Print ISSN: 1738-3110 / Online ISSN 2093-7717
JDS website: http://accesson.kr/jds
http://doi.org/10.15722/jds.23.11.202511.113

# Distribution Dynamics in the Post-COVID City: Implications for Spatial Structure and Urban Regeneration*

**Choongik CHOI**[1]

**Received: September 25, 2025. Revised: October 28, 2025. Accepted: November 05, 2025**.

## Abstract

**Purpose:** The COVID-19 pandemic triggered unprecedented disruptions in urban spatial structures and regeneration strategies across the world. This study seeks to explore the long-term spatial and policy implications of these transformations, focusing primarily on Seoul, Korea while drawing comparative insights from Amsterdam, Singapore, and New York. It aims to identify how cities adapted to post-pandemic realities through shifts in planning logic, governance innovation, and urban form. **Research Design, Data and Methodology:** The study employs an extensive literature review and comparative case study analysis to examine how pandemic-driven phenomena reshaped patterns of urban development, land use, and spatial organization. Particular attention is given to the integration of digital governance and sustainable recovery frameworks. **Results:** Findings indicate that COVID-19 accelerated the diffusion of smart-city technologies, expanded digital infrastructure for governance, and encouraged polycentric, green, and resilient urban transformations. Seoul's coordinated Digital & Green New Deal policies exemplify a holistic recovery strategy linking technology, environment, and inclusivity. **Conclusions:** Comparative analysis reveals convergent trends in post-pandemic regeneration: reclaiming public spaces, enabling flexible land-use systems, and aligning recovery programs with climate and equity goals. These insights highlight that cities can "build back better" by institutionalizing resilience, inclusiveness, and sustainability as enduring foundations of urban vitality.

**Keywords :** COVID-19, Distribution Networks, Urban Spatial Structure, Urban Regeneration, Smart Cities

**JEL Classification Code**: R58, O18, R52, I18, Q54

## 1. Introduction

The COVID-19 pandemic (2020–2022) caused unprecedented disruptions in urban life, prompting cities worldwide to rethink spatial structures and regeneration strategies. Lockdowns, social distancing, and a sudden shift to remote work altered how people use urban spaces, exposing both vulnerabilities and opportunities in city planning (Sharifi & Khavarian-Garmsir, 2020; Stoney et al., 2023). In dense metropolitan areas like Seoul, New York, and Singapore, commuting and downtown activities plummeted during lockdowns, while neighborhood amenities and digital connectivity became more vital (De Vos, 2020; Stoney et al., 2023). These conditions forced urban policymakers to adapt quickly – for instance, by reallocating street space for pedestrians, expanding public

* This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (NRF-2025S1A5A2A01005338)

1 First Author. Professor, Department of Public Administration, Faculty, Kangwon National University, Korea.
Email: choich@kangwon.ac.kr

health infrastructure, and accelerating digital service delivery (Yoon, 2021; Boland et al., 2020). As the immediate crisis eased, attention turned to long-term recovery and how cities could emerge more resilient and sustainable than before.

In distribution science and urban planning literature, debates are emerging on how pandemics influence urban logistics (e.g. shifts in last-mile delivery) and how cities can adapt their spatial layouts to new forms of retail and work. Yet, many gaps remain regarding the mechanisms of change and the factors that explain different outcomes across cities. This study aims to fill these gaps by addressing the following research questions: (1) What are the long-term impacts of COVID-19 on urban spatial structure and land-use patterns, particularly in relation to central and peripheral urban areas? (2) How has the pandemic affected urban regeneration initiatives – for instance, the revitalization or repurposing of vacant and underutilized urban spaces? (3) In what ways do these spatial and regenerative changes intersect with distribution networks (such as urban logistics and last-mile delivery), and how can the lens of distribution science inform our understanding of post-COVID urban dynamics? (4) Through what theoretical framework can we explain the mechanisms by which COVID-19 has induced these changes, and why might the outcomes differ between cities (considering factors like governance models, institutional capacity, and cultural context)? By clarifying these objectives and questions, we situate our research at the nexus of urban planning and distribution science, contributing to scholarly discourse with both conceptual insight and practical relevance. In the following sections, we develop a robust theoretical framework to guide the analysis, describe a rigorous methodology (ensuring transparency and reliability), compare findings across cases with an eye toward causation (not just description), and derive policy implications for building more resilient and smarter cities in the post-pandemic future.

This study employs Seoul, Amsterdam, New York, and Singapore as comparative case studies due to their global significance and diverse approaches to urban policy and regeneration. Seoul, as South Korea's capital, is an exemplary East Asian megacity that implemented the Korean New Deal, combining digital and green recovery strategies. Amsterdam is notable for adopting the innovative 'Doughnut Economics' framework post-COVID-19, positioning itself as a leader in sustainable urban planning. New York, as a global financial hub and one of the hardest-hit cities in the early stages of the pandemic, provides insight into resilience strategies for dense metropolitan areas, particularly around open streets and public health infrastructure. Singapore exemplifies the use of smart-city technologies and long-term planning in navigating pandemic challenges, particularly with remote work policies and adaptive CBD strategies. Together, these four cities offer complementary perspectives across geography, governance, and policy innovation, making them ideal for comparative analysis of urban resilience, spatial restructuring, and regeneration in the aftermath of COVID-19.

This paper also analyzes the long-term impacts of COVID-19 on urban spatial structure and regeneration policy, with a focus on South Korea (especially Seoul) and comparative insights from global cities such as Amsterdam, Singapore, and New York (Lee & Sohn, 2025; Choi, 2024). Key themes include the rise of smart city initiatives for pandemic management, the integration of disaster resilience and climate goals into urban planning, and the adaptation of urban regeneration programs to post-pandemic realities (Yoon, 2021). The study covers the period before and after the pandemic (roughly 2015–2025) to contextualize changes against pre-existing urban trends. By examining policy documents, academic studies, and city case examples, we derive insights into urban regeneration practice in the post-pandemic era. Ultimately, the goal is to inform strategies that can help cities "build back better" – making urban centers not only economically vibrant, but also healthier, greener, and more resilient to future shocks.

## 2. Literature Review and Theoretical Foundations

### 2.1. COVID-19 and Changes in Urban Spatial Dynamics

Early evidence shows that COVID-19 fundamentally upended urban spatial dynamics, affecting mobility, land use, and local economies (De Vos, 2020; Stoney et al., 2023). Globally, cities experienced a dramatic decline in daily commuting and central business district (CBD) activity during the pandemic's peak. For example, when Austin, Texas mandated telework for public employees in March 2020, traffic at major intersections dropped by roughly 50%, accompanied by measurable declines in air pollution (Sharifi & Khavarian-Garmsir, 2020). Such shifts echoed worldwide as remote work became widespread, reducing congestion and transit ridership. Surveys of employers indicated that many plans to reduce office space and continue hybrid work arrangements even after the pandemic (Lee & Sohn, 2025, 2021; Boland et al., 2020). The reduced need for daily commuting has implications for urban form: planners began discussing polycentric or decentralized city models, where jobs and services are more distributed across metropolitan areas rather than concentrated only in downtown cores (Sharifi & Khavarian-Garmsir, 2020; Stoney et al., 2023). The concept of the "15-

minute city" – where residents can work, shop, and recreate within a short walk or bike ride – gained new traction as a vision for post-COVID urban living (Citaristi, 2022; Jowell et al., 2025).

Public space and green infrastructure also emerged as critical urban assets during the pandemic. With indoor venues limited by social distancing, citizens flocked to parks, greenways, and sidewalks for exercise and social interaction (Florida et al., 2020). Studies noted increased usage of urban parks wherever accessible, highlighting the importance of equitable green space distribution for public health (Florida et al., 2020). International agencies like UN-Habitat framed the pandemic as part of a "triple C" crisis – COVID-19, climate change, and conflict – underscoring the need for cities to build resilience by investing in green and inclusive infrastructure (Citaristi, 2022). Many city governments responded by fast-tracking "green recovery" projects. For instance, numerous European cities (Paris, Milan, Amsterdam, etc.) accelerated the construction of bicycle lanes and pedestrian zones in 2020 to offer safer mobility alternatives and cut vehicle emissions (Sharifi & Khavarian-Garmsir, 2020; Sharifi & Khavarian-Garmsir, 2020). In South Korea, the national government incorporated urban greenery into recovery plans, pledging to create 723 hectares of urban forests by 2025 as part of a Green New Deal initiative (Yoon, 2021). This investment aimed to improve environmental quality (e.g., reducing fine dust) while enhancing urban livability and climate resilience (Yoon, 2021).

The pandemic's economic shock hit city centers particularly hard. Retail strips and downtown shopping districts saw dramatic drops in foot traffic due to lockdowns and the collapse of tourism (Deshmukh, 2024). By 2020, roughly 20–25% of retail sales in advanced economies like South Korea and the UK had shifted online, accelerating the pre-pandemic trend toward e-commerce (Deshmukh, 2024). As a result, many brick-and-mortar stores closed, and commercial vacancy rates soared (Deshmukh, 2024). Urban land use experts began calling for adaptive reuse of these vacant spaces – such as converting empty shops into community facilities or health clinics – to prevent urban blight (Sharifi & Khavarian-Garmsir, 2020; Florida et al., 2020). Notably, having active urban regeneration programs helped some neighbors weather the economic storm. In South Korea, districts with ongoing regeneration projects proved more resilient: one analysis found that while sales of small businesses nationwide fell about 31% in 2020, in regeneration districts small business sales actually increased by ~13%, suggesting these community-oriented investments buffered local economies (KRIHS, 2022). This finding aligns with broader literature that diversified, mixed-use neighborhoods can better sustain vitality during crises (Florida et al., 2020).

Several cross-cutting themes emerge from the literature on COVID-19's urban impact. First is the pivotal role of digital infrastructure and smart-city tools in pandemic response (Choi, 2024). Cities with robust data systems could monitor infections and adapt services more effectively (e.g. using contact-tracing apps, mobility data, and telemedicine). Second is the importance of flexible and resilient urban planning (Choi, 2024). The crisis forced cities to temporarily repurpose streets, parks, and buildings; moving forward, urban plans may need built-in mechanisms for rapid land-use adjustments in emergencies (Lee et al., 2023). Third, many authors highlight the opportunity to integrate sustainability and "green recovery" goals into post-pandemic urban policy (Choi, 2024). In effect, COVID-19 recovery funding became a chance to advance climate action (for instance, investing in energy-efficient buildings or renewable energy as part of stimulus programs). These themes inform the subsequent analysis in this study, which examines how they materialized in South Korea's policies and in comparison, with other global cities (Table 3).

## 2.2. Urban Regeneration Policy Responses in South Korea

Even before COVID-19, South Korea had prioritized urban regeneration to revitalize aging neighborhoods and stimulate local economies. The Urban Regeneration New Deal, launched in 2017, funded hundreds of community-led projects in city centers and old residential districts (Lee et al., 2023). These included improving housing, modernizing traditional markets, and creating cultural hubs to rejuvenate declining areas. The pandemic threatened to exacerbate urban decline through business closures, job losses, and population outflow, but it also presented an opportunity to redirect regeneration efforts toward emerging needs (Yoon, 2021; Choi, 2025). In July 2020, the Korean government unveiled the Korean New Deal, a sweeping national stimulus package for post-pandemic recovery, which encompassed both a Digital New Deal and a Green New Deal (Yoon, 2021). Within the Green New Deal (2020–2025), urban regeneration goals were reinforced with a focus on sustainability and resilience. Projects were launched to retrofit aging public housing for energy efficiency, create green jobs through local construction, and support neighborhood entrepreneurs – effectively marrying traditional regeneration with climate action and economic recovery (Yoon, 2021). By 2021, national funding for regeneration increased, recognizing that these community-level projects could play a key role in sustaining local economies during the crisis (Im & Kang, 2025).

A notable adaptation in South Korea's response was the push for adaptive reuse of vacant properties. As retail shops and offices emptied out, both central and local governments

introduced measures to convert or repurpose these spaces (Choi, 2024; Im & Kang, 2025). Seoul's municipal government, for example, offered regulatory incentives for landlords to temporarily lease vacant storefronts to pop-up businesses or social enterprises at reduced rent. This aimed to maintain street vitality and prevent blight in hard-hit commercial areas. Likewise, older office buildings were targeted for conversion into rental housing or co-working facilities to address new demand and avoid dereliction (Choi, 2024). These initiatives in Korea mirrored trends elsewhere. The UK's 2021 "Build Back Better High Streets" plan also advocated for reinventing main streets post-COVID through mixed-use conversions and loosening zoning rules. In fact, a UK–Korea collaborative research project was launched in 2022 to exchange knowledge on post-pandemic city center revival, specifically focusing on repurposing retail space (Deshmukh, 2024). The emphasis on adaptive reuse reflects a broader principle: urban resilience can be strengthened by ensuring that infrastructure and real estate can flexibly adjust to changing economic and social conditions (Sharifi & Khavarian-Garmsir, 2020; Florida et al., 2020).

In summary, the literature indicates that COVID-19 accelerated several pre-existing urban policy directions. Digital transformation of cities, decentralization of urban form, greening of infrastructure, and creative reuse of space all gained momentum as cities coped with the pandemic. South Korea's experience, backed by national policy support, provides a rich case of how these ideas were put into practice. The following sections outline the methods of analysis and then discuss the findings in detail, focusing on how Seoul and other major cities have navigated these challenges and what long-term urban spatial changes are taking shape.

## 2.3. Urban Theoretical Foundations and Conceptual Framework

A strong theoretical foundation is essential to explain how and why COVID-19 has reshaped urban spatial structures and regeneration processes. This study integrates three complementary perspectives—urban resilience theory, smart city models, and urban distribution networks—to construct a conceptual framework that elucidates the mechanisms of urban adaptation under pandemic stress.

Urban resilience is defined as a city's capacity to absorb, recover, and adapt to external shocks (Qin et al., 2024). In the pandemic context, resilience involves public-health preparedness, socio-economic flexibility, and the ability of infrastructure systems to sustain essential operations. Qin et al. (2024) conceptualize resilience as comprising governance, socio-economic, infrastructure, and energy/material flow dimensions. Each interacts dynamically: governance systems coordinate emergency response; socio-economic systems buffer shocks through adaptability; infrastructure ensures continuity of mobility and utilities; and energy/material flows secure the logistics backbone. Cities that adaptively manage these interlinked subsystems demonstrate higher recovery capacity and lower systemic vulnerability (Sharifi & Khavarian-Garmsir, 2020).

Smart-city frameworks complement resilience theory by highlighting technology-enabled adaptability. Smart cities utilize data, IoT, and AI to manage resources efficiently and respond to crises. During COVID-19, these tools supported digital contact tracing, tele-medicine, and remote governance, enabling rapid decision-making and service delivery (Megahed & Abdel-Kader, 2022). The "antivirus-built environment" proposed by Megahed and Abdel-Kader (2022) emphasizes that ICT-embedded urban systems can mitigate health risks and sustain operations under lockdown. Empirical cases show that data-driven management facilitated faster economic and social recovery (Kummitha, 2020). Consequently, technological capacity is treated as a moderating variable in the proposed model, amplifying a city's inherent resilience.

From a distribution-science perspective, urban spatial structure is closely tied to logistics and retail systems. COVID-19 radically altered consumption and mobility, triggering a 25% surge in global parcel deliveries and redefining last-mile distribution (World Economic Forum, 2021). These shifts reshaped urban geography—vacant retail spaces were converted into micro-warehouses, and local delivery hubs proliferated. The crisis revitalized the 15-minute-city model (Moreno et al., 2021), which emphasizes proximity-based urban living to reduce travel and disease exposure. Thus, distribution networks represent the material and spatial dimension of resilience, bridging economic activity and everyday accessibility.

Synthesizing these strands, COVID-19 can be conceptualized as an exogenous systemic shock acting upon an urban system whose outcomes depend on three interrelated capacities: resilience, smart-technology adaptation, and distribution-flow continuity. Urban resilience determines absorptive capacity, smart-city systems enhance adaptive responsiveness, and distribution networks sustain essential flows. Cities with strong governance, pre-existing smart infrastructure, and flexible logistics networks experienced milder disruptions and faster regeneration, whereas fragmented and less technologically equipped cities endured prolonged decline. This triadic model advances the analytical scope of distribution science by linking institutional adaptability, technological mediation, and spatial logistics within one conceptual structure.

## 3. Research Methods and Materials

This research employs a qualitative, comparative case study approach. We conducted an extensive literature review of academic articles, policy reports, and government documents published between 2020 and 2025, covering topics of urban planning, smart cities, and regeneration in the context of COVID-19. Key sources include publications by international organizations (e.g. UN-Habitat, OECD), national and city government releases (such as Korean ministry press releases and Seoul city reports), and case studies documented in planning forums. We paid particular attention to South Korea's urban policies during the pandemic, while also gathering data on three global cities – Amsterdam, Singapore, and New York – selected for their notable and varied responses to COVID-19.

The research design is structured to identify thematic impacts and then compare cross-city experiences. First, through content analysis of literature, we extracted recurring themes in how COVID-19 affected urban spatial structure (patterns of land use, mobility, and urban form) and urban regeneration strategies. These themes guided the collection of case evidence. Second, we compiled qualitative case profiles for Seoul, Amsterdam, Singapore, and New York, detailing each city's major policy measures and spatial changes during 2020–2025. These profiles draw on official statistics, planning documents, and media reports (for example, data on traffic reduction, park usage, or building vacancies, and the introduction of specific programs like Singapore's remote working initiatives or New York's Open Streets). Third, we conducted a comparative analysis, looking for common strategies and divergent approaches among the cities. A summary table was created to distill key initiatives and outcomes in each case (Table 2).

No human subjects or primary survey data were involved; all information was obtained from published sources and archival data. The analysis is thus interpretive, seeking to integrate findings from multiple sources. By triangulating between literature themes and real-world city cases, the study aims to derive robust insights. The focus on South Korea throughout the analysis allows an in-depth examination of one national context, against which international parallels and contrasts can be drawn. This methodological approach provides both breadth (global perspective) and depth (country-specific detail) to understand the pandemic's long-term implications for urban spatial structure and regeneration.

This conceptual framework visually articulates the interconnections among urban resilience, smart city models, and urban distribution networks as they respond to the external shock of COVID-19. At the top, COVID-19 is represented as a global disruptive event, symbolizing an unprecedented health and social crisis that tested the adaptive capacities of cities worldwide. The diagram's structure reflects a cascading process of influence—beginning with the pandemic as an external shock, moving through distinct but interrelated domains of urban governance, technology, and logistics, and culminating in an integrated conceptual model of urban adaptation and regeneration (Figure 1).

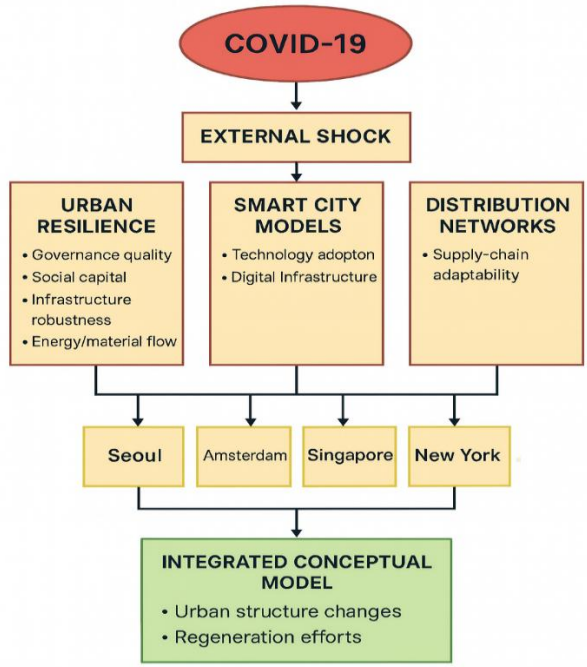


**Figure 1:** Research Conceptual Framework

The Urban Resilience dimension emphasizes institutional coordination, social capital, and infrastructure robustness as critical pillars of recovery. Smart City Models highlight the role of technological innovation—particularly data analytics, digital infrastructure, and information systems—in enabling cities to sustain functionality under crisis conditions. Urban Distribution Networks connect these dimensions to the material flow of goods and services, illustrating how supply-chain adaptability and spatial logistics underpin urban continuity.

The inclusion of Seoul, Amsterdam, Singapore, and New York as case studies situates the framework in comparative context. Each city exemplifies unique governance capacities and technological readiness, showing how resilience strategies and smart innovations interact with local distribution dynamics to shape post-pandemic urban transformation. Finally, all pathways converge into an Integrated Conceptual Model, encapsulating two central outcomes—Urban Structure Changes and Regeneration Efforts. This synthesis underscores the notion that recovery is not merely reactive but transformative, involving reconfigured spatial organization, policy innovation, and

renewed civic structures. The diagram captures the evolving paradigm of post-COVID cities: systems that are simultaneously resilient, data-driven, and logistically interconnected, oriented toward sustainable and adaptive urban futures (Table 3).

## 4. Results and Discussion

### 4.1. Digital Infrastructure and Smart City Responses

COVID-19 greatly accelerated the deployment of digital technology in urban governance (Boland et al., 2020; Anttiroiko, 2021). Cities that had invested in smart city infrastructure prior to 2020 were often able to respond more effectively through data-driven measures. South Korea's experience is illustrative: the national smart city program provided a foundation for pandemic management via the Epidemic Investigation Support System (EISS), a platform leveraging urban data (CCTV, cellular GPS, credit card records) to assist health authorities with rapid contact tracing. This innovative tool allowed Seoul and other Korean cities to map infection spread in near real-time, demonstrating how smart-city technology can enhance disaster response (Sharifi & Khavarian-Garmsir, 2020; Anttiroiko, 2021). An OECD report cited Korea's EISS as a best-practice example of adapting city data systems for crisis management (Anttiroiko, 2021). Many other cities worldwide similarly turned to digital solutions, from smartphone exposure notification apps to AI-powered monitoring of crowd densities in public spaces (Choi, 2024; Anttiroiko, 2021).

Moreover, the pandemic catalyzed longer-term digital transformations in urban living. Remote work, telemedicine, and online education became mainstream practically overnight, forcing both governments and private firms to bolster digital infrastructure and services (Boland et al., 2020; Yoon, 2021). In South Korea, these shifts were met with significant public investment. The Digital New Deal (part of the 2020 Korean New Deal stimulus) committed billions of won to expand 5G and AI infrastructure, with targets to enable up to 40% of work to be done remotely and to digitize 80% of public services (Yoon, 2021; Anttiroiko, 2021). By 2025 the government planned to establish high-precision digital maps for all cities and create 108 smart city management centers nationwide, while extending high-speed internet access even to rural villages (Yoon, 2021; Anttiroiko, 2021). These measures acknowledge that many emergency-era practices (like telecommuting and virtual services) will persist post-pandemic, permanently altering urban service delivery and daily life.

However, research and policy discussions caution that simply having advanced technology is not enough; its benefits must be inclusive (Anttiroiko, 2021; Jowell et al., 2025). The pandemic exposed digital divides – populations without reliable internet or devices struggled to access remote schooling, telehealth, or e-commerce. Thus, an emerging focus in smart city discourse is on "inclusive smart cities," ensuring that digital innovations improve well-being for all residents, not just tech-savvy groups. For example, Korea's Digital New Deal included initiatives to increase digital literacy among seniors and to provide affordable data plans, recognizing that universal connectivity is essential for resilience (Yoon, 2021). Other countries likewise pursued "smart recovery" strategies that embed digital inclusion goals (e.g. distributing tablets to low-income students, expanding public Wi-Fi) alongside high-tech projects. The pandemic, therefore, left a legacy of both upgraded digital infrastructure and a policy impetus to close digital gaps. Moving forward, urban planners are likely to treat digital connectivity as critical infrastructure, akin to utilities, and a pillar of urban resilience. Cities that successfully integrate smart systems into everyday governance – for monitoring public health, managing traffic flows, disseminating information, etc. – will be better prepared for future crises, whether sanitary, environmental, or otherwise (Anttiroiko, 2021; Sharifi & Khavarian-Garmsir, 2020).

### 4.2. Spatial Restructuring: Mobility, Public Space, and Land Use

Perhaps the most visible spatial impacts of the pandemic were on mobility patterns and land use in cities. The sudden reduction in commuting left downtown office districts nearly empty, while residential neighborhoods saw more daytime activity than ever before. These shifts prompted urban planners to reconsider the traditional monocentric city model dominated by a dense CBD. In its place, polycentric or networked urban structures gained appeal (Sharifi & Khavarian-Garmsir, 2020; Stoney et al., 2023). The idea of 15-minute or 24-hour neighborhoods – where most needs can be met locally – moved from theory to practical policy. For instance, Singapore's Urban Redevelopment Authority (URA) began studying how city centers and suburbs might evolve as more companies embrace remote working, envisioning a greater mix of uses in both downtown and outlying areas (Urban Redevelopment Authority Singapore, 2020; Urban Redevelopment Authority Singapore, 2021). Planners in Singapore see opportunity to add housing and amenities in the central business district (to keep it lively with fewer office workers), while strengthening suburban hubs with co-working spaces and services so that working near home is convenient (Urban Redevelopment Authority Singapore, 2020; Urban Redevelopment Authority Singapore, 2021). This strategy builds on Singapore's long-term plan (pre-COVID) to decentralize jobs to regional

centers – a trend now validated and accelerated by the pandemic experience (Jowell et al., 2025; Urban Redevelopment Authority Singapore, 2021).

Similar principles emerged elsewhere. In Amsterdam, officials explicitly viewed COVID-19 as a catalyst to not "fall back on easy mechanisms" of growth, but to chart a new path for the city that balances social, economic, and environmental needs (Boffey, 2020). This included rethinking land use in the historic center and surrounding boroughs. Amsterdam's post-COVID strategy embraced Doughnut Economics, a model focusing on meeting residents' basic needs within ecological limits (Boffey, 2020). In practice, this translated to initiatives like converting empty office buildings into affordable housing and community spaces, expanding cycling infrastructure, and supporting local food production – all of which reduce the city's dependence on long commutes and global supply chains (Boffey, 2020). City officials reported that these efforts maintained public support and kept sustainability at the core of planning, suggesting a more inclusive and green recovery is achievable (Sharifi & Khavarian-Garmsir, 2020; Jowell et al., 2025). Likewise, other cities saw the pandemic as an opportunity to correct imbalances in their urban form. Glasgow (UK), for example, announced a "City Centre Living" strategy in mid-2020 aiming to double its downtown population by 2035, largely by repurposing vacant commercial floors into homes – an approach explicitly linked to COVID-19 recovery and revitalization (Deshmukh, 2024). These examples reflect a broader trend: leveraging the downturn in commercial real estate to address pre-existing issues like housing shortages and to create more mixed-use, less commuter-reliant urban districts (Sharifi & Khavarian-Garmsir, 2020; Stoney et al., 2023).

Another major spatial restructuring involved the reallocation of street space and expansion of the public realm. During lockdowns, cities worldwide experimented with converting streets for pedestrian and bicycle use, both to enable socially distanced movement and to provide outdoor venues for businesses (such as restaurant seating) (Sharifi & Khavarian-Garmsir, 2020; Florida et al., 2020). New York City's Open Streets program, launched in 2020, became a prominent example of this re-prioritization of streets for people over cars (Reardon et al., 2008). At its peak, over 300 street segments in NYC were periodically closed to traffic, allowing residents to exercise, stroll, and dine safely outdoors. Similar initiatives – often termed "open streets" or "slow streets" – took place from Paris to Bogotá, revealing a latent demand for pedestrian-friendly urban design. Many cities recorded improved air quality and stronger community engagement on these car-free streets, spurring debate about making some changes permanent (Reardon et al., 2008; De Vos, 2020). In New York, although the number of active Open Streets dropped after 2021 as volunteer support waned, advocacy groups and city officials are now discussing dedicated funding and policies to sustain this program in the long run. The key lesson is that urban space can be used more flexibly than previously thought, and residents responded positively to reclaiming streets as public space. As a result, many city governments are institutionalizing these changes: adopting new street design standards, expanding bike lane networks, and revising traffic regulations to prioritize pedestrians and cyclists as part of the post-pandemic recovery agenda (Stoney et al., 2023; Jowell et al., 2025).

### 4.3. Urban Regeneration and Adaptive Reuse Strategies

The COVID-19 pandemic not only disrupted urban systems but also redefined the paradigms of urban regeneration, infusing them with the principles of resilience, adaptability, and smart transformation. Post-pandemic recovery efforts have increasingly converged with spatial strategies to revitalize underutilized urban areas, integrating economic restoration with environmental and technological innovation. From the perspective of urban resilience theory, this marks a transition from reactive redevelopment to proactive adaptation—where regeneration functions as a structural tool to absorb shocks, redistribute functions, and ensure long-term sustainability.

South Korea's response provides a compelling example of this evolution. The Green New Deal, launched in 2020, represents a deliberate synthesis of economic recovery, climate policy, and urban regeneration (Yoon, 2021). It not only channeled fiscal resources into traditional redevelopment but also embedded the smart city logic of digitalization and efficiency into regeneration projects. Funding prioritized initiatives such as retrofitting public housing with green technologies, building smart community facilities—including tele-health centers and digitalized libraries—and enhancing public health infrastructure in socially vulnerable districts (Yoon, 2021; Anttiroiko, 2021). These interventions align with the "infrastructure resilience" and "energy/material flow" dimensions of the resilience framework, as they simultaneously enhance environmental performance and ensure continuity of essential urban functions.

At the local scale, community-led regeneration programs emerged as essential vehicles of socio-economic resilience, supporting local employment, sustaining neighborhood services, and maintaining the social fabric during crisis conditions (Im & Kang, 2025; Choi, 2024). The government's decision to expand their budgets in 2021–2022 reflects a recognition that resilience is not solely institutional but deeply community-embedded. In Seoul, the city's mid-term regeneration plan underwent significant

revision to incorporate "contactless infrastructure" within neighborhood projects—installing automated parcel lockers, shared teleworking hubs, and tele-health kiosks (Choi, 2024). This hybridization of digital innovation and physical place-making demonstrates how smart city models operate as mediating mechanisms between technological systems and urban life. In essence, it reveals that the future of regeneration lies not merely in rebuilding structures but in weaving digital connectivity into the everyday spatial experience of communities (Table 1).

A pivotal manifestation of this adaptive turn is found in the adaptive reuse of vacant commercial spaces, a domain that bridges resilience and distributional reconfiguration. The pandemic-induced contraction of retail and office activity generated widespread vacancies in central business districts across the world. Rather than allowing these voids to metastasize into urban blight, cities adopted flexible reuse policies that reimagined empty spaces as potential nodes of renewal. In Seoul, municipal partnerships with local stakeholders enabled the conversion of unused storefronts into pop-up retail spaces, artist studios, and community centers, supported through short-term, subsidized leases (Im & Kang, 2025). These initiatives revitalized the micro-scale distribution networks of the city—keeping foot traffic, entrepreneurship, and social interaction alive within urban cores even during downturns.

On a macro scale, cities like New York advanced more systemic forms of reuse, with state and municipal governments introducing zoning reforms and tax incentives to encourage the conversion of obsolete office towers into residential housing. This adaptive policy directly addresses two enduring challenges—office oversupply and housing undersupply—by transforming spatial redundancy into social opportunity. Scholars such as Richard Florida framed this as a "powerful resetting opportunity," arguing that the crisis could catalyze a more equitable and livable urban order through mixed-use redevelopment and land-use diversification (Florida et al., 2020; Sharifi & Khavarian-Garmsir, 2020). In this sense, distribution network theory provides a useful lens: as the traditional spatial hierarchy of work, commerce, and residence dissolves, cities are reconstructing their internal flows—of people, goods, and information—around shorter, more resilient circuits of proximity and accessibility.

The New York experience underscores a broader global pattern: crises often accelerate structural reforms that were long overdue. The adaptive reuse movement now spreading to major cities worldwide signals a philosophical shift in regeneration—from a growth-oriented paradigm to one rooted in resilience, inclusivity, and multi-functionality. In this context, post-COVID regeneration is no longer viewed merely as an economic recovery mechanism but as an integrative strategy that reconciles housing affordability, urban vitality, and sustainable land use within a single framework of transformation (Table 1).

**Table 1:** Comparative Themes and Strategic Lessons from COVID-19 Urban Responses

| Theme | Core Insight | Typical Actions | Expected Outcomes |
|---|---|---|---|
| Pandemic shock & agenda reset | Rapid disruption to commuting, downtown activity, and service delivery reframed urban priorities toward resilience and sustainability. | Reallocate street space; expand public health capacity; digitize services; support local economies. | Faster adaptation to shocks; healthier public realm; stronger local amenities. |
| Urban spatial dynamics | Shift from monocentric, commute-centric patterns toward more polycentric, mixed-use neighborhoods. | Promote 15-minute access; diversify job and service locations; integrate housing near jobs. | Reduced peak congestion; balanced activity across the metro; quality of life gains. |
| Digital transformation | Smart systems became baseline infrastructure for crisis response and everyday governance. | Scale data platforms; remote work and learning; telehealth; digital inclusion programs. | Faster, fairer access to services; real-time management capacity. |
| Green recovery & nature-based solutions | Recovery investments bundled with climate adaptation and mitigation. | Urban forests, cooler streets; active mobility networks; energy retrofits. | Lower emissions; heat and flood risk reduction; co-benefits to health. |
| Economic shock to retail & logistics | E-commerce surge and downtown vacancies pushed adaptive reuse and last-mile logistics. | Convert shops/offices; enable pop-ups; reposition logistics hubs. | Revived high streets; diversified downtowns; resilient distribution. |
| Urban regeneration redefined | From physical renewal to integrated social, digital, and health infrastructure at neighborhood scale. | Community hubs; telehealth; shared workspaces; inclusive programming. | Inclusive, flexible community assets; durable local vitality. |
| Flexible planning & governance | Regulatory agility and scenario-based planning proved decisive. | Temporary use codes; accelerated permits; adaptable standards. | Faster policy cycles; learning-by-doing embedded in practice. |
| Equity & inclusion | Community partnerships sustained response; recovery aims to close spatial and digital gaps. | Grant programs; community stewardship; inclusion by design. | Broader participation; shared benefits; reduced disparities. |
| Comparative case logic | Diverse governance models reveal convergent strategies and transferable tools. | Cross-city learning; shared playbooks; adaptable templates. | Scalable patterns cities can tailor to local context. |

| Theme | Core Insight | Typical Actions | Expected Outcomes |
|---|---|---|---|
| Practical implications | Lock in emergency innovations and align capital plans with resilience and climate goals. | Update master plans and codes; fund maintenance for new public-realm assets; measure co-benefits. | Lasting gains in livability, resilience, and economic adaptability. |

**Table 2:** Post-COVID Urban Initiatives and Outcomes

| City | Key Post-COVID Urban Initiatives | Major Themes & Outcomes |
|---|---|---|
| Seoul (South Korea) | - Smart City & Health Tech: Deployed Epidemic Investigation Support System (EISS) for rapid contact tracing.<br>- Korean New Deal: Invested in digital infrastructure and green projects (e.g. creation of 25 smart eco-cities, 723 ha of urban forests).<br>- Regeneration Adaptation: Continued Urban Regeneration New Deal (2017) with an added Green New Deal component in 2020–21 to address pandemic impacts; relaxed planning regulations to expand hospital capacity (e.g. negative-pressure beds). | - Resilience through Technology: Smart systems used for crisis response improved governance efficiency and public safety.<br>- Sustainable Recovery: Economic stimulus was aligned with climate goals (energy-efficient housing, green spaces), tying short-term recovery to long-term environmental sustainability<br>- Adaptive Planning: Greater flexibility in land-use rules and support for community-led projects enhanced local resilience and allowed faster adaptation of urban spaces during emergencies. |
| Amsterdam (Netherlands) | - Doughnut Economics Model: Adopted in 2020 as a framework for post-COVID planning, focusing on meeting social needs within ecological limits<br>- Active Mobility & Public Space: Expanded bicycle networks and pedestrian zones during the recovery, building on successful COVID-era experiments in car-free streets<br>- Circular Economy Projects: Post-pandemic stimulus invested in circular initiatives (reducing waste, supporting local production) to future-proof the city's economy and supply chains. | - Inclusive & Green Regeneration: Climate sustainability and equity were integrated into all urban policies (embracing the "thriving in balance with the planet" ethos)<br>- Amsterdam's recovery explicitly tied economic revival to environmental and social targets, setting a global example.<br>- Reduced Car Dependence: The city accelerated its shift toward a car-light city center, improving air quality and livability. Many temporary COVID mobility changes (bike lanes, low-traffic streets) are being made permanent, aligning with climate goals.<br>- Holistic Model: Amsterdam pioneered a visionary, holistic recovery approach. Its use of Doughnut Economics as a guiding framework is being studied by other cities as a potential best practice for post-crisis urban planning. |
| Singapore | - Decentralized Urban Hubs: Reinforced plans for multiple regional centers and mixed-use towns to reduce pressure on the CBD, leveraging the remote work trend to encourage jobs outside the downtown<br>- CBD Incentive Scheme: Utilized an incentive (introduced 2019, highlighted during COVID) that offers higher plot ratios for office-to-residential conversions in the CBD, in order to add housing and diversify uses downtown<br>- Smart Nation Solutions: Employed digital tools (contact tracing apps, even robots in parks) during the pandemic; subsequently expanded telemedicine and e-government services as permanent features of urban life. | - Polycentric City: There is a deliberate move toward a more balanced urban structure between downtown and suburbs. More amenities and offices are being introduced in residential areas (a "15-minute city" approach) to enhance local livability and reduce commuting dependency.<br>- Agile Real Estate Market: Policies enabling quick adaptation of land use (such as converting vacant offices to other uses) have helped Singapore prevent urban blight. The city's regulatory framework was updated to allow faster redevelopment of obsolete properties, improving resilience of the real estate sector.<br>- Tech-Driven Resilience: Singapore's strong emphasis on innovation and data (from pandemic tech tools to long-term digital services) has bolstered public trust in technology. This tech-centric approach to urban management helped the city respond effectively to COVID-19 and is now embedded in its planning ethos for future challenges. |
| New York City (USA) | - Open Streets & Outdoor Dining: Launched in 2020 as emergency measures to provide socially-distanced outdoor space; by 2022 many were extended or made semi-permanent, with plans to institutionalize open streets across the city.<br>- Housing Conversions: Initiated efforts (2021–22) to rezone and incentivize conversion of underused commercial buildings (especially offices in Midtown) into residential uses, aiming to address the housing shortage and revitalize empty business districts.<br>- Infrastructure Investments: Directed federal stimulus and local funds to transit upgrades, building ventilation improvements, and green infrastructure (e.g. coastal resilience projects) as part of recovery, often targeting the hardest-hit communities first. | - Public Realm Expansion: New York's reclaiming of street space for public use improved community health and supported local commerce during COVID-19. It set a precedent for reallocating urban space to pedestrians and has influenced permanent street design changes toward people-centric planning.<br>- Adaptive Reuse: The city is turning crisis into opportunity by aggressively pursuing adaptive reuse of real estate. Plans to convert offices to housing are seen as a way to make the urban core more mixed-use, resilient, and equitable, potentially easing high rent pressures and enlivening downtown with new residents<br>- Equitable Resilience: New York has emphasized helping the hardest-hit neighborhoods (often outside Manhattan) with recovery investments, such as improved transit access and open space, aiming for a more inclusive economy post-pandemic. The focus on equity in distributing recovery resources has been a key theme in the city's long-term resilience strategy. |

**Table 3:** Comparative Overview of Theoretical Foundations and Key Dimensions

| Theoretical Lens | Core Concept | Main Components / Dimensions | Role in COVID-19 Context |
|---|---|---|---|
| **Urban Resilience Theory** | Cities as adaptive systems capable of absorbing and recovering from shocks (Qin et al., 2024) | (1) Governance resilience (leadership, coordination, institutions)<br>(2) Socio-economic resilience (business, labor, communities)<br>(3) Infrastructure resilience (transport, utilities, health facilities)<br>(4) Energy / material flow resilience (supply chains, logistics) | Explains why cities with adaptive governance and redundancy mechanisms recover faster and sustain core urban functions during disruption |
| **Smart City Models** | Data-driven, ICT-enabled management of urban systems (Megahed & Abdel-Kader, 2022) | IoT / AI-based monitoring; real-time data analytics; e-governance; smart healthcare and mobility platforms | Demonstrates how digital infrastructure amplifies resilience, allowing continuity of work, health, and education during lockdowns |
| **Urban Distribution Networks** | Spatial and logistical flows of goods and services shaping urban form (World Economic Forum, 2021) | Retail distribution, last-mile delivery, logistics hubs, and supply-chain resilience | Reveals the pandemic-driven transformation of consumption and mobility patterns; links to 15-minute-city proximity models |
| **Integrated Conceptual Model** | COVID-19 as an external shock interacting with resilience capacity, smart systems, and distribution flows | Governance quality, digital readiness, and supply-chain adaptability jointly determine urban outcomes | Synthesize prior theories into a triadic framework for analyzing spatial, technological, and institutional adaptation |

## 4.4. Comparative Case Studies: Seoul and Global Cities

To illustrate the above themes in context, this section compares how Seoul, Amsterdam, Singapore, and New York responded to the pandemic's urban challenges. Despite different local contexts, common principles can be observed across these cities, alongside unique innovations in each case. Table 2 provides a summary of key post-COVID urban initiatives and outcomes in the four cities.

### 4.4.1. Seoul, South Korea – Smart, Safe, and Green City Initiatives

Seoul's pandemic experience was characterized by agile use of technology and strong government coordination. The city's advanced data systems (e.g., a citywide Smart City platform) were repurposed for public health surveillance and communication, contributing to Seoul's reputation for effective COVID-19 management (Kim, 2024; Stoney et al., 2023). In terms of spatial policy, Seoul accelerated projects to make the city both smarter and greener as part of the national New Deal recovery strategy. By 2025, the government planned to remodel 225,000 public rental homes with energy-efficient designs and create hundreds of smart schools, libraries, and hospitals nationwide (Lee et al., 2023; Yoon, 2021). Seoul's ongoing urban regeneration programs were infused with "contactless" infrastructure — for example, installing smart delivery lockers and tele-health clinics in rejuvenated neighborhoods to support safer, digitally enabled living (Sharifi & Khavarian-Garmsir, 2020). The city also witnessed demographic shifts: Seoul's official population fell below 10 million in 2021 (for the first time in decades), partly due to foreign workers leaving amid the pandemic (Kim, 2024; KRIHS, 2022). This decline prompted city leaders to redouble efforts to attract residents and visitors back through improvements in housing affordability, quality of life, and urban design in central areas (KRIHS, 2022; Citaristi, 2022). Signature initiatives launched in the wake of COVID-19 include the Seoul Smart City Plan 2030 and the Net-Zero Seoul 2050 strategy, which together commit to a tech-driven, climate-resilient model of urban regeneration emphasizing safety and inclusivity (Kim, 2024; Jowell et al., 2025). Seoul's case exemplifies an integrated approach: digital innovation, green investment, and community revitalization are pursued in tandem to enhance urban resilience.

### 4.4.2. Amsterdam, Netherlands – Doughnut Economics and Inclusive Recovery

Amsterdam garnered global attention by being the first city to formally adopt the Doughnut Economics framework in its post-COVID strategy (Boffey, 2020; Raworth, 2017). Rather than aiming to simply restore pre-pandemic growth, Amsterdam's recovery policies are evaluated against a balanced set of social and environmental metrics, ensuring the city meets basic human needs without overshooting ecological ceilings (Stoney et al., 2023; Jowell et al., 2025). In practice, Amsterdam's urban regeneration efforts since 2020 have aligned with doughnut principles. Initiatives include converting empty offices into affordable housing, expanding the bicycle network and pedestrian areas, and supporting local circular economies such as urban farming

and zero-waste programs (Deshmukh, 2024; Jowell et al., 2025). City officials explicitly stated that COVID-19 was a catalyst to "not fall back on easy mechanisms" of the past, but to pursue a transformative agenda addressing climate change and social justice together (Jowell et al., 2025; Florida et al., 2020). Early evidence suggests Amsterdam's approach has maintained public support and kept sustainability at the core of urban planning, offering a model for other cities seeking a holistic recovery (De Vos, 2020; Sharifi & Khavarian-Garmsir, 2020). Amsterdam also took short-term actions that complemented its long-term vision: during the pandemic, the city rapidly expanded outdoor dining and walking space, and post-pandemic it is moving to make many of those changes permanent, such as making the city center more car-light. The Amsterdam case underscores how a clear, values-driven framework like the doughnut model can guide urban spatial policy after a shock, ensuring that economic recovery efforts simultaneously advance equity and ecological goals.

#### 4.4.3. Singapore – Smart Nation Resilience and Decentralization

Renowned for its Smart Nation program, Singapore approached the pandemic as an opportunity to refine its urban form toward greater decentralization and flexibility. Even before COVID-19, Singapore's land use plans aimed to develop multiple regional centers to alleviate pressure on the downtown core. The pandemic reinforced this direction by demonstrating the viability of remote work and the importance of community-level amenities. Urban planners at the URA have examined how "city centers and suburbs could evolve as more companies embrace digitalization and remote working" (URA Singapore, 2021; Fujii & Ray, 2021). One outcome has been increased support for "city center living" — policies to add residential units in the CBD so it remains lively even if office demand drops (Fujii & Ray, 2021). For example, the government's CBD Incentive Scheme (introduced 2019) offers developers higher plot ratios if they convert offices into residences or hotels, a measure that found new relevance during COVID-19 when many office buildings were underused (URA Singapore, 2021; Fujii & Ray, 2021). Concurrently, Singapore is enhancing its suburban hubs with co-working spaces, public services, and recreation so that working near home becomes more attractive and convenient (Anttiroiko, 2021; Sharifi & Khavarian-Garmsir, 2020). Technologically, Singapore leveraged its prowess for pandemic containment, from digital contact tracing apps to deploying robotic monitors in parks, but from a spatial perspective, the biggest shift has been the validation of polycentric development as a resilience strategy (Stoney et al., 2023; Sharifi & Khavarian-Garmsir, 2020). In essence, the country demonstrated that a highly centralized city-state can maintain economic resilience by distributing workplaces and investing in smart infrastructure island-wide, rather than over-concentrating in one downtown. This principle is being noted by other global megacities now revisiting their post-pandemic master plans.

#### 4.4.4. New York City, USA – Public Space Reallocation and Adaptive Reuse

New York City was an early epicenter of COVID-19 and faced acute socio-spatial challenges. The city's policy responses have since become case studies in urban adaptability. The Open Streets and outdoor dining programs launched in 2020 showed how quickly street space allocation can be changed to meet public health needs (New York City DOT, 2021; Reardon et al., 2008). These programs not only provided safe outdoor space during the crisis but also revealed co-benefits: they spurred a re-imagining of streets as public realms rather than mere traffic conduits (Florida et al., 2020; Reardon et al., 2008). By 2025, NYC is looking to make many of these street closures permanent features, and the city has begun instituting new rules and funding mechanisms to support community groups in managing Open Streets (Florida et al., 2020). Another major focus for New York has been the adaptive reuse of real estate in the wake of COVID-19. Manhattan's office vacancy rates hit record highs by 2021 as remote work persisted, prompting city and state officials to propose plans to ease the conversion of older office buildings into residential units, particularly affordable housing, as a way to rejuvenate underused business districts (Boland et al., 2020; New York City DOT, 2021). Urban experts such as Richard Florida advocated for such zoning changes and incentives, framing the office downturn as an opportunity to address NYC's housing shortage and create a more equitable urban core (Florida et al., 2020; Choi, 2025). Consequently, New York's recovery strategy includes not only bringing back jobs and transit ridership to the core, but also potentially reconfiguring the core itself to be more mixed-use and resilient. The city is investing in infrastructure with dual goals: for instance, improving ventilation in buildings and subways for health safety (which also improves energy efficiency), and expanding parks in flood-prone areas to serve both recreation and climate adaptation purposes (Citaristi, 2022; Jowell et al., 2025). In sum, NYC illustrates how a large, established metropolis can evolve under duress — accelerating trends in pedestrianization, experimenting with land use, and pivoting urban policy to prioritize health and sustainability. The challenge ahead is securing the political and financial support to make these emergency innovations permanent. As of 2025, New York's civic debate continues on how to fund Open Streets and similar programs long-term (Kim, 2024), but there is clear momentum toward embedding these changes into the city's fabric.

## 5. Conclusions

Despite their differing contexts and institutional legacies, the cities examined—Seoul, Amsterdam, Singapore, and New York—demonstrated a shared logic in their pandemic responses, converging around principles that mirror the interdependence of resilience, technological adaptability, and distributional efficiency. Drawing from urban resilience theory, it becomes evident that flexibility in spatial and regulatory planning served as a fundamental adaptive mechanism. Cities that swiftly repurposed urban spaces—converting streets into pedestrian corridors or reprogramming underused facilities for emergency functions—embodied the core of governance and infrastructure resilience, validating calls for more scenario-based planning codes that institutionalize agility and redundancy (Sharifi & Khavarian-Garmsir, 2020; Stoney et al., 2023).

Equally significant was the operationalization of smart city models, wherein data-driven governance and digital connectivity underpinned urban continuity. Initiatives such as Seoul's Epidemiological Intelligence Support System (EISS), Singapore's TraceTogether platform, and New York's integrated health analytics exemplify how ICT infrastructures now function as the nervous systems of resilient cities (Anttiroiko, 2021; Fujii & Ray, 2021). These systems transformed raw data into real-time decision tools—illustrating that the "smart" dimension of urbanism is not an accessory to resilience but its essential enabler, enhancing adaptive capacity and coordination under uncertainty.

At the same time, the distributional dimension of resilience—rooted in urban distribution network theory—surfaced as communities and local economies reorganized around shorter, more localized circuits of production and exchange. Amsterdam's neighborhood cooperatives, Seoul's community regeneration projects, and New York's open-streets initiatives reactivated the "last-mile" infrastructure of civic life, demonstrating that social and material proximity are dual foundations of urban recovery (Florida et al., 2020; Choi, 2024). By empowering local businesses and citizens, these cities reinforced socio-economic resilience as both an outcome and a precondition for systemic stability.

Moreover, their recovery strategies illustrate a growing synthesis between short-term crisis management and long-term sustainability transitions. Rather than treating pandemic recovery and climate mitigation as separate agendas, governments mobilized stimulus resources to advance green and equitable urban regeneration—for instance, using relief funds for public green infrastructure, low-carbon housing retrofits, and climate-adaptive public spaces (Citaristi, 2022; De Vos, 2020). This integrated logic resonates with the energy and material flow resilience dimension in resilience theory, where each investment produces multiple co-benefits—economic, social, and environmental—thus optimizing limited fiscal capacities while advancing sustainable urbanism (Jowell et al., 2025; Stoney et al., 2023).

Between 2020 and 2025, these shifts coalesced into a structural transformation of urban form and governance. The pandemic acted as both a disruptor and an accelerator, catalyzing the evolution from monocentric, commuter-dependent cities toward polycentric, mixed-use, and digitally mediated urban systems (Sharifi & Khavarian-Garmsir, 2020; Anttiroiko, 2021). Remote work and distributed logistics reshaped the spatial logic of cities, while regeneration expanded from physical redevelopment to encompass digital connectivity, public health preparedness, and climate resilience (Choi, 2024; Citaristi, 2022). Korea's dual-track Digital and Green New Deal policies exemplify this synthesis, uniting technological innovation and environmental sustainability under a cohesive resilience strategy (Yoon, 2021).

From a policy perspective, the convergence of these theoretical domains yields several implications. Smart infrastructure has proven indispensable to crisis management, underscoring that inclusive ICT investment is a prerequisite for equitable resilience (URA Singapore, 2021; Stoney et al., 2023). Regulatory frameworks must also evolve—embedding adaptive governance and planning flexibility as permanent institutional features (Sharifi & Khavarian-Garmsir, 2020; Choi, 2024). Furthermore, the coupling of urban regeneration with climate action demonstrates that sustainability, resilience, and economic recovery are not competing priorities but complementary dimensions of the same adaptive system (Citaristi, 2022; Stoney et al., 2023). The interplay between governance capacity, technological integration, and distributional equity—the core elements of our conceptual framework—has therefore emerged as the true architecture of post-pandemic urban resilience (Florida et al., 2020; Choi, 2024).

Ultimately, the long-term legacy of COVID-19 will not merely be in the vulnerabilities it exposed but in the systemic learning it provoked. The comparative trajectories of Seoul, Amsterdam, Singapore, and New York reveal an adaptive urbanism that blends technological intelligence, institutional trust, and distributive justice. If urban resilience represents the city's immune system, then smart city innovation is its cognitive layer, and distributional reorganization its circulatory network. Together, these dimensions constitute an integrated conceptual model of post-COVID urban regeneration—one that aspires to make cities not only more efficient and connected but also more

just, sustainable, and human-centered (De Vos, 2020; Florida et al., 2020).

## References


Anttiroiko, A. V. (2021). Successful government responses to the pandemic: Contextualizing national and urban responses to the COVID-19 outbreak in east and west. *International Journal of E-Planning Research (IJEPR)*, *10*(2), 1-17.

Boffey, D. (2020). Amsterdam to embrace'doughnut'model to mend post-coronavirus economy. *The Guardian*, *8*.

Boland, B., De Smet, A., Palter, R., & Sanghvi, A. (2020). Reimagining the office and work life after COVID-19. *McKinsey & Company*, *8*.

Choi, C. (2024). Building Back Better: Distribution Dynamics in Post-Pandemic Urban Resilience. *Journal of Distribution Science*, *22*(4), 69-77.

Choi, C. (2025). Trading Carbon, Trading Justice: Ethical Dimensions of Market-Based Climate Solutions. *East Asian Journal of Business Economics (EAJBE)*, *13*(1), 1-16.

Citaristi, I. (2022). United nations human settlements programme—UN-habitat. In *The Europa directory of international organizations 2022* (pp. 240-243). Routledge.

Deshmukh, G. (2024). Repurposing City Centres Symposium, London, 14 July 2023. *Town Planning Review*, *95*(2), 219-223.

De Vos, J. (2020). The effect of COVID-19 and subsequent social distancing on travel behavior. *Transportation Research Interdisciplinary Perspectives, 5*, 100121.

Florida, R., Rodríguez-Pose, A., & Storper, M. (2023). Critical Commentary: Cities in a post-COVID world. *Urban studies*, *60*(8), 1509-1531.

Fujii, T., & Ray, R. Singapore as a sustainable city: Past, present and the future. (2021). *The Singapore economy: Dynamism and inclusion*, 143-192.

Im, B., & Kang, S. (2025). Effects of urban regeneration projects on store survival rate in neighborhood commercial areas: the case of South Korea. *Journal of Asian Architecture and Building Engineering*, *24*(4), 3264-3280.

Jowell, A., Veidis, E., Alani, O., & Barry, M. (2025). Cities, health, and equity. In *The Elgar Companion to Health and the Sustainable Development Goals* (pp. 274-297). Edward Elgar Publishing.

Kim, H. M. (2024). *Urban Renewal in Central Seoul: Planning Paradigm Shifts*. Routledge.

Kummitha, R. K. R. (2020). *Smart technologies for fighting pandemics: The role of techno- and human-driven approaches in controlling virus transmission. Government Information Quarterly, 37*(3), 101481. https://doi.org/10.1016/j.giq.2020.101481

Lee, J., Chung, H., & Gim, T. H. T. (2023). Shaping the New Normal: Exploring the Long-Term Effects of COVID-19 on Perception and Behavior in Urban Spaces in Seoul and Shanghai. *Journal of Korea Planning Association*, *58*(5), 48-66.

Lee, J., & Sohn, J. (2025). Investigating the Internal Difference in Commuting Flows within an Employment Center During COVID-19 in Seoul. *Papers in Applied Geography*, 1-21.

Megahed, N. A., & Abdel-Kader, R. F. (2022). *Smart cities after COVID-19: Building a conceptual framework through a multidisciplinary perspective. Scientific African, 17*, e01374. https://doi.org/10.1016/j.sciaf.2022.e01374

Moreno, C., Allam, Z., Chabaud, D., Gall, C., & Pratlong, F. (2021). Introducing the "15-Minute City": Sustainability, Resilience and Place Identity in Future Post-Pandemic Cities. *Smart Cities*, *4*(1), 93-111. https://doi.org/10.3390/smartcities4010006

Reardon, K. M., Ionescu-Heroiu, M., & Rumbach, A. J. (2008). Equity planning in post-hurricane Katrina New Orleans: Lessons from the ninth ward. *Cityscape*, 57-76.

Sharifi, A., & Khavarian-Garmsir, A. R. (2020). The COVID-19 pandemic: Impacts on cities and major lessons for urban planning, design, and management. *Science of The Total Environment, 749*, 142391.

Stoney, C., Asquith, A., Kipper, K., McNeill, J., Martin, J., & Spano, A. (2023). Policy-making, policy-taking, and policy-shaping: Local government responses to the COVID-19 pandemic. *Australian Journal of Public Administration*, *82*(4), 440-461.

Qin, R., Cui, P., Zhou, S., & Zhang, F. (2024). Dynamic Analysis for Enhancing Urban Resilience Against Public Health Emergencies of International Concern. *Land*, *13*(12), 2220. https://doi.org/10.3390/land13122220

Urban Redevelopment Authority (URA) Singapore. (2021). *URA's CBD Incentive Scheme and City Decentralization Plans* (Planning brief).

World Economic Forum. (2021). *The future of the last-mile ecosystem.* Geneva, Switzerland: World Economic Forum. https://www3.weforum.org/docs/WEF_Future_of_the_last_mile_ecosystem.pdf

Yoon, K. (2021). Discourse of the post-COVID 19 new deal in South Korea. *East Asia*, *38*(4), 373-388.