its ecosystem and implemented new initiatives. One of the biggest obstacles was the lack of a unified vision across 12 municipal domains, ranging from health and education to energy and public infrastructure. To address this problem, in 2018 Cascais developed a managed services digital command centre, C2, to give it a holistic and integrated approach to the management of city operations in a multidisciplinary room. The solution was powered by Deloitte's smart place operating system, CitySynergy.

Cascais redefined the city's operating model by integrating data and processes from each municipal vertical domain instead of dealing with each in separate silos. Integration increased the quality of services to citizens and achieved savings based on higher effectiveness and efficiency.

The city platform now provides 15 smart initiatives (including citizen connection websites and a citizen engagement app) with integrated maps with assets and dependencies, online dashboards, customised reports and a Digital Twin. It supports management of an ecosystem of more than 30 service partners, enables predictive management through event correlation and data analytics, and facilitates decision-making and urban planning. "A command centre with predictive capabilities, to try to anticipate the future, that's what citizens want in the future", says Miguel Pinto-Luz, the Deputy Mayor of Cascais.

C2 has helped improve operations, increase efficiencies and cut costs. For example, Cascais has implemented a smart waste management system that is expected to reduce journeys along routes by 180,000 kilometres and carbon dioxide emissions by 350 tons per year, producing savings of around EUR 600,000 annually.[315] By integrating real-time traffic and road condition data, the system not only optimises routes but also identifies the best times for garbage collection, potentially reducing operating costs by up to 40 per cent and boosting energy savings by up to 20 per cent. Cascais has also improved citizen satisfaction levels and achieved 20 to 30 per cent for energy savings, and 30 per cent reduction in water consumption. The city is proud of having signed Service Level Agreements with its citizens and with the outcomes this has brought.

With its efficiencies, Cascais can allocate resources more effectively and attract new businesses, residents and universities, making it the most dynamic and forward-looking city in Portugal. More importantly, the model developed by Cascais could be replicated by other cities around the world.[316 317]

Vienna, Austria

Vienna was one of the first cities in the world to publish open government data in 2011, but its platform VeroCity took open data to a new level. Its data aggregation and analysis capabilities are based on the European Commission's Context Broker building block, which can sort through data of all sorts and sources.[318]

The Context Broker allows the platform to offer real-time visual information that caters to all stakeholders in the city. The platform can facilitate day-to-day activities, such as urban mobility, environmental monitoring, urban infrastructure management, energy efficiency improvement and much more. The platform provides access to visualised information for users, avoiding the need to work through details in the raw data. This enables the city to deliver transparency in monitoring and benchmarking, while promoting participation by its citizens.

The city has also launched WienBot, a chatbot that provides answers to a range of user questions while also continuously learning from its 'conversations'. This ability to capture most frequently-asked questions or used keywords, enables the chatbot to suggest questions in advance. Currently WienBot answers questions on the 250 most frequently-accessed contents of the City of Vienna's official website www.wien.at. It also suggests other useful city services that might help users. The list of questions was updated recently in response to the COVID-19 pandemic.

As a result of these efforts towards technological management of city operations, for the second year in a row, in 2019 Vienna ranked first in the Smart City Strategy Index.[319] [320]

Calgary, Canada

With the aim of monitoring the watershed that feeds the municipal water system and capturing information such as river water heights, reservoir water heights, flow rates and rainfall, in 2015 the city of Calgary expanded its Process Information (PI) System. The process enabled the city to monitor the watershed in real-time and improve predictions of potential flooding.

This real-time system helps the city to reduce water quality problems during flooding events. The process also makes it easier to communicate with the provincial government.[321]

Hong Kong

Hong Kong is constantly augmenting the use of AI in the government and public sector. A priority is continuous improvement in the management of the city's services. For example, the city is planning to deploy chatbots to use historical data to respond to citizens' complaints and answer questions.

The city also plans to use AI in traffic management. The city already collects real-time traffic data on speeds and volumes via sensors across 80 per cent of major routes, to reduce congestion around the city.

The city also has sensors collecting data on landslides, pollution and water levels, so that it is better prepared for disasters, and it also uses sensors to monitor energy use.

A third of Hong Kong's population will be aged 65 or above in 20 years' time. The city plans to use robotics to support the elderly and assist care providers. Further, the hospitals in Hong Kong have deployed AI to schedule weekly tasks for thousands of nurses.

Visa applications are inspected by AI to prevent errors and misconduct. The city also plans to transform the 'digital persona' and use AI to create e-Identity for every individual. This will ensure that individuals with a trusted authentication can gain trouble-free access to private and public services online.[322] [323]
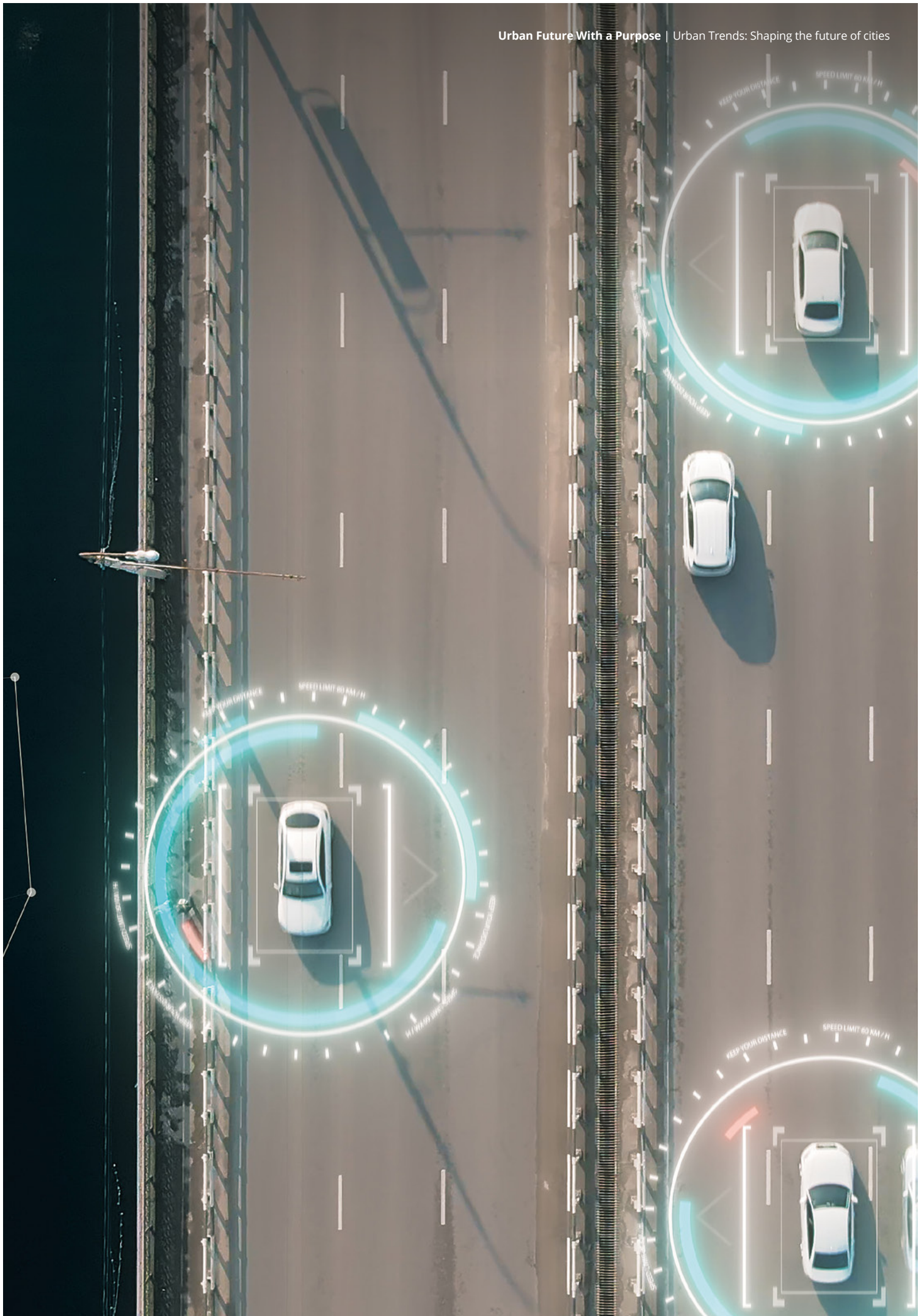
Cybersecurity and Privacy Awareness

Piyush Pandey
Managing Director Cyber Risk Solutions
US & Global Smart Cities Cyber Leader

Andrea Rigoni
Global Government and Public
Services Cyber Leader

Frederico Macias
5G Cyber Global Leader
& Deloitte Portugal
Cybersecurity Leader

Cities tend to promote awareness of the importance of data privacy and to get prepared for the impact of cyberattacks, since data will be an important city commodity.

"It has been an interesting evolution over the last decade or two in terms of cybersecurity protections. Initially cities very much felt that they needed to create a fortress; then they started to realise that using the cloud was going to be more secure because many cloud service providers have 24/7 security experts with greater capacity to monitor, detect and prevent attacks."

Jeff Merritt
Head of IoT and Urban Transformation,
World Economic Forum

As services are becoming highly integrated and interconnected, vulnerabilities created by data exchanges are more common, and data security is therefore vitally important. Threats to privacy and cyberattacks have been on the increase for a long time, but the past few years have seen an explosion in cyberattacks on data and physical assets.[324] In 2018, the total cost of losses from cyberattacks for the cities in a survey averaged EUR 2.8 million.[325] A ransomware attack on the city of Atlanta in 2018 cost the taxpayer an estimated EUR 14.5 million.[326]

This integration and interconnection introduce the concept of 'smart' (or, at least, smarter) cities. Smart cities offer the prospect of societal benefit and greater personal comfort and convenience, thanks to ubiquitous connectivity. But this connectivity needs to be implemented securely, if smart cities are to have a future.

Cybersecurity is now a key consideration for developers and planners of smart cities, and attention is turning to the risks inherent in such a highly interconnected environment. However, while the cybersecurity industry has developed a mature understanding of how to measure and mitigate the impact of cyberattacks on infrastructure in 'non-smart' cities, there is limited knowledge of the potential impact of attacks on smart cities.

An attack on smart city infrastructure may create effects that cascade – or 'ripple' – outwards and impact other parts of the city or country, or beyond. These cascading effects can be non-linear and grow far larger than the initial direct damage, revealing hidden interdependencies and disrupting systems that were believed to be segregated from the impact point. Resilience is *the* essential concept that must be considered when creating these complex and highly interconnected environments. It is essential to use resilience as a cornerstone of city-building, and to do so in a way that can be scaled up and remain flexible for future upgrades and enhancements.

While investing in cybersecurity may be a strain on city budgets, the costs of not investing can be even larger as losses could run into billions of euros. City leaders have acknowledged that the consequences of a cyber incident could extend beyond data loss, and include a financial impact, reputational damage, reduced social trust, and disrupted crucial city services and infrastructure.

As the complexity of technologies, operational interdependencies, and systems management increases, so does the interest of hackers in profiting from this environment. Developing smart city initiatives without considering cybersecurity and privacy can result in a highly vulnerable environment that poses security risks to critical infrastructure and data, and in some cases may even create safety risks for citizens. For instance, there are strong doubts in some countries about autonomous vehicles (43 per cent of people in the US do not feel safe in a driverless car)[327] so the development of a smart product has resulted in a need to invest in cybersecurity and data privacy. Planners must ensure that cybersecurity should be considered not just in this example of autonomous vehicles, but also in all the other critical and safety-focused aspects of smart city infrastructure.

The integration of multiple critical services – transport, communications, finance, energy production/distribution, and others – is likely to produce an environment that requires its own infrastructure protection plan. This integration, and its resulting complexity, may also lead to an environment that is 'more than the sum of its parts', and require new conceptual approaches and models for security.

Advance planning is essential. By one estimate, 95 per cent of Cities 4.0 (as labelled so by ESI Thoughlab, referring to hyper-connected cities that use technology, data, and citizen engagement in pursuit of the SDGs), ensure that cybersecurity is considered early in the process, compared with only 51 per cent of other cities.[328]

However, many cities are not ready for the challenges. Besides lagging far behind in the digital revolution, with outdated technologies running critical infrastructure, they lack the human resource expertise to be capable of addressing the challenges.[329] Creating ecosystems of innovation – as Tel Aviv has done – could be one approach to improving security. Another approach is to invest in models of public/private cooperation and coordination, in the knowledge that the orchestration of security (as opposed to securing individual components) is the key to sustainable security. Efforts must be backed by city executives and not left to external entities or departments alone. Privacy and security are critical topics not to be neglected.

Fig.02 An integrated cyber governance model enables a "trusted ecozystem"

An integrated and comprehensive governance model spells out responsabilities and roles for each critical component to build a trusted ecosystem.
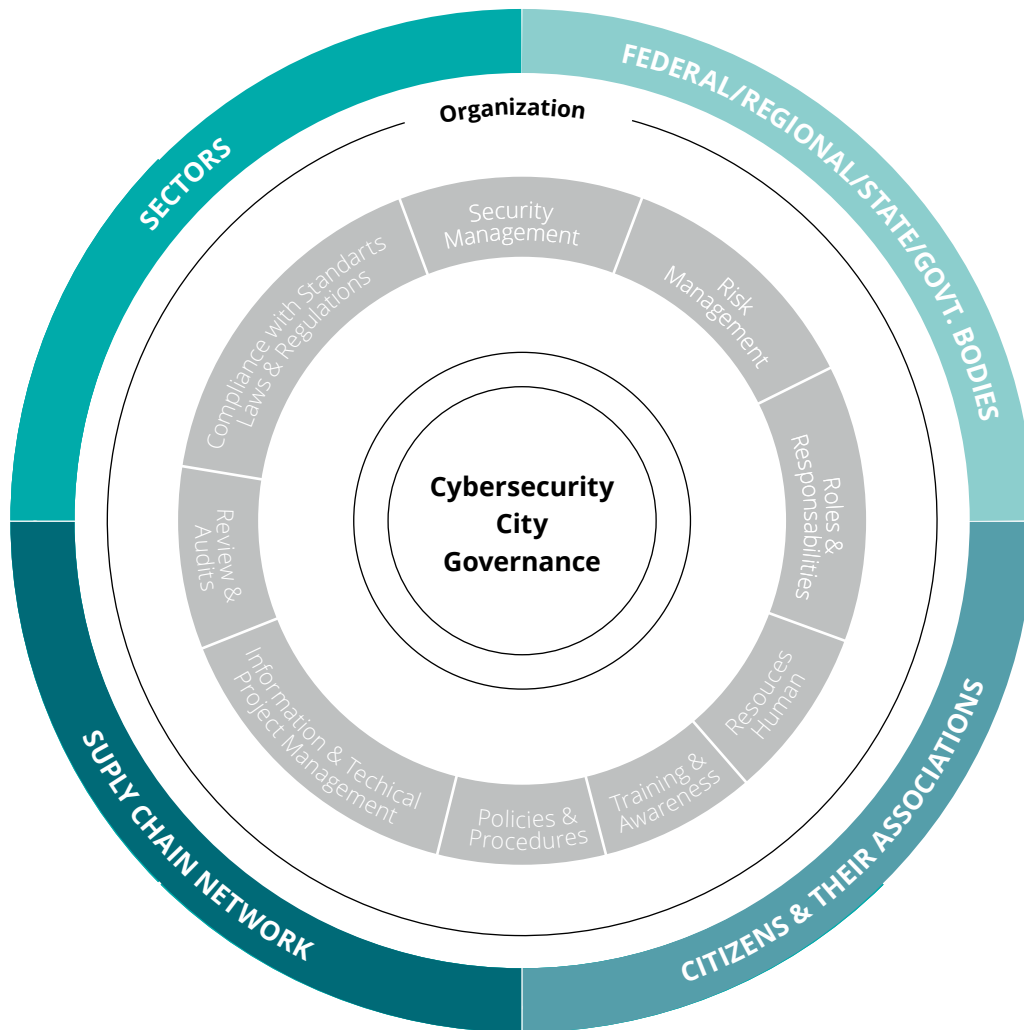
Sectors
- Facilitate cybersecurity compliance and accreditation
- Support secure technical implementation
- Report cybersecurity and data privacy risks
- Conduct internal audits and reporting

Federal/Regional/State/ Govt. Bodies
- Aligning standards and regulations to new business models and protecting interests of users and constituents of the city
- Establish and drive cybersecurity, privacy and resiliency leading practices
- Perform city governance audits orchestrate cross sector information sharing and communication

Supply Chain Network
- Facilitate cybersecurity compliance and accreditation
- Orchestrate secure data exchange and manage interoperability risk
- Secure integration of digital assets and third party risk analysis and reporting
- Report cybersecurity and data privacy risks
- Conduct internal audits and reporting

Citizens & Their Associations
- Gain cybersecurity and privacy awareness & training
- Responsible for secure device onboarding and cyber events reporting
- Compliant to cybersecurity standards and rules

Why is privacy awareness, cybersecurity and related safety systems relevant in a city?

Technical innovation across smart city applications is developing rapidly. So privacy awareness, data protection and digital infrastructure resilience are crucial for the efficient functioning of a city's operations and the safety of residents.

A lack of cyber/privacy awareness can increase both distrust and also vulnerability to cyberattacks: It has been observed that in many cities, only top-level managers and officials have a high level of cybersecurity awareness. A lack of awareness among the majority of people creates a substantial risk of cyberattacks and an inability to deal with them. The interdependent nature of smart cities requires stronger public awareness of the security frameworks in a smart/intelligent infrastructure. In a 2019 study, Forrester stated: "Expect the development of more (AI-powered) deepfake–based attacks fabricating convincing audio and video at a fraction of the cost. To mitigate risk, IT departments need to further invest in training and awareness programs."[330]

Lack of stand-alone cybersecurity departments/ units in a connected city can act as a barrier to achieving higher levels of cyber-resilience and privacy awareness: Many cities are launching smart city and mobility initiatives, which involve high volume data management and exchange, but the IT departments of local governments usually have the primary responsibility for making those digital operations secure. This could restrict the effectiveness of cyber risk management within the city, particularly when there are insufficient skills and experience within the IT department. Rising interconnectivity will create the need for a better risk-response system to secure digital confidentiality and rapid issue management, both of which are crucial elements in a smart city ecosystem.

Disruption to services could be very damaging and even life-threatening: As cities turn into truly smart cities, where data is a strategic asset, cybersecurity integration maturity and social trust related to data exchanges must become transformational, involving continuous improvement and enhancement of cybersecurity frameworks and solutions to protect the city's systems and citizens' data and even lives (a cybersecurity failure in a health system can directly threat life; and an attack to autonomous driving operations is another example of how people's lives could be affected).[331]

How to ensure a successful implementation?

A trusted secure ecosystem is built on a set of founding principles, which include a Zero Trust model, transparency and privacy, regulations and compliance, micro segmentation, risk-based identity and resiliency. In approaching cybersecurity, cities must have in mind three major goals:

1. **Govern like a nation:** Smart cities combine advanced infrastructure with dense, high-speed connectivity. They offer new economic opportunities and new possibilities for urban life. The potential risks of disruption are also significant, and mitigating these risks requires a professional, methodical and long-term approach to security – in other words, the sort of approach a government would take to protect critical infrastructure, with regular development and enhancement of cybersecurity policies, guidelines and tools.

2. **Smart cities as a defensive ecosystem:** Disruption to smart cities is a matter of high concern for professionals tasked with securing these environments. But 'smartness' is a two-way street, posing risks but also containing defensive and self-healing properties. Dense connectivity can allow malicious actors to move swiftly, but defensive countermeasures can move just as fast, and can draw on the insight and visibility provided by myriads of individuals and devices. A smart city is a living organism, and should be constructed to encourage security orchestration and empowerment among its organic and digital residents.

3. **Reboot with resilience:** Smart cities must be designed with cyber resilience in mind. Resilience is a well-understood concept in critical infrastructure protection, but it has a price. Resilient infrastructure and technology tend to contain redundant or reversionary capabilities (i.e. back-ups), and these rarely come for free. The temptation is strong to remove these up-front costs, except for those who have previously witnessed disruption to highly connected environments, and the resulting economic, social and political costs. To them, resilience seems like a bargain. Rebooting with resilience is much easier than the alternative.

"When the G20 Global Smart Cities Alliance started looking at cybersecurity issues, we began with a very basic policy of understanding accountability: at the end of the day, who within city government is ultimately accountable is important. If you don't answer that question and if you don't have absolute clarity there, then you are going to have trouble."

Jeff Merritt
Head of IoT and Urban Transformation,
World Economic Forum

"We have introduced a bug bounty programme where we ask people: you, white hackers, people who are experts in this, help us look for mistakes, help us look for errors on our websites and we can work together to have more secure government websites and a more secure cyberspace."

Kok Yam Tan
Deputy Secretary of Smart Nation
and Digital Government Office, Singapore

To reach those goals, several issues should be kept in mind:

Syncing city with cyber strategy, and allowing for flexibility: Cities should define a detailed cybersecurity strategy that is in line with their broader smart city strategy and that can mitigate the risks arising from the ongoing convergence, interoperability and interconnectedness of city systems and processes. Cities should consider carrying out regular and extensive impact assessments of their data, systems and cyber assets to identify, assess, and mitigate the risks in technology processes, policies and solutions. Cities should leave space for adjustments and improvements, as new solutions, approaches and connections may emerge that impact the strategy in place and require changes. Cities must follow 'cybersecurity by design' principles.

Having a clear cyber and data governance in place, with accountability: Cities need to formalise a governance approach to data, assets, infrastructure and other technology components. A comprehensive governance model should spell out responsibilities and roles for each critical component in the smart city ecosystem. Data management—including robust data sharing and privacy policies, data analytics skills, and monetisation models that facilitate the sourcing and usage of 'city data'—is a critical aspect of governance.

Leveraging the ecosystem and building strategic partnerships to grow cyber capabilities: The cyber skills gap is not going away any time soon, so cities need to be innovative and proactive in plugging the cyber skills gaps in their administration and teams. This approach may require the city administration to explore non-traditional methods of tapping into cyber talent such as crowdsourcing, prizes, and competitions to solve cyber-related issues. A smart city requires new skills and competencies across its various ecosystem layers. Cities can also augment existing capabilities through strategic partnerships and outsourcing contracts with service providers.

Align regulation policies: Policies, legislation, and technology must be aligned continuously to maintain the right balance between protection, privacy, transparency and utility. Governance, policies and processes must mature along with the city's overall cyber strategy.

Adopt a specific tool to manage the cybersecurity landscape of a smart city: The world's increasingly connected ecosystems, such as smart cities and smart transport systems, call for new tools to manage their massive cyber risk operations. The broad range of compliance rules for a city determines the need to automate the collection process as well as compliance with this highly complex framework of regulations. This can only be achieved with a specifically developed asset, able to provide daily support to the smart city's Chief Information Security Officer (CISO) team. This secure asset should be a platform that orchestrates an end-to-end cyber risk management programme across the broad smart ecosystem lifecycle of government sectors, vendors and third parties, regulators, security organisations and, of course,... citizens. It should be able to: contextualise (consolidate smart disparate systems into a holistic view of the entire ecosystem's security); evaluate (determine compliance gaps to be mitigated based on regulatory requirements and frameworks); monitor and respond (track and respond to cyber activity and threats to the ecosystem), and sustain (maintain the security of the ecosystem for holistic and ongoing resilience). Each smart city ecosystem is different, so this asset should be tailored to the specific connected environment, such as a smart city by complementing and enhancing the city's current security with a tailored and scalable approach.

Invest in awareness campaigns on privacy: The critical beneficiaries of a cyber secure city are its residents. It is important to have informed and aware citizens, in order to generate trust in the initiatives in place, and promote better behaviours in terms of data sharing and managing data risks.

"In the end it all comes down to trust and right now there is an understandable low level of trust when it comes to using highly personal data because of the way industries are using it for narrow commercial interests and not for the good of the individual or public."

Kent Larson
Director of City Science Group,
MIT Media Lab

Watch and listen to the insightful conversations about this trend.

Where to see this in action?

Tokyo, Japan

With the Olympics Games being a preferred target for cybercriminals since London 2012, Tokyo and Japan started working on cyber protection after being awarded the 2020 Games (postponed to 2021 due to the coronavirus pandemic). The aim is that preparing for the Olympic Games should give momentum to measures for improving Japan's national cybersecurity capabilities.[332]

Japan's 2015 Cybersecurity Strategy included initiatives to increase security such as public-private cybersecurity partnerships, workforce development (leveraging from an ecosystem of partners, the 'Cross-Sector Forum'), and cyber exercises. It also called on business leaders to incorporate cybersecurity in their business strategy and invest proactively in cybersecurity for innovation and growth.[333] The involvement of the business sector went further through a 'Declaration of Cyber Security Management' in March 2018.[334]

Additionally, projects such as Cyber Colosseo[335] were created by the National Cyber Training Center to respond to cyberattacks that were expected to target the Tokyo Olympic/Paralympic Games. Colosseo, started in 2017, is training professionals to the standards needed for protecting the event, but in doing so it will also create a new workforce of professionals for Japan's cybersecurity market after the Games have ended.[336] In 2018, the Tokyo Metropolitan Government produced a guideline for cybersecurity countermeasures for the Olympic/Paralympic Games.[337]

Pushing the concept of Society 5.0, cybersecurity is at the centre stage in Japan, and Tokyo is benefiting from this investment. The city considers the cyberspace environment and the internet to be drivers of innovation and economic growth, and it is one of the top cities in the world which has strength in both aspects (access and security). As of 2019, 91 per cent of Tokyo's residents had internet access, and the city was ranked number one for digital security in the Safe City Index 2015, 2017 and 2019, published by The Economist Intelligence Unit[338].

The city has prioritised investment in digital security, such as privacy policy, awareness of citizens' privacy, public-private partnerships, and the technology employed, and it has created dedicated cybersecurity teams to secure its digital ecosystem. For instance, in 2020 the Japanese government passed a new amendment to the Act on the Protection of Personal Information (APPI) to bring policy more in line with the EU's General Data Protection Regulation (GDPR). New guidelines will provide individuals with greater personal information protection and include provisions expanding an individual's rights to require the deletion or disclosure of personal information.[339]

With the increasing reliance on digital infrastructure, cyber risks are increasing, especially in relation to transaction services. For instance in 2020 a digital payment system – which is a primary pillar of smart city infrastructure – suffered a major cyberattack, resulting in numerous illicit withdrawals at regional banks. This highlighted the vulnerabilities of e-commerce amid rising digitalisation.[340]

As a result, in September 2020 the Japanese government increased the focus on strengthening cyber defence strategies and announced plans to set up a government entity, the National Digital Agency, to lead digital transformation in Japan.[341] [342]

Tel-Aviv, Israel

In 2010, faced with the prospect of an ever-increasing number of cyberattacks, the nation's Prime Minister consulted with Israel's National Cyber Initiative, which recommended that instead of creating a government-led cybersecurity programme, it should create a cybersecurity ecosystem that could identify and respond to the threats by itself. In response, a constantly evolving framework for this ecosystem was built, in collaboration with the government and the military, knowledge institutions and the business sector.[343]

With the government as a catalyst, Israel's cybersecurity industry accounts for 31 per cent of global investments in this sector, ranking in second place after the USA in 2021.[344] It is an economic growth engine, and Tel Aviv is the its birthplace: companies like Snyk, SentinelOne, Cato Networks, Forter and BigID achieved unicorn status in 2020.[345] Tel Aviv is also home to the Municipal Innovation Center, which showcases demos of smart city solutions and digital innovation for city leaders and administrators in a non-biased environment, to help local governments implement secure smart systems. Tel Aviv also hosts an important annual global conference, called Muni World and Expo, as well as other international cyber events.

Tel Aviv leverages its innovation and start-up environment to strengthen its ecosystem. The involvement of and close connection to the military is a key element in this. In 2020 Tel Aviv University launched a free online cybersecurity course covering topics such as cryptography, security of identification systems, attack and defence strategies, and viruses and other malware, with participation by students from over 150 countries. In just six months, it became the number one security course in the world, out-competing 1,750 other courses.[346]

Toronto, Canada

Following a recommendation by the Auditor General, Toronto has been working on developing its cybersecurity in response to threats and attacks. It currently uses network protection technology and cybersecurity practices to secure the integrity of infrastructure and to protect its assets.[347]

The city established a Cyber Security Program in 2017 which was revised and expanded in 2019. It has appointed a Chief Information Security Officer, with responsibility for establishing a cybersecurity strategy to manage cyber risk and strengthen the existing cyber defences.[348] Moving forward, it plans to increase its security capabilities through a partnership with the Auditor General's Office, provide cybersecurity training to city staff, and offering support for cybersecurity activities.[349]

Canada currently faces a lack of cyber talent, and the University of Toronto (U of T) has joined forces with five other Canadian universities to explore the feasibility of a cybersecurity operations centre for higher education in Canada.[350] The city has also hosted other initiatives, such as the Catalyst Cyber Accelerator, to leverage from the cybersecurity ecosystem and develop expertise.[351] Toronto has the knowledge institutions, market conditions, and financing to position itself as a global leader in cybersecurity, both on its own and also as a part of the Ontario Global Security Hub.[352]

In 2019, the City of Toronto was ranked sixth in The Economist's Safe Cities Index. High performance results in the Digital Security, Health Security, Infrastructure Security and Personal Security categories placed the city sixth out of 100 cities that were scored in this study.[353]

As our world has become more interconnected, the importance of privacy has grown. Initial enthusiasm for a hyperconnected smart city concept was followed by a strong backlash from citizens over privacy concerns, and a project to develop Alphabet's Sidewalk Lab and transform Toronto's waterfront was abandoned in 2020. Although it included in a plan for a sustainable and affordable community, 'raincoats' for buildings, autonomous vehicles, and cutting-edge wood-frame towers to make housing more affordable, the project failed to convince the population of the benefits of sensors and monitoring, and instead raised fears and suspicions around privacy (and 'surveillance capitalism').[354]

Although offering benefits to the population, the inability to gain its trust and the lack of transparency are seen as reasons why the project was dropped, illustrating the balance that local authorities will have to achieve going forward as they implement smart city projects. Toronto has now presented a new vision for the area, to replace the Sidewalk Lab project with a citizen-centric and community focus.

The vision of Jeff Merritt

Jeff Merritt
Head of IoT and Urban Transformation, World Economic Forum

The World Economic Forum has suggested a 'Great Reset' in the aftermath of COVID-19. How will COVID-19 shape the way we will see our urban ecosystems in the future?

What's truly unique about this moment right now, is that over the past year we have gone through a shared experience where around the world cities, regardless of what region they are in, what size are in, have all had to go into crisis mode. I think that this is a breakthrough moment for cities because in a way it has been an equaliser. It has demonstrated for cities that you can't just sort of coast along and hope that things will be okay; that we're living in a world where there is incredible uncertainty, unpredictability, and that means that cities have to be more agile, more responsive, and data-driven. I see this as a great moment for potential growth. There is an opportunity for cities to embrace this moment, and instead of making small incremental changes, to really think about the changes that they need to make in the next decade, for the next century, to be able to thrive in the world that we are living in.

What would you say are the main trends now shaping the future of urban ecosystems and what you feel is the role of data and technology in this?

We need to become much more resilient (resilience isn't something just for the big mega cities). Equity issues have been at the front and centre in the COVID pandemic (in the United States the death toll for latino/black communities has been significantly higher than for white communities, and economic challenges have hit low-income communities the hardest). Tech itself is a mega trend that is happening now. It's not just a sort of enabler, it is something that is really coming into every element of our lives, into our homes, and our workplace, into our cities; and we need to think about tech not only as something that we can leverage, but as something that we need to shape.

What do you believe should be the role of the Forum in improving quality of living and sustainability?

The World Economic Forum is the international organisation for public-private cooperation. That is what we do best, and that is where I believe we have the greatest contribution to make to the world.

Many of these challenges, if not all of those challenges that we're talking about right now, are collective action issues. That means that on their own, government, the private sector, or civil society would be unable to address the issues. You need to bring all stakeholders together to find common ground and for each to contribute in a unique way. We have been talking about public-private cooperation and partnerships for decades it seems, and we're not making enough progress. We need to be able to define frameworks that are truly a win-win scenario. The Forum provides that space as a neutral, trusted entity to bring stakeholders together and really hash out the details of how to enable successful collaboration.

There is a big trend towards data platforms and urban platforms. What is the relevance of these technologies in delivering a better service to citizens while also streamlining the city's processes?

Technology, believe it or not, usually is never the biggest challenge: behaviour change is. We have had a lot of amazing platforms that are able to pull things together, integrate data across city departments, provide amazing dashboards, amazing opportunities for building efficiency. The challenge is getting cities to work across silos which are built into the DNA of city operations. These very rigid structures with separate leadership and separate budgets have undermined the type of collaboration that we need in order to maximise the value of platforms. It is not enough simply to put a platform in place and hope that changes everything. We need to think about the governance structures that have to accommodate these platforms, we need to make sure we're beginning to change behaviours to stimulate collaboration among public servants.

What kind of recommendations would you give to local governments in order to be cyber secure?

There has been an interesting evolution in cybersecurity protection over the past decade. Initially cities very much felt that they needed to create a fortress, and the efforts went into building up massive internal government servers, in the belief that they were secure if all the data was kept in them, their physical property. Fast forward a couple years, and they started to realise that by using the cloud they were going to be more secure because cloud service providers have 24/7 security experts that are monitoring everything, and they actually have more capacity and can do it better. On cybersecurity, the G20 Global Smart City Alliance started with a very basic policy of understanding accountability. You ultimately need to have accountability, you need to have clarity of responsibility. If you can do that, then I believe you can build a framework and an approach to keep your city safe.

On one hand, we want to feel secure and use AI and predictive policing, face and voice recognition, to protect our urban ecosystems. On the other hand, we have the privacy issue. What is the right balance?

A lot of times we go in and we want technology to solve our problems. You have to remember that technology is a tool. At the end of the day technology is neither good nor bad. The question is how are we using it? Policing is about ensuring law and order, ensuring trust and respect among communities, and collaboration with the government. That is a relationship that happens between government and the people, and communities with each other. Technology does not build relationships, it does not build trust: people do. There is no substituting a strong community policing strategy and strong community engagement with a piece of technology. You can only add the technology once you have the trusted relationship. One of the tools that we rolled out when I was in New York – that I was a big fan of – was gunshot detection. There is a lot of distrust between communities and the police and what we have seen many times is that in traditionally marginalised low-income communities people are less likely to call for help. But when you're able to insert a technology like gunshot detection, you're able to pinpoint with an amazing precision where a gun shot came from, and you're then able to empower your police officers and law enforcement to respond and help the community.

How do you think the future of our mobility will look like?

I'd like to see people not needing to travel as much as they have in the past, and that's where the COVID pandemic has been incredibly helpful. I'd like to see us travelling less, it's not about just swapping your gas vehicles with electric vehicles. That doesn't solve our problems. We have too many people who are on the road who probably don't need to be. I may get really excited when I see the efforts, like in Paris around a 15-minute city, of really building stronger neighbourhoods, thinking about how do we have communities that are multi-use, that involved residential, retail, commercial areas; that builds for stronger communities. There are so many more options when you reduce the amount and length of travel - and we are already seeing examples in places like Helsinki, where they have rolled out integrated systems. That is the future: lots of options and hopefully less travel every day.

The Forum is working on net zero carbon cities as climate change us a huge challenge that cities must address. How committed do you think that cities are to the goals?

It is an enormous challenge. We have a lot of optimism and excitement right now, but I am not sure that people have really come to terms with how difficult it is. The key here is to have a holistic integrated strategy because that is where you get efficiencies. You also need to leverage public-private cooperation as I think too much of the burden is being put on to government. As an example, in order to meet the goals of the Paris Agreement we need to see in the next ten years or so the majority of our buildings becoming net zero carbon buildings. Currently only one per cent meet that goal. Retrofitting all the legacy old stock is a massive task. We need get down to the details, thinking about how to adequately incentivise the key stakeholders. Government, the finance community, property managers, and the construction real estate community have a role to play in that.

It is not going to happen unless we have a very clear action plan and clear responsibility and accountability. The good thing is that we are agreed about where we want to go. Now we have to be aligned on how we are going to get there.

In times of falling municipal revenues, how can we fund this transition?

I feel like a broken record: the answer is obviously public-private cooperation. We need to go back to the drawing board and say 'should government really be leading on this?' Or 'perhaps the private sector should be leading on some of these issues with government supporting'. I am not saying that everything should be outsourced, but government can put in place the governance structures, and set boundaries, conditions and the rules of play. That doesn't mean they have to be the ones that deliver all the services themselves. The burden shouldn't fall always on the public sector to solve all our problems.

Another issue is that the way in which we do long-term strategic planning in cities is very outdated. It reflects an era where there was predictability about the future, where we would do capital planning a decade ahead, where we thought that we would be able to plan our growth and our strategies in an incremental way. Well, that is not how the world works today: it is unpredictable, change is occurring at an exponential rate, and we really need to envision and create a new approach, a new methodology, for how we do more agile strategic planning.

How would your dream place to live look like in 2030?

I want stronger communities that are diverse, safe, where there is trust. I would like to see that we are able to take advantage of the moment now - which is a bit of a wake-up call – to think about what it means to build relationships of trust between communities, government and the private sector. Inclusion, equity is not just good to have, it is essential. It is a foundation that we build on, and this is good for the economy, for culture and art, and for creativity and innovation. Those types of communities will be more resilient, more sustainable.

Watch the full interview.
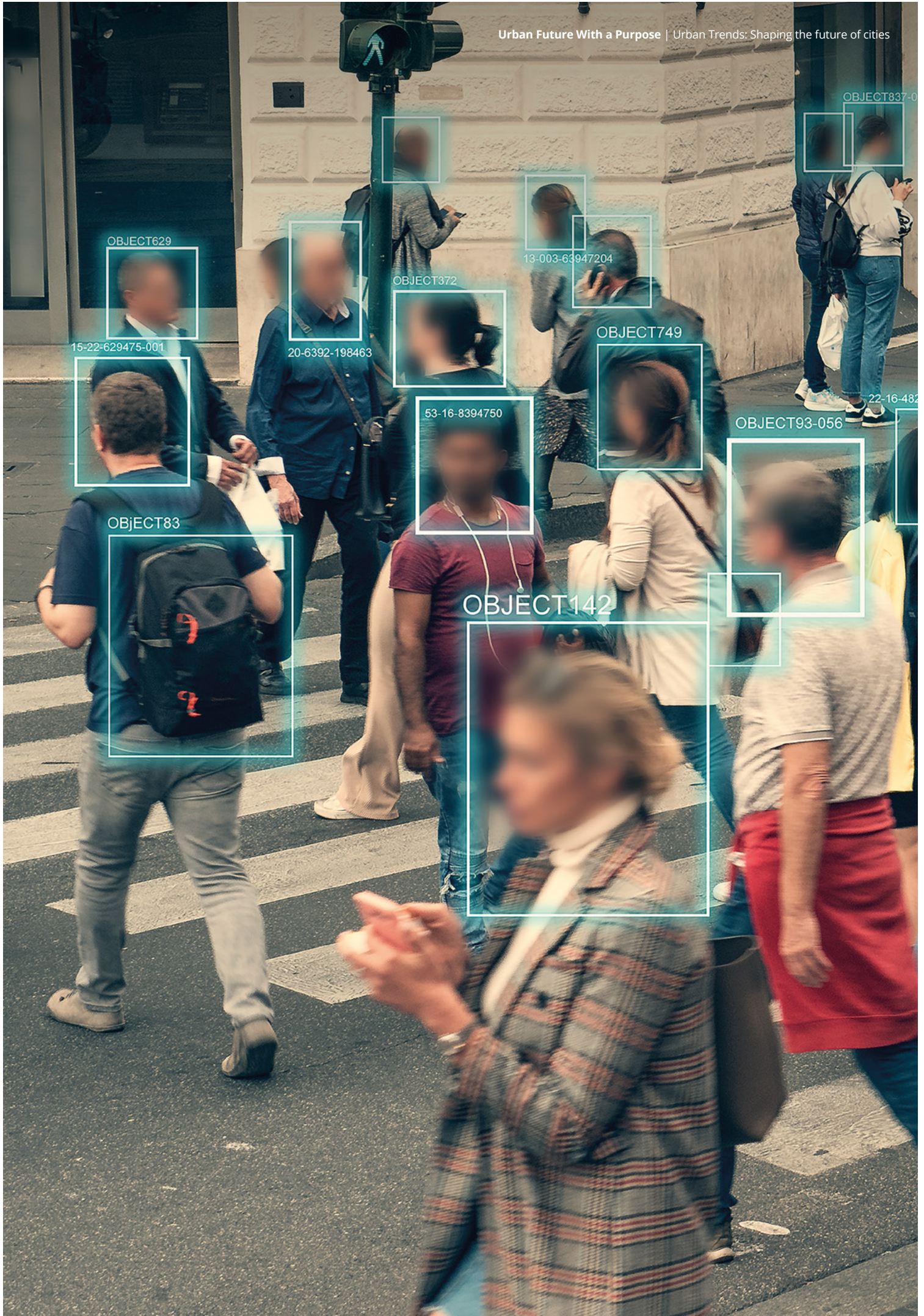
Surveillance and Predictive Policing Through AI

Jean Gil Barroca
Global Public Sector Digital
Modernisation Leader

Cities are leveraging artificial intelligence (AI) to ensure safety and security for their citizens while safeguarding privacy and fundamental human rights.

"Technology is not good or bad, the question is how are we using it. Technology doesn't build relationships, it doesn't build trust: people do. You can only add the technology once you have the trusted relationship in place."

Jeff Merritt
Head of IoT and Urban Transformation,
The World Economic Forum

Surveillance and predictive policing through AI is the most controversial trend in this report but one that has important implications for the future of cities and societies.

Technology is frequently used as a synonym of evolution, but the ethics of its use may need to be questioned. An underlying question is what society are we aiming to build. There are doubts and uncertainties about the impact of AI on communities and cities: the most fundamental concern is privacy, but there are frequent debates about AI from other perspectives, such as its impact on jobs, the economy and the future of work. Therefore, one cannot disconnect the discussions about surveillance and predictive policing from recent debates about the societal, ethical, and even geopolitical dimensions.

The pace of adoption of AI for security purposes has increased in recent years. AI has recently helped create and deliver innovative police services, connect police forces to citizens, build trust, and strengthen associations with communities. There is growing use of smart solutions such as biometrics, facial recognition, smart cameras, and video surveillance systems. A recent study found that smart technologies such as AI could help cities reduce crime by 30 to 40 per cent and reduce response times for emergency services by 20 to 35 per cent.[355] The same study found that cities have started to invest in real-time crime mapping, crowd management and gunshot detection. Cities are making use of facial recognition and biometrics (84 per cent), in-car and body cameras for police (55 per cent), drones and aerial surveillance (46 per cent), and crowdsourcing crime reporting and emergency apps (39 per cent) to ensure public safety. However, only 8 per cent use data-driven policing.[356] The AI Global Surveillance (AIGS) Index 2019 shows that 56 out of 176 countries used AI for surveillance for safe city platforms, although with different approaches.[357] The International Data Corporation (IDC) has predicted that by 2022, 40 per cent of police agencies will use digital tools, such as live video streaming and shared workflows, to support community safety and an alternative response framework.[358]

Surveillance is not new, but cities are exploring the capabilities of predicting crime by analysing surveillance data, in order to improve security. Cities already capture images for surveillance purposes, but by using AI, images can now be analysed and acted on much more quickly.[359] Machine learning and big data analysis make it possible to navigate through huge amounts of data on crime and terrorism, to identify

patterns, correlations and trends. When the right relationships are in place, technology is the layer that supports law enforcements agencies to better deliver their job and trigger behaviour change. The ultimate goal is to create agile security systems that can detect crime, terrorism networks and suspicious activity, and even contribute to the effectiveness of justice systems.

Cities are also exploring other uses of surveillance and artificial intelligence technologies. AI is being used for urban tolling and emission zones to reduce air pollution for sustainability purposes. Another emerging area of application is the prevention of another health crisis. Paris uses AI to monitor the metro system to ensure passengers are wearing face masks. The aim is not to identify and punish rule-breakers but to generate anonymous data that helps authorities to anticipate future outbreaks of infection.[360]

How to achieve these goals while respecting privacy and liberties remains a crucial question.

Experts say it is almost impossible to design broadly adopted ethical AI systems because of the enormous complexity of the diverse contexts they need to encompass. Any advances in AI for surveillance and predictive policing need to be accompanied by discussions about ethical and regulatory issues. Even though the value proposition of these technologies might seem attractive from a use case perspective, liberties and civil rights need to be protected by proper privacy and human rights regulations.

Although a controversial issue in Western countries (and some cities in the US have banned it), predictive policing is being deployed widely in Asia. A survey by Deloitte has shown considerable differences in the acceptance and desirability of these technologies between regions. Both surveillance and predictive policing are considered undesirable in more privacy--aware geographies such as the EU and North America. Latin America and Asia have shown greater acceptance.

In summary, cities need to consider if using technology for surveillance and policing implies making concessions to convenience at the expense of freedom.

"There is a lot of mistrust between communities and the police, and what we have seen again and again is that traditionally marginalised low-income communities are less likely to call for help. Introducing technology like gunshot detection empowers your police officers and law enforcement agencies to respond and help the community."

Jeff Merritt
Head of IoT and Urban Transformation,
The World Economic Forum

Why are AI-enabled surveillance and predictive policing relevant for cities and their citizens?

Prevention and reduction of crime, to make cities more secure: Predictive policing aims to prevent crime, and can be the most efficient and effective way of keeping communities safe and increasing their trust and confidence in police services while reducing response times.[361] For example, the police in Vancouver use predictive models to identify areas where robberies are expected to occur and then post officers to deter potential thieves or other criminals.

Support for the police force and other entities beyond crime detection: Police departments in many cities are short-staffed, making it harder to ensure public safety at all times and in all places. As the size of the population increases, it will be difficult for police forces to provide effective security and monitor crowds. Law and order agencies across the world can make use of AI to ensure proper coverage of all areas with only a limited increase in the need for resources.[362 363] Artificial intelligence can also help local governments identify behaviours that impact environmental sustainability or public health.

AI can improve the seamless interconnection between municipal bodies: Cities whose security systems are spread across police departments, firefighters and other agencies or security entities may benefit from AI that can detect complex patterns and connections between events in different departments, leading to improved incident response times.[364]

Safeguarding the lives of police and law enforcers: Technologies such as video surveillance and robotic security devices can be used for identifying and preventing potential threats. They can prevent crimes from happening and avoid putting the safety and lives of police officers at risk.[365]

Reduce health costs and other security expenses: Cities can reduce the health service costs of treating victims of crime. This may result in lower insurance premiums in high-risk cities, and in some cases, reduce the need for private security services.

How to ensure a successful implementation?

Balance security interests with the protection of civil liberties, including privacy and freedom: The use of AI for policing does not have unanimous support because some people see it as a threat to individual privacy and liberty. For example in 2020, the Californian city of Santa Cruz banned the use of predictive policing tools and New York City has mandated that police should disclose their use of surveillance tools. Local authorities must therefore ensure that they apply strict criteria to the use and retention of personal data and are transparent about data usage.[366] Moreover, cities should consult with stakeholders and discuss the benefits and motives for deploying AI and surveillance technologies.

Experiment responsibly and regulate first: Any experimentation with surveillance and AI technologies needs to be accompanied by proper regulation to protect privacy and civil liberties. Policymakers and security forces need to introduce regulations and accountability mechanisms that create a trustful environment for experimentation of the new applications. Regulations can help mitigate the risks related to potential disruptions that AI innovations might cause.[367]

Establish institutional review boards: These should carry out reviews of any applications that imply the use of personal data. They should include experts from multiple disciplines such as ethics, privacy and technology, policymakers, civil servants, and community representatives. Ethical considerations need to address three critical areas: fairness, equity and inclusion.

Create mechanisms for algorithms that can be accountable and reviewed: With the advent of explainable artificial intelligence, it is increasingly possible to deploy algorithms that can become accountable and subject to revisions. Explainable AI makes it possible to monitor issues such as bias and the fairness of algorithms. Cities should use white-box algorithms that respect the principles of transparency, interpretability, and explainability. For example, according to the US Department of Justice, black people are five times more likely to be arrested than white people. This suggests that there may well be racial bias in AI algorithms, whereas a key reason for using AI to detect crime is to avoid prejudice by humans. However, bias may be built in (albeit unconsciously) by the individuals who write the algorithms.[368 369 370]

Prioritise the usage of environment data instead of personal data. The use of personal data heavily affects trust and might affect privacy and civil rights. Whenever possible, cities should use anonymous, aggregated, non-identifiable data to obtain insights. IoT and sensors make it easier to collect and analyse environmental data to predict events; this limits the need for personal data.

Promote strong collaboration and trust between law enforcement systems and citizens: Trust is a key requirement for the application of AI for security and policing. To get the most out of technology, there must be community engagement.

Accompany digitalisation with a change in culture: To benefit fully from using AI, the police, justice systems and city governments must change their organisational culture in order to accommodate such substantial developments.[371]

"Whether it is about sensors, CCTVs, digital contact tracing, it is very important for us to be sensitive to how people feel about the data collection and data use, and we must communicate and be very clear about what we are doing."

Kok Yam Tan
Deputy Secretary of Smart Nation and Digital Government Office, Singapore

"If you have strong collaboration between your law enforcement agencies and communities and there is a relationship of trust there, then you can layer upon that [with technology]. This is the key point: you can layer on it, you can't substitute."

Jeff Merritt
Head of IoT and Urban Transformation, The World Economic Forum

Watch and listen to the insightful conversations about this trend.

Where to see this in action?

Singapore

At the forefront of adopting technology with the aim of creating a secure environment, Singapore is already leveraging AI across police, border security and homeland security applications. It has implemented measures for using smart technologies such as sensors, data analytics and AI to make lives safer.

For example, the Singapore Civil Defence Force (SCDF) has deployed UAVs (unmanned aerial vehicles) for monitoring activities such as fire tracking, surveillance, and search and rescue missions. The Ministry of Home Affairs uses UAVs to conduct aerial surveillance for monitoring crowds during mass public events, such as on New Year's Eve. The Immigration & Checkpoints Authority introduced iris scanning in July 2018, enhancing the pre-existing network of cameras with facial recognition capabilities.

Since December 2016, drones have helped police to catch criminals conducting illegal activities in the forest, and have led to savings of 80 per cent in time and 60 per cent in costs compared to traditional methods of building inspection.[372] Drones have also helped monitor major pipelines and traffic congestion at checkpoints. In 2018 police officers caught 125 illegal immigrants through a night-time drone operation.

The Singapore Police Force (SPF) intends to use wearable technology such as smart glasses with video feeds to facilitate information gathering. These glasses are expected to carry out real-time video analytics such as facial recognition.

To deal with COVID-19 related challenges, the government used AI in initiatives such as:

- VigilantGantry, which automatically screens the temperatures of individuals with a video camera and thermal scanner. According to Singapore Government Developer Portal, "It augments existing thermal scanners to improve the rate of contactless scanning, ease bottlenecks in long queues outside buildings and reduce manpower required for temperature screening measures."[373]

- SPOTON, a mass temperature screening solution for venues with little infrastructure support. It "can screen up to ten people at once, with a temperature indicator for each face and automated alarms and email alerts when high temperatures are detected."[374]

- A robot named Spot which patrols and reminds people in public parks to observe a social distance of at least one metre.

- A network analysis tool to help contact tracing by the Singapore armed forces.

Hence, Singapore has advanced measures for using smart technologies such as sensors, data analytics and AI to make lives safer.[375 376 377]

As part of the National Artificial Intelligence Strategy, which covers five national projects (transport and logistics, smart cities and estates, healthcare, education, and safety and security), the government has a vision: "By 2030, Singapore will be a leader in developing and deploying scalable, impactful AI solutions, in key sectors of high value and relevance to our citizens and businesses."[378] Two projects for improving security with AI are:

1. *Computer vision drowning detection system (CVDDS) at 27 swimming pools*,[379] to be implemented in 2021

2. *Border clearance operations:* Singapore will explore the use of AI to assist immigration officers in evaluating the risk profile of travellers before they arrive at checkpoints, and to tier the level of security screening accordingly. This will be done through technologies such as machine learning, computer vision, cognitive systems, and explainable AI.[380]

Kanagawa, Japan

In preparation for the Tokyo Olympics, the Japanese police force launched AI-enabled predictive policing.

The AI systems are capable of determining whether multiple crimes were committed by the same person by comparing data relating to each crime. Using this information, AI predicts the criminal's next move.

The AI system itself has 'deep learning' algorithm for teaching the computer systems in real time as it collects more data. The process enables the system to have full access to police force statistics, while also providing access to other details of the crime, such as time, place, weather and geographical conditions.

There is also a plan to permit AI access to social media in order to identify the specific areas or people who may be involved in a crime. The Kanagawa police began studying the feasibility in 2018 of this and carried out joint research with the private sector before putting a system in place. In addition to the above, the National Police Agency has also set up a panel to advise on how the police should make use of AI.[381 382 383]

Rio de Janeiro, Brazil

With high murder rates and feeling of insecurity (in 2015 81 per cent of Brazilians feared that they would be a victim of homicide in some form), the city implemented measures to predict crimes more successfully and lower the crime rate.

In 2016, the Igarapé Institute (a think tank) partnered with Via Science (a data analytics firm) to develop the CrimeRadar app, a crime prediction platform that assessed the frequency of crime across locations and times in the metropolitan region.

The platform runs on smartphones and desktop browsers. The software uses advanced data analytics to monitor crime rates and potential risks across the municipality.

CrimeRadar provides a visualised representation of the safety levels in specific locations and times. It also makes crime data more accessible and transparent and thus improves security for citizens. The platform has helped to reduced crime in the region by 30-40 per cent.[384 385 386]

Cascais: Getting ready for the future

Cascais at a glance

Cascais, located within the Lisbon metropolitan area, boasts a coastline that attracts more than 1.2 million visitors every year. With a mid-sized population of around 213,000 people, Cascais is not just a tourist destination—the city's aspirations go much beyond that.

With an ageing but wealthy population, Cascais sees its main challenges as achieving sustainable development, minimising inequalities and promoting inclusion and the quality of life. Inspired by its vision to become "the best place to live for a day or a lifetime", the city relies on smart city systems and has a strong commitment to digital transformatio to make continual improvements in the city.

With over 30,760[387] companies and a university ranked among the top 30 in Europe,[388] the city has developed a strong and collaborative ecosystem with a governance model that fosters innovation and invites community participation in co-creation. Cascais is a Deloitte Living Lab, and has made it its mission to "test innovative solutions capable of being scaled" and to be a global knowledge hub or benchmark for other cities.

"Our vision of a city is quite simple: the city is the deep place where you implement your project of happiness together with your family, where you raise your children."

"We like to be early adopters, we have investment capabilities, we like to assume risk."

Miguel Pinto-Luz
Deputy Mayor, Cascais, Portugal

Watch the full interview.

Cascais,
Portugal

Cascais
Factsheet

Year of establishment:
1364

Area:
97,4km²

Coastline:
32km

Residents:
213,608[389]

Tourists per year:
1.2 million

Expat Population:
32km

Natural reserve territory:
32%

Walkways and bikeways:
96km

Universities:
4

Nationalities:
123

Museums:
20

Hospitals:
5

Public Schools:
65

Main sectors:
Tourism and Services

A trendsetting municipality in Europe

How Cascais implements 12 urban trends

Although a small urban centre, Cascais provides an excellent example of most of the 12 city trends identified in this study. Its initiatives could be used as a reference for other urban environments all over the world. To showcase the progress that Cascais has made and its aims for the future, Deloitte has selected some examples of this city's initiatives.

By 2030, Cascais aims to become a truly intelligent and automated city, pioneering municipal digital innovation, service automation, participation by citizens, and sustainable urban planning in Portugal.

Living and health

Cascais has a strategy for healthy living in its municipality with an emphasis on green public spaces, to offer a more verdant city to its inhabitants and visitors. In the broadest of terms, it is a strategy focused on livability.

This has been done partly to mitigate the impact of climate change, as stated in the city's 2017 Action Plan for Adaptation to Climate Change (PA3C2).[390] The strategy relies on the creation or re-adaptation of public spaces such as parks and other green areas. One of the initiatives is the restoration of Quinta do Pisão Nature Park in the Sintra-Cascais Natural Park, 380 hectares of abandoned forest and agricultural land that has been turned into a park for visitors and residents. It represents the effort to bring nature closer to the city dweller.

As of December 2020, the municipality is part of the 'Green City Accord',[391] in which mayors and local government leaders in Europe join around a common vision for urban living, committing by 2030 to make their cities attractive to live in, with clean air and water and access to parks and green spaces, and with a focus on the circular economy.

However, the concept of livability in Cascais goes further. Even before the COVID pandemic, with the aim of giving back streets to the people, the municipality had already closed some streets to cars to promote a true neighborhood environment. 'Bairro Amarelo'[392] is an outdoors restaurant district event that happens regularly in the city, boosting local commerce and especially the restaurant scene.

This city has also invested a great deal of effort to become an intelligent health community, fostering healthy aging and community wellbeing. Cascais has an interactive project called 'Smart Health' that uses geotagging to gather real-time health and welfare data on the population. This project, in partnership with NOVA IMS, enables decision-making by the city in these areas to be based on transparent evidence. For instance it reports the number of people with anti-smoking, hypertension or diabetes appointments.[393] The strategy for the promotion of health is to aim for Education for Health, Equity in Health and Citizenship in Health, reduce inequalities and provide all citizens with the conditions for a healthy life.[394]

Under a process of decentralisation of health competences in Portugal, Cascais was one of the first of a small number of municipalities to take on the responsibility for developing a local health and social security programme: VidaCascais. Examples of projects under the VidaCascais programme are mass colon cancer screening, Academia Saúde[395] and Espaço S.[396] Academia de Saúde is an arrangement in which 56 entities in the local public sector and for-profit and non-profit organisations discuss and develop a Local Health Promotion Strategy. Cascais is also a pioneer in using a digital platform for responding to the pandemic: COVID War Room was established to obtain a clear and integrated view of the COVID-19 situation in the city (suspicious cases, test schedules and results, and maps showing the spread of infection). It also ensured that the entire population was easily and seamlessly tested for the virus and that resources were properly managed and allocated. The platform also supports the mass vaccination operation that began in March 2021.

"Cascais is a strong municipality in financial terms, our budget is quite big. It has the second largest budget in the entire country, and that gives us firepower to invest in new technology, invest in studies and all that stuff."

"Technology is a part of the system, it's not an end in itself, but it's a mean that facilitates the path for that vision of making Cascais the best place to live in."

Miguel Pinto-Luz
Deputy Mayor, Cascais, Portugal

Mobility

Mobility is one of the areas where Cascais is particularly keen on leading the implementation of new, sustainable, scalable and future-proof ideas and projects.

MobiCascais is an as-a-service that enables its users to reserve, manage, and pay for the use of mobility-connected services in Cascais by paying a daily, weekly, monthly or annual yearly fee. The integrated platform includes services such as bike sharing, scooter sharing, smart parking, taxi rides, transport on request, carpooling, an electric vehicle infrastructure, and information on transport (bus and train) routes and stations. Users have a card, an app and a web portal to select from the wide range of real-time mobility options. MobiCascais is based on the mobi.me system.

At the beginning of 2021,MobiCascais had 2,000 shared bicycles, 70 kilometre of bicycle paths, 300 parking kiosks, 1,280 car parking spaces, 42 municipal bus lines, trains, an EV chargers network, and shared cars, and is expected soon to include taxis and Uber, and evolve into a service on-demand.[397]

With a focus on sustainability, Cascais plans to launch a hydrogen bus fleet and a 'Green Bus' for rides to the Natural Park and Guincho. It is also testing the use of autonomous vehicles: in a first phase it introduced an autonomous bus, with a 15/16 passenger's capacity, to connect the university to the beach, a route of about one kilometre. In a second phase, the autonomous vehicle will connect the Nova SBE campus to the Carcavelos train station, a route of about 1.5 kilometres.[398] The city has also invested in a network of more than 96 km of soft mobility ways, and in intelligent pedestrian crossings in all neighbourhoods, with the aim of improving safety and encouraging more sustainable ways of short-distance mobility. Public transport is free for residents, students and municipality workers.[399]

Economy

Cascais sees its future as one of inclusion and innovation, where citizens work with the city, its companies and knowledge institutions to build a community that is innovative, in which everyone feels they are a part.

Cascais aims to become a Living Lab for testing new solutions and approaches in a vibrant ecosystem that benefits from an international top-ranked university (NOVA SBE) and an open-minded City Hall. Deloitte is one of its partners. Some initiatives are listed here:

• DNA Cascais is an entrepreneurship agency for the city, where ideas and business are born and incubated. In the past ten years, DNA Cascais has supported 320 companies, helped create over 1,600 jobs, and promoted over 3,200 interactions between entrepreneurs.[400]

• Cascais Invest[401] is the Agency for Development and Internationalization of the Cascais Municipality. It is the investment arm of Cascais, responsible for links to the global private investment sector, to promote investment and economic growth.

• Reskill Hub, created in partnership with NOVA SBE, is a platform to support the re-skilling of the workforce, to meet the requirements of an unpredictable digital world. A pilot project will begin in Cascais but may be extended nationally.[402]

• Innovation Center[403] is an office park that complements and serves the university campus, providing an ecosystem linked to research and innovation. It provides space and amenities for meetings between university staff and their partners and external strategists, with the objective of creating successful companies.

• Estoril Conferences[404] is a platform for promoting an open dialogue on global challenges that brings together a high-level panel of leaders in several areas – including Nobel prize laureates. Since 2009, there have been six biannual conferences in Cascais, addressing the most important and global issues.

• Cascais Data is an open data platform providing open data, crucial for understanding the city better.[405]

• Cascais is involved in several award programmes and competitions relating to technology and innovation, such as Big Impact.[406]

All these initiatives reflect a desire to boost inclusion in Cascais, starting at the local neighbourhood level, since a close community relationship is fundamental for strengthening social cohesion. The municipality recognises residents associations[407] as important partners in neighbourhood relations and between the municipality and its citizens.

Attention is also given to the elderly. Cascais recently created a Digital Academy to ensure that this segment of the population is equipped with skills to embrace the digital transformation of the city, even during the pandemic when isolation has been mandatory. It is aligned with the Senior Academy, which has been functioning in Cascais for several years and provides education to people over 65. In addition, the municipality is following an international trend towards co-housing spaces for both elderly and young people, and a new project is planned.

Cascais +Tech is a project that aims at ensuring access to Office 365 for all students and their families and, with a student card, to public online libraries. Parents have access through the Cascais EDU app (an application to keep track of the education and diet of their children).[408]

⦿ Energy and environment

Adapting to a more sustainable planning strategy, Cascais has been implementing circular economy projects with an emphasis on the smarter management of its resources. One of its projects is iRec[409], which incentivises recycling by giving rewards. Anyone returning used beverage containers to one of the ten machines in shopping areas in the municipality of Cascais, wins 'Citypoints' – the city rewards system. But efforts by the city go further, justifying the fact that it has been elected one of the world's 100 most sustainable cities by CDP: currently energy use by Cascais comes 73 per cent from renewable sources, with 52 per cent from wind power and 13 per cent from hydroelectricity.[410]

Cascais uses wastewater for the irrigation of green spaces[411] and has installed a system of sensors for air quality monitoring[412] that measures indicators such as pollutants, noise and meteorology. The introduction of sensors for waste containers in 2015 to minimise the number of waste collection routes has reduced journeys by around 180,000 km per year[413] and annual CO2 emissions by 352,000 tons.[414] Taken together, its smart environmental initiatives has enabled the municipality to save over EUR 600,000 every year.

In 2017 Cascais became one of the first cities in Portugal to replace the traditional public lighting system for its 3 kilometres boardwalk, using solar energy for the 128 LED luminaires, equipped with photovoltaic panels and batteries that accumulate energy during the day to power the luminaires at night.

Cascais is also producing energy locally to become more resilient to shocks. It is working on developing energy communities from public buildings, and has launched biological urban farms across the municipality. There are already 26 bio community gardens. Quinta do Pisão Nature Park, for instance, is home to a biological production where you can even "pick your own crop" from the hectare of vegetable gardens and hectare of lavender field.[415] Santa Maria do Mar Monastery's winery is home to local wine production.

But its citizens are the best ambassadors for a city. Cascais has had a 'Neighborhood Tutor'[416] initiative in place since 2009 in which a representative (a Tutor) in each neighbourhood is in contact with Cascais Ambiente (the city's company for environmental issues), to monitor and report on any environmental issues, such as urban cleaning, waste management and green spaces. The same model is applied to beaches and urban farms. Currently, 220 Tutors watch over 95 per cent of the territory.

🎓 Government and education

Cascais' operations are managed through C2 – a command centre for responding to incidents and obtaining an integrated view of what is happening across the municipality. Cascais was one of the first cities in Portugal to adopt a city platform for integrating its innovative smart city solutions to get best out of them. The command centre is powered by CitySynergy, Deloitte's smart places operating system.

Cascais has an integrated vision across 15 smart initiatives run by the city, ranging from health and education to energy and public infrastructure. Achieving this required the creation of a new operating model, which integrates, processes and correlates data, ensuring an improvement in the quality of services to citizens, as well as savings based on greater effectiveness and efficiency. The Mayor can now take decisions from integrated maps with assets and dependencies, online dashboards, customised reports, and a Digital Twin for predictive management. The platform has achieved efficiencies in many areas, including a reduction in operating costs by 40 per cent and increasing energy savings by up to 20 per cent. Cascais has also registered an improvement in the satisfaction of its citizens, has secured 10 to 27 per cent savings in mobility services, 20 to 30 per cent in energy savings, and 30 per cent reduction in water consumption.

CitySynergy is critical for supporting the local ecosystem and maintaining connection with the city's citizens. A part of the smart initiatives integrated within the platform is concerned with connection and participation of citizens. For example, websites and apps like CityPoints and FixCascais are connected to the platform. The municipality wants to have the highest voter turnout in the country and to have the best integration with citizens, by offering them ways to participate both online and offline, while also making daily lives easier by being able to use municipal services seamlessly online.

Cascais has made a series of initiatives:

- Most municipal services (95 per cent) are virtual, in a system based on a single login and authentication – My Cascais[417] – to access the various services and available platforms, make requests, consultations, and contribute with proposals or signal needs. MyCascais correlates data, connects systems and allows for rapid deployment of city services.

- FixCascais[418] is an app for citizens to report problems in public spaces, such as damaged sidewalks, badly placed or broken traffic signs, or the need for street cleaning. This platform handles an average of 7,000 monthly requests.[419]

- The city has also gamified the promotion of good citizenship with Cascais Citypoints[420], which recognises and rewards 'supercitizens' who contribute to local sustainability. Points are awarded to citizens who perform predefined actions, and these points can be exchanged for vouchers for products or services.

- A participatory budget initiative was launched in 2011 in which residents of all ages can participate in city planning initiatives. In 2019, 139,349[421] votes were received, and a budget of EUR 10 million was allocated to projects suggested under this initiative. This continues to be the most voted participatory budget in Portugal and one of the most voted (in percentage terms) in Europe.[422]

- The 'Youth Participatory Budget'[423] involves young people in planning. The Municipality of Cascais provides EUR 10,000 to every school to apply ideas for improving the space or the lives of students. Young people are also invited to submit ideas worth up to EUR 300,000 to improve the community – funds in the Cascais Participatory Budget.[424]

- With the app Cascais 360[425], locals and tourists can obtain information about when they can visit places such as a museum or a garden, or simply go to the beach.

- Creating valuable learning experiences and fostering participation is one of the end goals of the 'Smart Citizenship Academy'.[426] This is a space for reflection, debate and co-creation about living democracy and citizen participation, and is organised alongside Nova SBE. Cascais is soon to develop a Data Sharing initiative to promote the open usage of data.

- 'Volunteers Cascais Jovem!' involves young people in meaningful and helpful activities. This annual programme aims to provide young people with opportunities for vocational and professional exploration, through short-term collaboration in projects and events developed by the Cascais City Council.[427]

- The 'Cascais EDU APP'[428] is an innovative application that gives parents and guardians access to a range of information about the school life of their children in public schools (timetables, evaluations, tests, etc).

In Cascais, people are at the core of everything and the municipality strives for citizen satisfaction.

"This command centre is the brain of the city nowadays. It is where we collect all the data points that we are now collecting from all the sensors that we have in place, apps, sites, emails, calls, all these data points are being collected in this centre. Around 75 to 80 per cent of all our issues in the city are solved in this this place. This is why it is a game changer."

"I'm here for now 18 years and my effort has been to fill that gap and to create a trust level playing field for everyone to trust in each other. And the best way to gain the trust of the population is to share power with them."

"We don't believe in a top down approach. We strongly believe in a balance between of a top down approach together with the bottom up approach with the grassroots movement. Having these two dimensions fighting each other is good for building up trust, but it's even better to create new solutions for the city."

Miguel Pinto-Luz
Deputy Mayor, Cascais, Portugal

Safety and security

The city has implemented video surveillance in the municipality, alongside the police and legal entities.[429] In beaches, which are areas susceptible to severe environmental impact, surveillance is useful for preventing damage to sand dunes, and local fauna and flora.

The road to 2030

A vision for the future of the city

Embracing the motto "To make Cascais the best place to live for a day or a lifetime", the city wants to leverage its resources. It has created a roadmap to 2030, which consists of a clear strategy with the following goals and pillars:

Goals

- **Quality of life** – Increase the quality of life of citizens by enhancing the development of Cascais as a smart city.

- **Economic competitiveness** – Attract companies and resources and integrate new stakeholders.

Pillars

- **Resilience** – Absorb, recover and prepare for future shocks (economic, environmental, social and institutional).

- **Sustainability** – Harness the natural resources of the municipality .

"You may have a vision for the next ten years, but then you must have the means for fast prototyping. If you want to change an area or a region within the municipality, you need to create an agile approach, fast prototype and try to changing the system."

"In 2030, I see Cascais being carbon neutral, with mobility-as-a-service implemented massively, and having more and more sustainable buildings, better schools, more universities."

Miguel Pinto-Luz
Deputy Mayor, Cascais, Portugal

The plan will be delivered through six domains.

Economy and innovation

Focus on informing citizens, becoming a source of inspiration regarding both resilience and a sustainable lifestyle, and creating a credible brand, trustworthy and capable of attracting human resources and companies into the municipality.

Vision: Become an European hub for green initiatives
Main initiative: Green Growth Initiatives Co-creation Programme

Participation and citizenship

By 2030, ensure that the conditions are in place for participation by vulnerable groups, promoting schools as a place for citizenship awareness, mainstreaming policies that focus on children (under 15), their rights and needs.

Vision: Have the highest voter turnout in the country
Main initiative: An open and participative governance initiative

Mobility

The municipality aims to reduce the dependency on cars, making areas of the city more accessible to more people, with a higher quality of service and at a lower cost.

Vision: Zero carbon emissions in logistics mobility
Main initiative: Create Cascais PLUS, a sustainable urban logistics programme

Health and wellness

Have the best health and wellness in the country and become a reference point for the rest of the world and a flagship for an intelligent health community, healthy ageing and recovery tourism.

Vision: Become a worldwide leading smart health community
Main initiative: Promote Smart Health Community, focusing on intelligent health, healthy ageing, and recovery tourism

Environment and energy

Make all events sustainable, reduce social inequalities, reduce electricity consumption in buildings and street lighting, and promote a circular economy for water resources, materials and energy.

Vision: Become a world capital of nature
Main initiative: Create a sustainability credit system

Education and society

Enhance knowledge sharing, and promote the development of new initiatives.

Vision: Serve as an example for lifelong education
Main initiative: Create a digital platform for knowledge exchange

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Miguel is often found sharing his vision at leading industry events, such as the World Economic Forum and the European Commission. He has also developed strong relationships with the United Nations, global leadership teams and advisory boards of global forums.

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Cities must become more resilient, digital and sustainable. We stand with mayors, urban planners and community innovators in envisioning, designing, implementing and operating the foundations of urban living

Deloitte's Smart City Solutions Centre is a Centre of Competences for both Smart Cities and Future of Mobility solutions, that leverages on technology assets and human expertise to add value to public and private clients.

A core 20+ team of skills specialists invest heavily in developing products to increase operations' efficiency, and on research and methodologies to design and advise the future of cities. In addition, 45 Analytics & Cognitive consultants provide support to Smart City Solutions Centre's projects.

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