Toward A New Resilience

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Abstract The urbanization of Tokyo took place in conjunction with a near continuous series of unprecedented disasters, events, and reconstructions; from the early fires in the Edo Era, to the Great Kanto Earthquake in 1923, the fire-bombing of World War II, the 1964 Tokyo Olympics, the Great East Japan Earthquake, and somewhat anti-climactic, the 2020 Olympic Games. After each event history was marked and Tokyo was changed, usually improved, built back better. This chapter lightly unveils the secret behind the city's ability to recover and make use of transformational events. We conclude that Tokyo's resilient and adaptive urban system is based on three fundamentals—a strong rail network, livable communities, and convective flows. These fundamentals are supported by a complicated urban nexus, and an entangling *mesh* of sectors and people that reaches to every corner of the city and acts at multiple scales. The example of Tokyo shows that resilient and adaptive cities rely on the cooperation of both human stakeholders and multiple layers of physical factors. This insight could be valuable for growing cities in emerging countries. It provides a basis for the advancement of urban resilience and adaptivity.

Keywords Urban system · Urban nexus structure · Mesh · Urban crisis

1 The Urban Structure of Tokyo

The Tokyo Metropolitan Area is one of the most competitive cities in the world (Mori Foundation 2022), an accomplishment all the more remarkable because Tokyo is a megacity. In fact, it is currently the largest city in the world, with a population

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W. Yan et al. (eds.), *Resilient and Adaptive Tokyo*,
https://doi.org/10.1007/978-981-99-3834-6_16

nearing 40 million people. With so many people crowded together it would not be surprising to learn of any number of social or logistical problems. While those problems do exist, and historically have even been severe, the city has now become a model for sustainable urbanization for many emerging economies (ARCADIS 2022). Strolling through the streets of Tokyo we can find cultural attractions, gourmet food, vivid streetscapes and a diversity of local cultures; all supported by an efficient infrastructure, including a well-connected inner and inter city transportation network. You may wonder how a city with so many markers of success could develop in spite of a history of massive disasters. We would argue the achievement is more intriguing because the city has done so well through deliberate choice.

The chapters of this volume include stories that describe physical and institutional conditions. They outline nexus thinking methods, for observing and evaluating cross-sectoral efforts. And they propose solutions for the development of green infrastructure, renewable energy, and participatory planning. Reading through the material we began to feel that we are indirectly describing a particular code for making a resilient metropolis. That code can be generalized by four parts - a powerful city core, an advanced railway network, compact communities, and the resulting convective flow of goods and people cross a metropolitan region. Each of these are elaborated on below.

1.1 A Powerful City Core

Generally, the central area of a city is the location of its social and economic engine, and if the city is large enough, it can propel a nation. During its long history Tokyo established a central business district (CBD) around Marunouchi-Tokyo Station. Unlike some cities in the world where the business center shifted ore weakened as a result of suburbanization, Tokyo never stopped upgrading its CBD. Quite the opposite, as suburbs grew around the metropolis in the late half of the twentieth century, subcenters such as Shinjuku, Shibuya, Ikebukuro, and Ueno also grew at a remarkable pace. All of them are well known destinations in the city, some of them are world famous. Not by accident, all of them are all located on the Yamanote Line, a ring-shaped train line that encircles much of what might be called central Tokyo. Functionally, these subcenters were not a replacement of the CBD but were the containers of spillover effects. Consequently, the CBD and subcenters form an enlarged urban structure, with the main CBD and multiple subcenter cores scattered just inside and around the Yamanote Line. The huge compact region created by this ring was designated as the central core of the Tokyo Metropolitan Area (TMA) from the 1990s, a designation continuously revised in the city's strategic development plan (Tokyo 2022). Although the monolithic approach to this large area is often criticized, many people believe that when "Tokyo is strong, Japan is strong; [and when] Tokyo is weak, Japan is weak." Meanwhile, the Japanese government also decided to decentralize some divisions and institutions of the government to new cities such as the Minato Mirai 21 District in Yokohama City, Makuhari City in

Chiba, Saitama New City in Omiya, and Saitama City; all in order to improve its disaster resilience through decentralization, and to improve regional sustainability. The effort has consequently motivated the private sector to move out from the core to the suburbs as a way to balance their development.

1.2 Advanced Railway Networks

Tokyo is famous for its well-developed railway network and its use as the main public transportation instrument (Calimente 2012; Yajima et al. 2019). The railway network connects the central core, new cities, and local communities, forming a strong framework for the urban systems that support the region (Kono n.d.). With this railway network we can see that:

- The central core of Tokyo accommodates the daily movement of eight million workers, the highest rate in the cities of the world.
- The high density, high frequency, and seamless connection of trains between the central core and suburbia creates the most efficient and convenient commuting system.
- The railroad stations were built as both service and living centers for residents. This makes Tokyo one of the most advanced models of transit-oriented development (TOD) in the world (Calimente 2012).
- The partnership of railway companies, municipalities, landowners as well as citizens forms a new type of commons in the modern city that can be leveraged as a tool in urban planning and land development (Nakamura 2018). Cooperation between these groups makes the TOD possible in most of the metropolitan area and supports the establishment of both the working and living practices of its citizens (Sanders 2015).

1.3 Livable Communities

Residential communities are the basic organ of a city. Livability is the most fundamental factor under consideration when people determine where to live, an idea which includes the cost of finding or building a home (Wheeler 2004). The goal of urbanization, in an ideal world, is to continually protect communities from disasters and risks, to improve access to food, water, and energy, and to meet the needs of citizens as they progress through the varied stages of life (Ramaswami 2020). Planning in Tokyo has managed to maintain a focus on the perspective of its residents and the production of a better living environment even through its most dramatic period of rapid economic growth in the post war years (Liu et al. 2022). Several chapters in this volume make this point, as some readers may have noticed. With regards to the future, adapting to a shrinking population, the metropolitan

government has developed a picture of Tokyo for 2040 where residents live in compact developments along the railway network. The plan aims to also revitalize underused land and social infrastructure in the hinterland of existing railway systems. As such it is not only a physical plan but a political movement promoted by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT). If done correctly it would additionally act as a part of the city's trend toward building a zero carbon society.

1.4 Convective Flow of Goods, People, and Information

Tokyo expanded radically during much of the twentieth century, growing from a little more than one million people to over thirty-one million. In 1962 it passed into the small club of world megacities (TMG), and currently has a population of around 36 million in the greater metropolitan area, making it the largest city in the world.

All of this growth was supported by the massive flow of energy and resources, both in and out. The scale of urbanization caused severe environmental problems, while opportunities concentrated more and more in urban areas, causing a flood of population out of the countryside and into cities like Tokyo. Reversing this one-way flow from rural to urban areas was an urgent issue for the Japanese government. As a result, the central government revised its national terrestrial planning in 2008, highlighting *convective flow* (MLIT 2008). This term, "convective flow" signifies the tight communication and exchange of goods and services between urban and rural areas as well as among regions. According to the new plan, urban and regional plans and projects were to help develop local centers and nodes with unique characteristics. Ideally, the centers and nodes would not only be the locus of consumption but would additionally provide goods and services to other nodes in the system. Since its adoption pragmatic policy has been implemented under the supervision of the MLIT, making use of three paths, each aimed at creating a sustainable social infrastructure as well as public services. The three paths are as follows; first, control housing and urban stock by regulating new construction of hard infrastructure; second, upgrade incrementally in order to adapt to slow onset change; and third, manage urban facilities like parks or water treatment plants through engagement with the private sector.

Beyond investment in infrastructure, investment in ecosystems was also promoted across the country. Through the accumulation of investment in natural resources it is expected that productivity and access to public services could be improved. To give an example, a typical program was the concept of the "Circular Sphere of Forest, River, Settlement, and Sea," promoted by the Ministry of Environment since 2007 (MOE 2007). This idea is easily linked with the principles of nexus thinking, as the discussion in chapter "Design-Led Nexus Approach for Sustainable Urbanization" of this volume.

A powerful city core, an advanced railway network, livable communities, and convective flows, are all aspects of a single entity, the city of Tokyo. While there are

other aspects to consider, such as good governance and social cohesion, it is our conclusion that these are the key elements that shape the essential structure of a resilient and adaptive Tokyo. They ensure the city sits at the top of the list for sustainability among the world's megacities.

2 The Urban Nexus in Tokyo

With the urban structure of Tokyo in mind, we can conceptualize the complexity of a metropolitan urban nexus system with a mesh, as illustrated in Fig. 1. The horizontal layers consist of the physical and social factors supporting the management of a city or region, and the columns are spatial scales. From bottom to top, the nexus factors are stacked in order of the ecological basement, geographic agglomeration, hard infrastructure, soft infrastructure, actors, connectors as well as people. Each layer is related to community, city, and the metropolis in consideration of the general systems of urban planning and management.

The terms within the mesh can be thought of as parts of what the philosopher Timothy Morton calls Ecological Thought (Morton 2009), where Nature is deeply entwined with the synthetic constructs of humanity. In his way of thinking the 'mesh' takes on the same meaning as a network, like the Internet or world-wide-web. As he writes, "*By extension, 'mesh' can mean 'a complex situation or series of events in which a person is entangled; a concatenation of con-straining or restricting forces or circumstances; a snare'*" (Morton 2010). From the point of view of the authors this is an idea very similar to the centra term of this volume, the Nexus. While we do not intend to look deeply into the philosophical significance of this pronouncement it is a useful point of reference. Applying the term helps us to

	Community	City	Metropolis
Vision — Well-being	Compact life	Multi-centric urban structure	Global megalopolis
Connector — Product/goods/services	Seamless connection	Competition/i innovation	Industry and logistics
Actors — Company/organization	Developers/citizens/ landowners	Municipality/council/ NPO	Multi-level governance
Soft infrastructure — Institution (Law/rule)	Neighborhood planning	City planning	Metropolitan strategy planning
Hard Infrastructure — Urban infrastructure	Transit-oriented development (TOD)	Railway-led urbanisation	Convection of urban and rural
Agglomeration — Building and land use	Growth/shrinkage	Adaptation	Layered development
Ecological foundations — Planet/Resources	Geology/topology	Multiple circulation	Sustainability

Fig. 1 Urban nexus structure of the metropolis

grasp the withdrawn (Morton 2012) factors hidden beneath the complicated foreground.

The nodes of the mesh in Fig. 1 are localized to many characteristics in Tokyo, expressing the evolution of systems between nature and society. Through the evolutionary urbanization process, cities have attracted people, expanded buildings and built-up land, and consequently changed the interface between human and nature in the form of hard infrastructure and soft institutions. From the perspective of hard infrastructure, advanced railways and public transportation systems are the typical components that ensured the possibility of Transit-Oriented Development over the metropolitan region. Meanwhile, planning systems are the institutions created to manage both the infrastructure and urban systems.

Urban planning in Tokyo contains formal knowledge legally established in urban planning at the neighborhood level, the city level and the regional level. Various actors including government officials, politicians, and professionals are engaging in planning with the development of experience, products, projects, services, and eventually forming industries and the logistical flow of materials and energy. The top layer of the mesh indicates the ultimate objective of urban planning and management, to create and support more well-being and a high quality of life for citizens.

Historically, Tokyo has led the movement of urbanization through transit-oriented development. Residential communities are constructed with both public and private products (i.e., buildings, roads, and infrastructure), and services collected around railway stations, leading to a relatively compact life. There are always contradictions and conflicts among the multiple layers and scales because of different interests by stakeholders, as well as the timeframes connected to each. Nonetheless, the function and performance of services relies on the cooperation of sectors, both formally and informally. Nexus thinking and the nexus approach provide a pragmatic method to explore common benefits by leveraging our understanding of those interactions and interlinkages. Interactions in the urban nexus have been popularly recognized in scientific research (Newell et al. 2019) while the benefits of interlinkages are often handled in practice as a result of politics and institutional norms (Romero-lankao et al. 2017).

The design-led nexus approach by M-Nex suggests three components: an iterative design method, the FEWprint evaluation tool (ten Caat et al. 2022), and the cooperation of a participatory living lab to engage in practice (Yan et al. 2021). In this way the M-Nex approach is an integration of knowledge and action, from data management, to workshops and stakeholder engagement (Chapter "Design-Led Nexus Approach for Sustainable Urbanization"). Chapter "Calculating the Demand for Food, Energy, and Water in the Spatial Perspective" examined the effect of food-energy-water at the neighborhood scale while chapter "Assessing Urban Resource Consumption and Carbon Emissions from a Food–Energy–Water Nexus Perspective" analyzed the interlinkage of sectors. Through the chapters we recognized the impact of urbanization on land use, natural resources, and green infrastructure. We learned of the nexus effects of food-energy-water nexus at the scale of the neighborhood, the city, and the region, considering CO_2 emissions across industries.

Solutions and their nexus effects, including energy systems, participatory planning activities at living labs, and collaborative political instruments were proposed and examined for further discussion. We believe this knowledge is valuable for understanding Tokyo so far and can be used to push forwards to a more sustainable pattern of urbanization.

3 Challenges in Tokyo for More Resilience and Adaptivity

Because of its geographic location and geological conditions, the urban development of Tokyo was filled with a history of combating disasters and disruptive events. This was true from its very beginning, punctuated by large events such as the Meiji Fire in 1657, the Great Kanto Earthquake in 1923, the war in 1945, and recently, the Great East Japan Earthquake of March 11, 2011. Each disaster caused misfortune to the city, but post-disaster reconstruction also brought new opportunities for urban planning learning and practice. Consequently, the city was built with both hard and soft infrastructure grounded in resilience.

The most recent lesson comes from the Great East Japan Earthquake, the event that struck Japan on March 11, 2011. In the post-disaster reconstruction the power system controlled by Tokyo Electric Power Company was dismantled, the electric power market was fully liberalized, and new energy systems and urban resilience structures were developed (Ofuji and Tatsumi 2016; Shinkawa 2018). At the same time, new ideas and mindsets were born through the process of reconstruction. Some of the new practices have contributed to global communities on resilient construction - the combination of hard infrastructure and soft aspects of activities including public participation were adopted in the Sendai Framework (Murayama 2016; Diaz-Sarachaga and Jato-Espino 2019).

Tokyo originally planned to declare its recovery from the disaster at the 2020 Olympic games. Unfortunately, the sudden outbreak of COVD-19 got in the way.

To some extent, so too did the urban structure and systems described above. The assets accumulated in Tokyo over a century and a half of urbanization would normally be viewed as markers of affluence in an advanced global city. COVID-19 revealed a new challenge, one that flew in the face of those achievements. Around the world cities with a high density of movement and business exchange were the first to suffer. In a mega city like Tokyo the established rhythm of production and daily life was abruptly stopped during the pandemic (Aruga 2021; Dubinsky 2022; Boratinskii et al. 2023; Yabe et al. 2020; Tsuboi et al. 2022).

Thanks to the development of information technology and telecommuting, somehow the cities were able to maintain many of their essential functions. However, there have been changes. Crowded commuter trains were largely empty, and bustling nightclubs were suddenly deserted. Meanwhile, people realized that the daily commute need not be part of their life. The once proud idea of “working in the center, living in the suburbs” lost its shine, and could be seen as a social norm created out of habit as much as an actual need, at least in our time of digital connectivity. By

introducing remote working, people have more time to spend in their neighborhoods. Wandering around the communities, many people noticed the poor communal environment, the narrow streets and alleys, the lack of green space, broken pedestrian paths, and so on. Positively speaking, the work-from-home movement could lead to improved livability in local neighborhoods, and may even become part of the process of adapting positively to Japan's aging society.

The Japanese government has promoted a so-called compact plus network for the next generation of urban development for years. In this scenario, people who lived in detached houses in suburbia gradually return to the urban center. However, the sudden pandemic might have broken this movement. Recent statistical data shows that the number of people moving out of Tokyo in 2020 surpassed the number moving in (Tokyo 2022). This may resolve the problem of over-concentration in Tokyo. Meanwhile, it will bring challenges for government and industrial sectors as they try to identify and predict future demands and develop plans to meet emerging trends. We imagine this could be an opportunity to rebalance the development of the city center, suburbia, and rural areas. It may also require us to rearrange large areas around railways stations in suburban regions. During the period of suburbanization, huge amounts of land was transformed to residential use and many live far enough from the stations that daily life is heavily dependent on private cars, even though commuting to the center is by train. The new social context, if it continues, could become a chance to revitalize the local environment and local communities, as residents become more involved in their decentralized lifestyle. However, this will not be realized easily because of path dependency (Romero-lankao et al. 2017), particularly the rigid political and sector-based regulating systems. Nexus thinking and the nexus approach are a useful philosophy that could shed light on the situation and help with development of a novel methodology to increase adaptation. Which is in the end what Tokyo excels at.

4 Conclusion

Entering the third decades of the twenty-first century, metropolitan regions are expected to be more prosperous and to better resist the effects of unprecedented disaster. This includes adapting to both climatic and social change.

Tokyo, one of the largest metropolitan areas in the world, has demonstrated the possibility of transformation from traditional to modern, from post-modern to resilient and adaptive. Today, Tokyo is still glorious, and the 1-year delay of the Tokyo Olympics in 2020 left a legacy for the core of the city as well as the nation. The 100-year pandemic provided an opportunity to review the path we have taken and to look with new eyes toward the future. The practice of resilience and adaptation is becoming ever more important across scales, sectors, and disciplines. Even so it also feels like it is always imminent. Perhaps that is its correct position, as resilience requires a certain amount of comfort with uncertainty and a lack of conclusion.

The current version of Tokyo, like many metropolitan areas in the world, faces a series of interlocking crises. Some are long term, some are short. Recovering from the pandemic, a shrinking population (and its partner problem, an aging population), planning for climate change and the next disaster, whether earthquake or something unforeseen. Tokyo is still in the process of building itself, coming to terms with problems so large and encompassing they cannot be comprehended and yet need to be responded to. These kind of problems are what Timothy Morton calls hyper-objects (Morton 2013)–economic, social, and climate crises. Alternatively, it might be easier to think of them as a poly-crisis, to use the term recently popularized by Adam Tooze (Wolf 2022), where multiple crises overlap and interact, creating problems larger than each one taken on its own. However, we label the challenge of taking on the enmeshed problems of our time, it is our hope that this text helps to prepare for them, and to develop better plans for our cities.

Acknowledgments This chapter is built on the achievements of the M-NEX project (https://m-nex.net) sponsored by the SUGI nexus and Japan Agency of Science and Technology (JST). The authors express their great gratitude to the contributors and partners of this publication project.

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