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Emerging Shocks and Stresses as Invaluable Variables for Resilient Design: *The Case of New York City*

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Abstract

This paper explores the quality of versatility within a metropolitan city. Cities are not considered as static notions, but as being in constant transformation. The paper investigates how the characteristics of neighborhoods in metropolitan cities are affected by pressures of changing spatial, social, economic, or environmental conditions. The consequential transformation of the metropolis' neighborhoods is identified by notions of shocks and stresses, be they unsolicited or self-induced. To achieve insights on the matter of versatility, New York City is deployed as a case study to investigate its current and historic transformation processes. The city's waterfronts are identified as protagonists during important events of change, making them valuable sources of information to understand the potential impact of shocks or stresses. The paper starts by introducing the city of New York by its character of diversity and change, identifying the ways in which change manifests itself in the city. Next, the paper explores the city's waterfront as a key player in historic transformation processes and identifies the crucial moments in time and space that have defined its urban transformation over history. Finally, the obtained insights are used to discuss the idea of the waterfront as a laboratory to learn from, explore different methods of analysis upon, and extract findings from. The content of this paper stems from a doctoral research project about spatial transformation processes in New York City.

Keywords

Transformation Processes, Architecture, Collective Spaces, New York City, United States of America

1. Introduction

During a global pandemic, we cannot help but wonder if the post-COVID world

will differ significantly from the world we used to know. While many cannot wait to return to a situation similar to before the pandemic, innumerous people, institutions, and even the World Health Organization have referred to these circumstances as *the new normal* (Kasai, 2020). The question that arises is: Will we easily forget this drastic stress-event and go back to our lives as they were before, or are we currently living in *the new normal*?

Presumably, the answer is neither one of the above. In fact, urban conditions are not static notions, nor are they merely changed by major events. On the contrary, cities globally are under perpetual and constant pressure of the impact of change, generating a continuous transformation of their spatial, social, economic, and even environmental conditions. Such changes can manifest themselves in countless forms, as positive or negative, as wanted or unwanted, as shocks or stresses, as volatile or permanent. The realization that a city is subject to constantly changing conditions, each interrelated and mutually dependent on each other, has significant implications for the responsibilities within the professions of architects, planners, and policymakers. However, this responsibility is often negated in both smaller or highly programmatically focused projects, and in bigger projects that often respond to one larger threat of change, for instance to mitigate the rising sea level. In order to counter this missed opportunity in architecture, planning, and policy, the question arises how these professions can be friendly to the inevitability of change in the future. In order to answer this, increased insights are needed as to which elements have an important impact on a city's transformation, and which aspects can contribute to dealing with erratic changes resiliently.

Starting from said challenges, this paper uses the city of New York as a case to study trends of change and their effects on the social and built environment of the city's neighborhoods. New York is a perfect example of a metropolis that has always been very dynamic, and that is subject to many forms of change, both planned and unplanned. Despite the rigid form of urban planning by a systematic grid, the city is in constant transformation. When recalling shocks and stresses triggering New York's transformation, immediate connections are made with negative examples, such as super storm Sandy in 2012, the terrorist attacks of September 11th 2001, the crash of Wall Street, a growing pressure of housing demand, or the recent pandemic. However, change can also take the form of planned interventions, like urban renewal projects, the world expo, festivals and festivities, and the election of a new mayor. Each form of change can trigger transformation processes in the city that forces the built, social and economic environment to adapt itself to new realities. In that regard, this paper starts by investigating types of changes that can manifest based on actual (historic) events in New York City. A distinction is made between changes that are either planned or unplanned, short-term or permanent, and ranging between the smallest human scale and the largest global scale. Next, the paper explains why urban waterfronts are often protagonists during important moments of transformation.

As an illustration, four key moments of change in New York's history are explained by their significance and the role that the waterfront location has played in this event of transformation. Finally, the paper concludes with a reflection upon the waterfront as a laboratory to learn from change and consequential transformation, and as a tool to articulate more tailor-made, resilient, and inclusive answers to the uncertainty of shocks and stresses in the metropolis' future.

The variable of *change* is often disregarded when interventions are proposed for the urban fabric. The innovation of this research lies in the substantiation of the unpredictability that is typical to changing conditions, by analyzing shocks and stresses through a multi-scalar and multi-layered perspective.

2. New York City under Constant Transformation by Change

A city is never static. On one hand, it exists out of an official notion of urban planning that is more tangible and perceivable. For New York, this is most pronounced in the rigid urban basis by a systematic grid of perpendicular streets and avenues. But at the same time, a city is constantly subject to a parallel, less official notion, the one of change. In reality, metropolitan cities like New York are in a permanent intermediate state because of their constant encounter with shocks and stresses. These shocks and stresses can have either a tangible or an intangible origin. Change can be obvious and clearly visible in the urban environment (**Figure 1**, left). The changing skyline of the city, for instance, is established by an accumulation of individual projects, each purposefully implemented into the urban fabric. But change can also manifest when larger ongoing societal or economic processes, pressures and interests touch upon a neighborhood

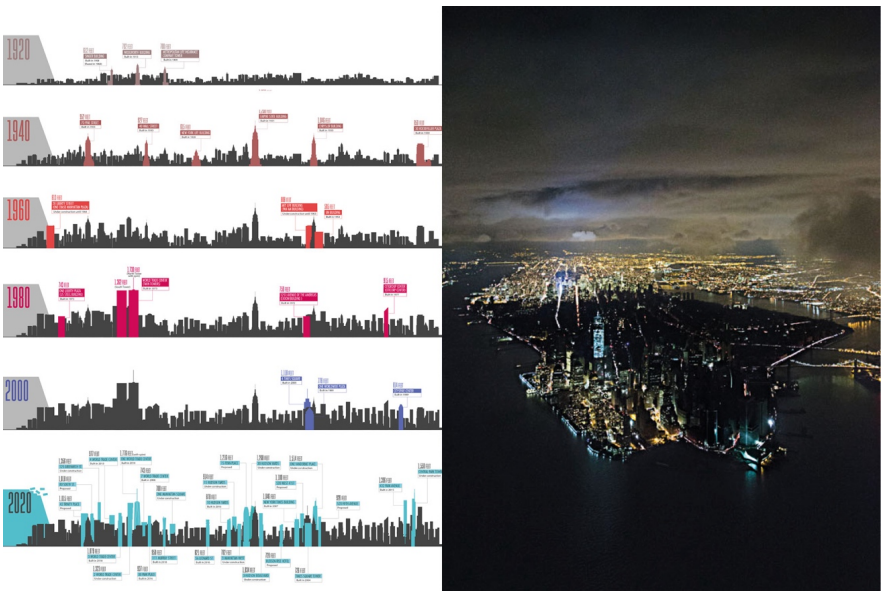

Figure 1. Left: Evolution of Manhattan's skyline. Transformation by official planning. Source: Liberty cruise. Right: Massive blackout after the impact of super storm Sandy. Transformation by officious discourse of shocks and stresses. Source: Photograph by Iwan Baan for New York Magazine.

(Figure 1, right). Larger processes like climate change, changes in economy, changing immigration waves or demographics, can also affect the city's conditions. The former (the cities' built and predominant social environment) is undergoing continuous pressures of the latter, by innumerable types of changes that impact, transform, and redefine the character and configuration of the city. The urban fabric is often perceived as a static notion, but ultimately, change becomes an inevitable part of it, creating ongoing transformation processes and unique situations with temporal characteristics.

This paper derives from the conviction that the impact of shocks and stresses is inextricably linked to urban transformation processes, and it is crucial to take this notion into account when aiming for resilient design and decision-making. However, urban transformation processes that are triggered by change are often unpredictable, and can manifest at different scales, by different intentions, and over different timespans.

Schlossberg's transition theory[1] gives a first illustration of different manifestations of change. Based on her theory, shocks and stresses can manifest in three different ways in the future: as anticipated, non-anticipated, and non-events (Schlossberg, 1989). Change can be anticipated, for instance, in the case of self-induced changes. Their impact can consequently be largely expected, mitigated, or even steered in the desired direction. Urban transformation by the implementation of public or private development projects is an example of an anticipated event. In contrast, other shocks or stresses may be non-anticipated. Because of the degree of unpredictability to change, many of its impacts are non-anticipated or unsolicited. Extreme weather events influence the urban spatial conditions at unexpected moments, while terrorist attacks or global pandemics are unpredictable in terms of when and if they will take place in the future. Nonetheless, their impact on the neighborhood's spatial, social and economic levels is often drastic. Finally, shocks and stresses can become non-events: their occurrence is expected and anticipated, but due to unforeseen circumstances, they do not occur. Examples are the cancellation of the 2020 Olympic Games, or a large, prestigious project that is not assigned to a city, or a political party that, against all odds, is not reelected.

The intentions of change can also differ. As stated in the introduction, the terms "shocks" and "stresses" often have a rather negative connotation because they are readily linked to events of disaster. But change can also result from a deliberate act, such as urban renewal projects or the organization of an event. In this paper, shocks and stresses are defined as any type of change that reflects itself upon the built or social environment of the city, be it intentional or unwanted, volatile or permanent.

The hypothesis of this paper starts from the assumption that shocks and stresses are inevitable aspects of the metropolitan city and that they can manifest

[1]Schlossberg's (1989) Transition Theory has initially been developed in light of events of change during the human life cycle, but is revisited for this research in light of events of change in the urban environment.

on multiple scales, occasions, and by different intentions, triggering transformation processes for neighborhoods that cannot always be predicted. By learning from shocks and stresses, as observed in New York City, four categories of change are retained. An initial categorization is based on the time span within which the change manifests, differentiating ***shocks*** (short-term) from ***stresses*** (long-term or permanent). A second categorization is made according to whether the changes were planned or unplanned by human actors, thus classifying the changes as either ***unsolicited*** or ***self-induced***. This subchapter ends with an elaboration on the ***multi-scalar*** manifestation of change, ranging from the smallest human scale, to the largest global scale.

2.1. Unsolicited Shocks

Unsolicited shock is the umbrella term for all types of unplanned, short-term peak events that impact the city. This may mean any event that is not planned intentionally but nonetheless impacts the built or socio-economic environment of the city, either as the result of human activity or a natural phenomenon.

An example of an unsolicited shock impacting a metropolitan city like New York is an extreme weather event like a hurricane. In recent decades, environmental conditions have been changing rapidly, affecting the built environment of urban waterfronts (Connolly, Svendsen, Fisher, & Campbell, 2013) and inner cities alike. In October 2012, super storm Sandy had a devastating impact on New York City and made it abundantly clear that the city needs proper risk management and resilient urban planning to answer to future extreme weather events (**Figure 2**, left). Hurricanes, coastal floods, and flash floods are all peak events that are increasingly pressuring New York's waterfronts. These unsolicited shocks are what highlight (environmental) inequity once again in metropolitan cities. As Ovink points out, Sandy has made it "shockingly clear that the socially vulnerable also live in the most environmentally vulnerable places" (Ovink & Boeijenga, 2018). The most diverse waterfront communities are hit hardest by the storm, and simultaneously their homes are flooded by polluted water, running through industrial sites or overflowing from sewers. Because of lower financial capital, they generally have less flood insurance or resources for rapid recovery. Whereas the impact of unsolicited shocks initially largely affects the urban fabric spatially, long-term effects often linger for social minority groups.

Although these shocks are labeled as unsolicited, some examples are still human-induced. On September 11th, 2001, New York faced the deadliest terrorist attack in human history. Additional to the enormous social impact, there was a simultaneous significant impact on the built environment, with a total of 10 billion dollars in property and infrastructure damage (Morgan, 2009). The impact of terrorist attacks drastically changes the way a city considers notions like safety, security and building constructions, and again forces the transformation of urbanity.

Figure 2. Left: Flooding after super storm sandy in red hook (shock). Source: AP Photo/Randall Chase. Right: Commercial facilities closed due to the COVID-19 pandemic (stress). Source: USAtoday.com.

Unsolicited shocks are a first identified form of change that triggers transformation of neighborhoods in a metropolis. They are peak events, limited in time, that are not intended by a city government or by stakeholders. They initially affect the built environment, but can have a resonating impact on the city's social, economic, or environmental conditions. Unsolicited shocks often have negative repercussions and should therefore be avoided. Intelligent city planning, architecture, or policy can contribute to mitigation or reduction of incidence and severity of unsolicited shocks in the city, although the level of unpredictability generally remains high.

2.2. Unsolicited Stresses

Unsolicited stress is the overarching term for all types of unplanned changes that impact the city, stretching over longer spans of time. They may denote any phenomenon that is not planned or desired, and yet influences the built, social, environmental, or economic operation of the city for a long time or even permanently.

Climate change is a prime example of an unsolicited stress that New York City is dealing with, and that simultaneously heavily impacts cities globally (Rosenzweig, Solecki, Blake, Bowman, Gornitz, Jacob et al., 2013). New York, among many other cities, is facing new realities of retreating coastlines, increasing heatwaves and overall more extreme temperatures, heavy rainfall and floods. Some consequences of the unsolicited stress of climate change manifest as unsolicited shocks, like the aforementioned impact of super storm Sandy in October 2012.

The year 2020 has introduced New York City—and the entire world—to a new unsolicited stress: the COVID-19 pandemic. Because of the pandemic's long time-span and drastic impact, it is labeled as a stress rather than a shock event. COVID-19 has affected the urban fabric of New York on many levels, from the built environment to the social demographic structure and the economic and even environmental situation. The retail sector evidently suffered from the decrease in tourism, but also from the drop in foot traffic, which decreased by 90 percent (OSC NY, 2020) (**Figure 2**, right). The real-estate sector had to deal with an outflow of residents from the city. It is said that the unsolicited stress of COVID-19 once again highlights the inequality that the city struggles with. Numerous medias reported the unequal effect of the pandemic, based on ethnicity and social status, declaring that "[d]ata from the New York City Department of Health has shown that Black and Latinx New Yorkers are twice as likely as white New Yorkers to die from the coronavirus", and the "resulting economic downturn ha[s] led to loss of health coverage among low-income New Yorkers" (Lew & Benjamin, 2021). Simultaneously, the closure of recreational facilities, the prevalence of teleworking, and overall smaller apartment sizes made many people decide to leave New York. According to Forbes, the people who leave are often wealthier families, who "have the financial means to purchase large homes in the nearby suburbs of New Jersey and Connecticut, the Hamptons or Long Island" (Kelly, 2020).

A third and final example of an unsolicited stress, as observed in New York City, is related to human interventions: namely, the insufficient infrastructure to support the growing needs of the city. For instance, when the public transportation system no longer meets the demands caused by an increasing population, a significant impact becomes visible on the urban environment, on property prices, and on the overall functionality of the city. An example in New York is its rapidly gentrifying post-industrial waterfronts, which—because of the former industrial identity—are barely served by the public subway system. Innumerous real-estate projects have recently been developed on post-industrial waterfront sites in New York City, usually with a multitude of high-rise buildings consisting of hundreds of apartments. This causes an unsolicited stress of lack of infrastructure, lack of public facilities, and insufficient accessibility by public transportation.

This second category of change, named unsolicited stresses, are longer-term or even permanent changes in the city that are not intended, or even desired, by the city government or by local stakeholders. They cause changes to the built or social environment that may resonate for decades, and even cause permanent shifts in demography, social status, property prices, and living conditions within the city. The longer time span that is typical for unsolicited stresses often derives from larger societal, economic, or environmental processes that trigger these changes. These (often global-scale) changes are harder to prevent at the scale of urban planning or architecture. A more feasible response is to mitigate their

impact by interventions on the metropolitan scale.

2.3. Self-Induced Shocks

"Self-induced shocks" is the third form of change that is identified, meaning all types of short-term peak events, deliberately implemented in the built environment. They may include any form of temporary change that is planned and desired by a certain party and has an influence on the spatial or operational configuration of the city.

Examples of self-induced shocks in the daily operation of the city can cover any event that is temporary and exceptionally takes place in the context of the standard urban fabric, such as the organization of a local festival or event. A self-induced shock can mean the personal interpretation of space by one person, one party, one business, using (public) space for other purposes than it was originally designed for. It can be a street protest, a block party, a commercial store placing billboards or clothing racks on the sidewalk. Any change that is intended, of short time span, and impacting the initial configuration or operation on any scale. More telling examples that drastically and physically affect the character of the built environment are the organization of the World Expo, the Olympic Games, world championships for sports, or other large international social events. For New York, a most prominent example is the organization of the 1934 and 1964 World's Fair in Flushing Meadows in Queens (**Figure 3**, left). Even though these events were temporary, their spatial impact on the built environment has been permanent, with the construction of several subway lines connecting to Manhattan, Brooklyn, and Long Island (Feinman, 2000), the beautification of the park that served as the fair's location, and overall urban renewal for the events.

Figure 3. Left: World expo of 1964 in queens (shock). Source: Greater Flushing Chamber of Commerce. Right: Protest against displacement in light of new housing projects (stress). Source: website Planning.org.

Although shocks and stresses often have negative connotations, they are not always unsolicited. Changes can just as well be self-induced. This third categorization of change, named self-induced shocks, entails temporary events, of which, in most cases, their impact will dissolve when the event finishes. However, when consequential changes are made to the surrounding urban fabric—for instance, when the event is of global importance—the impact of the self-induced shock can resonate for decades in the form of structural improvements.

2.4. Self-Induced Stresses

Self-induced stress is the umbrella term referring to all types of changes that stretch over longer time spans, which are planned and desired by a third party. Any form of planned, and therefore man-made changes to the urban character that are long-term or even permanent, qualify as self-induced stresses.

The most telling examples of self-induced stresses in the urban fabric can be found on the agenda of the city government's urban planning department. Examples can entail any significant change in zoning, large urban renewal projects or real-estate developments that trigger a significant and long-term change to the urban fabric. A few examples that can be witnessed in New York City are explained below because of their further relevance in this paper.

In New York City, a recent trend has arisen of rezoning post-industrial waterfront land for residential or recreational land use. In line with the research conducted by Curran (Curran, 2007), Bronstein illustrates how this notion heavily impacts the urban environment, stating that "[r]ezoning not only shrinks the amount of available land legally available for industry; it drives up prices in broad areas where industrial businesses are located, produces uncertainty about long-term capital investments in industrial operations, and invites conflict with nearby residential and retail uses" (Bronstein, 2009). Self-induced stresses have a permanent impact on the spatial configuration of the urban fabric as well as the social and economic structure of the broader environment of their intervention (**Figure 3**, right).

Linked to rezoning, another example of a self-induced stress is the construction of large real-estate development projects by the private sector. Mega-projects are increasingly replacing former industrial (often waterfront) sites, attracting new visitors and inhabitants, and directly impacting the former configuration of their surroundings. Ibert et al. describe this notion as "self-induced shocks": "Despite these systemic risks inherent in top-down massive interventions into the urban fabric, mega-projects have always played a decisive role in the development of cities. As 'self-induced shocks', they create a state of emergency that effectively leads to the pooling of finances, expertise, and public awareness" (Ibert, Sibel, Peters, & Müller, 2015). This paper follows a similar train of thought but distinguishes the terms "shocks" and "stresses", and considers urban mega-projects to be stresses.

A final example of a self-induced stress that is worth mentioning is the en-

hancement of accessibility of an area by adding or increasing public transportation. In recent years, New York has reinstalled the ferry as a public mode of transport, increasing the accessibility of multiple waterfront neighborhoods. Since increased accessibility is a significant trigger of gentrification (Dawkins & Moeckel, 2016), this self-induced stress is important for the future transformation of the city's waterfront. In preceding work, the author has investigated the link between the construction of a ferry landing and the increase of property prices in its proximity on New York's waterfront (Schreurs, 2019). One of the conclusions was that, thus far, there is no clear link between implementing the ferry and gentrification of the city's waterfronts, because of an opposite method of implementation. To date, ferries have mostly been introduced to serve neighborhoods that are already in an advanced state of redevelopment and gentrification. It is only recently, in the further rollout of New York's ferry network, that landings have been added in neighborhoods that are not yet gentrifying. Following the first available data and the knowledge that accessibility is a crucial trigger for gentrification, these ferry landings might have significant repercussions on property prices and the current demography of its direct environment.

Self-induced stresses are changes that permanently impact a neighborhood's spatial and social conditions. Since these interventions are planned, they are usually decided at metropolitan level, meaning that they are under the authority of the city government. Self-induced stresses have a significant impact on the urban fabric, from the small local scale to the larger metropolitan scale. By notion of self-induced stresses, the city generally has most power to contribute to resilient planning.

2.5. Multi-Scalar Impact of Change

By impact of the aforementioned types of change, a city is inevitably in constant transformation. As illustrated, types of change can be characterized by their duration (shocks or stresses) and by their intention (unsolicited or self-induced). However, change can simultaneously have its origin or effect on multiple scales, oscillating between the largest global scale, all the way down to the smallest human scale.

Change can be triggered by larger societal or economic processes that eventually influence neighborhoods in different ways. Examples include the direct or indirect consequences of climate change or industrial decline, but also the emergence of e-commerce, chain stores, changes in an area's overall demographics or changing waves of immigration. All of these larger global processes can potentially affect a neighborhood's conditions, by as well spatial, social, or economic translations into the existing environment. Such changes that find their origin at the global scale, are often translated into the neighborhood as unsolicited events. They can potentially cause temporal shock events with intense consequences, such as floods or storms, or longer-lasting stresses, such as the pollution of soil and water, gentrification of a neighborhood, redundancy of

smaller local shops, immigration, or changes in entire social or ethnic groups.

Changes that result from metropolitan-scale processes and interests are often the most pressing in the city. Issues like insufficient public transportation, the urge for more public space, an increasing housing demand, or the implementation of new modes of (public) transportation like a ferry or a city-wide shared bike system are examples of metropolitan-scale changes. They often have their translation into neighborhoods by larger self-induced stresses.

Finally, change can have its origin or impact on the smallest local and human scales. Examples comprise local shifts in designated land uses, a community's predominant religion or culture, an area's overall household composition, active local organizations, actual local activities, or the personal interpretation and use of space. These are the changes that define the identity of a neighborhood and are most relevant on the scale of the user, of the street.

Any type of shock or stress—be it by larger political decisions or by the appropriation of space by an individual—is a potential trigger for transformation of the urban environment and local neighborhoods.

2.6. The Eye-Opening Pandemic

Recently, a new global-scale environmental process, in the form of an unsolicited stress, has touched upon our daily lives. The impact of the global COVID-19 pandemic has highlighted once again that a need for flexibility and resilience to change is a valid concern. New York was one of the first cities in America to be hit hard by the pandemic in the spring of 2020. The combination of sudden unemployment, mandatory teleworking, the closure of catering businesses, museums and stores, and the general decrease of public activity made many residents decide to leave the city (Klein, 2020). Few cities in the Western world were hit as hard as New York by this pandemic. Analysts calculated that over the full year of 2020, the total number of people who left the city rose to a whopping 3.5 million (De Foer, 2021). This exodus has had a significant impact on the city and its daily operation. Especially higher-income families have the financial means to leave the city and to work from remote locations. The real-estate sector dealt with significant vacancies as a consequence of this plunge in interest in their market. Other sectors and activities were equally confronted with the unsolicited stress of the pandemic. Looking at the daily use of public space, the method of "order and control" that is increasingly defining the design of public space since the 1990s (Sorkin, 1992) has reached a new climax with this pandemic. Coronavirus restrictions prevented free appropriation and use of public space, while control and management of the public domain are stricter than ever, with delimited seating areas and even curfews. Although the mid-pandemic situation has repeatedly been labeled as "the new normal", spatial, social, and economic changes will continue to take place as either internal or external transformation processes in New York City's neighborhoods. The impact that the global-scale pandemic has had on the city's built and social environment is one (extreme)

step in a series of constant unexpected shocks and stresses that manifest themselves over time.

3. The Urban Waterfront: A Key Player in City Transformation Processes

3.1. Looking Back: The Urban Waterfront as Protagonist for Change

While cities in general are constantly transforming because of the impact of shocks or stresses, unsolicited or self-induced, it becomes apparent that New York's waterfront in particular seems to play a key role in many of the city's processes of transformation. Historically, large shifts in societal preconditions have often manifested themselves in different or more extreme manners in waterfront neighborhoods. The waterfront's specific spatial and social identity has been continuously forced to adapt to new emerging realities by the impact of different changes. By zooming in on four key moments in history (Figure 4), through the lens of shocks and stresses, an illustration is given of how New York's waterfront has functioned as a protagonist for change over time, and what the spatial impact of these changes has been on the scale of the metropolis.

The ***first*** key moment that significantly defined the unique spatial conditions of New York's waterfront has been the implementation of the Commissioners' Plan, as proposed in 1811 (Figure 4, 1). The mainland of the city was physically structured by a rigid system of perpendicular streets and avenues, dividing the

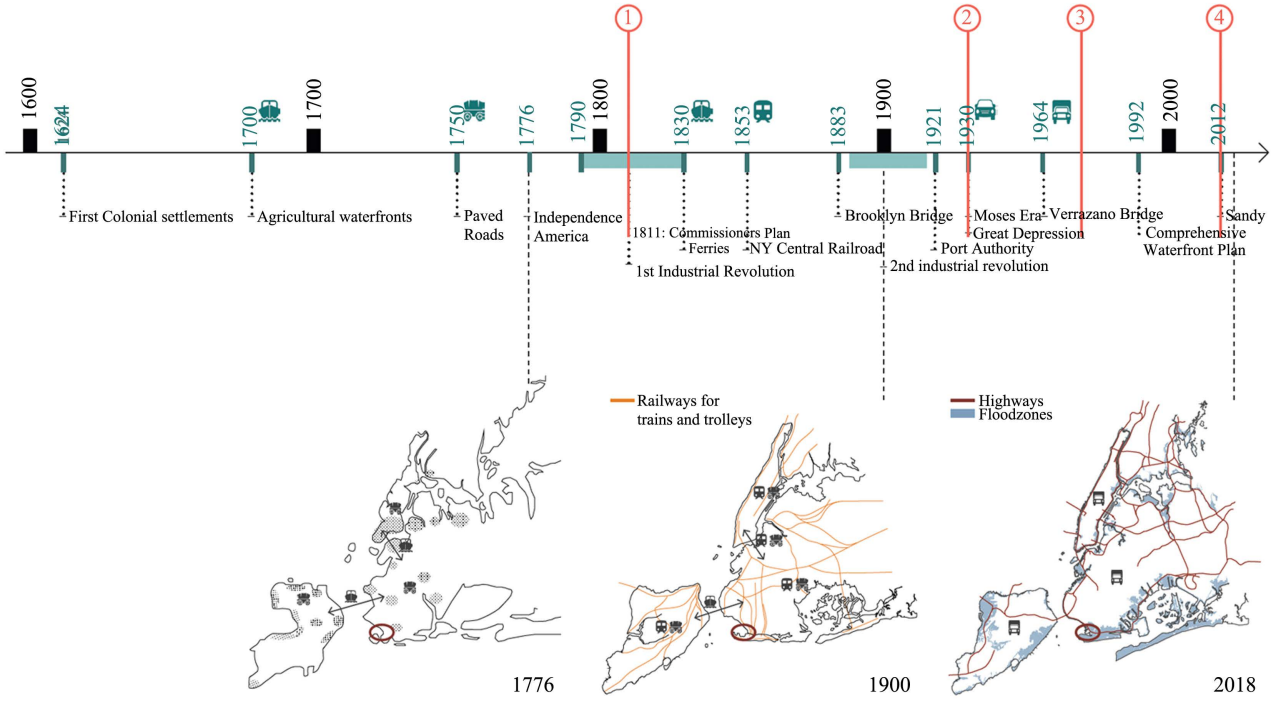

Figure 4. New York's waterfront played a protagonist role during important moments of transformation, indication of four key moments in history. Source: Author, 2020.

land into similar building blocks: a most extreme example of a self-induced stress. "The map of the plan creates the illusion of a flat and barren landscape with the grid representing the building of a new order; essentially no consideration was given to the space upon which it was being imposed" (Hoffman, 2013). "Grid cities seek their benefit in the system's repetition and elements like the easy division of properties, accessibility, clear vehicle and pedestrian fluxes, and affordability of sewage and electricity provision. The main focus lies on structure, readability, and predictability" (Schreurs, 2022). Deliberate interruptions to the repetitive grid are carefully implemented by the design of parks, diagonal streets, or larger infrastructures. However, the most important exception to this method of order and predictability, is the waterfront. Whenever the waterline intersects with the grid, unique spatial conditions are created by streets that become dead ends and building blocks that are no longer strictly rectangular (**Figure 5**).

This notion of the interrupted grid has allowed a variety of different infills over time, that vary from more standard inland conditions. As a result, since the early 19th century, the land directly adjacent to the coastline has been an aberration in the systematic urban planning system of the City of New York.

A ***second*** selected key moment in time, where the waterfront has historically functioned as a protagonist for change, builds further upon the aforementioned notion of the grid meeting the waterline. When, during the interbellum, large infrastructures for vehicular traffic were introduced to New York by city planners like Robert Moses (Caro, 1975), waterfronts were often selected as locations for implementing these self-induced stresses (**Figure 4**, 2). Spatially, these interventions changed the coastline of the city drastically. Whereas the initial interruption of the grid by the coastline created fragmented building blocks, large

Figure 5. The commissioners' Plan proposed as dominant grid, superimposed onto the existing island of Manhattan. Streets are intersected by the coastline. Source: Commissioners' Plan, 1811, Public domain.

infrastructures reinterpret the waterfront as a linear entity, with extensive highways. The linearity of the highways creates a border between the intricate, small-scale local neighborhoods and the adjacent waterbody. Because of these interventions, contrasts in scale between large metropolitan-sized infrastructures and smaller local activities and buildings remain visible in New York's urban fabric to this day, especially in proximity to the waterfront.

A ***third*** important key moment is situated in the latter half of the 20th century, in the aftermath of industrial decline. The decrease of industrial activity on the waterfront, in combination with complicated land ownerships, a lack of inhabitants' individual capital and waning interest in investment, pushed significant portions of New York's waterfront into a state of limbo (**Figure 4**, 3). Instead of large investments and self-induced development projects, many waterfront neighborhoods at the time transformed on a much smaller scale, attracting more marginalized social situations. Initially, this often resulted in a rapid increase of local unemployment, higher crime rates, drug-abuse, and homelessness on the edge of the city. However, in some places, this unconstrained identity and smaller scale of transformation resulted in locations where freedom of speech, social inclusion, and deviations from the norm were tolerated and even celebrated. By squatting in vacant warehouses and appropriating industrial piers on the Manhattan west waterfront, the LGBTQ+ community, artists and teenage runaways of the 1970s found a place to express themselves in the city (Cotter, 2019). That is how the waterfront of the late 20th century became a platform for self-expression and tolerance.

It was at this same time (and earlier) that the cheap waterfront land was used by the federal government to build affordable public housing towers to respond to the pressing demand for housing, especially for lower-income families. Together with the high number of immigrant workers that still lived on the waterfront in the wake of its industrial past, the edges of the city housed a multitude of social and ethnic minority groups, contributing again to its social inclusiveness.

The ***fourth*** and final selected key moment of change, which drastically affected the waterfront of New York, took place only one decade ago. America's East Coast experiences frequent hurricanes, but the impact of super storm Sandy in October 2012 marked a turning point, a wake-up call, for New York City (**Figure 4**, 4). The damage inflicted by this unsolicited shock has changed the city on spatial, social, economic, and environmental levels. The coastal neighborhoods functioned as a shock absorber for the inner city, and the most vulnerable communities were hit hardest (Ovink & Boeijenga, 2018). The impact of this shock also resonates on multiple scales, from the global problem of climate change to the human scale of inhabitants with insufficient flood insurance.

3.2. Looking Forward: The Urban Waterfront as Laboratory for Change

The coastline's interests have shifted regularly when a shock or a stress affected

its conditions. As a result, the coastal neighborhoods' spatial and/or social conditions regularly need to adapt to new societal discourses that are at play at a certain time or at a given location. Their location at the juxtaposition of water and land, their (in)accessibility, and their unique spatial conditions of an interrupted grid have historically resulted in waterfronts becoming protagonists in events of change. Because of these unique conditions, a waterfront neighborhood has the potential to transform into a border condition that is highly impressionable, and therefore also tolerant for change. The waterfront's deviant spatial layout has repeatedly proven to be more welcoming to a wide range of social and economic scenarios than inland locations. Time and again, the coastline has served as a place for experiments and extreme interventions, by, for instance, the construction of large infrastructures or the building of investment projects that failed to find other (affordable) locations in the city. Simultaneously, the waterfront has illustrated a higher tolerance for transformation on a smaller scale, based on local needs and small windows of opportunity. As a result, the coastline has often hosted minority groups, new social processes and small businesses more easily than the inner city. Minority groups and marginalized activities fight for their spot in the city and find this on the tolerant waterfront. As a result, these waterfront neighborhoods potentially become a hybrid representation of pressing contemporary societal and economic needs, lacks, and pressures in the metropolitan city. By the realization that the coastline largely functions as a protagonist for change, as a place for experimentation, and as a representation of pressing socio-economic needs and processes of the time, the waterfront of New York City becomes an educational laboratory of urban transformation processes.

In academia, the notion of an "urban laboratory" is regularly used in line with the definition of an actual scientific laboratory, where the goal is to observe and measure conditions within an outlined and controlled setting. However, the city is not a controlled setting. Instead, it is complex, unpredictable and in a constant state of change. Therefore, when the term "urban laboratory" is used in planning or architecture, one of the wider critiques that arises is that an urban environment cannot be compared with a controlled setting such as a laboratory, nor should it be simulated as one (Schrock, 2016). These critiques highlight the danger of repetitive outcomes versus the actual complexity of an urban setting (Latour & Woolgar, 1979). In that regard, it is the sociologist Robert Park, in collaboration with Ernest Burgess, who first approached the city as a laboratory from a more anthropological perspective in the early 20th century (Park, Burgess, & Sampson, 1925). Instead of a controlled setting, Park considered Chicago to be a complex living environment, composed of "traditions, cultures, behaviors and machinery mutually influencing one another" and maintained that cities give tangibility to the most pressing social problems. Park saw the city as an opportunity to map and observe, in order to retrieve data and gain knowledge, yet from a rather bottom-up approach. The city was to him an opportunity where

experiments could take place, but simultaneously where "observations of social conditions" could be controlled, hence, a laboratory. In contrast to the traditional notion of a scientific laboratory, Park's idea of a laboratory setting respected the complex transformation processes of the city, aiming to learn from them, instead of desiring to create a neutral and controlled space.

More recently, the notion of "living lab" or "living laboratory" has become popular in architectural and urban academia and education. The term was first introduced in 2003 by the researchers Mitchell, Larson, and Pentland at MIT, as a method in research and design that is user-centered and based on real-life contexts, with a predominant focus on public-private-people-partnerships (Bergvall-Kareborn & Stahlbrost, 2009). Today, the term "living lab" has gained many interpretations and definitions and is used in multiple contexts.

New York City itself has regularly been considered a laboratory, a testing ground. When Koolhaas published his retroactive manifesto for Manhattan, he gave an evaluation of Manhattan as an urban and architectural testing ground, a "mythical laboratory for the invention and testing of a revolutionary lifestyle" (Koolhaas, 1978). New York is explained by Scheerlinck as "a laboratory where […] streetscapes presented themselves to me, in real life, in movies or in novels, and especially, where I had the feeling I could learn from them" (Scheerlinck, 2021). Ovink describes New York as "bold, innovative, progressive and dynamic"; the best place to try things out, because the ground is "fertile for experimentation" (Ovink & Boeijenga, 2018). The reason that New York is often seen as a laboratory is not because it is a controlled setting, but because of its dynamics, because it is friendly to change and experimentation and because unexpected scenarios unfold in the midst of daily life.

By looking into New York's key moments in history and its transformation processes in previous subchapter, the city's coastal neighborhoods have been identified as most valuable sources of information, as its laboratory to learn from. As formerly explained, it are predominantly the waterfront neighborhoods that are repeatedly confronted with pressures of shocks and stresses, being forced to react constantly to new emerging conditions. They often form a "buffer" or an "absorber" for the impact of change on the city. This has resulted in these neighborhoods being in constant transformation, often gradually adapting to new realities by embracing changes on the smaller scales.

The waterfront neighborhoods' location, at the juxtaposition of water and land, is relevantly situated on the edge of the city, baring crucial information for city needs and development. In natural ecology, Stephen Gould makes a distinction between borders and boundaries: boundaries are the point in space where things end, while a border is the place where different entities meet and interact (Scott, 2007). In natural ecology, the waterfront is generally considered a border, where the combination of water and land conditions allows increased biodiversity and unprecedented opportunities for species' habitats. In urban planning, however, the waterfront is often perceived as a boundary. There is a dominant

functional relationship between land and water (like skyline views and waterborne transportation), but development often happens with a strong inland focus, with traditional constructions. However, when the urban waterfront instead has strong border conditions, its urban identity will function as a hybrid transition between water and land. Such neighborhoods are no longer a boundary where the land ends and the water abruptly begins, nor are they a mere membrane that separates one from the other. Instead, these neighborhoods become the border where two contrasting elements meet, interact with each other, and come to form unique spatial, social and economic conditions that are unprecedented in a traditional urban, inland environment. When this border condition is considered by a multi-scalar approach, it has the potential to become a laboratory to learn from, to test methods of development upon, and to extract findings from. At the global scale, the waterfront is generally a key player in the debate on climate change and shock impact. At the metropolitan scale, the urban waterfront is a place for transportation, infrastructure, innovation, and recreation, while the interruption of the grid on the land by the coastline of the waterway (**Figure 5**) creates unprecedented spatial conditions. In turn, these spatial conditions result in numerous unique scenarios of social and economic cooperation on the local scale, with clusters of small businesses and coexistence of different land uses and activities. At the smallest, human scale, the waterfront neighborhoods display a high tolerance for an individual appropriation of public space, creating vibrant and intricate streetscapes. This multi-scalar complexity is a highly relevant source of information. These waterfront neighborhoods' high levels of complexity, their mixtures of urban identities, their deviant spatial layouts, their multitudes of social and economic situations and high levels of inclusion and overall higher tolerance and inclusion makes them interesting cases to learn from; real-life laboratories. For a city like New York, it is these border conditions and overall high tolerance for transformation that come to represent pressing societal, economic, and environmental needs and lacks to the city.

4. Conclusion

Change causes continuous transformation of cities, contributing high levels of uncertainty to the professions of architecture, planning and policy making.

Although the impact of shocks and stresses in a metropolitan city is inevitable and often unpredictable, and manifests at multiple scales, in numerous forms, and on many occasions, it is the translation of this impact in space and time that is crucial. Especially the relation between the multi-scalar configuration of the existing environment, and the multi-scalar impact of change on the urban conditions is considered the crucial moment in space and time to obtain insights from.

For a coastal city like New York, historic transformation has made it clear that the city's waterfront is a welcoming host for change, where change either manifests first, more extreme or on a different scale than in the rest of the city. De-

spite its different identity from the inland, its transformative character becomes a perfect laboratory to learn from. Just as Robert Park considered the metropolitan city as a laboratory for life in general, giving tangibility to the most pressing problems of society (Park, Burgess, & Sampson, 1925), this research considers the hybrid waterfront with border conditions as the laboratory that gives tangibility to the most pressing social, economic, and environmental problems of the rest of the city. Be it the urge for a transportation shift in the 1930s (Caro, 1975), or a pressing problem of unemployment, drug abuse and homelessness in the 1950s. Be it the fight of the Gay Community for their rights in the city in the 1970s (Cotter, 2019), or the emerging impact of climate change and its effects on our contemporary built and social environment. The waterfront's border conditions give previews of these pressing problems, being a tolerant host to marginal conditions that are suppressed elsewhere in the city.

The city is not a static notion, nor should it be treated as one. Users, needs, and economies change, and a city never achieves a definitive form. The city's operation is a constant succession of intermediate scenarios. Today, more than ever, it is crucial to consider change by its multi-scalar translation onto the city, and the need for resilient responses in our design strategies.

Contributions

This paper is part of an ongoing research project, entitled "insights on the reconfiguration of vulnerable industrial waterfronts facing shocks and stresses, Coney Island Creek, New York City, USA". This is the author's doctoral research project on the transformation of post-industrial waterfront neighborhoods in New York City. The larger research project is conducted by the author, under the supervision of the promotor Prof. Dr. Maarten Gheysen, and the co-promotors Profs. drs. Kris Scheerlinck and Erik Van Daele, all affiliated with KU Leuven, Ghent, Belgium. Assessment of the project has been done by Prof. David Burney (Pratt University, New York, USA) and Prof. Dr. Caroline Voet (KU Leuven).

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Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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