

Evaluating Public Space Resilience: an index and a case study

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Abstract

Urban resilience is a critical concept in urban planning, yet it often blurs the line between crisis-triggering events and adaptive processes. To address this, the concepts of multiresilience and multiadaptation clarify how public spaces can handle multiple, overlapping risks. Multiresilience focuses on restoring pre-crisis conditions through inclusive, place-specific strategies, while multiadaptation emphasizes adjusting to unforeseen risks by achieving a new, often improved, equilibrium. This study introduces the Multiadaptation Place Index (MPI), a tool developed under the PRIN 2020 SUMMA research project to measure the adaptability of public spaces. The MPI assesses physical, social, and infrastructural factors to guide planners in designing inclusive, flexible interventions. The Hudson River Park in New York serves as a key case study, illustrating how adaptable urban spaces can enhance resilience and liveability under multi-risk scenarios.

Key words: Public space, resilience, liveability, inclusion

Main factors resilient planning

The implementation of resilient planning necessitates a shift from traditional, top-down approaches to more flexible, inclusive, and iterative processes. Key factors in this approach include inclusivity, flexibility, redundancy, diversity, and local knowledge (Banica et Al., 2020; Cutter et Al., 2003; Davoudi et Al., 2012). Inclusivity in planning ensures that all voices are heard, and the needs of marginalized groups are addressed. This can be achieved through participatory planning processes that engage community members in meaningful ways. Workshops, questionnaires, public consultations, and collaborative platforms can facilitate this engagement, allowing stakeholders to contribute their knowledge and perspectives. In areas facing multiple and overlapping risks—such as climate change, economic shocks, and social instability—inclusivity becomes even more critical, as it allows for the identification of vulnerabilities that may otherwise be overlooked and for the co-creation of solutions that are context-specific and equitable.

Flexibility in urban planning involves designing infrastructures and policies that can be easily adapted or modified in response to changing conditions. This might include the use of modular construction techniques, adaptable public spaces, and policies that can be updated based on new information or emerging risks. Flexibility ensures that urban systems remain responsive and resilient in the face of uncertainty. In multi-hazard environments, flexibility is essential to accommodate the dynamic nature of risks, where simultaneous or sequential shocks (such as floods followed by disease outbreaks) demand rapid and coordinated responses.

Redundancy involves creating multiple pathways and backup systems to prevent total system failure. In practice, this might mean designing urban transportation networks with multiple routes and modes of transport, ensuring that critical services like healthcare and communication have backup systems, and developing decentralized energy systems that can operate independently in case of a central grid failure. Redundancy in multi-risk contexts enhances the capacity to absorb disturbances without catastrophic collapse and provides the time needed to implement recovery measures.

Diversity in risk management strategies increases the likelihood that at least some solutions will be effective in any given scenario. This could involve a mix of structural and non-structural measures, such as building flood defences while also enhancing natural floodplains, promoting economic diversification to reduce reliance on a single industry, and fostering social networks that can provide support during crises. Diversity strengthens adaptive capacity by offering a portfolio of responses, reducing the risk of overdependence on any single system or approach (Benedict et Al., 2006; Jabareen, 2013). Local Knowledge and Practices are invaluable resources for urban resilience. Traditional and local knowledge often contain insights into sustainable practices

and risk management that have been developed over generations. Integrating this knowledge with modern technologies and practices can lead to more culturally appropriate and effective solutions. In multi-risk settings, local knowledge can reveal interconnections between hazards that are not always captured by scientific assessments, providing a more holistic understanding of vulnerability and resilience. Furthermore, resilience in multi-risk environments is defined not only by the capacity to withstand individual hazards but also by the ability to navigate the interactions between them. This requires a systemic perspective that accounts for cascading effects, compound risks, and long-term transformations. Adaptation, in this context, entails iterative learning processes, where actors engage in cycles of experimentation, monitoring, and adjustment. Adaptive governance mechanisms—such as flexible regulatory frameworks, polycentric institutional arrangements, and cross-sectoral coordination—play a crucial role in enabling timely and effective responses to complex risk landscapes.

Moreover, building resilience in places exposed to multiple hazards necessitates fostering social resilience, which includes strengthening community networks, enhancing social capital, and promoting inclusive decision-making. Socially resilient communities are better able to mobilize collective resources, disseminate information, and maintain trust in times of crisis (Birkmann, 2013; Bohland et Al., 2019; David, 2006; Folke, et al., 2010; Horton et Al., 2015; Meerow et Al., 2016). To design effectively in these places, an appropriate methodology must be used. This methodology, developed within the framework of the SUMMA research project PRIN2020 #20209F3A37, will be presented below, along with the Multiadaptation Place Index case studies and the core principles for multiadaptation design.

Multiadaptation Place Design

The methodology created to evaluate spaces subject to multiple risks is structured into ten precise phases: six dedicated to analysis and four to strategic planning. Its primary aim is to uncover current or potential hazards—whether separate or interconnected—that may impact public spaces, while also tracing their root causes, assessing users' perceptions, and proposing adaptive interventions to upgrade both resilience and quality. This process produces two detailed mosaics and the Multiadaptation Place Index (MPI). One mosaic consolidates all gathered data on risks, contributing factors, and perceptions; the other offers proposals for adaptation and enhancement. The MPI gauges a site's capacity to cope with multiple hazards while improving its assets.

The opening phase focuses on diagnosing the area to identify present or foreseeable urban hazards, using a standardized observation tool that classifies risks as minor, moderate, or critical. The risks observed may range from physical decline, environmental degradation, socio-cultural threats, human-induced hazards, and seismic dangers to public health issues, poor quality of life, insecurity, and erosion of local identity. The objective is to build a detailed risk profile by systematically mapping and categorizing these aspects.

In the subsequent stage, attention shifts to evaluating the drivers and conditions that shape or might shape these risks. Qualitative observation helps expose underlying factors, such as how mismanaged waste amplifies environmental harm or how fragmented social ties exacerbate insecurity. This phase is key to capturing the intricate relationships within the urban fabric.

The third stage assesses the impacts of risk overlap in a single location, compiling a database that logs each risk, its interplay, and the magnitude of cumulative effects, graded as low, medium, or high. For instance, an area facing both seismic threats and identity loss may struggle to function as a communal space, as insecurity and detachment erode its role. This offers a quantitative grasp of how layered risks undermine urban vitality and shapes targeted remedies.

Step four collects data on risk perception via surveys, exploring how individuals interpret and experience these hazards, whether they consider them transient or entrenched, and how they believe they can contribute to mitigation. The survey covers overall site impressions, evaluations of specific risks, their perceived permanence, and ideas for civic involvement, plus feedback on space quality.

The fifth phase entails reviewing existing plans, strategies, and policy tools relevant to the area, compiling a

mosaic that visualizes ongoing measures across sectors and scales. This informs the orientation of future actions.

The sixth stage identifies key local assets, from heritage landmarks to open areas, parks, and historical urban patterns, blending their presence and functions to evaluate both their value and adaptability. A neglected historic square, for example, may hold potential for revival through targeted upgrades. This produces a mosaic visualizing these quality features and functions as a foundation for future proposals.

Phase seven integrates the entire body of findings—identified risks, drivers, survey outcomes, and quality components—into a composite mosaic, creating a panoramic view of the multi-risk environment and offering a critical reference for planning.

In step eight, the process assesses the adaptability of the space using the composite mosaic, spotlighting zones where flexible transformation is feasible and where urgent action is needed to boost usability and safety. For example, an overlooked green area may be earmarked for community resilience initiatives. This stage leads directly to the formulation of the MPI.

The ninth step devises Multiadaptation interventions tailored to the areas highlighted previously, aiming both to tackle present and future risks and to enrich public space quality. This culminates in a mosaic displaying specific, context-sensitive strategies for urban renewal, ensuring a coherent and comprehensive approach to resilience.

The final phase calculates the Multiadaptation Place Index, which appraises how well urban subareas can respond to concurrent hazards, including unforeseen disruptions.

The MPI is a robust tool to assess the multi-resilience and adaptive capacity of urban settings. It delivers a holistic diagnosis of how effectively different zones manage risks, considering unanticipated changes. The index evaluates key aspects: risk exposure, adaptive capacity, response strategies, recovery potential, and participatory engagement.

Risk exposure gauges how intensely an area faces diverse hazards—natural (earthquakes, floods), socio-economic (poverty, unemployment), or related to urban liveability (health, accessibility, green spaces). Adaptive capacity refers to how social, economic, spatial, and infrastructural systems adjust to changing conditions. A city with dense social ties, varied economies, and resilient infrastructure typically scores high.

Response mechanisms assess the adequacy of risk management plans and grassroots initiatives, measuring their effectiveness across scenarios. Recovery potential captures a place's ability to bounce back and sustain functionality post-shock, influenced by resource availability, institutional strength, and infrastructure resilience, turning crises into opportunities for cultural and social regeneration.

Participation measures how extensively stakeholders—from government bodies and businesses to communities and individuals—engage in resilience strategies. High participation levels point to an inclusive, collaborative mode of adaptation, enhancing co-design with all actors involved.

Accordingly, the MPI is computed using the comparative assessment derived from the composite mosaic in step eight, spotlighting areas with the most significant adaptive potential. Key variables include actual and perceived risks, underused public spaces, streets suitable for pedestrian and cycling routes, tangible and intangible cultural resources, and nearby but connected public spaces.

Each factor is weighted (1–5), and the final score reflects the difference between the risk load and flexibility assets, yielding an index between 1 and 50, where 1 signal minimal potential and 50 maximal potential. For example, an area facing environmental, depopulation, and isolation risks totalling 15, but with 50 points in adaptive resources, scores 35 (50–15). This quantifies a site's capacity for dynamic adaptation and improvement. The MPI can be

applied across contexts to guide resilience strengthening. In a coastal city battling sea-level rise and economic decline, the MPI can help pinpoint vulnerable zones and craft tailored solutions, like coastal defences or economic diversification. In fast-expanding cities, it can highlight gaps in housing, public services, and sustainability, shaping interventions such as affordable housing, vibrant public spaces, and green infrastructure.

Case study

In order to both experiment the method and the relative MPI-Multiadaptation Place Index, the case of the renovated Hudson River in New York will be reported.

New York City, in the last years is facing major risks from climate change: rising sea levels, more frequent extreme weather events, and urban heat island effects continually threaten the city. To confront these challenges, New York has crafted and carried out a set of resiliency strategies designed to prepare the city for future climate impacts while safeguarding residents and vital systems. These efforts centre on strengthening infrastructure, enhancing adaptive capacity in neighbourhoods, and embedding sustainability in urban policies.

One of the key approaches for climate resilience in New York City is the “OneNYC” plan, launched in 2015 and updated in 2019. This plan’s goal is to make the city fairer, greener, and stronger against climate risks ahead. A critical part of OneNYC (New York City Mayor’s Office of Sustainability, 2020) is reducing threats posed by rising sea levels and storm surges. As reported by the New York City Panel on Climate Change (NPCC), sea levels around the city could rise up to 30 inches by 2050. To address this, the city has invested in coastal defence projects, notably the East Side Coastal Resiliency (ESCR) project, a \$1.45 billion undertaking to reinforce lower Manhattan against storm surges and rising tides. Besides coastal defences, New York has also prioritized green infrastructure to tackle flooding, heat hazards, and enhance urban quality of life. Green infrastructure includes the use of natural systems like parks, green roofs, and rain gardens to absorb rainfall and lessen pressure on city sewers during storms. This strategy not only limits flooding but also cools areas affected by the urban heat island effect, where dense built environments retain heat and increase temperatures. The Resilient Waterfront initiative in New York City is a cornerstone of the city’s wider strategy to confront climate change, guard against sea-level rise, and reduce the effects of extreme weather. With more than 520 miles of shoreline, New York is acutely exposed to climate risks, as highlighted by the destruction caused by Hurricane Sandy in 2012. In response, the city has launched multiple strategies to reinforce its waterfront, improve public access, and sustain economic activity. One of the centrepiece projects is the East Side Coastal Resiliency (ESCR) project, a \$1.45 billion investment blending flood defence infrastructure with upgraded public amenities along the waterfront. Spanning East 25th Street to Montgomery Street in Manhattan, the project integrates levees, floodwalls, and deployable barriers engineered to withstand a 100-year flood, aiming to shield at-risk neighbourhoods while maintaining public access to waterfront parks and recreation.

Beyond engineered defences, the city has focused on restoring natural ecosystems, which act as living barriers against storm surges. These ecosystems not only buffer floodwaters but also boost biodiversity and strengthen the city’s resilience.

Additionally, the Waterfront Revitalization Program (WRP) embeds climate resilience into land-use planning, ensuring that future developments along the shoreline are designed to endure projected climate stresses. This includes requirements for higher building elevations and the adoption of green infrastructure to better manage stormwater and lower flood risks. Bike lanes also play an essential role in New York’s green infrastructure agenda. Expanding the protected bike lane network promotes cycling, cutting car dependency and lowering greenhouse gas emissions. Furthermore, more bike lanes help calm traffic, improving safety for cyclists and pedestrians alike. The use of permeable pavement in some lanes allows rainwater to infiltrate the ground, relieving pressure on the city’s drainage system and aiding in flood control. By encouraging cycling as a sustainable transport option, New York not only reduces its carbon footprint but also develops a more resilient transportation system capable of weathering climate disruptions. Indeed, New York’s green infrastructure plans extend far beyond traditional parks, encompassing waterfronts and urban spaces like parklets, bike lanes, and pedestrian plazas. The inclusion

of these kind of public spaces constitutes a comprehensive approach to not only manage climate risks but also to enhance the quality of life for the city's residents. These urban design features foster healthier (Sepe, 2023), more liveable communities, while also contributing to New York's long-term sustainability and resilience in the face of increasing climate challenges. By leveraging every available space, whether it's a former parking spot, a small alley, or a city street, New York is leading the way in rethinking how cities can adapt to a changing climate while improving urban life.

This approach not only mitigates flooding but also helps to lower temperatures in areas affected by the urban heat island effect and improve urban health and liveability. A key example is the Green Infrastructure Program, which has already implemented hundreds of green projects across the city, reducing flood risks and improving urban air quality (Horton et Al., 2015; New York City Department of City Planning, 2021; New York City Environmental Protection, 2020; New York City Mayor's Office of Recovery and Resiliency, 2020; New Yorkers for Parks, 2001; Vardi Topal, Franck, 2023).

Hudson River Park

Hudson River Park stretches along the west side of Manhattan, from 59th Street down to Battery Place. Covering 550 acres of land and water, this unique park is the second-largest park in Manhattan after Central Park (New York City Department of City Planning, 2021; Pallarés, 2021).

As regard the first step of the protocol, the identified risks are the following. Hudson River Park, situated directly on the waterfront, is particularly vulnerable to flooding during extreme weather events. The low-lying sections of the park, particularly those close to historic piers, are at a high risk of inundation during storms.

The second identified risk is the urban heat island effect. Surrounding buildings, roads, and other urban infrastructure absorb and retain heat, causing temperatures in the park to rise significantly, especially during summer months. The park's open layout, while ideal for recreational activities, provides little protection from the heat in certain sections.

The third risk is the overcrowding. The park's pathways, particularly the bike lanes and pedestrian paths, is sometimes congested, especially on weekends and during events. This foot traffic could reduce the quality of the visitor experience and put strain on the park's infrastructure, from benches to lawns to waterfront facilities. After identifying the main risks, it is crucial to analyse the factors that contribute to or amplify these risks in Hudson River Park.

Proximity to the Hudson River, while offering opportunities for recreation, is also the primary factor contributing to flooding and coastal erosion. Its location directly exposed to the river makes the park vulnerable to storm surges and rising sea levels.

Global climate change is already having a tangible impact on New York City, and Hudson River Park is no exception. The effects of climate change, particularly rising sea levels and increasing storm intensity, are making coastal flooding more frequent.

Much of the park's infrastructure, including the renovated historic piers and bike paths, is subject to wear and tear due to exposure to natural elements.



Fig.1 New York, Hudson River Park (Source: Marichela Sepe Archive's)



Fig.2 New York, Hudson River Park view (Source: Marichela Sepe Archive's)



Fig.3 New York, Hudson River Park detail (Source: Marichela Sepe Archive's)

Frequent storms and erosion can accelerate the deterioration of structures, making them vulnerable to more significant damage.

In the third step, we analyse how risks might coexist and interact in Hudson River Park, creating potentially more severe effects when occurring simultaneously.

Flooding + Coastal erosion: when flooding and erosion occur simultaneously, they can cause significant damage to the park's infrastructure. Areas along the river, already subject to erosion, become more vulnerable during floods, and storm surges can accelerate the loss of land along the park's coast.

Flooding + Crowding: during extreme weather events like storms, the park may become impassable or dangerous for visitors. Crowding can hinder evacuation and emergency management, making it difficult to protect citizens who use the park as a temporary shelter or escape route.

Extreme heat + Crowding: during summer heatwaves, the risk of heat-related problems increases significantly, especially in crowded areas like Hudson River Park. The lack of shade and the large number of visitors can create no too liveable conditions, particularly for the elderly and children.

In the Risk Perception Questionnaires step, questionnaires were administered to 50 users of the place aging between 30 and 65 years old to assess how visitors to Hudson River Park perceive the risks of flooding, erosion, overcrowding, and extreme heat in the park.

Results of questionnaire showed that visitors are aware of the flooding risks, especially after events like Hurricane Sandy, but awareness of the long-term risks associated with climate change may be less widespread.

Many visitors see crowding as an annoyance rather than a safety risk, underestimating the importance of proper crowd management, especially during emergency events.

Finally, the perception of heat risks is underestimated, with many visitors not fully understanding the dangers of heatwaves, particularly in highly frequented public spaces.

In the step 5, Analysis of Plans, Programs, and Policies were identified. Hudson River Park benefits from several plans and programs designed to improve its resilience, many of which are part of New York's broader coastal

resilience strategy. These include the following. Hudson River Park Trust Initiatives: the Hudson River Park Trust, the entity that manages the park, has implemented various measures to enhance the park's resilience. These include creating flood-resistant infrastructure and protecting natural areas from erosion. The Lower Manhattan Coastal Resiliency Project: as part of the broader Lower Manhattan Coastal Resiliency initiative, this project involves developing flood barriers along the coastline, including parts of Hudson River Park. The goal is to protect both public and private infrastructure from storm surges and rising sea levels. The NYC Climate Resiliency Initiatives: the City of New York has developed a climate resilience plan that includes measures to protect urban green spaces like Hudson River Park from flooding and other extreme weather events. These plans involve improvements in green infrastructure, such as the installation of sustainable drainage systems and the reinforcement of coastal areas (New York City Department of City Planning, 2021; New York City Environmental Protection, 2020; New York City Mayor's Office of Recovery and Resiliency, 2020).

As regard, step 6: Potentialities and Qualities, the Park has many piers of the park and many large public spaces. Furthermore, there is both a beautiful natural environment and a beautiful skyline with the main skyscrapers view. The park's natural areas, such as the wetlands and planted areas along the river, are valuable resources for absorbing rainwater and improving urban biodiversity. There are also many equipment and furniture for free time and sport activities, and off-leash spaces for dogs. Finally, Hudson River Park, with its location and ecological features, is an ideal site for educational programs on climate change and sustainability. Visitors could learn more about environmental challenges through informative installations and educational tours.

In step 7 multi-risks areas are identified, including: coastal flood zones, namely the sections along the lower piers and close to the river would be highlighted as areas subject to more frequent flooding; the crowding areas, namely the high-traffic areas, such as those around recreational piers and bike paths, would be marked as risk zones for crowd management; the erosion hotspots, namely the sections of the park most exposed to coastal erosion would be mapped to identify where structural interventions are needed to prevent future damage.

The multi-adapting areas identified in step 8, include as follows. Multifunctional piers: piers that could be adapted to withstand flooding, with spaces that can be temporarily submerged during storms and used for events and activities during the rest of the year. Adaptive green zones: the park's green areas, particularly the planted sections along the coast, could be transformed into flexible zones, where flood-resistant vegetation and natural drainage interventions can help mitigate flood risks.

Based on the previous steps, the identified multi-adaptation project interventions include measures for water management. This could involve installing systems to collect and manage rainwater along pedestrian paths and bike lanes during storms. Additionally, flood-resistant zones could be created by designing adaptable spaces that can temporarily flood during storms, reducing the risk to surrounding areas. Another intervention is the installation of movable barriers: temporary barriers along the park's coastline that can be raised during storms to protect critical infrastructure and visitors.

The collected information enabled the calculation of the Multiadaptation Place Index (MPI) of step 10 of the protocol, a tool designed to assess the resilience and adaptive capacity of complex urban contexts (Sepe, 2023; Sepe, 2024). This is calculated using the assessment derived from the risks and highlighting the areas with the greatest adaptive potential. The first phase, focused on risk identification, highlights three primary hazards affecting Hudson River Park. These include flooding and sea-level rise, where the low-lying areas and historic piers face particular vulnerability during extreme weather events; the urban heat island effect, driven by surrounding dense infrastructure and a lack of shade in some sections, leading to significant temperature increases during summer months; and overcrowding, where the park's bike and pedestrian paths often experience congestion, particularly on weekends or during events, which strains the park's infrastructure and diminishes visitor experience.

In the second phase, it was observed that the park's proximity to the Hudson River, while offering recreational opportunities, also makes it highly susceptible to flooding and coastal erosion. Moreover, the park's infrastructure

is subject to wear from constant exposure to natural elements, heightening the risk of accelerated structural deterioration.

The risk perception among users revealed widespread awareness of flooding, but an underestimation of the risks linked to crowding and extreme heat, underscoring a gap in public understanding of these hazards.

The park's potentialities and qualities, highlighting multifunctional piers adaptable to controlled flooding, adaptive green zones planted with flood-resistant vegetation and equipped with natural drainage, a wide range of recreational facilities, off-leash areas for dogs, and significant potential for environmental education programs addressing climate change and sustainability.

In phase seven, risk mapping highlights coastal flood zones concentrated around the lower piers, crowding-prone areas along the recreational piers and bike paths, and erosion hotspots located along the waterfront, pinpointing where future structural interventions will be most needed.

Phase eight delineates multi-adaptation areas, such as multifunctional piers that can be submerged temporarily during storms and serve as event spaces in calmer periods, and adaptive green zones designed to absorb excess rainwater through resilient vegetation and natural drainage systems.

The calculation of the MPI results as follows. Risk exposure is rated medium-high due to the combination of flooding, erosion, and heat, with a weight of 10 out of 25. Risk perception is rated medium-low, with a weight of 5 out of 25. The potential, qualities, and flexibility are considered high, reflecting all the existing features, with a score of 50 out of 50. The final score combines the sum of perceived and real risks (15 points) and potential and qualities and flexible areas (50 points), yielding the MPI as 50 (adaptation) minus 15 (risk), equaling 35. This score places Hudson River Park within the high adaptive potential range on a 1–50 scale, signaling its strong capacity to absorb shocks and adapt. This result underscores Hudson River Park's role not merely as a recreational green space but as an emblematic urban site demonstrating how parks can play a pivotal role in metropolitan resilience, helping to mitigate climate risks while enhancing quality of life.

Furthermore, the park's ability to balance social functions—such as sports, leisure, and gathering—with ecological functions—such as biodiversity enhancement and rainwater absorption—positions it as an advanced urban laboratory of multiadaptation, representing a best practice in the design of resilient cities.

Core principles

The diverse case studies used to test this methodology have been instrumental in formulating core principles for multiadaptation planning. These principles are grounded in the notion that risks can be reframed as opportunities to reevaluate and strengthen the qualities of a territory, establishing resilience as a cornerstone of sustainable regeneration. The case studies include Cittaducale and Leonessa in Lazio, alongside Siena, Naples, Paris, Madrid, Copenhagen, and New York. These locations were selected due to the presence of various actual or potential risks: Cittaducale and Leonessa are vulnerable to earthquakes and population decline; Siena, Naples, and Madrid's historic centres grapple with the impacts of mass tourism and globalization; Copenhagen and New York confront flood threats and the erosion of local identity; while Paris faces challenges related to flood and overtourism.

Risk identification should encompass both isolated hazards and combinations of potential simultaneous events. This integrated perspective allows planners to anticipate complex situations where different risks overlap. For example, a city may confront floods, declining liveability, and infrastructure breakdowns all at once. By examining risks holistically, planners can develop more cohesive resilience strategies, using tools like risk matrices and scenario modelling to rank and address threats effectively.

Grasping how people perceive risk is a fundamental aspect of hazard analysis. This requires carefully crafted surveys that capture the subtle differences in how diverse user groups understand and respond to threats.

These instruments should be inclusive, ensuring representation across age, gender, social class, and cultural background. The insights gathered can shape communication strategies and interventions that are more responsive to community concerns and expectations.

Special attention must be paid to vulnerable populations—such as the elderly, children, people with disabilities, and those with chronic health issues—both when assessing risk perception and when designing adaptive measures suited to their needs. These groups typically face heightened exposure and have fewer resources to cope. Adaptation efforts should therefore include provisions like accessible shelters, priority evacuation plans, and tailored healthcare services. Direct engagement with these communities is crucial to understand their needs and to integrate their input into planning.

Surveying urban assets—such as heritage sites, materials, and infrastructure—is essential for designing multi-resilience and adaptation initiatives. These elements should be viewed not as constraints but as opportunities to improve urban liveability. For example, historical buildings can be retrofitted to withstand hazards without sacrificing cultural value, while public parks can double as flood retention areas. Embedding these qualities into resilience planning both preserves local identity and enhances the city's aesthetic and functional appeal.

Continuous monitoring of multi-resilience projects is necessary to anticipate abrupt changes and respond sustainably. This involves deploying advanced technologies—like sensors, satellite monitoring, and data analytics—to observe environmental shifts and urban dynamics in real time. Establishing urban observatories or resilience hubs can help collect and analyse this data, providing early warnings and supporting proactive action. Regular reviews and updates of resilience plans, informed by current data and stakeholder feedback, are also key to maintaining effectiveness.

Flexibility is a fundamental feature of any multi-resilience or adaptation strategy. It must be conceived across scales (from the building to the metropolitan level) and across domains, integrating urban, social, economic, cultural, and ecological dimensions. A flexible urban plan, for example, might include modular housing systems, adaptable green spaces, and policies that permit the swift reallocation of resources during crises. This multi-layered flexibility enhances a city's capacity to adjust to evolving challenges.

The adaptability of public spaces can be greatly strengthened by providing adequate pedestrian and cycling networks. Such infrastructure promotes versatility, accessibility, and broad usability across diverse populations. Encouraging active transportation also advances environmental sustainability by cutting emissions, reducing congestion, and fostering healthier lifestyles. Designing public spaces with these goals in mind helps create dynamic, inclusive environments that support social interaction and improve quality of life.

Accessibility must be prioritized in the design of all public spaces. This means ensuring that every publicly intended area is usable by individuals of all ages and abilities. Eliminating architectural and physical barriers is crucial for enabling access for people with disabilities, seniors, parents with strollers, and others with specific mobility needs. Early-stage design considerations should include ramps, lifts, tactile surfaces, clear signage, and attention to sensory aspects like lighting and acoustics. A strong commitment to inclusivity fosters social participation and integration, creating genuinely open environments.

Multi-resilience and adaptation projects cannot be uniformly applied, even when sites face similar hazards. Each location—whether a historic district, suburban neighbourhood, or redevelopment zone—has distinct features that must be respected. Tailoring interventions to the local context ensures cultural appropriateness, social acceptance, and technical feasibility. For instance, in a historic centre, flood mitigation might focus on preserving architectural heritage, whereas in a suburb, it may emphasize green infrastructure for stormwater management.

Communicating risks, hazards, and resilience plans effectively is essential and should be tailored for audiences of all ages and abilities. Using diverse communication channels—visual materials, interactive media, and clear,

jargon-free language—helps ensure broad accessibility. Public campaigns, educational initiatives, and community workshops can enhance understanding and engagement. Establishing feedback channels is equally important, allowing residents to share concerns and contribute to shaping resilience efforts.

Leveraging emerging technologies is key to improving risk communication. Tools such as Geographic Information Systems (GIS), mobile applications, and social media platforms enable the rapid and precise dissemination of information. For example, GIS can generate interactive hazard maps, mobile apps can deliver real-time alerts, and social media can support two-way communication between authorities and residents, facilitating both outreach and feedback.

Ensuring the transparency and wide dissemination of adopted or planned measures is critical. This can be achieved through dedicated web platforms, mobile apps, social media, sensor networks, and interactive mapping tools. Providing open access to resilience strategies, resources, and emergency protocols builds trust and keeps communities well-informed. Web portals can offer comprehensive documentation; apps can tailor alerts and guidance; and sensors paired with interactive maps can deliver real-time updates on environmental and infrastructure conditions, empowering citizens to make informed decisions during crises.

The integration of a quantitative assessment through the Multiadaptation Place Index (MPI) is crucial. Calculating the MPI enables planners to measure the adaptive capacity of urban areas in the face of multiple risks by synthesizing data on hazards, resources, and flexibility. This index provides an evidence-based foundation for prioritizing interventions and tracking progress over time, supporting more precise and impactful planning decisions.

Redundancy must be embedded into resilience strategies as a core principle. Incorporating overlapping systems and fallback mechanisms—such as multiple transport routes, decentralized energy grids, and backup communication networks—ensures that critical functions are maintained even when one component fails. Redundancy enhances a system's capacity to withstand shocks and reduces the likelihood of cascading failures during crises.

Diversification is essential for strengthening resilience across sectors. Promoting a varied mix of economic activities, social networks, ecosystem services, and infrastructural solutions reduces dependency on single systems and increases the likelihood that some components will continue functioning during disturbances. For example, combining grey and green infrastructure for flood management or fostering economic sectors beyond tourism helps cities better cope with uncertainty and evolving threats (Pelling, 2011; Slovic, 2000; Vale, 2014).

Observation on the MPI

The application of the Multiadaptation Place Index (MPI) to Hudson River Park provides an insightful quantitative and qualitative assessment of the park's resilience and adaptive capacity in the face of multiple risks.

The MPI was developed as part of a comprehensive protocol to evaluate spaces subject to multiple, often overlapping hazards. In the case of Hudson River Park, the assessment followed a sequence of diagnostic phases, beginning with the identification of three primary risks: flooding and sea-level rise, the urban heat island effect, and overcrowding. These hazards not only pose independent threats but also interact, creating compound risks such as flood-induced infrastructure failure or heat-related health crises intensified by crowding. This layered risk landscape underscores the importance of using a tool like the MPI, which integrates diverse data to yield a holistic resilience profile.

A critical observation from the MPI analysis is the park's medium-high risk exposure, rated at 10 out of 25. This score reflects the park's inherent vulnerability to environmental hazards and exposure to storm surges. Additionally, the surrounding dense urban environment amplifies heat retention, while heavy usage patterns contribute to infrastructural wear and crowding-related challenges. Importantly, the MPI framework does not

stop at measuring risks alone; it pairs this evaluation with an analysis of adaptive potential.

One of the most significant findings of the MPI assessment is the high score (50 out of 50) attributed to the park's potential, qualities, and flexibility. These assets not only enhance ecological resilience but also support social well-being, making the park a dynamic site for climate education and public engagement.

The MPI further captures the perceptual dimension of risk, as revealed through user surveys. While park users demonstrated relatively high awareness of flooding risks—likely influenced by collective memory of events like Hurricane Sandy—perceptions of overcrowding and heat risks were considerably lower. This mismatch between actual risks and public awareness highlights the importance of integrating risk perception into resilience assessments. By accounting for both objective hazards and subjective experiences, the MPI enables planners to design interventions that are not only technically effective but also socially meaningful.

The final MPI score for Hudson River Park was calculated by subtracting the combined risk score (15) from the adaptation score (50), yielding a total of 35 on a scale of 1–50. This places the park within the “high adaptive potential” range, signifying its robust capacity to withstand shocks, recover from disturbances, and transform over time. This result positions Hudson River Park as a best-practice model for multifunctional urban spaces that balance environmental, social, and infrastructural resilience.

Another key observation is that the MPI does not merely function as a static measurement tool but as a dynamic guide for future action. By mapping multi-risk zones (such as flood-prone waterfronts, overcrowded pathways, and erosion hotspots) alongside multi-adaptive areas (like flexible piers and green zones), the MPI points to specific spatial priorities for intervention. For Hudson River Park, this means focusing on enhancing flood management systems, expanding shaded and permeable surfaces, improving crowd management strategies, and developing public education initiatives on climate risks.

The MPI also promotes a systemic understanding of resilience, emphasizing not just the park's ability to resist individual hazards, but its capacity to navigate the complex interactions among them. This requires ongoing monitoring, iterative learning, and cross-sectoral collaboration—elements that are embedded within the MPI's multidisciplinary approach. Furthermore, the MPI's integration of ecological, social, and infrastructural variables makes it particularly well-suited for multifunctional spaces like Hudson River Park, where diverse functions coexist and reinforce each other.

The application of the MPI to Hudson River Park demonstrates how this tool can offer a comprehensive resilience assessment that integrates risk exposure, adaptive capacity, flexibility, and public perception. As climate change continues to reshape cities worldwide, tools like the MPI is useful for guiding interventions that are adaptive, inclusive, and forward-looking, transforming public spaces into vital assets for urban resilience.

Conclusion

The case of Hudson River Park in New York City illustrates the importance of adopting a multiadaptation approach in the design and management of urban public spaces exposed to multiple risks. As shown by the analysis, the park faces a complex risk landscape—including coastal flooding, erosion, the urban heat island effect, and overcrowding—which are increasingly intensified by global climate change. However, what emerges most significantly from this study is not only the park's vulnerability but its considerable potential as a resilient and adaptive urban space.

A key conclusion from this research is that resilience planning in urban environments like Hudson River Park requires a shift away from traditional, top-down approaches toward more inclusive, flexible, and iterative processes. This shift is essential to adequately address the dynamic and interconnected nature of risks facing urban areas today. Inclusivity, as underscored in contemporary resilience literature (Banica et al., 2020; Cutter et al., 2003; Davoudi et al., 2012), must become a cornerstone of resilient planning. This means that the engagement

of diverse stakeholders—including local communities, visitors, marginalized groups, and institutional actors—should not be a mere formality but an integral part of decision-making processes. Participatory mechanisms such as surveys, workshops, public consultations, and co-design platforms can help uncover overlooked vulnerabilities and generate locally relevant solutions. Furthermore, Hudson River Park’s multifunctional piers, adaptive green zones, and potential for temporary floodable spaces exemplify how flexibility can be translated into physical infrastructure. Policies should similarly allow for adaptability, enabling the park’s management to adjust operational strategies as new risks emerge or as conditions change over time. Hudson River Park also benefits from a combination of engineered interventions and nature-based solutions. This portfolio approach reduces dependency on any single measure and improves the park’s capacity to respond to a wide range of contingencies.

The methodology employed offers a robust framework for diagnosing complex risk environments and identifying adaptive capacities. The ten-phase protocol—spanning from risk identification and analysis of drivers to perception assessment, quality evaluation, risk mapping, and the formulation of adaptation strategies—provides a holistic approach that balances technical, social, and ecological dimensions. The MPI, by quantifying the difference between risk exposure and adaptive assets, delivers an evidence-based assessment of a site’s resilience potential. In the case of Hudson River Park, the final score of 35 out of 50 places the park in the high adaptive potential category.

The broader lessons drawn from this case resonate with international experiences in resilience planning, as seen in the SUMMA research project and other case studies across Europe and North America. Whether in Cittaducale and Leonessa confronting seismic risks, or in Copenhagen and Paris addressing flooding and overtourism, the principles of inclusivity, flexibility, redundancy, diversity, and local knowledge remain central to effective adaptation.

In conclusion, Hudson River Park stands not merely as a green recreational space but as an emblematic case study for urban resilience and adaptive design. It demonstrates how parks and public spaces can move beyond their traditional roles, becoming good practice for sustainability, liveability, and climate adaptation.

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