Is the COVID-19 Pandemic Accelerating the Path to Smarter Cities?

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Abstract

The impact of the COVID-19 pandemic has accelerated certain aspects of smart city development. Impressive leaps have been made in many sectors, from urban data platforms to urban mobility. However, to capitalise on that momentum, city governments need to ensure a strong focus on resilience and focus on citizen-centric goals that promote liveability, sustainability, and social equity. To better understand the future of smart cities, we begin by examining previous approaches that municipalities worldwide have deployed over the past few years. With the arrival of the pandemic, and with resilience taking centre stage, we take a look at how quickly cities have adapted to the situation, evolving to accommodate the needs of citizens and innovating to build back better. By utilising a plethora of tools in a smart city's toolbox, we explain how existing technologies and practices can better serve all stakeholders to help manage potential crises in the future, and making cities more resilient. We specifically highlight the importance of deep collaborations between citizens, the public sector, the private sector, and other smart cities for successful post-COVID-19 smart city transformation.

1   Smart City: Quo Vadis

The COVID-19 pandemic has posed several challenges to cities and municipalities worldwide. The situation has highlighted the importance of digitisation for the safe and continuous delivery of many municipal and private sector services. In 2021, the path out of the crisis—and with it, revitalising our cities, strengthening social cohesion, and reinvigorating the economy—will dominate most discussions.

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"Building back better and stronger" is the current theme—and the smart city concept is a key to this.

1.1   The Evolution of Smart Cities: Four Smart City Generations

Over the past two decades, the smart city concept has fundamentally changed regarding the approaches that cities and communities employed to manage urban digital transformation. In his seminal article on the three generations of smart cities, urban strategist Boyd Cohen (2015) has outlined the evolution of smart cities.

Initially, the smart city movement was driven by large technology companies that used the term smart city as a sales argument, promising efficiency and innovation to local governments (Smart City 1.0). It did not take long until the public sector realised that technology was a powerful enabler for achieving governmental, economic, and societal goals. But it became clear that local governments needed to actively lead and manage development projects to prevent vendor lock-in and dependency on private sector businesses (Smart City 2.0). Today, smart city strategies view technology as an enabler only—and not as a means to an end. Cities and municipalities have understood that top-down approaches and the latest technology are not necessarily crucial to successfully tackling urban challenges and mitigating risks.

Instead, collaborative and participatory citizen- and user-centric approaches (Smart City 3.0) display the most important success factors. In some cases, such as the Dutch Amsterdam Smart City project (Amsterdam Smart City, 2021), cities and municipalities start to use a digital platform approach to expand their smart city solution and partner ecosystem collaboratively. From our perspective (bee smart city, 2019), there will now be an emergence of a fourth generation in the smart city evolution. From the standpoint of stakeholder engagement and the perspective of technology, we see the emergence of a "city-as-a-platform" approach. Urban data platforms and digital twins—based on Internet of Things (IoT) applications—enable local governments to better plan and manage urban infrastructure, optimise processes, and improve decision-making (Smart City 4.0). Figure 1 highlights these four generations of smart cities.

To master the transformation to smart cities, a local government should incorporate the needs and challenges of its stakeholders, consisting of citizens, businesses, workers/commuters, entrepreneurs, academics and non-profit organisations, and its public sector employees. In the wake of the pandemic, the needs and challenges have changed and expanded.
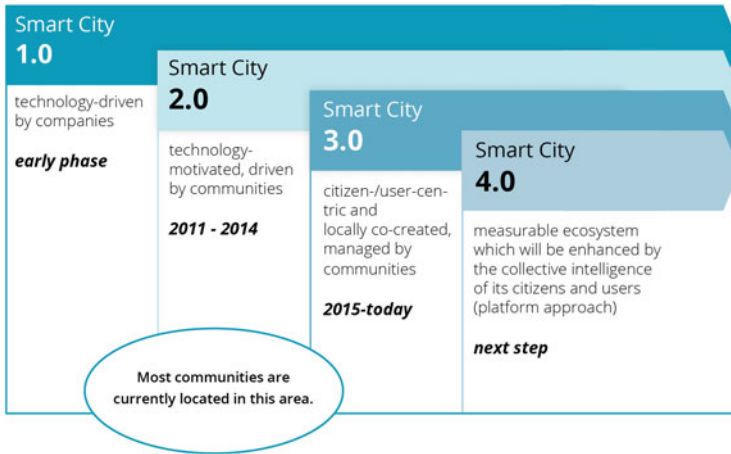
Fig. 1 The four evolutionary generations of smart cities. Source: Own illustration, bee smart city (2019)

1.2 Smart City Definition, Urban Development, and Fields of Action

The smart city concept is constantly evolving: The International Telecommunications Union (ITU) of the United Nations (2014) defines the term "Smart City" or "Smart and Sustainable City" as follows:

> A smart and sustainable city is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, the efficiency of operations—communal infrastructure and services, and competitiveness—while ensuring that it meets the economic, social, environmental and cultural needs of present and future generations.

In November 2020, an informal EU ministerial meeting on urban development adopted "The New Leipzig Charter" (Bundesministerium des Innern, für Bau und Heimat, 2020) as a framework for integrated urban development policy in Europe, which takes up the active design of digital urban transformation as a crucial factor for integrated urban development (see chapter "Urban Planning Aspects of the Resilient City"—Weidner, 2021).

While one aspect emphasises the development and implementation of integrated, inclusive, and common good-oriented smart city strategies, another aspect is that digital solutions—especially in times of crisis—can secure and strengthen the ability of municipalities to act. With digitalisation and the "Sustainable Development Goals" (SDGs) of the United Nations' "Urban Agenda 2030" (United Nations, 2015b) and principles of the "New Urban Agenda" (United Nations, 2016) being practically included in the "New Leipzig Charter", the framework clearly recognises
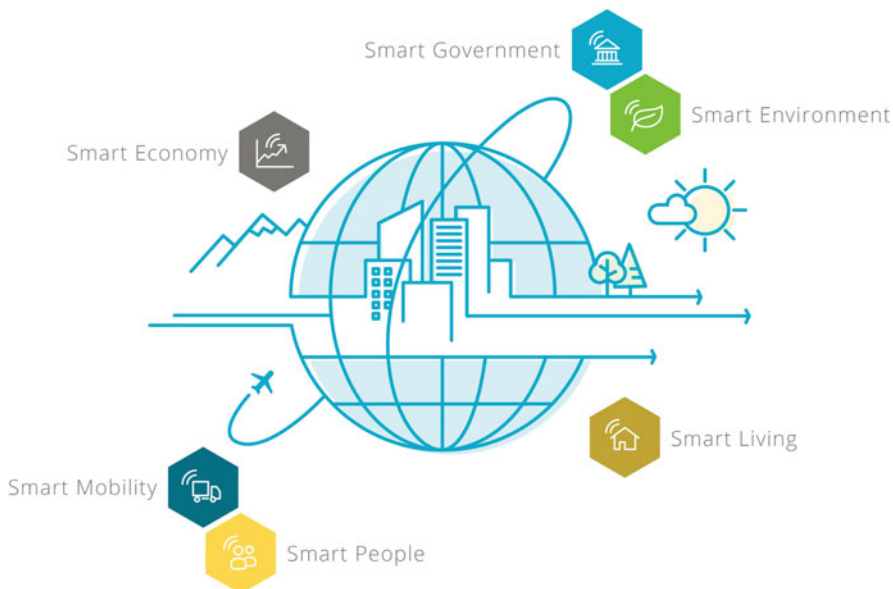
Fig. 2 The six fields of action of the smart city. Source: Own illustration, bee smart city (2019)

the importance of integrated urban development towards smart and sustainable cities and communities.

Digitalisation and sustainability are megatrends that influence all aspects of urban development. Therefore, a holistic perspective is required by local governments to identify the fields of action where smart city solutions and initiatives can contribute to seize development opportunities or to mitigate risks and increase resilience, with the goal of future-proofing the city in terms of livability and prosperity for all stakeholders.

A popular categorisation was developed by Giffinger and his European Smart Cities research group at the Centre of Regional Science of Vienna University of Technology, differentiating the smart city application areas at the city level into six fields of action (Giffinger et al., 2010): Smart Economy, Smart Environment, Smart Government, Smart Living, Smart Mobility, and Smart People (see Fig. 2).

A city implements solutions within these six fields of action and starts initiatives in sub-themes and application verticals to improve urban development. For example, during the pandemic, many cities implemented crowd management and access control solutions to help the local economy in city/district centres as well as the tourism sector within the smart economy field. Cities can easier manage and monitor the implementation of smart city strategies by categorising core fields of action, followed by specific sub-themes and verticals.

A holistic view additionally requires a spatially differentiated consideration of the smart city approach. Figure 3 shows the five spatial levels of action that are of
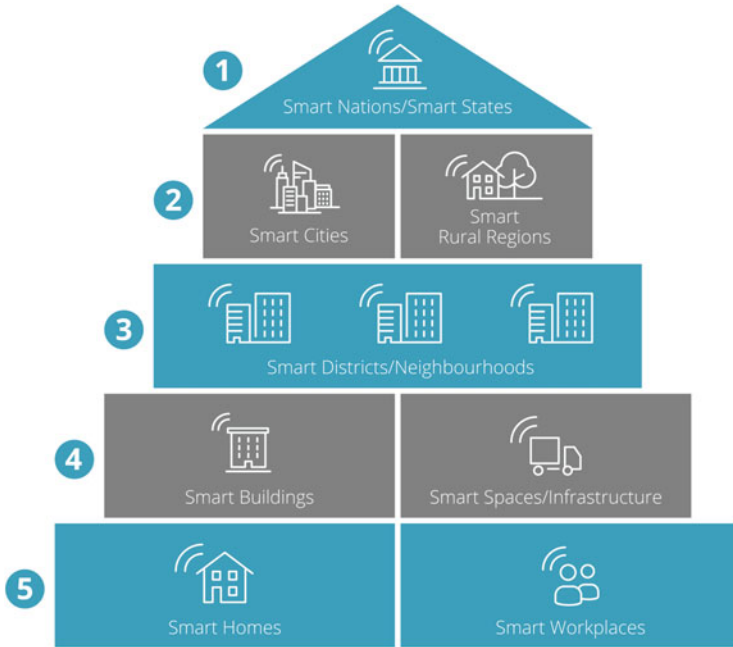
Fig. 3 The five spatial levels of action of the smart city concept. Source: Own illustration, bee smart city (2021)

importance to the successful implementation of a smart city strategy and to reach a city's overall development goals.

The pandemic constitutes a challenge for society, which needs to be addressed at all these spatial levels to prevent and/or better manage future pandemics. Each of these five levels requires and involves different stakeholders—therefore, the smart city concept represents a multi-stakeholder approach.

While national and state governments can set favourable regulations and conditions, including incentives, local action, and grassroots initiatives are required to truly achieve urban resilience and sustainability goals within a city or region. On the regional and local level, city and county governments oversee the development of smart city strategies and are responsible for reducing red tape, creating a culture of innovation, and involving all relevant stakeholders. City-wide initiatives and solutions are orchestrated by local government departments and subsidiaries, taking spatial disparities and inequalities into account. On the district and building levels, the real estate industry and utility companies are predominant in driving the implementation of solutions. At the same time, the city government provides planning support and encourages bottom-up initiatives of the civil society and citizens within districts.

The pandemic has led to the reconsideration of the spatial division of city functions. Proximity and accessibility are crucial elements of emerging planning

Fig. 4 The eight fields of action for Smart Districts and Neighbourhoods. Source: Own illustration, bee smart city (2021)

concepts to build back stronger. The 15-minute city—pioneered by the mayor of Paris, Anne Hildago, during her 2020 re-election campaign—is one of the most recognised concepts. Many other cities have adopted the concept during the pandemic crisis (Moreno et al., 2021). But this concept has also been criticised, as it requires changing complex planning approaches and organising the reallocation of space and resources (Pozoukidou & Chatziyiannaki, 2021). The concept of proximity and dense communities is not new; Jacobs has analysed the value of neighbourhoods and proximity in her book "The Death and Life of Great American Cities" (Jacobs, 1961). And yet, we should not neglect what we have witnessed during the pandemic: that the district or neighbourhood level is essential to increase resilience and liveability while solving central urban challenges (Yeung, 2021). Figure 4 shows the eight fields of action required to create smart districts and neighbourhoods.

At its core, the smart city concept can be operationalised to an ecosystem of technical solutions and non-technical initiatives/processes implemented on the respective spatial level and within the respective field of action and relevant sub-themes, as discussed earlier in this chapter.

For example, a smart kiosk/digital signage solution in a neighbourhood can encourage residents to conserve fossil resources (field of action no. 1) by displaying energy consumption data for the neighbourhood and/or showing savings opportunities for electricity and water gas, and waste. By displaying the current weather and suitable suggestions for activities in the community, the technical

solution can also increase leisure and recreation activities that lead to improved health or increase the duration of stay (field of action no. 6). Suggestions can also include activities organised by residents or civil society initiatives in the neighbourhood, strengthening the sense of community and social cohesion (field of action no. 3). The technical solution can also be commercialised by enabling neighbourhood management to advertise local offers for a fee in cooperation with local retailers, cultural institutions, gastronomy, or service providers (field of action no. 2). Through IoT-based applications, such as connectivity (e.g. free public WiFi hotspots) and emergency services (e.g. showing crowded streets, parks, or beaches in near real-time and advising visitors which parts of the city are safe to visit to adhere to distancing rules), the neighbourhood is also expanding digital infrastructure and service provision (field of action no. 8).

Startups, small and medium-sized enterprises, and corporations are continuously expanding the ecosystem of available smart city solutions, adapting their solutions to meet new end-user needs that change due to the pandemic and other challenges (e.g. climate crisis). While the cholera epidemic of the 1830s helped shape the Parisian sewer system (Kesztenbaum & Rosenthal, 2017) and the Spanish flu led to better ventilation standards for buildings (Hobday & Cason, 2009), the pandemic has the potential to accelerate the evolution of the smart city concept at all spatial levels and within all fields of action.

2   Preventing Pandemics: How Can Smart Cities Increase Resilience?

The current situation has shone a spotlight on the vulnerability of modern cities and highlighted how cities and municipalities have accelerated the spread of the virus. Fortunately, the pandemic has also accelerated the evolution of smart city principles and forced the fast adoption of many forward-thinking policies. Increasing resilience is a key feature of any smart city strategy, but rather than focusing on broader future-proofing verticals, such as climate change or resource security, pandemic resilience is better targeted at the city and neigbourhood levels, focussed on citizen-centric themes.

By placing the needs of residents at the heart of any smart city plan, cities can become more resilient. The rise of the 15-minute city (Appleton, 2020) or 20-minute neighbourhood as forward-thinking urban planning solutions can help to limit the damage caused by any future pandemic. Residents will no longer have to travel greater distances to meet their needs, and the adoption of hyper-local mentalities will help forge greater community links. The latter is particularly important when it comes to lockdown situations, allowing local governments to act faster and deploy safety measures in an efficient and sustainable way, saving lives and protecting businesses at the same time. However, the 15-minute city concept must be handled with care. Three main aspects should be considered: (1) Not all centrally located amenities (such as centres of learning and cultural hubs) can or should be decentralized. (2) Gentrification, which could force citizens out of the very areas

that were designed to improve their quality of living, needs to be prevented. (3) The concept needs to be applied to all districts for coherent urban planning. Properly applied, the 15-minute city can be an urban planning success story.

Similarly, the adoption of a local mindset has been reinforced by the rise of cycling, walking, and micro-mobility platforms as viable transport options in our cities (Dekki, 2020). The pandemic has accelerated a trend towards slow streets, green spaces, and reduced access for internal combustion engine vehicles. Not only do these measures improve the liveability of a city, but they are an essential part of policy and planning priorities such as the Paris Agreement (United Nations, 2015a) and for achieving the Sustainable Development Goals. Impressive examples include Paris' plans to pedestrianise the Champs-Élysées (Guy, 2021) and how the City of Athens has re-allocated up to 50,000 m^2 of land exclusively for cycling and walking (Connolly, 2020).

The needs of citizens reach beyond urban planning. As cities embrace the digital transformation, more government services are accessible online. Providing a wide range of government services to citizens and other stakeholders using digital portals, irrespective of time, location, and staff availability, allows the government's wheels to turn even during trying circumstances. The digital transformation of government services is just one of many ways that modern technology can be leveraged to strengthen urban resilience. With the advent of smart technology and the deployment of city-wide IoT networks (Appleton, 2021), local governments and citizens now have access to sophisticated data tools that can help shape policy and influence decision-making.

Examples of urban data that was used to tackle the pandemic include the use of AI to predict where and when areas of the city are likely to become crowded, sophisticated track and trace applications that monitor and analyse the spread of infections, and citizen participation platforms (Roch, 2020) that are being leveraged to democratise the utilisation of urban space and participatory budget spending. Though many of these tools have been implemented to tackle the pandemic, they are also important for accelerating the development of smart city principles (Chagoury, 2020). By managing the pandemic at a local level, starting from smart neighbourhoods, smart cities and smart states will follow suit, controlling the spread of the pandemic and keeping citizens safe, economies stable, and governments running in order to benefit all stakeholders.

These are just some examples of the solutions that Smart Cities have developed to improve resilience with regard to future pandemics. However, there are more valuable assets in the smart city toolbox that could be deployed in the future in order to better manage crises that can also be used to transform cities into more sustainable and liveable environments. To quote directly from the New Leipzig Charter (Bundesministerium des Innern, für Bau und Heimat, 2020):

> Cities and urban systems need flexibility as well as the ability to respond to external disruptive events and chronic stress. The robustness of cities to cope with changing framework conditions should be supported by an ability to learn from past events and

from each other, flexible urban governance for the common good as well as the balanced implementation of just, green and productive cities.

The ability to learn from past events is crucial to building better resilience and managing the cities of the future (see chapter "The Future Viability of City Networks"—Spars, 2021).

3   To Better Manage Pandemics: The Toolbox of a Smart City

Urban management is a broad umbrella term, but in the context of pandemic management, the recent situation has highlighted areas that can be improved significantly. While there is much to be done on national levels, cities and rural regions can make better use of existing strategies or adopt new ones to help tackle the issue, creating more resilient environments in the event of future pandemics.

Healthcare is a key pillar to future-proofing modern smart cities. The current situation has seen medical services overstretched and the quality of care was significantly reduced as medical professionals struggled to administer care to overwhelming patient numbers. Several solutions can be adopted at a municipal level to help take the strain off local healthcare services.

Barcelona is a prime example of a city that has embraced the digitalisation of healthcare. The city's pioneering Telecare Service (Generalitat de Catalunya, 2020) was introduced in 2013, but the number of active users of the system has skyrocketed during the pandemic. It is a telemedicine service that protects vulnerable citizens, allowing them to call ambulances, communicate with medical staff, and take preventative actions without having to leave their homes. Although this Barcelona city council initiative (Barcelona Provincial Council, 2013) targets elderly and vulnerable citizens, it is actively helping to ease the pressure on general practitioners and hospitals, making healthcare more accessible for everyone.

Similar projects have been appearing in other locations. While they are not all government initiatives, the current situation has shown a greater need for private enterprises to help support medical services and a greater willingness for lawmakers to offer flexibility. For example, during the pandemic, the German government enacted a law change that allowed the use of private telemedicine services for customers of the nation's public health insurance scheme for the first time. This law change enables publicly insured individuals to use private telemedicine services, cut doctor waiting times, and allow easier access to prescription medications for those who need them most. Allowing patients to contact doctors and health services remotely also helps to tackle one of the city's biggest pandemic challenges: mobility. Urban mobility has suffered greatly at the hands of COVID-19 and it is no secret that mass-transit systems have seen a reduction in their user numbers (see chapter "How COVID-19 Is Changing Mobility Behaviour and What that Means for Sustainable Urban Transport"—Jarass et al., 2021). Despite this, public transport is a crucial lifeline for many urban residents and an essential pillar of any local economy (Green Alliance, 2020).

To help keep cities moving, mobility providers need to adapt to changing situations quickly. One way to help make public transportation more appealing during a pandemic is to tap local data systems for real-time information on passenger numbers as well as peak times and scan for historical trends and make decisions based on these data sets. For example, at peak times when trains or buses are crowded, mobility companies should be able to deploy additional services to prevent overcrowding, making journeys more comfortable for passengers, with adequate social distancing measures in place.

While public transport has struggled over the past year, other mobility services have gained enormous traction. Cycling has become a popular transport method, with many cities reacting positively to the trend and implementing new bicycle lanes and providing safe and secure bicycle parking. Other micro-mobility solutions such as widely available e-bikes and bike-sharing platforms, as well as the addition of e-scooters have become viable alternatives to private car usage. However, to make the most of these solutions, cities will have to provide adequate parking, safe lane designation, provide better transport connections, and measure the sustainability of these solutions to ensure that the cities of the future can keep moving during a pandemic or similar crisis.

Keeping the economy moving is just as important as keeping people moving. There are two significant concerns for businesses: maintaining a reliable workforce and providing goods and services in exchange for money.

Flexible working, in the form of remote working and flexible working hours, can help address work/life balance inequalities. The recent adoption of flexible working during the pandemic has helped nurture a better work/life balance for employees, who can enjoy more family-friendly environments, reduced commuting times, and greater trust from their employers. These principles can improve the quality of life for many urban residents, even in a post-pandemic situation (see chapter "The Future Workplace: Reimagining the Office for the Twenty-First Century"—Kane, 2021). However, this can only be done if they are supported by local labour regulations. For other sectors, maintaining safe and sanitary working conditions and giving employees access to regular health checks is essential to keep businesses running.

The exchange of money is a broader topic with many concerns. However, the quick adoption and transition to cashless payments and services are one of the simplest but most effective ways for cities and local areas to help prevent the spread of infectious diseases.

Clear instructions, concise guidelines, and strict compliance enforcement can help keep businesses afloat and economies strong. However, there is one industry that many cities rely on: tourism—which will need particularly help to become more resilient in the future.

Urban tourism is an industry that will take time to recover and will require smart innovation to help reinvent itself (Glasco, 2020). While many solutions are being put into practice today, we need to look into the future to see how smart tourism, and smart cities, can continue to operate during troubled times.

Closer collaboration between private and public sector agencies and other cities can help boost innovation and create stronger, more unique, and attractive tourism

services for consumers. Urban authorities must assist private companies to help find solutions to the biggest problems facing the industry (United Nations World Tourism Organization, 2020), whether that involves new concepts of hygiene, exciting new attractions, or providing digital coverage and augmentation for events.

The fast-tracking of new health safety concepts, from contactless ticketing and contact tracing apps to interactive signage and UV sanitation devices, must be a priority for tourism numbers to recover.

No matter whether the proposed solutions are digitally focused or rely on traditional methods, building trust between travellers and local governments and businesses should be the cornerstone of any smart tourism strategy. In a time of great uncertainty, mired by misinformation and a lack of situational clarity, trust and clear communication is essential to the tourism industry's recovery.

All of the above-mentioned solutions available in a Smart City's resilience toolkit can be underscored by the practical use and application of data. As each city and industry faces its unique problems, there are no one-size-fits-all solutions. However, by capitalising on gathered data, analysing trends, and pinpointing trouble spots, a modern smart city can successfully manage a pandemic, adapt to new situations, and provide flexibility to protect citizens, save lives, and keep industries afloat.

4   Collaboration to Accelerate Smart City Innovation

Important steps have been taken towards accelerating the smart city agenda and transforming cities into liveable, equitable, and healthy places, but more needs to be done.

One of these to-dos is a better focus on collaboration: Collaboration between a wide range of stakeholders and organisations is essential to make progress to smart cities. Partnerships between public and private sector organisations can help enable a higher level of innovation and allow cities to deploy solutions faster and more efficiently. Studies have shown that 50% of city leaders have agreed that finding the right partners to collaborate with has been one of the biggest hurdles in the way of cities reaching their goals. Close collaboration is important, but it must be done transparently and securely (Thambiran, 2020), putting the needs and rights of citizens in the foreground, especially with the rising dependency on data.

Sharing data and ideas is at the heart of any smart city development, but while governments should seek out private sector partnerships, they should also foster better collaboration between internal city departments and how they can interact best with private enterprises. Urban planning departments can greatly influence the shape and direction of our future cities (Kunzmann, 2020) and they should not be excluded from the smart city agenda. Instead, they should be innovating new ways to enhance our cities, working closely with the real estate sector to develop more sustainable public spaces, creating smart buildings, and nurturing smart districts. It is easy to focus on the digital aspect of smart city development, but that can only succeed without neglecting the physical elements of city planning.

The smart city journey is not a cheap one, and without emphasising the benefits of technological innovation and highlighting the importance of making cities more liveable and sustainable for all stakeholders, important funding could be cut. During the crisis, budgets have already been cut, and city budgets have not been spared. Budgets are likely to be re-evaluated (Thambiran, 2020), given that a smart city can both help to mitigate future crises and adapt to changing needs and desires of city populations.

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